VOLUME I

WALTON COUNTY, FLORIDA
HURRICANE AND STORM DAMAGE REDUCTION

GENERAL INVESTIGATIONS STUDY
DRAFT REPORT

MAIN REPORT	
APPENDIX A	ENGINEERING DESIGN
APPENDIX B	ECONOMIC INVESTIGATIONS
APPENDIX C	REAL ESTATE PLAN

APRIL 2012

US Army Corps of Engineers®
Mobile District

WALTON COUNTY, FLORIDA
HURRICANE AND STORM DAMAGE REDUCTION

GENERAL INVESTIGATIONS STUDY

EXECUTIVE SUMMARY

The purpose of this study is to assess the needs for hurricane and storm damage reduction and opportunities for environmental restoration and protection along the Gulf Coast of Walton County, Florida. Walton County is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. The beaches of Walton County encompass approximately 26 miles of shoreline extending eastward from the City of Destin in Okaloosa County, Florida to the Walton/Bay County line.

Since 1990, several coastal storms have eroded the coastline of Walton County resulting in recession of the protective beach and dune system. The purpose of this report is to document the economic investigations, engineering analyses, and environmental considerations conducted to formulate a shore protection project for Walton County, Florida, which will reduce the damaging effects of hurricanes and severe storms to properties along the coast. The project is constructible, acceptable to the public, environmentally sustainable and justified by an economic evaluation.

This study was authorized both within the United States Senate and the U.S. House of Representatives. In the Senate, the Committee on Environment and Public Works adopted a committee resolution (unnumbered) on July 25, 2002, and in the House, the Committee on Transportation and Infrastructure adopted a resolution, Docket 2690, dated July 24, 2002. The non-Federal sponsor for this study is the Walton County Board of Commissioners. Their central point of contact is the Director of Beach Management for the Walton County Tourist Development Council (TDC).

A number of measures were initially considered for alternative development to provide hurricane and storm damage reduction for the Walton County shoreline. Those measures can be classified as either non-structural or structural in nature. Non-structural measures consist of actions that: control or regulate the use of land and buildings such that damages to property are reduced or eliminated; acquire threatened or damageable property; or, consist of retreat which is relocation of threatened property. Structural measures are composed of those actions that block or otherwise retard erosive coastal processes, or restore or nourish beaches to compensate for erosion. Typically, the hardened structural measures consist of seawalls, bulkheads, revetments, breakwaters, or groins. Beach and dune fill is considered a soft structural alternative. Screening of these measures narrowed the alternative development to consist of a non-structural acquisition and structural beach and dune fill alternatives.

The acquisition alternative would remove all damageable structures from the front lots and would eliminate storm damage to approximately 81 percent of the approximately 814 damage elements in the study area. This results in about a $57,819,000 reduction of the total average damages and about a $3,106,000 reduction of the average annual

damages. The cost of this alternative is significant with the resulting approximate cost being about $3.42 billion dollars. The annual cost of this acquisition alternative would be about $193,303,000. Because the annual cost exceeds the annual benefits, this alternative is not economically justified.

For the beach and dune fill alternatives, it was recognized that the dunes along the Walton County shoreline provide the principal protection for the damageable structures. Likewise, the dunes are protected by the shoreline berm. It was decided early in the study process that alternative plans would not change the existing natural berm or dune heights. As such, a range of beach and dune fill alternative plans were formulated to evaluate both berm width and dune width alternatives. The evaluation approach adopted a two-phase process with the first phase of the evaluation optimizing the proposed berm width. The second phase would build on the results of the first phase by optimizing the dune width. Thus the resulting beach and dune fill alternative is a combination of the optimized berm width and the optimized dune width evaluations. Four berm width alternatives were evaluated with an additional two added to confirm optimization. After the optimized berm width alternative was determined five dune width alternatives were evaluated.

These evaluations resulted in an economically justified beach fill plan that could be implemented to provide hurricane and storm damage reduction for the Walton County shoreline. This plan is considered the National Economic Development (NED) plan as it maximizes beneficial contributions to the Nation while satisfying the study objectives. The NED plan is composed of a 50-foot berm width that includes a 25-foot berm and an additional 25 feet of advanced nourishment along approximately 15.2 miles of the Walton County Shoreline. The project will also include added dune widths of either 10 or 30 feet.

After consultation with the non-Federal sponsor, a locally preferred plan (LPP) was developed to include the work contained in the NED plan and include additional shoreline length of about 3.6 miles to provide consistent shoreline protection in areas that were not economically justified. The non-Federal sponsor is willing to provide funding for work in this area. The LPP, similar to the NED plan, will include a 50-foot berm with added dune widths of either 10 or 30 feet throughout the project length. Per ER 1105-2-100, the recommended plan may deviate from the NED plan if the non-Federal sponsor agrees to pay the cost difference between the NED plan and the LPP, the LPP has outputs similar in-kind, and the LPP has benefits that are equal or greater to the NED benefits. A waiver, that the LPP be considered for recommendation, was requested and on 7 February 2012, was approved by the Assistant Secretary of the Army for Civil Works (ASA(CW)). As such, the LPP is the Tentatively Selected Plan (TSP).

Initial construction of the NED plan will require the placement of 3,273,000 cubic yards (cy) of material while initial construction of the TSP will require the placement of 3,868,000 cy of material. During the 50-year life of the project it was determined that the project will require periodic renourishment for both the NED plan and the TSP. Four renourishments will occur on a 10-year cycle and require about 1,585,000 cy and 1,789,000 cy of material for the NED plan and TSP, respectively. Material for the initial beach fill placement and renourishments will come from a nearby offshore borrow area.

The NED plan would have a total economic project first cost of about $91,459,000 with the TSP total economic project first cost totaling about $103,459,000. The NED plan would have an annual cost of about $4,474,000 with the TSP annual cost totaling about $5,102,000. The annual benefits of the NED plan would total about $6,391,000 with the TSP annual benefits totaling about $6,559,000. The BCR of the NED plan is about 1.43 while the BCR of the TSP is about 1.29. The NED plan would protect about 15.2 miles of the Walton County shoreline while the TSP would protect about 18.8 miles. Of the plans considered the local sponsor has expressed their desire to implement the TSP. Listed in the table below is a comparison of the project features and economics of the NED plan and TSP.

Plan Comparison
Project Features and Economics, NED Plan and TSP
(Note – Monetary amounts are shown in FY 2011 Dollars)

Category	NED Plan	LPP
Project Length	15.2 Miles	18.8 Miles
Initial Beach Fill Quantity	3,273,000 cy	3,868,000 cy
Renourishment Cycle	10 years	10-years
Renourishment Quantity	1,585,000 cy	1,789,000 cy
2014 Initial Construction Cost	$55,496,000	$63,306,000
2024 Renourishment Cost	$14,434,620	$16,218,674
2034 Renourishment Cost	$9,635,078	$10,825,930
2044 Renourishment Cost	$6,431,393	$7,226,285
2054 Renourishment Cost	$4,292,941	$4,922,478
Total Economic First Cost	$90,290,000	$102,499,000
Interest During Construction	$1,168,568	$1,263,422
Total Economic Project First Cost	$91,459,000	$103,762,000
Average Annual Economic First Cost	$4,349,000	$4,934,000
Annual O&M	$124,500	$168,000
Total Average Annual Economic Cost	$4,474,000	$5,102,000
Average Annual HSDR Benefits	$6,375,000	$6,543,000
Average Annual Recreation Benefits	$16,000	$16,000
Total Average Annual Benefits	$6,391,000	$6,559,000
Benefit-to-Cost Ratio	1.43	1.29
Net Benefits	$1,917,000	$1,457,000

The plan tentatively selected for construction is the TSP. The project is composed of a 50-foot berm width that includes a 25-foot berm and an additional 25 feet of advanced nourishment in all construction reaches. The project will also feature added dune width

in all construction reaches of either 10 or 30 feet. The initial construction cost for the project will total $63,306,000 with additional costs to be incurred during the project life for periodic renourishments. Typical cost share for hurricane and storm damage reduction projects is 65 percent Federal and 35 percent non-Federal. Adjustment can be made to this ratio based on adequacy of public access and parking, whether private shoreline is being protected, and if any economically unjustified reach is being included in the selected plan. A cost share analysis found that the initial construction costs of the NED Plan would be about 33 percent Federal and about 67 percent non-Federal. The renourishment costs were adjusted similarly while at the same time assuring that, per Section 215 of Water Resources Development Act of 1999, the maximum Federal participation in any reach was limited to 50 percent. The resulting cost share for the NED renourishment costs is about 26 percent Federal and about 74 percent non-Federal. The cost share ratio for the initial construction costs of the TSP would be about 31 percent Federal and about 69 percent non-Federal. The cost share ratio for the TSP renourishment costs is about 24 percent Federal and about 76 percent non-Federal. The overall cost ratio for both the initial construction costs and the renourishment costs of the NED plan is about 30 percent Federal and about 70 percent non-Federal. The overall cost ratio for both the initial construction costs and the renourishment costs of the TSP is about 28 percent Federal and about 72 percent non-Federal.

Agency Technical Review (ATR) of this report was conducted in accordance with the Corps' "Peer Review of Decision Documents" process and has been reviewed by Corps staff outside the South Atlantic Division. This review was coordinated by the National Planning Center of Expertise in Coastal Storm Damage Reduction, North Atlantic Division, U.S. Army Corps of Engineers. Comments and responses will accompany the report to the Assistant Secretary of the Army for Civil Works (ASA(CW)) and the Office of Management and Budget (OMB). Documentation of ATR certification will accompany the final report.

An Independent External Peer Review (IEPR) will be conducted on the draft report after approval for public release of the draft report. The IEPR will be conducted by a non-USACE national team of experts in the field, and coordinated by the National Planning Center of Expertise in Coastal Storm Damage Reduction, North Atlantic Division, U.S. Army Corps of Engineers. Comments and responses will accompany the report to the ASA(CW) and the Office of Management and Budget (OMB). Documentation of IEPR certification will accompany the final report.

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WALTON COUNTY, FLORIDA
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1.0 INTRODUCTION

1.1 GENERAL

This report presents the results of an investigation that has been conducted to analyze and formulate a hurricane and storm damage reduction project for Walton County, Florida. Since 1990, several coastal storms have eroded the coastline of Walton County resulting in recession of the protective beach and dune system.

1.2 STUDY AUTHORITY

This study was authorized both within the United States Senate and the U.S. House of Representatives. In the Senate, the Committee on Environment and Public Works adopted a committee resolution (unnumbered) on July 25, 2002, which reads as follows:

> *"Resolved by the Committee on Environment and Public Works of the United States Senate, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and related improvements in Walton County, Florida, in the interest of protecting and restoring the environmental resources on and behind the beach, including the feasibility of providing shoreline and erosion protection and related improvements consistent with the unique characteristics of the existing beach sand, and with consideration of the need to develop a comprehensive body of knowledge, information, and data on coastal area changes and processes as well as impacts from Federally constructed projects in the vicinity of Walton County, Florida.*

> In the House, the Committee on Transportation and Infrastructure adopted a resolution, Docket 2690, dated July 24, 2002, which reads as follows:

> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and environmental restoration and protection in the vicinity of Walton County, Florida.*

1.3 NON-FEDERAL SPONSOR

The non-Federal sponsor is the Walton County Board of Commissioners. Their central point of contact is the Director of Beach Management for the Walton County Tourist Development Council (TDC). A Feasibility Cost Sharing Agreement was executed between the U.S. Army Corps of Engineers (Corps) and Walton County in December 2003, that defined the cost share responsibilities for conducting the feasibility study. The agreement provided that the feasibility costs would be shared 50/50 between the Corps and Walton County and that 50 percent of Walton County's share would be provided in cash with the remainder provided as in-kind services.

1.4 PURPOSE AND SCOPE OF STUDY

The purpose of this study is to assess the needs for hurricane and storm damage reduction and opportunities for environmental restoration and protection along the Gulf Coast of Walton County, Florida. The purpose of this report is to document the economic investigations, engineering analyses, and environmental considerations conducted to formulate a shore protection project for Walton County, Florida, which will reduce the damaging effects of hurricanes and severe storms to properties along the coast. The project will be constructible, acceptable to the public, environmentally sustainable and justified by an economic evaluation.

1.5 DESCRIPTION OF STUDY AREA

Walton County is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida, Figure 1. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet. The western two-thirds of Walton County are comprised of a coastal peninsula extending from the mainland, and the eastern third is comprised of mainland beaches. Choctawhatchee Bay lies north of the peninsula. Walton County includes 11.9 miles of state-designated critically eroding areas and three State of Florida park areas that cover approximately six miles of the 26-mile shoreline.

The Walton County shoreline is characterized by high dune elevations partly due to the presence of Pleistocene bluffs formed as a result of an exposed submarine berm formed during inundation of the Florida Peninsula during that geologic period. Primary dune elevations in Walton County range from 11.5 to 44.5 feet North American Vertical Datum, 1988 (NAVD88) and average 25.5 feet. Along the mid-section of Walton County, Bluff elevations exceed 60 feet in height, Figure 2A. Bluff erosion and undercutting occur in this area due to the interface of relatively low flat beaches and the bluff toe. An unusual attribute of the Walton County shoreline is the presence of coastal dune lakes. These lakes are rare worldwide and are almost exclusive to the Gulf Coast within the United States. The lakes are about five feet deep and intermittently breach the dune system and discharge directly into the Gulf of Mexico, Figure 2B.

Mild winters and warm hot summers characterize the project area, with an average in excess of 280 days a year of sunshine. The average daily temperature is 67 degrees

Fahrenheit and the average water temperature is about 70 degrees Fahrenheit. The months from June through November constitute the hurricane storm season, and this area is subject to tropical storm and strong hurricane conditions. The highest period of rainfall occurs during the storm season, with an average annual rainfall of 64 inches.

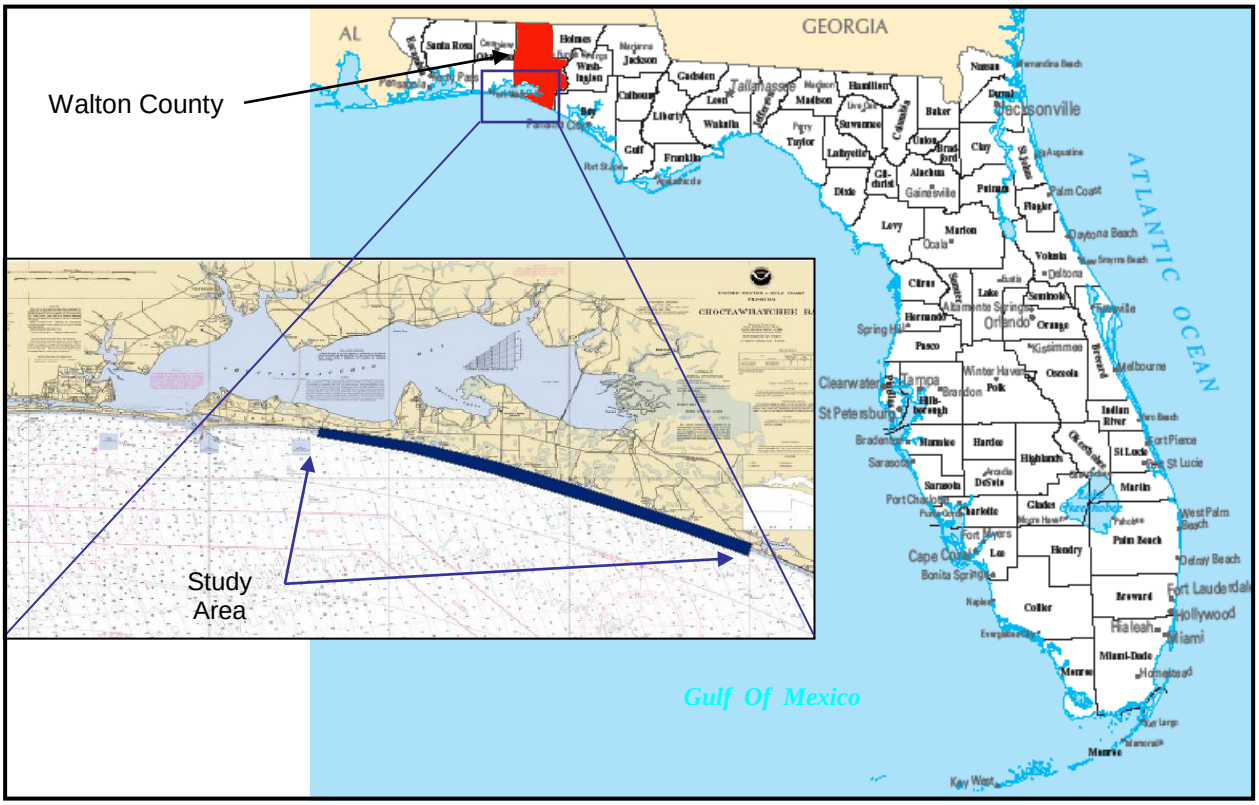


FIGURE 1. WALTON COUNTY LOCATION MAP

FIGURE 2A. HIGH BLUFFS WESTERN WALTON COUNTY

FIGURE 2B. COASTAL DUNE LAKE

1.6 BACKGROUND

Walton County's shoreline is receding and its protective dunes and high bluffs are being adversely impacted by hurricane and coastal storm forces. The impacts of these storms to property and infrastructure are considerable and can possibly be reduced through a beach restoration and stabilization project. Behind the dune system, upland drainage feeds several freshwater lakes that intermittently breach the dune system and discharge directly into the Gulf. Primary dune elevations range from 11.5 to 44.5 feet NAVD88 and average 25.5 feet National Geodetic Vertical Datum (NGVD).

During the late 1990s, the area endured several strong hurricanes resulting in extensive shoreline erosion (Taylor Engineering, 2003). In 2004 the area was affected severely by Hurricane Ivan (Sep 04) and early into the 2005 hurricane season it was impacted by Hurricanes Arlene (June 05) and Dennis (July 05). Photographs depicting the Walton County shoreline as well as structures are displayed in Plates 1 through 11 at the end of this report. Visual comparisons are shown for pre-Ivan, post-Ivan and Post Dennis.

1.7 PREVIOUS STUDIES AND REPORTS

Previous investigations and reports have been completed for the area. The most recent studies pertinent to the erosion problems at Walton County are summarized below:

(1) "State of the Beaches" of Walton County, Florida 2001, 2002, 2003, 2004, and 2005 Walton County Tourism Development Council. These reports present data, analysis, and recommendation for managing the Florida coastline. Specific emphasis is placed on determining trends in beach width and explaining the physical and coastal processes that cause the changes.

(2) Beach Management Feasibility Study for Walton County and Destin Florida, Taylor Engineering, Inc., April 2003. The purpose of this study was to determine the most technically feasible and financially acceptable alternatives for protecting 9.2 miles of "critically eroding shoreline." The feasibility study is a six-part study funded by Walton County.

1.8 EXISTING WATER RESOURCES PROJECTS

There are four existing Federal projects in or adjacent to Walton County. In Walton County and its neighboring counties of Okaloosa and Bay, there is the Gulf Intracoastal Waterway. The existing project, authorized by the River and Harbor Acts of 1942, 1943, and 1966, provides for a through waterway with minimum dimensions of 12 by 125 feet from Apalachee Bay, Florida, to the Mexican Border via coastal bays, sounds and lands cuts. The existing project from Carrabelle (east of Walton County) to the Rigolets, Louisiana was completed in 1957. Maintenance on the waterway is sporadic across its length but on an annual basis. In Walton County the waterway transits through Choctawhatchee Bay and a land cut to St. Andrew Bay on the east.

In neighboring Bay County there are three other existing projects:

a. Panama City Harbor, Florida. The existing project provides for an entrance channel 38 feet deep and 450 feet wide in the Gulf of Mexico, thence 38 feet deep and 300 feet wide across Lands Ends Peninsula to deep water in St. Andrew Bay, with a branch channel 36 feet deep and 300 feet wide, leading from the inner end of the main entrance channel westward to the Port Authority Terminal at Dyers Point. The entrance channel is protected by east and west jetties extending 2,075 feet and 2,896 feet, respectively. The existing project was completed in 2003. Suitable sands dredged from the entrance channel are bypassed to down drift beaches on a 24 – 36 month cycle. Prior to the recently completed modifications, the project provided for a 32-foot deep project which was begun in 1933 and completed in 1949.

b. Panama City Beaches, Florida. A hurricane and storm damage reduction project for 18.5 miles of the Panama City Beaches was authorized by the Water Resources Development Act of 1986. This project extends from Phillips Inlet near the Walton County line eastward to the Panama City Harbor entrance channel. The authorized plan consisted of a 7-foot elevation berm landward of the erosion control line with a 50-foot top width over approximately 16.8 miles of shoreline. Approximately 6.4 million cubic yards (cy) of sand was dredged from six borrow sites approximately 2000 feet offshore and from the Panama City Harbor entrance channel. Renourishment was estimated to be required at five-year intervals. A slightly modified plan was constructed by the Bay County Tourist Development Council between 1998 and 2000 under the authority of Section 203 of the Water Resources Development Act of 1996. Bay County was approved for reimbursement of the Federal share for the authorized project.

c. East Pass Channel, Florida. The existing East Pass Channel from the Gulf of Mexico into Choctawhatchee Bay, Florida, located east of Walton County, was authorized by the River and Harbor Act Of 1965 and consists of a channel 12 feet deep, 180 feet wide, and 1.5 miles long from the Gulf into the bay via East Pass and a spur channel six feet deep and 100 feet wide from the main channel into Old Pass Lagoon to the harbor at Destin, a distance of about 0.2 miles. The main entrance channel from the Gulf is protected by two converging rock jetties, spaced 1,000 feet apart at the seaward end. This channel was completed in 1969. An extension of the 6 by 100-foot channel into Old Pass Lagoon was authorized by the Energy and Water Development Appropriation Act of 1981 and completed in 1983. Project maintenance is on an 18-month cycle with most of the dredged sands being passed down drift as part of the regional sediment management plan.

1.9 PLANNING PROCESS

The plan formulation process for this study applied the six step planning process described in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G, 1983). This planning process is more fully specified in Corps of Engineers' Engineering Regulation ER 1105-2-100 (the

Planning Guidance Notebook, 22 April 2000). Steps in the plan formulation process include:

1. The specific problems and opportunities to be addressed in the study are identified, and the causes of the problems are discussed and documented. Planning goals are set, objectives are established, and constraints are identified.
2. Existing and future without-project conditions are identified, analyzed and forecast. The existing condition resources, problems, and opportunities critical to plan formulation, impact assessment, and evaluation are characterized and documented.
3. The study team, including Federal, State, County and local officials and interested individuals, formulates alternative plans that address the planning objectives. A range of alternative plans are identified at the beginning of the planning process and screened and refined in subsequent iterations throughout the planning process.
4. Alternative project plans are evaluated for effectiveness, efficiency, completeness, and acceptability. The impacts of alternative plans will be evaluated using the system of accounts framework (NED, EQ, RED, OSE) specified in the Principles and Guidelines and ER 1105-2-100.
5. Alternative plans will be compared. Contributions to National Economic Development (NED) will be used to prioritize and rank alternatives that are consistent with protecting the nation's environment and are publically acceptable. The public involvement program will be used to obtain public input to the alternative identification and evaluation process.
6. A plan will be selected for recommendation, and a justification for plan selection will be prepared.

2.0 PROBLEMS AND OPPORTUNITIES

2.1 PROBLEMS

Walton County's shoreline is receding and its protective dunes and high bluffs are being adversely impacted by hurricane and coastal storm forces. The impacts of these storms to property and infrastructure have been considerable. Erosion is also having an impact on the environment due to decreased beach area and elevation. Such impact directly affects the availability of suitable nesting habitat required for nesting sea turtles and the areas needed by shorebirds to forage and rest. Damage to the previously established dune system destroyed much of the existing vegetation that provides stabilization. The absence of the dunes and associated vegetation eliminates much of the suitable habitat required to sustain beach mice populations and other wildlife that relies on these types of habitats for their continued survival. These problems can be summarized by the following statements which will be used by the study team in developing the planning objectives:

- Damage to properties and infrastructure due to hurricane and storm induced erosion.
- Damage to beach and dune habitats due to hurricane and storm induced erosion.
- Reduced beach recreational opportunities due to hurricane and storm induced erosion.

2.2 OPPORTUNITIES

Because of the damaging effects of hurricanes and severe storms to properties and infrastructure along the coast, there is an opportunity for a hurricane and storm damage reduction project for Walton County, Florida. Such a project can reduce damage caused by wind-generated and tide-generated waves and currents by stabilizing or restoring the eroded shoreline. Stabilizing or restoring the shoreline provides environmental restoration opportunities within the proposed project area. Restoring a beach-dune system allows greater stability and sustainability of the coastal environment once it has become re-established. Restoring the beach and dune habitats that support a variety of associated flora and fauna can contribute to the success and continual survival of several threatened or endangered species. The restoration effort will also contribute to the well-being of various other flora and fauna that naturally occur in the immediate vicinity. Restoration opportunities include increasing both the beach berm and dune widths to reduce, stabilize and/or restore the shoreline to provide protection to properties and infrastructure, increase sea turtle nesting habitat, and provide numerous benefits to a variety of shore birds, beach mice, and natural vegetation as well as other inhabitants of the coastal environment. These opportunities can be summarized by the following statements which, in addition to the problem statements, will be used by the study team to develop the planning objectives:

- Reduce damages to properties and infrastructure along Walton County's coastline.
- Restore wildlife habitat along Walton County's coastline.
- Provide increased recreational opportunities along Walton County's coastline.

2.3 PLANNING GOALS AND OBJECTIVES

The primary goal of this study is to investigate, analyze and recommend solutions to provide for hurricane and storm damage reduction opportunities along the coastline of Walton County, Florida. Over the years coastal erosion in the project area has seriously reduced the ability of the shoreline to provide adequate protection from routine coastal storms. Planning objectives were identified based on the problems, needs, and opportunities as well as existing physical and environmental conditions present in the project area and consist of:

a. Reduce shoreline erosion along the shoreline of Walton County.

b. Reduce the potential for storm damages caused by hurricanes and storms along the shoreline of Walton County.

c. Restore beach and dune ecosystem habitats along the shoreline of Walton County.

d. Increase the recreational opportunities along the shoreline of Walton County.

In general, the primary Federal objective is to formulate alternatives and make recommendations for Federal participation in construction of a project that will offer the most significant contribution to the National Economic Development (NED) account and that is consistent with protecting the Nation's environment. Furthermore, the development of the alternative plans should be formulated in a systematic manner to ensure that all reasonable alternatives are evaluated.

2.4 Assumptions

The planning assumptions for this study are**:**

- The Federal discount rate of 4-1/8 percent is used in this evaluation. The period of analysis is 54 years, beginning in 2010 and ending after 2063. There are three pre-base years from 2010 to 2013. The base year is 2014.
- Benefits are stated in constant FY2011 dollars.
- The analysis will consider expected future beachfront development.
- Critically eroding beach will be protected to some level at one area by a local project to be constructed as a one-time fill funded by state and county jointly.
- Structure values will be based on depreciated replacement costs.
- Land use zoning and construction codes will not change during the period of analysis.
- Damaged or destroyed properties will be repaired to pre-storm conditions.
- Lost land will be valued at nearshore prices.
- Empirical storm frequencies based on historical records for the study area are assumed to be predictive of the probability of future events.
- Beach mice will continue to be a protected species and there will be no changes to existing environmental laws.
- Existing state and county owned public park limits would remain the same in the future.
- Emergency nourishment in the future without project condition, will take place following each serious storm event and will not be a project cost.

2.5 Constraints

Planning constraints are statements of things unique to a specific planning study that alternative plans should avoid. The constraints for this study are:

- This analysis considers applicable Federal and State laws.
- Sufficient parking must be available within a reasonable walking distance on free or reasonable terms. Reasonable public access must be furnished to comply with the planned recreational use of the area; however, public use is construed to be effectively limited to within one-quarter mile from available points of public access to any particular shore.
- There is a requirement for the benefit-to-cost ratio (BCR) to be greater than 1-to-1.
- The project will be formulated to avoid impacts to dune, lake and Gulf connections.
- Private beaches owned by beach clubs and hotels cannot be included in Federal shore protection activities if the beaches are limited to use by members or paying guests.
- Consideration should be given to public health, safety, and social well-being, including possible loss of life.
- Wherever possible, provide an aesthetically balanced and consistent appearance without changing the existing natural berm or dune height.
- Avoid detrimental environmental and social effects, specifically eliminating or minimizing the following where applicable:
    a. Air, noise and water pollution;
    b. Destruction or disruption of manmade and natural resources, aesthetic and cultural values, community cohesion, and the availability of public facilities and services;
    c. Adverse effects upon employment as well as the tax base and property values;
    d. Displacement of people, businesses, and livelihoods; and,
    e. Disruption of normal and anticipated community and regional growth.
- Maintain, preserve, and, where possible and applicable, enhance the following in the study area:
    a. Water quality;
    b. The beach and dune system together with its attendant fauna and flora;
    c. Wetlands and other emergent coastal habitats;
    d. Commercially important aquatic species and their habitats;
    e. Nesting sites for colonial nesting birds;
    f. Habitat for endangered and threatened species.

3.0 INVENTORYING AND FORECASTING RESOURCES

3.1 STUDY METHODOLOGY

3.1.1 Evaluation Framework

Shore protection projects are formulated to provide hurricane and storm damage reduction while recreation benefits are incidental. ER 1165-2-130 provides policies and guidelines for determining the extent of Federal participation in potential Federal projects for protection from shore erosion, hurricanes, and abnormal tidal and lake flooding that result in damages or losses to coastal resources and/or development. Federal participation in shore protection projects must produce economic justification from storm damage reduction benefits or a combination of damage reduction benefits and recreation benefits not to exceed 50 percent of the total benefits required for justification.

The specific methodologies that will be used for the benefit study are based on the general principles and guidelines contained in the Principles and Guidelines (P&G) and are documented in Engineering Regulation (ER) 1105-2-100, 22 April 2000, Planning – Planning Guidance Notebook, Section I – Hurricane and Storm Damage Reduction, Appendix D – Economic and Social Considerations, and Appendix E – Civil Works Missions and Evaluation Procedures.

The general economic principles and guidelines for assessing NED benefits are documented in the Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, Chapter II - National Economic Development Benefit Evaluation Procedures (March 10, 1983). This document is referred to as Principles and Guidelines, or P&G.

3.1.2 Beach-*Fx* The Hurricane And Storm Damage Simulation Model

The Beach-*fx* model is a Corps engineering-economic Monte Carlo simulation model that relates beach profile change to storms, coastal processes, and nourishment programs. It is an event-based, data-driven Monte Carlo simulation model. This structure has been used successfully in the past in a large number of Corps studies and Beach-fx has been certified for use on hurricane and storm damage reduction studies.

Beach-*fx* represents an improvement on previous models in this arena by being strongly based on representation of the coastal and engineering processes, incorporating the impact of multiple storms, and incorporating uncertainty in damage functions, physical characteristics of structures, and economic valuations. Expected structural damages generated through the simulations are expressed as losses due to flooding, erosion and waves.

3.1.3 Engineering

3.1.3.1 Representative Profiles

Coastal process models need to use a detailed distance vs. elevation (x, z) representation of the shoreline. The amount of data required for such a representation is not needed in an economic-engineering type model such as Beach-*fx* and so a simplified representation for the profile has been adopted. This simplified representation for the profile uses five key features, which are dune width, dune height, dune slope, berm width, and berm height.

Figure 3 is a depiction of the simplified Beach-*fx* profile. This representation is founded on three assumptions: 1) a single dune, 2) a single berm (no separate construction berm), and 3) an equilibrium submerged profile.

The beach variables that change with storms are dune width, dune height, berm width, and upland width. Beach variables that are unchanged and remain constant throughout the analysis are upland elevation, dune slope, berm height, foreslope, and shape of the submerged profile. Thus, in response to a given storm, the berm can be eroded or accreted (change in berm width), the dune can change height and/or width, and can translate landward or seaward (change in upland width).

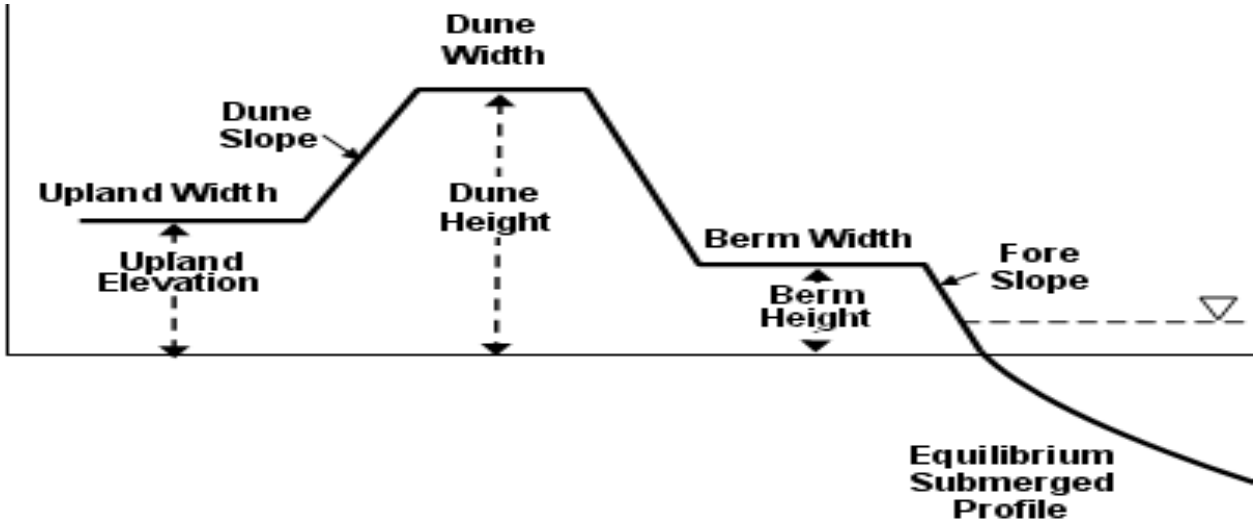


FIGURE 3. BEACH-*FX* SIMPLIFIED BEACH PROFILE

Figure 4 is a depiction of the simplified Beach-*fx* profile with damage elements viewed in Beach-*fx* model.

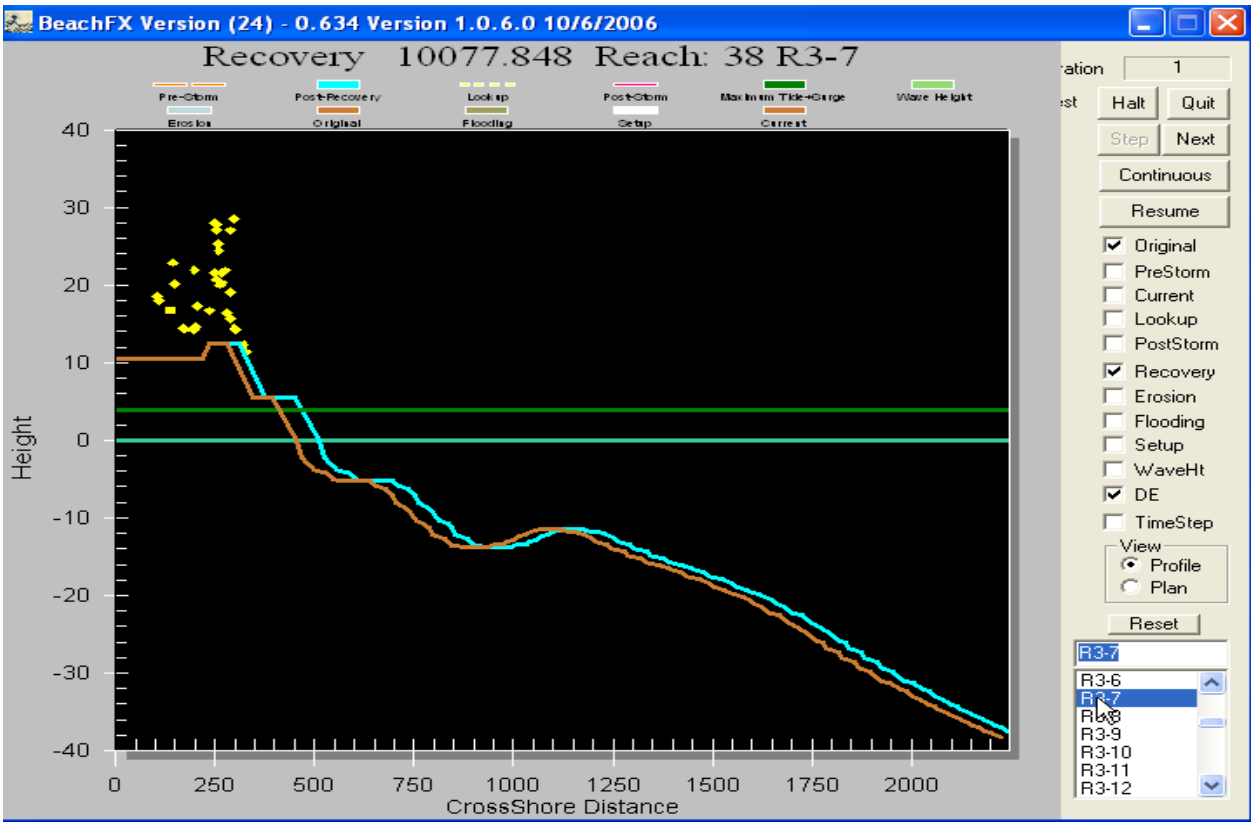


FIGURE 4. CHARACTERIZATION OF A REPRESENTATIVE PROFILE WITH DAMAGE ELEMENTS IN BEACH-*FX*

3.1.4 Storm Set

The set of plausible storms include all historical storms that have occurred in the Walton County area and have caused at least one foot of surge. The plausible storm set is detailed in Appendix A, Section 1, Attachment I-A.

The Monte Carlo simulation uses the same set of storms that were used to create the Shoreline Response Database (SRD). As a given storm event from the simulated sequence takes place, the current profile is used to look up the results that are associated with that storm in the SRD for the profile that is 'closest' to the pre-storm profile as tracked in the simulation. These results are then used to define the post-storm profile, to track volume changes, and to determine within-storm erosion, wave heights and water elevations due to the storm along the cross-shore profile.

3.1.4.1 Storm-Induced Beach Change Model (SBEACH)

A pre-computed database of beach profile responses to storms for a range of storms and profiles was generated utilizing the Storm-Induced BEAch CHange Model (SBEACH), (Larson and Kraus 1989).

SBEACH provided estimates of the short-term cross-shore response to a suite of plausible tropical storm events derived from the historical record of tropical storms impacting the Walton County area.

3.1.4.2 Generalized Model for Simulating Shoreline Change (GENESIS)

The Generalized Model for Simulating Shoreline Change (GENESIS) (Hanson and Kraus 1989) provided estimates of long-term shoreline response to existing and without project conditions.

The SBEACH and GENESIS models were developed by the Corps Research and Development Center (ERDC-CHL). Beach-*fx* is run for multiple period of analysis cycles and provides statistics on probable benefits and costs of the evaluated shore protection design alternatives, which is used to determine the economic justification of the project.

Beach-*fx* simulates beach response over time as storms, natural recovery, and management methods alter the beach profile. Events of interest (storms, beach nourishment) take place at calculated times. As each event takes place, the model simulates the physical and economic responses associated with that event. A set of simplified beach profiles, as defined by key data points, are tracked by the simulation model as the beach profile evolves over time.

3.1.5 Shoreline Response Database (SRD)

The Shoreline Response Database (SRD) is a relational database used to pre-store results of SBEACH runs for all plausible storms, and a range of pre-defined profiles, as expressed by ranges of berm width, dune width, and dune height. Two kinds of results are stored: changes in berm width, dune width, dune height, and upland width, and cross-shore profiles of erosion, wave height, and water depth. The SRD is site and study specific, that is, it is created for each shore protection study. The SRD, once generated, is used as a ‘lookup table’ by the Monte Carlo simulation. Within the Monte Carlo simulation, the shoreline modifications are tracked continuously by the simplified profile representation (primarily dune width and height and berm width). The driving force for profile change is the list of plausible storms. These plausible storms are then used to create SBEACH input, which is run against a range of profiles that is expected to cover the range of natural and managed profiles.

For each such pair (storm and profile), both simplified and detailed SBEACH results are stored in the SRD. The output of SBEACH for a given run is an ASCII file that describes the initial, final, maximum, and minimum cross-shore profiles, and the water and wave heights along the cross-shore. This file must be post-processed by software that extracts the values of changes in berm width, dune width, and dune height, and stores the information in the SRD.

3.2 EXISTING CONDITIONS

3.2.1 Demographics

Walton County is located in the State of Florida. The County is comprised of about 1,058 square miles of area. The 2009 estimated population is 55,105 persons which is a 35.7 percent increase over the base population estimate of 40,601 in 2000 making it one of the fastest growing counties in Florida. The population density is about 52 persons per square mile and the estimated number of housing units in 2008 was 41,859. The median household income was $43,779 with 14.9 percent of population estimated to be living below the poverty level. The median value of owner-occupied housing was $96,400. The racial makeup of the county in 2008 was estimated at 88.8 percent white, 7.6 percent African American, 3.8 percent of Hispanic or Latino origin, 1.1 percent American Indian and Alaska Native, and 0.7 percent Asian, with 1.8 percent of the population comprised of two or more races. The Gulf of Mexico borders Walton County to the south and, along with its four neighboring counties, its shoreline comprises part of 200 miles of Gulf beaches in the Florida panhandle. In Figure 3, from west to east, the Florida panhandle counties are as follows: Santa Rosa, Okaloosa, Walton, Bay, and Gulf.

3.2.2 Population

In the 29 years from 1980 to 2009, the population of the five counties, Santa Rosa, Walton, Bay, Okaloosa and Gulf increased by 171%, 159% ,69%, 62% and 48%, respectively. The State of Florida's population increase over the same period was 90%. Combined, the average population growth of the five counties was about 91 percent which is about equal to the growth rate of Florida for that same time frame. Out of the five counties, Okaloosa County has the greatest population at 178,473 persons and Gulf County has the least at 15,755 persons.

3.2.3 Employment

From 1990 to 2009 the number of persons in Florida's labor force increased by 48.1 percent. Four of the five counties in the study area exceeded the State's increase except for Gulf County which had only a 28.5 percent increase. The highest percentage labor force increase occurred in Walton County, a 140.8 percent increase, Santa Rosa County was the second highest gaining county with an 85.2 percentage increase. The State's unemployment rate for 2009 was a high 12 percent but all five counties in the study area had significantly lower rates. Gulf County's unemployment rate in 2009 was the highest at 9.6 percent and the lowest was 7.1 percent in Okaloosa County.

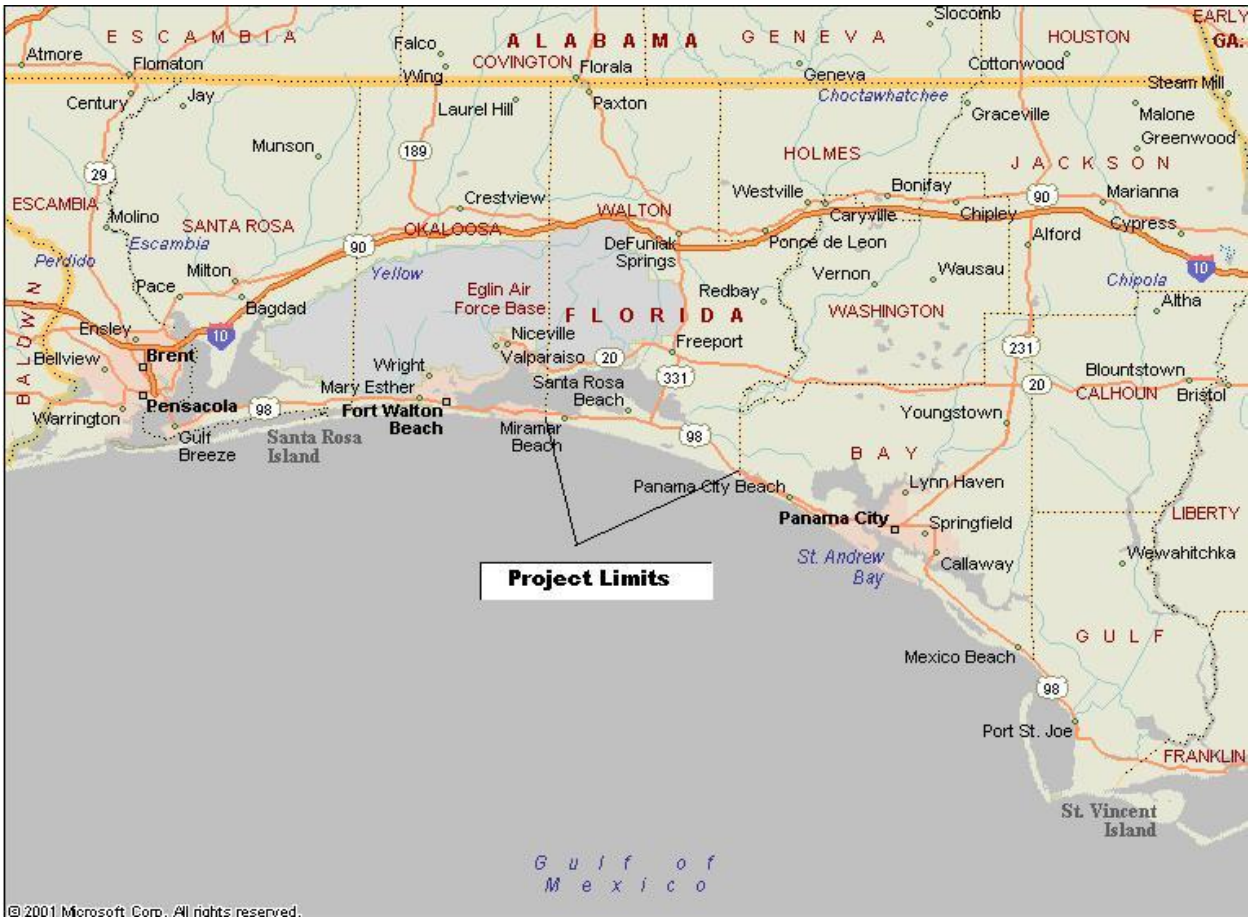


FIGURE 5. COUNTIES OF INTEREST

3.2.4 Households

All five counties experienced a significant increase in the number of households from 1990 to 2000. With increases of over 46 percent, Santa Rosa and Walton Counties had the greatest growth in the number of households. Of the five counties, Okaloosa led with 66,269 households in 2000. The median household income also increased from 1989 to 2007 for the five counties. Of the five counties, Okaloosa County had the highest median household income in 2008, but Walton County had the greatest percentage increase from 1989 to 2008, 105.6 percent. The median household income for Santa Rosa and Okaloosa Counties both were higher than that of the State of Florida in 2008.

3.2.5 Study Reaches

Walton County's 26 miles of coastline initially was subdivided into study reaches that very nearly coincided with the neighborhood divisions that already existed in the county's coastal community. That division resulted in 10 major study reaches initially formulated for economic delineation (see Table 1).

TABLE 1
INITIAL MAJOR STUDY REACHES

Reach	Reach Name
1	Miramar Beach to Sandestin
2	Sandestin and 4 Mile Village
3	Topsail Hill Preserve State Park
4	Beach Highlands and Dune Allen
5	Santa Rosa Beach
6	Blue Mountain Beach
7	Gulf Trace, Grayton Beach, Grayton Beach State Park and Watercolor
8	Seaside and Seagrove
9	Deer Lake State Park, Watersound and Seacrest West
10	Seacrest West, Rosemary beach and Inlet Beach

Damages to the Walton County coastal area wrought by Hurricane Ivan in 2004 prompted call for expediting the study process and getting the feasibility report complete ahead of the planned schedule outlined in the Project Management Plan (PMP). The Project Delivery Team (PDT) proposed a plan for expediting the study process. That plan included reducing the number of study reaches to five. This was made possible because significant erosion occurred due to Hurricane Ivan in September of 2004. Hurricane Ivan removed a significant portion of physiographic differences in the shoreline, thus reducing the number of representative profiles needed to account for variation between and among reaches.

Due to the effects of Hurricane Ivan on the beach the PDT decided that the project existing conditions had changed significantly. As a result new surveys of the beach were ordered and obtained. A new existing condition was established and named post-Ivan. That existing condition then became the initial point of beach condition (base condition) for the period of analysis.

Further, the PDT sought out, briefed and obtained from all the affected stakeholders approval of the expedited study plan which resulted in a revised PMP. Table 2 and Figure 6 lay out the revised major study reaches.

TABLE 2
REVISED MAJOR STUDY REACHES

Reach	Reach Name
1	Miramar Beach, Sandestin and Four Mile Village
2	Topsail Hill Preserve State Park
3	Beach Highlands, Dune Allen, Santa Rosa Beach, Blue Mountain and Gulf Trace
4	Grayton Beach State Park, Grayton Beach
5	Watercolor, Seaside, Seagrove, Watersound Seacrest Rosemary and Inlet Beach

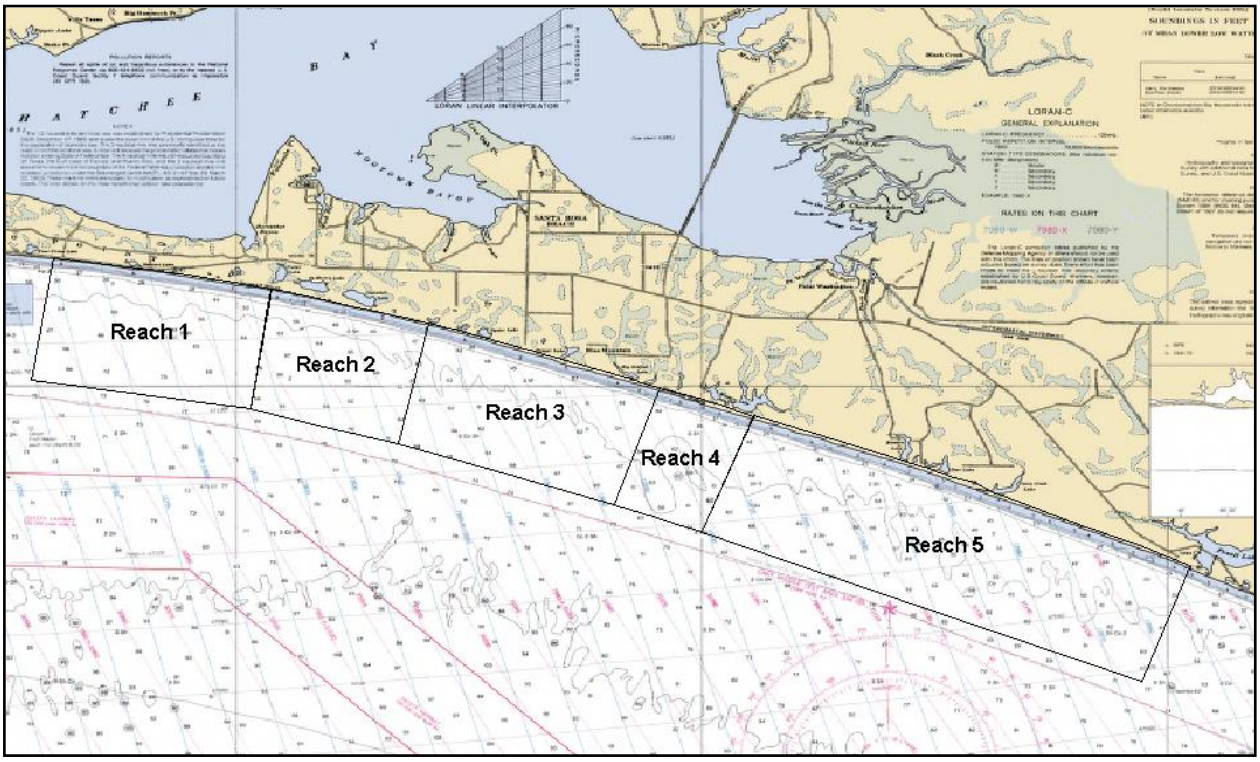


FIGURE 6. REVISED STUDY REACHES

3.2.6 Study Reaches Hierarchy and Naming

The study reach hierarchy begins with the five study reaches shown in Figure 6. Within these reaches there are 117 sub-reaches or Beach-*fx* model reaches, which are the same except for their naming convention.

The five study reaches were delineated for easy reference and visualization of the approximately 26-mile study area by grouping similar neighborhoods and subdivisions. These study reaches were numbered from Reach 1 to Reach 5 running west to east in the study area.

Early on in the study the PDT delineated the 26-mile study area into smaller increments named ‘sub-reaches’ which were about 1,000 feet in length, some longer, a few shorter but the majority averaged 1,000 feet. This was a very convenient way of defining the smallest reach unit since profiles were taken about every 1,000 feet and the Florida Department of Environmental Protection (FDEP) had set monuments about the same 1,000-foot spacing. This portioning created 117 sub-reaches which were numbered running from west to east, beginning with one and ending at 117.

The naming scheme for the 117 Beach-*fx* model reaches was symbolized by ‘RX-Y; the R is Reach, the X is the study reach designator and the Y or YY is the numeric reach designator, whose value ranges from 1 to a maximum of 51, to represent the number of

approximate 1,000-foot sub-reaches in one of the five study reaches. Also, the Y or YY value was reset to begin at one within each of the five study reaches again with the numbering increasing from the west to the east.

The post-Ivan survey data was employed to produce revised representative profiles. The result of which reduced the number of representative profiles to 11. Reaches 1, 2, 3, and 4 could be represented by two profiles each while Reach 5 required three representative profiles. These representative profiles characterized the typical without project beach morphology for input into Beach-*fx*.

In the with-project condition these profiles are combined with alternative design templates to characterize that condition for various beach fill alternatives. Table 3 lists the various sub-reaches and associated profiles.

TABLE 3
WALTON COUNTY STUDY AREA – SUB-REACHES, MODEL REACHES, AND REPRESENTATIVE PROFILES

Sub-Reach	FDEP Monument	Beach-*fx* Model Reach	Representative Profile	Study Reach
1	R-1	R1-1	R1P1	**1**
2	R-2	R1-2	R1P1	**1**
3	R-3	R1-3	R1P1	**1**
4	R-3A	R1-4	R1P1	**1**
5	R-4	R1-5	R1P1	**1**
6	R-5	R1-6	R1P1	**1**
7	R-6	R1-7	R1P1	**1**
8	R-6A	R1-8	R1P1	**1**
9	R-7	R1-9	R1P1	**1**
10	R-8	R1-10	R1P1	**1**
11	R-9	R1-11	R1P1	**1**
12	R-10	R1-12	R1P1	**1**
13	R-11	R1-13	R1P1	**1**
14	R-12	R1-14	R1P1	**1**
15	R-13	R1-15	R1P2	**1**
16	R-14	R1-16	R1P2	**1**
17	R-15	R1-17	R1P2	**1**
18	R-16	R1-18	R1P2	**1**
19	R-17	R1-19	R1P2	**1**
20	R-18	R1-20	R1P2	**1**
21	R-19	R1-21	R1P1	**1**
22	R-20	R1-22	R1P1	**1**
23	R-21	R1-23	R1P1	**1**
24	R-22	R1-24	R1P1	**1**
25	R-23	R2-1	R2P1	**2**
26	R-24	R2-2	R2P1	**2**
27	R-25	R2-3	R2P2	**2**
28	R-27	R2-4	R2P1	**2**
29	R-29	R2-5	R2P2	**2**
30	R-30	R2-6	R2P1	**2**
31	R-40	R2-7	R2P1	**2**
32	R-41	R3-1	R3P1	**3**
33	R-42	R3-2	R3P1	**3**
34	R-43	R3-3	R3P1	**3**
35	R-44	R3-4	R3P2	**3**
36	R-45	R3-5	R3P2	**3**
37	R-46	R3-6	R3P2	**3**
38	R-47	R3-7	R3P2	**3**
39	R-48	R3-8	R3P1	**3**
40	R-49	R3-9	R3P1	**3**
41	R-50	R3-10	R3P1	**3**
42	R-51	R3-11	R3P1	**3**
43	R-52	R3-12	R3P1	**3**
44	R-53	R3-13	R3P1	**3**
45	R-54	R3-14	R3P1	**3**

TABLE 3
WALTON COUNTY STUDY AREA – SUB-REACHES, MODEL REACHES, AND REPRESENTATIVE PROFILES

Sub-Reach	FDEP Monument	Beach-*fx* Model Reach	Representative Profile	Study Reach
46	R-55	R3-15	R3P1	**3**
47	R-56	R3-16	R3P1	**3**
48	R-57	R3-17	R3P1	**3**
49	R-58	R3-18	R3P1	**3**
50	R-59	R3-19	R3P1	**3**
51	R-60	R3-20	R3P1	**3**
52	R-61	R3-21	R3P1	**3**
53	R-62	R3-22	R3P1	**3**
54	R-63	R3-23	R3P1	**3**
55	R-64	R3-24	R3P2	**3**
56	R-65	R3-25	R3P2	**3**
57	R-66	R3-26	R4P1	**4**
58	R-67	R4-1	R4P1	**4**
59	R-68	R4-2	R4P1	**4**
60	R-69	R4-3	R4P2	**4**
61	R-70	R4-4	R4P2	**4**
62	R-71	R4-5	R4P1	**4**
63	R-72	R4-6	R4P2	**4**
64	R-73	R4-7	R4P2	**4**
65	R-74	R4-8	R4P1	**4**
66	R-76	R4-9	R4P1	**4**
67	R-78	R5-1	R5P2	**5**
68	R-79	R5-2	R5P2	**5**
69	R-80	R5-3	R5P2	**5**
70	R-81	R5-4	R5P2	**5**
71	R-82	R5-5	R5P2	**5**
72	R-83	R5-6	R5P1	**5**
73	R-84	R5-7	R5P1	**5**
74	R-85	R5-8	R5P1	**5**
75	R-86	R5-9	R5P2	**5**
76	R-87	R5-10	R5P2	**5**
77	R-88	R5-11	R5P2	**5**
78	R-89	R5-12	R5P2	**5**
79	R-90	R5-13	R5P2	**5**
80	R-91	R5-14	R5P2	**5**
81	R-92	R5-15	R5P2	**5**
82	R-93	R5-16	R5P2	**5**
83	R-94	R5-17	R5P3	**5**
84	R-95	R5-18	R5P2	**5**
85	R-96	R5-19	R5P3	**5**
86	R-97	R5-20	R5P2	**5**
87	R-98	R5-21	R5P2	**5**
88	R-99	R5-22	R5P3	**5**
89	R-100	R5-23	R5P3	**5**
90	R-101	R5-24	R5P2	**5**

TABLE 3
WALTON COUNTY STUDY AREA – SUB-REACHES, MODEL REACHES, AND REPRESENTATIVE PROFILES

Sub-Reach	FDEP Monument	Beach-*fx* Model Reach	Representative Profile	Study Reach
91	R-102	R5-25	R5P2	**5**
92	R-103	R5-26	R5P1	**5**
93	R-103A	R5-27	R5P3	**5**
94	R-104	R5-28	R5P3	**5**
95	R-105	R5-29	R5P2	**5**
96	R-106	R5-30	R5P2	**5**
97	R-107	R5-31	R5P2	**5**
98	R-108	R5-32	R5P1	**5**
99	R-109	R5-33	R5P1	**5**
100	R-110	R5-34	R5P1	**5**
101	R-111	R5-35	R5P1	**5**
102	R-112	R5-36	R5P1	**5**
103	R-113	R5-37	R5P1	**5**
104	R-114	R5-38	R5P1	**5**
105	R-115	R5-39	R5P1	**5**
106	R-116	R5-40	R5P2	**5**
107	R-117	R5-41	R5P2	**5**
108	R-118	R5-42	R5P2	**5**
109	R-119	R5-43	R5P2	**5**
110	R-120	R5-44	R5P2	**5**
111	R-121	R5-45	R5P2	**5**
112	R-122	R5-46	R5P2	**5**
113	R-123	R5-47	R5P2	**5**
114	R-124	R5-48	R5P3	**5**
115	R-125	R5-49	R5P3	**5**
116	R-126	R5-50	R5P3	**5**
117	R-127	R5-51	R5P3	**5**

3.2.7 Public Access and Parking

Current shore protection guidance provides for Federal participation in restoring and protecting publicly owned shores available for use by the general public. Typically, beaches must be either public or private with public easements/access to allow Federal involvement in providing shoreline protection measures. Private property can be included, provided that the protection and restoration is incidental to protection of publicly owned shores or if such protection would result in public benefits. Table 4 lists the location of the access points and the parking availability along the shoreline of Walton County. Not all reaches contain access points. Figures 7A, 7B, and 7C are aerial depictions of the access points that are presented for the entire shoreline of Walton County. Each parking space assumes 4.5 persons per vehicle times 1.5 turnovers per day to yield visits parking will support.

TABLE 4
WALTON COUNTY ACCESS AND PARKING

Construction Reach	Model Reach	Access Points	Parking Spaces	Visits Parking Will Support
1	R1-3	Miramar Beach Regional Access West	85	574
1	R1-4	Miramar Beach Regional Access East	85	574
1	R1-10	Scenic Gulf Drive	100	675
1	R1-12	735 Scenic Gulf Drive	0	0
1	R1-14	132 Norwood Drive	0	0
1	R1-15	Open Gulf Street	0	0
1	R1-16	~ 90 Beach Drive	6	41
1	R1-17	253 Sand Trap Road	3	20
1	R1-18	End of Tango De Mer	0	0
1	R1-22	San Destin Day Use Area	110	743
1	R2-1	719 Top Sail Hill Road	0	0
2	R3-4	363 Highland Avenue	5	34
2	R3-4	127 Highland Avenue	0	0
2	R3-5	Dune Allen 5753 W. Co Hwy 30A	75	506
2	R3-9	5605 Co Hwy 30A	0	0
2	R3-9	5173 Co Hwy 30A	15	101
2	R3-9	4991 W. Co Hwy 30A	0	0
2	R3-10	4850 W. Co Hwy 30A	5	34
2	R3-11	Gulf Place West Access Point	13	88
2	R3-12	Gulf Place Middle Access Point	13	88
2	R3-13	Gulf Place East Access Point	14	95
2	R3-11	4447 W Co Hwy 30A	42	284
2	R3-13	92 South Spooky Lane	0	0
2	R3-14	4201 Co. Hwy 30A	0	0
2	R3-14	186 Gulf View Heights Street	30	203
2	R3-21	2365 S. Co Hwy 83	22	149
2	R3-21	446 Blue Mountain Road	5	34
2	R3-21	590 Blue Mountain Road	5	34
2	R3-21	726 Blue Mountain Road	5	34
3	R4-5	125 Sandy Lane	12	81
3	R4-6	288 Garfield St.	41	277
3	R4-6	199 Banfill Street	41	277
3	R4-6	208 Holtz Avenue	0	0
3	R4-7	91 Boat Ramp Road	0	0

TABLE 4 (CONTINUED)
WALTON COUNTY ACCESS AND PARKING

Sub- Reach	Model Reach	Access Points	Parking Spaces	Visits Parking Will Support
3	R4-6	913 Main Park Road	0	0
4	R5-2	Van Ness Butler Jr. Beach Access and parking and Watercolor Parking Garage and access	100	675
4	R5-4	Seaside (Access & Parking)	60	405
4	R5-5	2560 Co Hwy 30A	0	0
4	R5-6	2624 Co Hwy 30A	2	14
4	R5-6	2680 Co Hwy 30A	0	0
4	R5-6	~ 2750 Co Hwy 30A	0	0
4	R5-6	2790 Co Hwy 30A	32	203
4	R5-7	2845 Co Hwy 30A	0	0
4	R5-7	2920 Co Hwy 30A	0	0
4	R5-8	3020 Co Hwy 30A	4	27
4	R5-9	118 Montgomery Street	0	0
4	R5-9	52 S Andalusia St	0	0
4	R5-9	South end of Dothan Avenue on Montgomery Street	0	0
4	R5-10	3458 E. Co Hwy 30A - San Juan Neighborhood B A	20	135
4	R5-10	3512 E. Co. Hwy 30A	0	0
4	R5-10	3576 E. Co Hwy 30A - Pelaya Neighborhood B A	0	0
4	R5-12	3694 E. Co Hwy 30 A - Campbell Street Neighborhood	75	506
4	R5-12	3874 E. Co Hwy 30A	20	135
4	R5-13	57 Seagrove Place	9	61
4	R5-18	679 Eastern Lake Road	6	41
4	R5-18	491 Eastern Lake Road #33 - Eastern Lake N B A	0	0
4	R5-18	188 San Roy Road - neighborhood come out to helio	0	0
4	R5-19	11 Beachside Dune - Sugar Dune	16	108
4	R5-20	258 Beachfront Trail - Walton Dune	10	68
4	R5-22	308 Beachfront Trail	10	68
4	R5-22	Beachside Drive	16	108
5	R5-22	Deer Lake State Park	1	7
5	R5-32	8040 E. Co Hwy 30A - Gulf Lakes Neighborhood B A	0	0

TABLE 4 (CONTINUED)
WALTON COUNTY ACCESS AND PARKING

Sub- Reach	Model Reach	Access Points	Parking Spaces	Visits Parking Will Support
5	R5-34	8286 E. Co. Hwy 30A - Seabreeze Neighborhood B A	10	68
5	R5-35	Saint Lucia Lane	100	675
5	R5-35	Rosemary Avenue	0	0
5	R5-35	8520 E. Co Hwy 30A - Seacrest Drive Neighborhood B A	0	0
5	R5-46	East Water Street	50	338
5	R5-46	East Water Street	50	338
5	R5-46	188 Winston Lane Beach Access	5	34
5	R5-47	264 South Wall Street - Wall Street Neighborhood	9	61
5	R5-47	435 West Park Place Ave.	67	452
5	R5-48	139 South Orange Street	67	452
5	R5-49	118 West Park Place Avenue FL #20	67	452
5	R5-50	202 South Walton Lakeshore Drive Phillips Inlet Access	15	101
TOTALS		73 Access Points	1,553	10,478

FIGURE 7A
AERIAL SHOWING PARKING AND ACCESS POINTS

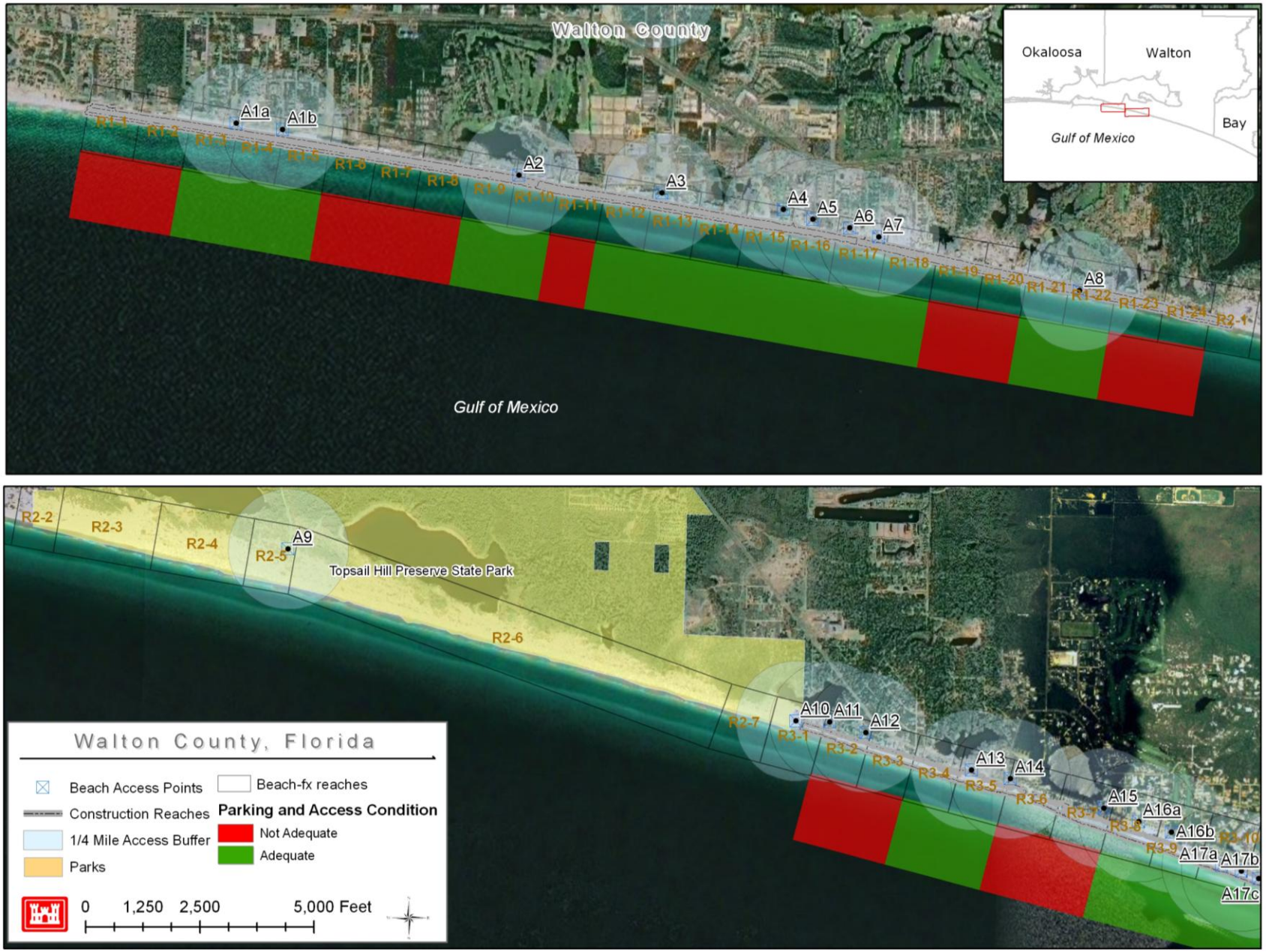


FIGURE 7B
AERIAL SHOWING PARKING AND ACCESS POINTS

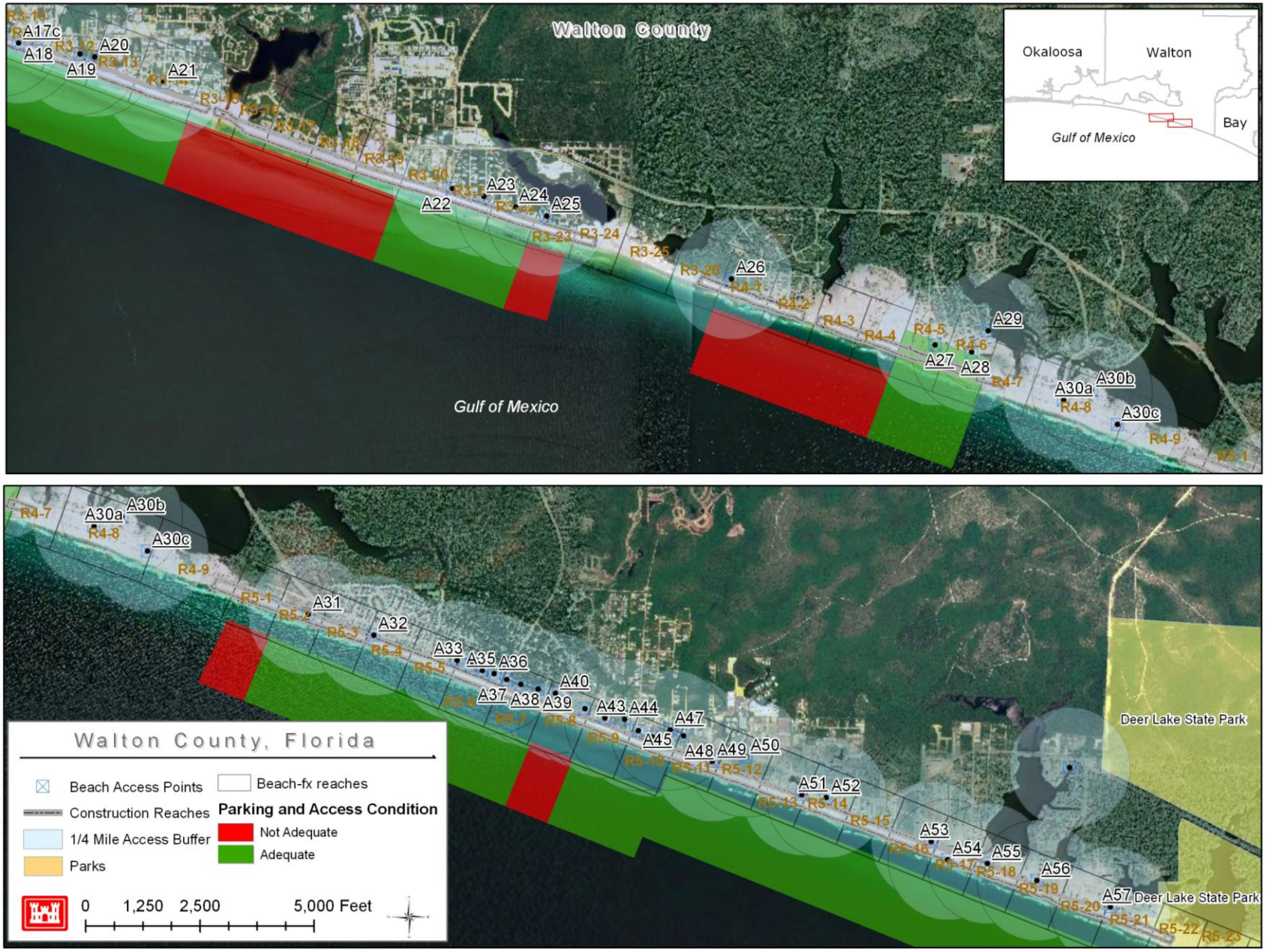
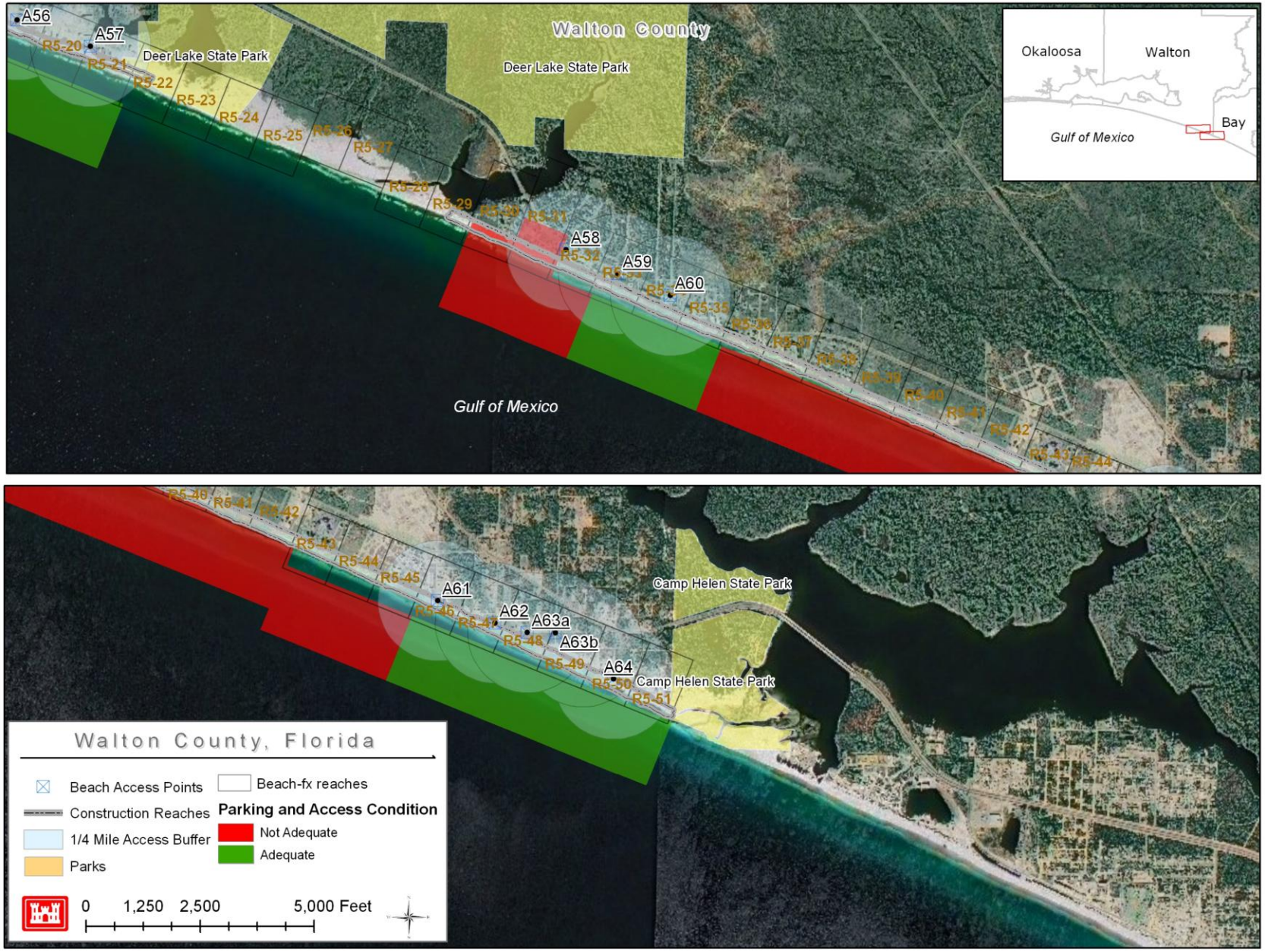


FIGURE 7C
AERIAL SHOWING PARKING AND ACCESS POINTS



3.2.8 Land Use

The coastal beach community layout is somewhat typical of other beach and shoreline development along the Gulf Coast; a checkerboard pattern of single and multi-family residential areas intermixed with a few commercial areas. Walton County's beach shoreside development has less commercial trade on the front row shoreline probably due to the high cost of the land and real estate taxes which affects profitability. Instead most commercial trade establishments prefer to locate on the north side of the beach road.

The current trend in land use on the shoreline continues to be principally single and multi-family development, with little commercial trade development.

3.2.8.1 State Parks

There are three State Parks in the Walton County Study area. They feature great diversity and natural beauty.

Grayton Beach State Park

Grayton Beach State Park is located south of U.S. Hwy 98 approximately halfway between Panama City Beach and Destin. Grayton Beach State Park offers a wide variety of activities for the visitor. Along with the beaches, there are two trails in the 2,228-acre coastal park. There are also 35 campsites with camping and cabin rentals with an additional 22 campsites to be provided in a renovation project that also includes a new ranger station and enhanced ADA accessibility and boardwalks.

Topsail Hill Preserve State Park

Topsail Hill Preserve State Park features one of the most diverse natural eco-systems in the state, with wet prairies, scrub, pine flatwoods, marshes and cypress domes. The park has more than three miles of beaches and five dune lakes. The lakes total more than 170 acres within the 1,637 acre park. In addition to the beaches, this recreation area provides opportunities for bicycling, camping, fishing, nature trails, picnicking, scuba, and swimming. The park has a 2.5 mile long maritime nature trail which traverses ancient dunes and scrub communities. The park has RV accommodations, with 156 sites and 16 rental cabins. Topsail Hill Preserve State Park is located in Santa Rosa Beach about 10 miles east of Destin, FL. .

Deer Lake State Park

The Deer Lake State Park on County Hwy 30A, just west of Watersound, offers park goers a look at intact ancient sand dunes and vast ecosystems. The park has an area of approximately 2,000 acres, the majority of which lies on the north side of the park across County Hwy 30A. A walking trail approximately one mile long is located in the wooded area in the northern portion of the park. The park has recently completed a remodeling project on the walkway to the beach providing ADA accessibility.

3.2.9 Future Development

Development is both ongoing and continuous at Walton County, as it is likely to continue into the immediate and the near future until the small amount of remaining beachfront, save the state and county properties, is completely developed. The characteristic of the existing beachfront is composed of single and multi-family housing. The multi-family housing includes 29 multi-floored condominiums and resort complexes consisting of four floors or more.

3.2.10 Property Inventory

Recent beachfront development in Walton County has predominately been high-rise condominiums, residential resorts and residential communities. Currently, there is a height restriction of four stories or 50 feet for coastal structures in Walton County; however, there are a number of structures in excess of this height restriction that were either constructed prior to or have been granted waivers subsequent to the height restriction. Most of the coastal area that is not state or county property is highly developed. Construction of new single and multifamily residential structures is ongoing at a brisk pace. The few remaining undeveloped large private holdings are showing signs of infrastructure preparations for development.

In the spring of 2004 a complete property inventory of existing structures that may benefit from a storm damage reduction project was undertaken. In 2010 a windshield survey of the study area was undertaken. That survey revealed no significant changes had occurred since the last inventory was completed. Some structures that were under construction are now fully constructed. They were already entered in the initial property inventory along with their values. The purpose of this inventory is to gather data required for the Beach-*fx* data inputs and to obtain a database that would facilitate the gathering of critical metrics that locate the structure spatially in relation to the shoreline and the beach profile as well as its elevation. Routinely, recreational facilities that are damaged or destroyed by storm events are repaired or rebuilt.

Beach-*fx* considers the inventory of structures (damage elements) as items that are containerized in ‘lots’. Lots form boundaries that contain damage elements. Lots are defined as quadrilaterals that approximate lot parcels as delineated in the tax assessor’s files, databases and Geographic Interface Systems (GIS). An aggregation of lots that are for the most part contiguous composes a reach. All reaches taken in aggregate compose the study area.

Photos of structures along with pertinent statistics of construction and foundation type, number of floors, and accompanying detached structures that may benefit from a project were also collected.

The result of that inventory is displayed in Table 5.

TABLE 5
STRUCTURE INVENTORY COUNT BY REACH BY TYPE

Damage Element	Major Study Reach				
	1	2	3	4	5
Commercial	10		1	7	13
Single-Family	99		268	118	348
Multi-Family	62		37	21	99
Walkovers	151		189	20	263
Pool	36		12	9	84
Gazebo	4		7		7
Jacuzzi	4				
Total	366		514	175	814
Grand Total	1869				

3.2.11 Value Of Coastal Inventory

3.2.11.1 Structure Value

The value of structures in the study area required for economic analysis to determine NED benefits, need to be expressed in terms of depreciated replacement costs.

The Mobile District Real Estate Division conducted investigations to determine the depreciated replacement cost for single family residential structures. Tax Assessor's records were examined and studied on the current inventory. Variables of interest relating to assessed value, date of construction, type of construction, number of floors, square footage, recent sales and selling prices, along with other information was analyzed. Sampling techniques, professional judgment, professional guidelines, and consultations with the tax assessor's office and field visits composed of methods used to complete the investigations.

Some of the findings from that analysis were that there were two significantly different classes of valuations between the types of development in Walton County: pre-1990 construction and post-1990 construction. The handful of pre-1990 typical construction was generally less than 1,800 square foot, one-story structures. Many were on grade and most were of masonry or brick construction and only a few made of wood. Assessed values for these structures were very low when compared to calculated depreciated replacement costs. The value of the land has outgrown the value of the structure. When these structures are sold they are usually torn down for larger and more expensive ones. On average they were assessed about one-half of their depreciated replacement cost. The Walton inventory for these structures saw their assessed value increased by 200 percent to arrive at their true depreciated replacement cost.

Post-1990 construction was much larger than 1,800 square feet and most are multi-storied structures. The division between masonry, and wood was about equal for the majority of structure while the remaining minority was brick or wood. Selling prices over the last 5-10 years have been much above what would normally be expected in the market place. Turnovers are occurring in as little as two years and there are large increases in the selling price when compared to purchased prices. Most of the increasing value was carried in the land. The agreed upon methodology for determining depreciated replacement cost was to estimate replacement cost as 125 percent of assessed value.

A relationship between assessed values and depreciated replacement cost for multi-family structures was found to be highly variable and not reliable. The methodology that would render the best estimate of depreciated replacement cost for these structures was to begin with current per square foot construction costs and depreciates that value by two percent each year of age. Current construction costs developed from activity in the last five years was estimated to be $160.00 a square foot for construction less than 20,000 square feet and $175.00 per square foot for construction greater than 20,000 square feet.

Walkovers were valued at an average $200.00 per linear foot for wood structures and $275.00 per linear foot for structures constructed from a commercially produced composite called 'Trex' that was used for public access provided by the TDC's public accesses. Pool values were based on an average updated composite value obtained by interviews and sampling for an earlier study in neighboring Bay County. The few Jacuzzis and tennis court values were based on typical sized units at current costs.

3.2.11.2 Content Value – Structure-Content Ratio

The National Flood Insurance Agency (NFIA) claims database was searched for paid claim history in Walton and the neighboring counties of Bay, Okaloosa and Fort Walton. These records show the date of the loss and what was paid for building and content loss for each claim. No claims were found for any of these counties. The NFIA is now under Homeland Security. They have been contacted for updated claim data. As of the date of this report no updated data has been provided.

A web search of trade associations of homeowner casualty underwriters revealed that insurers generally use a content to structure ratio between 50 and 75 percent of replacement cost. The Walton county inventory is valued at depreciated replacement cost not full replacement cost. The average insurers' content to structure ratio of 62.5% was used to estimate the value of contents for Walton County based on depreciated structure replacement cost.

Table 6 presents the structure and content value of damageable property based on depreciated replacement cost. Damageable property value is used here to reflect that only the lower two (2) floors of multi-storied structures were valued in the property inventory as they alone were susceptible to modeling damages.

TABLE 6
VALUE OF WALTON COUNTY
STRUCTURE AND CONTENT VALUE BY REACH
(DOLLARS IN MILLIONS)

	Reach				
	1	2	3	4	5
Damage Elements	366		514	175	814
Structure Value	$317.3		$164.9	$33.7	$276.9
Content Value	$156.1		$78.9	$16.2	$133.5
Total	$473.4		$243.8	$49.9	$410.4
Grand Total	$1,177.5				

3.3 ECONOMIC BENEFIT EVALUATION

3.3.1 Assumptions

The economic benefits are from four categories: storm damage reduction, lost land reduction, elimination of emergency nourishment costs and increased recreation. The primary benefit category is the storm damage reduction as mandated in Engineering Regulation ER 1105-2-100, shore protection projects are to be formulated to provide for storm damage reduction.

Benefits are stated in constant Fiscal Year (FY) 2011 dollars. The period of analysis is 50 years from January, 2014 through and including all of the year 2063, there are four pre-project base years, 2010 through 2013, making the period of study 54 years. The base year is 2014. The structure inventory is valued at FY 2011 dollars.

3.3.2 Storm Damage Reduction

Beach-*fx* calculates the storm damage reduction from inundation, storm-induced erosion, long-term erosion and wave attack on a damage element-by-damage element basis for each storm event for the study period for a large number of iterations.

3.3.3 Damage Functions

The damage functions used in Beach-*fx* are those developed for the Institute for Water Resources (IWR). A Coastal Storm Damage Workshop (CSDW) was held in Alexandria, Virginia to solicit expert-opinion for economic consequence assessment of coastal storm damage. The workshop is part of longer-term research effort whose objective is to develop a peer-reviewed, step-by-step methodology for estimating coastal storm damages.

The objective of that workshop was to discuss and recommend damage relationships needed to predict structural damage from coastal storms as functions of hazard intensity levels, with associated uncertainties, resulting from erosion, waves, inundation, and their combined effects. Because information on the relationship between residential structural damage and storm parameters is limited, this workshop used expert-opinion as a means of gaining information on these relationships (see Ayyub 2001). A report describing the results of the workshop both in terms of damage relationships and future information needs identified by the experts at the workshop is included in Attachment II of Appendix B – Economic Investigations.

The CSDW developed a set of lookup curves, defined for various damage types and foundation types, to calculate percentage loss associated with structure and contents. For each damage type the input to these curves, or the "damage driving parameter", has been defined by the CSDW. The appropriate damage-driving parameters for each damage type are:

Flooding:
- Depth of water over walking surface of lowest walking floor

Waves:
- Difference between the top of wave (crest) and the bottom of the lowest horizontal member

Erosion:
- Percent of footprint compromised

Damage functions for each damage type (erosion, inundation, and wave) are currently associated with damage element type (single family residential, multi-family residential, walkway, etc.) foundation type (shallow piles, deep piles, slab, etc.) and construction type (wood frame concrete, masonry, etc.) and armor type (no armor, sheet pile, etc.) are used to select the appropriate damage function.

Damages are calculated at the damage element level, following each storm. For each damage type, a damage driving parameter is calculated for each damage element, and used as a lookup into stored damage functions.

3.3.4 Damage Element

Damages are estimated based on the concept of a "damage element". Damage elements are structures, walkways, etc., anything that can incur economic losses. In Beach-*fx's* system hierarchy reaches contain lots, and lots contain damage elements. For each storm, damages are estimated by examining the reach, lots, and damage elements within the lots. Thus, the basic unit on which damages are calculated at present is the damage element. Damage elements have attributes relating to type, geographic location, and value. Each damage element has information relating to structure and content value (treated as a three-parameter distribution for purposes of incorporating uncertainty). For location information, a structure's center point is referenced, as well as its width and length. A single value of ground elevation is

specified, which also includes a three-parameter distribution for describing the first floor elevation and uncertainty.

3.3.5 Damage Estimation

Damages are estimated, based on calculation of the value of a “damage-driving parameter” for the damage element, which is then used as the independent variable to use for lookup into the stored damage functions. These damage functions provide the percentage loss for structure and contents.

3.3.6 Structure and Content Damages

The determination of structure and content damage was calculated using the IWR damage functions. These damage functions generally give the percent damage as related to a water level for inundation damages, and the percent of structure footprint compromised to calculate storm induced and long-term erosion damages.

3.3.7 Inundation Damages

Inundation damages occur when storm surge elevations exceed the elevation of the dune line, or when waves break over the dunes. Inundation damages were assumed to begin for existing conditions when the maximum water level exceeded the first floor elevation of structure, since there is not always a continuous dune system.

3.3.8 Lost Land Reduction

P&G states that erosion protection benefits include loss of land, structural damage prevention, reduced emergency costs, and reduced maintenance of existing structures and incidental benefits. The loss of land benefit is measured as the value of nearshore upland. Nearshore upland is sufficiently removed from the shore to lose its significant increment of value because of its proximity to the shore, when compared to adjacent parcels that are more distant (inland) from the shore.

3.3.9 Loss of Land Benefit

With a project in place land that would be lost in the without project future condition would be preserved by a project. The design template that represents the project that provides full benefits to protected properties would be in place for the period of analysis preserved through the process of periodic renourishment. This benefit is based upon the value of near shore lands. Normally determinations of the market value for the land losses are based on the value of near shore upland. Near shore upland is sufficiently removed from the shore to lose its significant increment of value because of its proximity to the shore, when compared to adjacent parcels that are more distant (inland) from the shore.

For this project, near shore values were estimated by Mobile District's Real Estate Division. The criterion used was, near shore lands are those parcels that are sufficiently removed from the shore to lose any direct water frontage value. These parcels have; no Gulf frontage, no view of the water, no access point to the Gulf as part of any deeded subdivision rights. The methodology used was to track 2005 and 2006 sales of near shore parcels in Walton County. Since property values varied according to location and sale prices also varied broadly due to the pause in the market caused by the storm activity on the Gulf in 2004 and 2005, a range of values, a low and a high, price per square foot was calculated. Then the average of the high and low was used to estimate the value of land lost. The value used represents a long-term value suitable for the period of evaluation. The value of land lost ranges from a low of $35 per square foot to $112.50 per square foot. In each eroding reach the average yearly erosion rate multiplied by the length of the reach multiplied by the price per square yard gave the average annual value of land lost.

3.3.10 Emergency Nourishment Cost

Emergency nourishment is performed at the reach level. At each time step of the model, the need for emergency nourishment is tested for each reach. The test consists of an examination of the current model-simulated reach dune height, dune width, and berm width, which are compared to user input "triggers", that is, limits below which emergency nourishment takes place. For example, if the input berm width trigger is 100.0 feet, then if the current berm width is below 100', emergency nourishment takes place. Each trigger acts independently, such that if either the berm width, or the dune, or the dune height trigger is activated, emergency nourishment takes place.

Once emergency nourishment is triggered for the reach, the emergency nourishment will start after a user-entered mobilization time. (There is also a user-entered mobilization cost which can be associated with the reach-level mobilization). Thus, if the trigger for emergency nourishment takes place on day 255 of the simulation, and the mobilization time is 30 days, then emergency nourishment will start on day 285.

The volume of emergency nourishment is determined based on the user input emergency template, defined by dune height, dune width, and berm width. This information is used to calculate a needed volume for the reach. Three parameters are then used to determine how long it will take to place the volume and how much it will cost: the production volume (cubic yards (cu/yd) per day), the borrow to placement ratio (cu yds) of borrow per cu yd placed), and the unit cost ($/cu yd). Based on the needed volume, production rate, and borrow to placement ratio, the time for restoration of the emergency template is determined and at that time increment after start of nourishment, the dune template is set to the emergency template, subject to rules that preclude diminishing the existing berm height, dune width, or dune height if they are currently greater than the corresponding template values.

Model output includes the cost of emergency nourishment for the complete future without project condition and for each alternative plan. The cost avoidance benefit of a

project feature is defined as the difference between the with and without project emergency costs.

3.3.11 Storm Induced and Long-Term Erosion Damages

Storm induced erosion is defined as the horizontal distance from 0 NGVD on the pre-storm profile to the landward most position where vertical erosion during the storm exceeds 0.5 feet. Recession is calculated, averaged and a standard deviation computed for each sub-reach over the simulation period.

A project-induced planform change rate, which accounts for the longshore dispersion of the beach nourishment material, is specified for each Beach-*fx* reach. GENESIS Model was used to estimate the long-term planform change rate for the future without and future with project conditions. GENESIS simulates changes in shoreline position due to the presence and combinations of beach fills and nearshore structures such as groins, jetties, seawalls, and breakwaters. GENESIS was used to predict and optimize the performance of the NED Plan and renourishment requirements given various design transitions.

3.3.12 Wave Attack Damages

Wave conditions, which drive the model, consist of wave height, period, and direction and can originate from multiple sources. Predictive simulations estimate the performance of any proposed beach fill or structural modifications.

Damage elements along the shoreline can be damaged from wave run-up or from waves breaking directly on the damage element when storm surge elevations are high. These damages are determined using the IWR expert elicitation damage functions.

3.3.13 Emergency Nourishment

In the without-project condition it is assumed that emergency nourishment will be performed as needed, over the 54-year period of study. The non-Federal sponsor indicated that, in the absence of a Federal project, they will, acquire funding to pursue a renourishing action after each significant storm. When a disaster is declared for a particular county, the Federal Emergency Management Agency (FEMA) will provide up to six cubic yards per linear foot to mitigate for loss. There is a cost sharing provision requirement by FEMA that can be as low as zero percent.

The non-Federal sponsor has just completed a dune restoration project to partially replace the erosion losses due to Hurricane Ivan to provide storm protection for existing infrastructure, mainly Scenic Highway 98 and Gulf-front development. The current most threatened areas are the beneficiaries of this effort; Miramar Beach, Dune Allen and the Inlet Beach areas. The funding was provided by FEMA.

Temporarily, the non-Federal sponsor has deferred emergency work in anticipation of a Federal project. This deferral should be viewed as an anomaly and such work will be performed if project implementation is delayed for some reason.

Beach-*fx* executes a nourishing action after each hurricane event, which averages about 125,000 cy of material on the beach. This material is trucked in for placement on the beach and has a cost of about $30 per cy. Reach 2, which is all State Recreation Area Lands and Reach 4 which is primarily State Recreation Area Lands do not receive emergency nourishment.

3.3.14 Rebuilding

The model allows the user to define a distribution (triangular, you provide minimum, most likely, and maximum) of the number of days required for rebuilding, at the damage element (DE) level, that is, the distribution can be changed for each damage element. Thus, the user might enter 350, 365, or 380 to get a distribution around one year. At the start of each iteration, a value is drawn for the sample, setting the rebuilding time for the damage element for that iteration. The Walton County existing condition rebuilding parameters for single and multi-family construction was 365, 730 and 1,825 days. Walkovers, pools, jacuzzis, were assigned 365, 548 and 730 days. The number of times rebuilding could occur was unlimited if sufficient room on the lot permitted rebuilding.

If a DE is damaged to any degree, and has not been "rebuilt" more times than the maximum allowable, then a "rebuilding event" is set at a time in the future corresponding to the random rebuilding time. When the simulation reaches that time, the lot on which the DE exists is checked to see if it is buildable. The model makes a simple check based on whether or not the landward toe of the dune has retreated past the center point of the lot. If so, the lot is not buildable, and rebuilding does not take place.

If the lot is rebuildable at the time of rebuilding, then structure and contents values are restored to their initial values at the start of the simulation, such that they are able to be taken as damages again at the next storm event, and the number of times the damage element is rebuilt is incremented by one.

3.3.15 Combining Damages – Composite Damage Function

Total damage element damages are calculated using a composite damage function that takes into account damages for all damage mechanisms present while avoiding double counting. Because a structure may be damaged by more than one storm damage hazard a methodology was needed to be developed for combining the damages. This methodology was defined during the IWR workshop and is included in Attachment II of Appendix B – Economic Investigations.

3.3.16 Recreation Benefits

In order to determine the recreation benefits for a tentatively selected plan an economic value must be placed on the recreation experience at the Walton County Beaches. This value can then be applied to the increase in visitation which results from the project to determine the NED recreation benefits. For this report, unit day values (UDV's) are used to determine the economic value of recreation at Walton County Beaches. UDV's are administratively determined values which represent the National Economic Development (NED) recreation values for typical types of recreation. Guidance for their use is provided by Engineering Regulation 1105-2-100.

UDV's are determined using a point system that takes into account the following factors: recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental (esthetics) quality. A good deal of judgment is required in the assessment of point values. A group of planning professionals with knowledge of the study area made independent judgments of the UDV values which were averaged. The UDV point totals convert to a recreation value of $5.07 for the without project condition and $5.16 for the with project condition. These values were applied to the increase in visitation over the study period. The difference between the without and with project value of recreation determines the recreation benefits. The complete recreation analysis can be found in Attachment I of Appendix B. The source of the value of recreation is obtained from Economic Guidance Memorandum, 10-03, Unit Day Values for Recreation, Fiscal Year 2010.

3.4 ENVIRONMENTAL

3.4.1 Environmental Considerations

The study area is located in Walton County, Florida as illustrated in Figure 1. During the late 1990s, this region endured several strong hurricanes, most notably Hurricanes Opal in 1995 and Hurricane Georges in 1998. More recently, the entire coast of Walton County sustained major beach and dune erosion from Hurricane Ivan in 2004 and Hurricane Dennis in 2005. Erosion occurred both in terms of beach profile lowering and dune erosion. Major dune recession occurred throughout the County, including a number of locations where high dune-bluff escarpments replace the once established dune systems. These areas have become particularly vulnerable to further storm erosion.

Environmental Impacts associated with Hurricane Ivan have resulted in decreased beach area and elevation. Such impacts directly affect availability for suitable nesting habitat required for nesting sea turtles. If nesting does occur, the lower elevations allow the nests to be more vulnerable to water inundation from lesser magnitude storms. Narrower beaches decrease the areas for shorebirds to forage and rest. Damage to the previously established dunes system destroyed much of the existing vegetation that provides stabilization. The absence of the dunes and associated vegetation eliminates

much of the suitable habitat required to sustain beach mice populations and other wildlife that relies on these types of habitats for their continued survival.

These impacts provide environmental restoration opportunities within the proposed project area. Restoring a beach-dune system allows greater stability and sustainability of the coastal environment once it has become re-established. Restoring the beach and dune habitats that support a variety of associated flora and fauna contribute to the success and continual survival of several threatened or endangered species. The restoration effort will also contribute to the well-being of various other flora and fauna that naturally occur in the immediate vicinity. Restoration opportunities include increasing both the beach berm and dune widths to increase sea turtle nesting habitat and provide numerous benefits to a variety of shore birds, beach mice, and natural vegetation as well as other inhabitants of the coastal environment. The dune vegetation will be restored with naturally occurring dune vegetation designed to create a dune that matches the surrounding natural dune patterns in the area.

The general environmental criteria for projects of this nature are identified in Federal environmental statutes, executive orders, planning guidelines, and the USACE Environmental Operating Principles (EOP). It is the national policy that ecosystem restoration, particularly that which results in the conservation of fish and wildlife resources be given equal consideration with other study purposes in the formulation and evaluation of alternative plans. The basic guidance during planning studies is to assure that care is taken to preserve and protect significant ecological and cultural resources, and to conserve natural resources. These efforts also should provide the means to maintain and restore, as applicable, the desirable qualities of the human and natural environment. Formulation of alternative plans should avoid damaging the environment to the extent practicable and contain measures to minimize or mitigate unavoidable environmental damages. Consistent with laws and policy, alternative plans formulated should avoid damaging the environment to the extent practicable and contain measures to minimize or mitigate unavoidable environmental impacts.

EOP's have been established for evaluation of water resource projects throughout the study process to ensure conservation, environmental preservation, and restoration is considered at the same level as economic issues. These principles are: 1) Strive to achieve environmental sustainability, 2) Consider environmental consequences, 3) Seek balance and synergy, 4) Accept responsibility, 5) Mitigate impacts, 6) Understand the environment, and 7) Respect other views. The following criteria were used to address environmental impacts during the evaluation of alternatives.

- Protection, preservation, and improvement of the existing fish and wildlife resources along with the protection and preservation of coastal and offshore habitat and water quality;

- Consideration in the project design of the least disruptive construction techniques and methods;

- Protection and preservation of endangered and/or threatened species, Critical Habitat, and Essential Fish Habitat (EFH); and
- Preservation of significant historical and archeological resources through avoidance, if possible, or data recordation if destruction of the resources is necessary.

Of primary concern is compliance with the Clean Water Act. Potential water quality impacts associated with the borrowing and placement of fill material associated with beach nourishment operations must be considered. Such activities will include evaluation of sediment from identified borrow sources for placement within the littoral zone throughout the study area. Sediment characteristics of concern are sediment grain size and color. Borrow sediments identified as suitable must match, as closely as possible, the sediment characteristics at the nourishment site. This information has been utilized in the preparation of the Section 404(b)(1) evaluation and also in developing the management requirements to minimize impacts to threatened and/or endangered species under Section 7 of the Endangered Species Act.

Additional issues that have been addressed include coordination with the U.S. Fish and Wildlife Service (USFWS) on six Coastal Barrier Resource System Units. The Coastal Barrier Resources Act (CBRA) limits the expenditure of Federal funds in designated system units so that expenditure would not enhance future/further development of the area. It was initially determined by the Corps that the activities would protect or enhance fish and wildlife resources and habitats within these units which are exempt under CBRA. The CBRA Units that are within the project limits are illustrated in Figure 8 of the Environmental Assessment (EA). Coordination with the USFWS concerning the consistency of proposed actions with the requirements of CBRA has been conducted for the tentatively selected plan and the USFWS does not agree with the Corps' determination for the CBRA exemptions. By letter dated February 22, 2010 the USFWS issued their determination that this project is not consistent with the purpose of CBRA. It should be recognized that CBRA units P31A, FL-96, and FL-94 are the only units that have been determined to fall within the Federal cost-shared project reaches as discussed in Section 4.9. These reaches are for the most part at the tapered ends of those reaches. The decision has been made that funding of these reaches will be 100% locally funded.

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) identified habitats within the marine and estuarine areas of the US that were essential to the management of certain specific fin and shellfish. Areas identified by the Gulf of Mexico Fishery Management Council as EFH include all the marine and estuarine areas of Walton County. Consultation with the National Marine Fisheries Service (NMFS), Habitat Conservation Division has been completed and focuses on minimizing impacts to EFH. Of particular concern is avoidance or minimization of impacts or the enhancement of EFH.

Coordination with the NMFS concerning potential impacts to listed species and critical habitats has been conducted for the selected Federal plan. The consultation and coordination includes efforts to minimize impacts and benefit the recovery of listed

species. Coordination with the USFWS has been conducted through the recent finalization of the Statewide Programmatic Biological Opinion (PBO) for Shore Protection Activities along the Coast of Florida dated August 2011. Due to issues regarding piping plover and beach mice that could not be resolved, the PBO does not address these two species. Coordination for the piping plover and the Choctawhatchee beach mouse will be conducted prior to the final report.

All Federal activities that will affect any land, water use, or natural resource of the coastal zone shall be carried out in a manner which is consistent, to the maximum extent practicable with the enforceable policies of the Florida Coastal Management Program. In addition, water quality certification from the State of Florida is required for all actions to be implemented. The feasibility study of the critically eroded shoreline has been conducted and determined to be consistent with State of Florida's beach management plan.

3.4.1.1 Coastal and Marine Resources

Coastal Walton County consists of approximately 26 miles of both developed and undeveloped beach and dune systems including six miles of state recreation areas and nine miles of state-designated critical eroding areas. The county's coastline also supports a number of coastal dune lakes considered rare worldwide and unique to the northern Gulf of Mexico and the United States. The existing coastal resources within the study area range from natural pristine systems found within state recreation areas to severely disturbed systems found within the more developed areas. The dune systems fronting developed areas range from little or no dune to larger relatively healthy dune systems. North of the county's coastal areas lies Choctawhatchee Bay. The ecosystem associated with Choctawhatchee Bay is typical of northern gulf coast estuaries including wetlands consistent with adjacent estuaries and submerged aquatic vegetation. It is not expected that the Bay will be affected by the proposed beach restoration and will not be considered in this study.

The area has been further characterized by a previous study conducted by Taylor Engineering, Inc. (2003) as a coastal peninsula extending west from the mainland defining the western two-thirds of the coastline and mainland beaches characterizing the eastern third. Behind the county dune system, upland drainage feeds the coastal dune lakes that intermittently breach the dune system and discharge directly into the Gulf of Mexico. The area supports a variety of coastal wildlife with natural communities consistent with the northern Gulf of Mexico. The proposed beach restoration effort may potentially affect three beach zones which define the natural communities within the placement and borrow areas. These zones, addressed in this evaluation, are classified as coastal beach and dune, intertidal swash, and nearshore. These zones are discussed in greater detail in the EA.

An unusual attribute of the Walton County's coastal beach and dune community is the presence of coastal dune lakes. There are a number of dune lakes throughout the Walton County coast as shown in Figure 8. Coastal dune lakes are relatively small

bodies of water that occur in coastal communities along the northern Gulf of Mexico. The lakes are typically separated from the Gulf by a barrier beach and dune system which may be intermittent with or without a meandering tidal outlet. The lakes contain and support valuable wetlands and a variety of coastal wildlife with natural communities unique to this region that may be impacted if the periodic breaching process is impacted by this project. Some of the coastal dune lakes have dune systems 500 feet wide and ridges extending 10-30 feet high and are important breeding areas for insects and crustaceans. Many birds and mammals also utilize coastal dune lakes for food and habitat. The intermittent connection to the Gulf is what distinguishes these lakes as rare. Prior to Ivan, most of the coastal dune lakes were not openly flowing into the Gulf of Mexico. Following Ivan, most all of them were flowing freely into the Gulf. The Florida Natural Areas Inventory designates the coastal dune lakes as “critically impaired in Florida because of extreme rarity.” A more detailed discussion of the coastal dunes lakes can be found in the EA.

The study conducted by Taylor Engineering (2003) also evaluated the native beach characteristics of Walton County and found that the sand in the beach system was fairly uniform throughout the study area. The beach system sediments consist of medium-grained sand with minor amounts of carbonate material. A color analysis determined the Munsell color classification of the native beach sand. Generally, the native sand is described as white with slight variations in localized areas. The geotechnical section of this document presents additional information pertaining to the native beach and borrow area characteristics. In general, the sediment contained in the borrow area is similar to that of the Walton County beaches and considered to be compatible.

FIGURE 8. APPROXIMATE LOCATIONS OF COASTAL DUNE LAKES THROUGHOUT WALTON COUNTY

3.4.1.2 Threatened and Endangered Species

There are several listed species know to exist within the Walton County project area and will require coordination with the appropriate agencies as specified by Section 7 of the Endangered Species Act. Of particular concern within the project areas are:

- Atlantic loggerhead sea turtle
- Green sea turtle
- Leatherback sea turtle
- Kemp's ridley sea turtle
- Hawksbill sea turtle
- Gulf sturgeon
- Choctawhatchee beach mouse
- Piping plover
- Various shorebirds
- Florida manatee
- Gulf coast lupine

A more detailed discussion of the listed species can be found in the EA. Formal consultation has been conducted with both the USFWS and NMFS in accordance with Section 7 of the ESA for species and critical habitats under their purview.

3.4.1.3 Critical Habitats

The proposed beach restoration area falls within the designated Gulf sturgeon Florida Nearshore Gulf of Mexico critical habitat (Unit 11). This area falls under the jurisdiction of the NMFS. Consultation with NMFS regarding the effects of the proposed action on Gulf sturgeon and subsequent potential modification to Gulf sturgeon critical habitat has been conducted. The direct berm and beach placement is adjacent to designated critical habitat for the Choctawhatchee beach mouse (CBM). Consultation with the USFWS regarding the effects of the proposed action on the CBM and subsequent potential modification to its critical habitat has been conducted.

3.4.1.4 Essential Fish Habitat (EFH)

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCA) require that Federal agencies assess potential impacts to EFH for NMFS managed commercial fisheries. In accordance with the MSFCA, any Federal action that has the potential to adversely affect EFH requires consultation with the NMFS. EFH is defined as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity and include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include aquatic areas historically used by fish where appropriate. The near and offshore areas of the Walton County project reaches supports a variety of fish species, primarily small species and juveniles of larger fish species. EFH for many of these species occur within the project area and include such species managed under the purview of the NMFS, Habitat Conservation Division as identified in the EA. EFH consultation has been completed with NMFS, Habitat Conservation Division.

3.4.1.5 Cultural Resources

The Walton County shoreline has been the site of numerous cultural resources investigations since the 1940s. Over forty archaeological and historical sites are known to exist within one mile inland of the current beachfront with at least two of those sites considered potentially eligible or eligible for the National Register of Historic Places. Known archaeological sites suggest that humans have occupied the area as far back as 8500 BC, beginning with the Archaic period. The Walton County coast has been continually although sparsely inhabited up to the present.

In accordance with Section 106 of the National Historic Preservation Act and other relevant cultural resource laws, recommendations and actions have been coordinated with the Florida State Historic Preservation Officer (FLSHPO). Coordination with the appropriate Federally recognized American Indian tribes have been conducted as part

of the required public notice. Plans to avoid or conduct more intensive evaluations of any cultural resources identified during the surveys have been developed and coordinated.

Mobile District's cultural resources staff has provided the appropriate narratives for the National Environmental Policy Act (NEPA) documentation summarizing the results of the cultural resources investigations and coordination. No significant cultural resources have been identified. The Mobile District, as lead Federal agency, has determined that the project will have no effect on historic properties.

3.4.1.6 Hazardous Materials

The material contained in the selected nearshore borrow areas consists of medium-grained marine. These areas are far removed from any historically known sources of contaminants. Also, the material is primarily composed of unconsolidated quartz sand which is considered inert and in areas of high current and wave energy conditions, in which such material is considered to likely be free of contaminants. Typically, considering these conditions, based on 40 CFR 230.60, no testing for contaminants should be necessary. Because of recent events in the Gulf of Mexico, there is concern that there may offshore oil contamination. To date, there has been no evidence to confirm this presence but random sampling may be necessary during the Design and Implementation Phase if instances of offshore contamination are found elsewhere.

3.4.1.7 Sediment Compatibility

The State of Florida requires shoreline storm protection and restoration activities that artificially place sand on the beach from remote sources must use sand similar to the native beach sand in order preserve the beach's natural characteristics to the maximum extent practicable. Beach compatible fill is material that maintains the general character and functionality of the material occurring on the beach and in the adjacent dune and coastal system.

The non-Federal sponsor has conducted offshore studies to include geological and geophysical interpretation of seismic records and vibracores, performed by Taylor Engineering, Inc. Subsequent investigations looked at the entire coastline to confirm locations with sufficient quantities for the initial beach placement and future renourishments. To satisfy the state's stringent sand suitability standards, an assessment has been conducted to compare and show that the selected borrow area sand is reasonably compatible with that of the native beach sand. This detailed assessment is included in the geotechnical section of this report.

A Sediment Quality Assurance Plan has been prepared that outlines the steps that must be taken to observe, sample, and test the placed sediments to assure compliance with the standards set by the state of Florida. The technical requirements addressed in this plan include the location of dredging, sediment quality monitoring on the beach, and remedial actions if necessary.

3.4.1.8 Environmental Mitigation

It is believed that the beach restoration efforts will provide numerous benefits towards improving the size and quality of habitats for shoreline wildlife that result from wider beaches and healthier dunes. Biological opinions have been issued by USFWS and NMFS to incorporate methods and measures to avoid and/or minimize environmental impacts to existing habitats and threatened or endangered species and associated critical habitats. These methods and conditions will be incorporated into the proposed action. Based on the identified borrow area and the various coordination conducted with the support agencies, no mitigation requirements have been identified.

3.4.1.9 Borrow Area Environmental Impacts

The non-Federal sponsor has conducted a biological resources survey along with a detailed sub-bottom seismic survey in June 2007. Offshore equipment employed for borrow area excavation typically consists of a hopper dredge and possibly pipelines, equipment barges, marker buoys, and small tugs. Dredging would temporarily affect water quality by increasing local turbidity levels around the dredging sites. Increased water column turbidity during sand excavation would be temporary and localized. The spatial extent of elevated turbidity is expected to be within 1,000 meters of the operation, with turbidity levels returning to ambient conditions within a few hours after completion of the dredging activities. Therefore, no significant long-term impacts to water quality are expected to occur. Elevated turbidity levels resulting from construction should not have a significant negative effect on organisms inhabiting the area.

Given the naturally dynamic waters of the Gulf of Mexico coast, organisms inhabiting the offshore areas adapt well to reasonable environmental changes such as moderate increases in turbidity. Fish and other mobile species may temporarily leave the dredging site if turbidity becomes too great. Dredging activities would result in significant mortality of non-motile benthic organisms. No significant impacts to managed species of finfish or shellfish populations have been identified from the borrow area excavation operations.

3.4.1.10 Environmental Compliance, Coordination, and Agency Views

On 29 June 2004, an interagency meeting was held at the Walton County, Tourist Development Council facility in Santa Rosa Beach, Florida. The purpose of the meeting was to initiate environmental coordination with the interagency team involved in the permitting and environmental compliance processes for the Walton County Shore Protection Feasibility Study. The meeting's primary objects were to identify and discuss environmental issues and opportunities, permitting issues, and environmental compliance requirements associated with the proposed Walton County project. In attendance were representatives from the Corps, Walton County, USFWS, Florida Department of Environmental Protection (DEP), and Florida Fish and Wildlife Conservation Commission (FWCC). It should be noted that representatives from the

NMFS were invited to participate. Communications with the Habitat Conservation Division expressed that the project did not raise issues that would require their representation. A Memorandum for Record (MFR) summarizing the meeting was prepared and distributed. A copy of the MFR is included in the EA.

An important topic of discussion at the interagency meeting dealt with the NEPA process that should be conducted for the Walton County project, specifically whether the project would require an EA or Environmental Impact Statement (EIS). The USFWS expressed that their agency is not viewing this project as one that would require an EIS. Although the project area encompasses some 26 miles of shoreline, the activities will be comprised of segmented beach nourishment and/or dune restoration. The group in attendance felt that given the project characteristics, low level of controversy, absence of contamination, and precedent set by other local beach projects that an EA would be the appropriate level of environmental documentation for the Walton County project. An EA must adequately address the cumulative impacts of the entire project and may be subject to future change into an EIS should any major issues and controversy arise. If the EA results in a finding that no significant resources would be impacted by the proposed actions, a FONSI would be prepared.

The Mobile District has reopened communications with the interagency team to reaffirm this determination. Reaffirmation has been received from the team that their position is that an EA would be the appropriate level of NEPA documentation. The USFWS, in an email dated December 9, 2009 concurs that with the information available an EA is the appropriate level of NEPA documentation. Also in an email dated December 9, 2009, Florida DEP has indicated that they feel the determination as to the appropriate level of NEPA documentation is the Corps' decision as long as it adequately addresses the information outlined in the Joint Coastal Permit (JCP) application package. A conference call was held on December 16, 2009 between Corps representatives and Ntale Kajumba and Paul Gagliano from EPA Region IV. After describing the project and answering several questions the EPA representatives felt that the Corps was justified in the determination to generate an EA. They also affirmed that this decision is the responsibility of the Corps; however, the information contained in the EA must support the FONSI. If the EA reveals significant impacts, then an EIS must be initiated.

The Mobile District maintains the position that based on project characteristics, low level of controversy, absence of chemical contamination, lack of any mitigation requirements, and precedent set by other local beach projects that an EA would be the appropriate level of environmental documentation for the Walton County project.

3.4.2 Status of Environmental Compliance Actions, Coordination, and Documentation

It should be recognized that the non-Federal sponsor proceeded with pursuing a beach restoration plan of their own. Their local project area lays the length of Walton County. The proposed local plan includes a berm design that exhibits a construction profile that has a 207-foot wide berm measured from the existing 9.5 feet NAVD contour with a10-

foot wide dune crest. The proposed plan view and profiles totally encompasses the tentatively selected plan and uses the same borrow site. Subsequently, the County has already completed the process of applying for the state WQC/CZC. They have also completed coordination for threatened and endangered species as required by the ESA, initiated coordination on essential fish habitat (EFH), completed cultural resources coordination, and prepared a draft EA for their local plan. Although their efforts are for a larger area, these same coordinations are required to be conducted for the tentatively selected plan, but have provided a level confidence that the same outcome will be achieved. Much of the information already generated by the sponsor for the local plan has been used in the various coordinations and consultations for the tentatively selected plan.

Although the non-Federal sponsor has conducted the coordination required by the ESA, the Fish and Wildlife Coordination Act (FWCA) requires that Federal agencies consult with the USFWS regarding fish and wildlife resources in the project area. This consultation has been conducted for the tentatively selected plan.

The Coastal Barrier Resources Act of 1982 must also be considered for the tentatively selected plan. The CBRA restricts Federal expenditures and financial assistance within designated CBRA zones in the Gulf and Atlantic Coasts. Several CBRA units are located within the project area. Coordination with the USFWS concerning the consistency of the tentatively selected plan in accordance with the requirements of CBRA for the six system units has been completed in efforts to ensure that the expenditure of Federal funds does not enhance the potential for development within these units.

Table 6A at the end of this section summarizes the coordination and consultations required for environmental compliance for the tentatively selected plan.

3.4.2.1 Water Quality Certification (WQC) Coordination

A Water Quality Certification/Coastal Zone Consistency application with the Florida Department of Environmental Protection (FDEP), Bureau of Beaches and Coastal Systems dated June 27, 2007 has been prepared by the sponsor for their local plan. Their application has been deemed complete but the final permit has not yet been issued. The state has indicated that since the application for the local plan totally encompasses the tentatively selected Federal plan that much of the information submitted in the local application will be accepted for the Federal plan. Most of the required information is already contained in the permit application and the only thing that would be necessary is to replace the project description with the selected Federal plan. The Corps is currently coordinating this effort with FDEP and the non-Federal sponsor.

3.4.2.2 Endangered and Threatened Species

An existing Regional Biological Opinion (RBO) issued by NMFS pertaining to hopper dredging in navigation channels and sand mining areas in the Gulf of Mexico concerning sea turtles and Gulf sturgeon will be useful during the coordination process.

The RBO that was issued in November 2003 directly pertains to dredging operations at the borrow area. A second RBO that will be useful during the coordination of this project is currently being developed by the USFWS with cooperation from the Corps for beach fill projects in the State of Florida. If available during the final coordination stages of this project it will be useful for the coordination of the threatened and endangered species under Section 7 of the Endangered Species Act, but does not address Gulf sturgeon critical habitat. A biological assessment was submitted to initiate formal consultation with NMFS regarding Gulf sturgeon critical habitat.

Although coordination efforts were conducted by the sponsor for the local plan, the Corps has, in addition, conducted formal Section 7 consultation with the USFWS and NMFS for the tentatively selected plan. Biological assessments (BA) were prepared and submitted initiating consultation with both agencies, which addressed the potential impacts to the listed species and/or critical habitats. Copies of these BA's are included in the EA. Based on the evaluation for species and critical habitats under the purview of the USFWS, it is the Corps' assessment that the actions may have an adverse affect on sea turtles, piping plovers, and CBM. Upon further consideration of the previous biological opinion (BO) issued for the local Walton County Project, it is the USFWS opinion that the effects of the proposed activities are not likely to jeopardize the continued existence of these species and not likely to destroy or adversely modify designated critical habitat for the CBM. Subsequently, based on the evaluation for species and critical habitats under the purview of the NMFS, it is the Corps' assessment that the actions may have an adverse affect on Gulf sturgeon but not likely to jeopardize their continued existence and not likely to adversely modify Gulf sturgeon critical habitat.

By email dated March 1, 2010, the NMFS indicated that the Walton County Federal project would not result in additional impacts already coordinated for the non-Federal sponsor (EA-APPENDIX B). In August, 2011, the USFWS finalized the Statewide Programmatic Biological Opinion (PBO) for Shore Protection Activities along the Coast of Florida. The draft PBO indicates that for sand placement actions such as this in the State of Florida, the USFWS has determined that the proposed action would not jeopardize the continued existence of nesting sea turtles. However, there is still a potential for incidental takes in the form of long-term and short-term impacts on sea turtles. The USFWS has therefore imposed terms and conditions to be implemented that would minimize the potential for incidental takes. The USFWS also agrees with the Corps' determination that the proposed action may adversely affect (MAA) non-breeding piping plover. Due to issues regarding piping plover and beach mice that could not be resolved, the PBO does not address these two species. Coordination for the piping plover and the Choctawhatchee beach mouse and will be providing this consultation in a separate document. A copy of the PBO is included in EA-APPENDIX B. Based on the formal consultations regarding threatened and endangered species and associated designated critical habitats, no mitigation requirements have been identified.

3.4.2.3 Fish and Wildlife Coordination Act (FWCA)

Although the non-Federal sponsor has conducted the coordination required by the ESA and formal consultation has been initiated for the tentatively selected plan, the Fish and Wildlife Coordination Act (FWCA) requires that federal agencies consult with the USFWS with regarding fish and wildlife resources in the project area. Such coordination will result in a Fish and Wildlife Coordination Act Report. This coordination has been conducted with the USFWS for the tentatively selected plan in accordance with the FWCA of 1958 regarding impacts to significant fish and wildlife resources and impacts to federally listed or proposed species or their designated or proposed critical habitat, which is in accordance with Section 7 of the Endangered Species Act of 1973. A copy of the coordination letter is included in the EA. A scope of work and transfer of funds to the USFWS has been completed for the preparation of this report. The USFWS has completed and submitted a draft FWCAR report to the Mobile District staff dated October 7, 2010. A copy of the draft FWCAR is included in EA-APPENDIX B.

3.4.2.4 Essential Fish Habitat (EFH)

Coordination with the NMFS, Habitat Conservation Division in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) has been completed involving the dredging and placement activities for tentatively selected plan. Activities have been undertaken to assure that plans identified for this study are not in conflict with existing Federal fishery management plans or do not result in unacceptable impacts to the habitats of managed species.

The Corps will be adhering to water quality requirements under the conditions specified by the Florida Department of Environmental Protection (DEP) to further reduce impacts to EFH. Consultation with the NMFS, Habitat Conservation Division concerning EFH has been completed for the tentatively selected plan pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (PL 94-265). A copy of the coordination documentation is included in the EA. The Corps' assessed the project in relation to impacts to fisheries resources and determined that the overall impact to identified species is considered negligible given the relatively small area and will not result in significant impacts to EFH.

By letter dated October 6, 2010, NOOA's National Marine Fisheries Service (NMFS), Habitat Conservation Division has stated that they have reviewed the Corps' EFH assessment and subsequent information for the proposed selected plan and determined that the NMFS does not have any EFH consultation recommendations to offer. A copy of this letter of determination in included in EA-APPENDIX B. Based on the formal consultations regarding EFH, no mitigation requirements have been identified.

3.4.2.5 Coastal Barrier Resources Act (CBRA)

The CBRA Units that are within the project limits include FL-94, FL-96, FL-95P, FL-93P, P32, and P31A as illustrated in Figure EA-8 of the EA. Coordination with the USFWS concerning the consistency of the tentatively selected plan in accordance with the

requirements of CBRA for the six system units has been initiated to ensure that the expenditure of Federal funds does not enhance the potential for development within these units. A copy of the coordination document in included in the EA.

CBRA units 95P and FL-93P are considered as otherwise protected areas (OPA) and only applies to Federal flood insurance which does not apply to this project. CBRA unit P32 falls within a segment of the project that cannot be justified for Federal funding and will be 100 percent locally funded, which is exempt from CBRA requirements. The Corps initially determined that the tentatively selected plan qualifies for an exemption under Section 6 Exemptions for CBRA units P31A, FL-96, and FL-94. 16 U.S.C. § 3505 (a)(6)(A) identifies projects relating to the study, management, protection, and enhancement of fish and wildlife resources and habitats, including acquisition of fish and wildlife habitats and related lands, stabilization projects for fish and wildlife habitats, and recreational projects. 16 U.S.C. § 3505 (a)(6)(G) also exempts nonstructural projects for shoreline stabilization that are designed to mimic, enhance, or restore natural stabilization systems.

Upon completion of the CBRA consultation, the USFWS does not agree with the Corps' determination for the CBRA exemptions. In their response letter dated February 22, 2010, the USFWS issued their determination that this project is not consistent with the purpose of CBRA. It should be recognized that CBRA units P31A, FL-96, and FL-94 are the only units that have been determined to fall within the Federal cost-shared project reaches as discussed in Section 4.9 of the EA. These reaches are, for the most part, at the tapered ends of those reaches. The non-Federal sponsor is aware of this situation and has agreed to locally fund these segments. Therefore, no Federal funds will be used towards the development of these segments will be 100 percent non-federally funded. Since no Federal funding will be used in the construction of these segments of the project, the CBRA will no longer be applicable.

3.4.2.6 Cultural Resources

Archival research and field work has been initiated by the non-Federal sponsor. Sonographics, Inc conducted a cultural resource survey and detail phase sub-bottom seismic survey in June 2007. Potential identified cultural resources were investigated using qualitative visual observations. It was determined that none of the anomalies detected appeared to represent any type of cultural resources and a determination was made that the activities associated with this project are unlikely to affect any historic or cultural resources. The county subsequently initiated coordination with the Florida Division of Historic Resources presenting this determination. In a letter dated December 11, 2008, concurrence was issued by the Florida Division of Historic Resources for the project. This determination covers the same areas as the tentatively selected plan. Section 106 consultation has been initiated for the Federal plan using this existing information.

In accordance with Section 106 of the National Historic Preservation Act and other relevant cultural resource laws, recommendations and actions have been coordinated with the FLSHPO. The Mobile District's cultural resources staff has composed a letter indicating that the Mobile District has reviewed the aforementioned cultural resources survey and review by the FLSHPO. Based on this information, and the nature of the project, the Mobile District, as lead Federal agency, has determined that the tentatively selected plan will have no effect on historic properties as per 36 CFR 800.4(d)(1). A copy of this coordination is included in the EA. By letter dated March 11, 2010 the FLSHPO provided their concurrence that the Federal action will have no effect on historic properties. A copy of this coordination is included in EA-APPENDIX B. Based on the consultation regarding cultural resources, no mitigation requirements have been identified.

3.4.2.7 National Environmental Policy Act (NEPA) Documentation

During an interagency meeting held in June 2004, it was determined that given the project characteristics, low level of controversy, absence of chemical contamination, and precedent set by other local beach projects that an EA would be the appropriate level of environmental documentation for the Walton County project. The EA must adequately address the cumulative impacts of the entire project. It is recognized that if the findings of the EA is that the major Federal undertaking will not significantly affect the environment then a Finding of No Significant Impact (FONSI) will be prepared.

An EA, based on the tentatively selected plan, has been prepared and included with this report. Also, a 404(b)(1) Evaluation Report has also been prepared based on the final geotechnical assessments conducted on both the borrow and native beach characteristics. The 404(b)(1) confirms that the borrow material closely matches that of the native beach. Any adverse impacts would come from increased turbidity, which is expected to be short term in nature. No mitigation requirements have been identified associated increased turbidity levels resulting from placement of the borrow material on the beaches. This report is included as part of the EA.

As required by NEPA, a public notice for this project has been issued on April 27, 2010, in accordance with rules and regulations published in the Federal Register on 26 April 1988. These laws are applied whenever dredged or fill materials may enter waters of the United States, or for the transportation of dredged material for the purpose of placement into ocean waters. The only comment received in response to the public notice was from the Seminole Tribe of Florida. By letter dated May 27, 2010, they indicated that they have no objection to the project. A copy of their letter is included in the EA.

It should also be considered that all of the required formal consultations have been completed and no mitigation requirements have been identified for the proposed selected project.

TABLE 6A
STATUS OF AGENCY COORDINATIONS AND CONSULTATIONS

APPLICABLE LAW/REGUALTION	AGENCY	COORDINATION/CONSULTATION	
		INITIATED	STATUS
National Environmental Policy Act (NEPA)		Public Notice Issued April 27,2010	1 no objection comment received.
Endangered Species Act (ESA)	U.S. Fish and Wildlife Service	Consulted initiated January 15, 2010	In August, 2011, the USFWS finalized the Statewide Programmatic Biological Opinion (PBO) for Shore Protection Activities along the coast of Florida. The PBO indicates that for actions such as this in Florida, the USFWS has determined that the proposed action would not jeopardize the continued existence of nesting sea turtles. The final PBO will require separate coordination for the piping plover and beach mouse.
	NOAA-National Marine Fisheries Service, Office of Protected Resources	Consultation initiated January 15, 2010	Email dated March1, 2010, concurring that project would not result in additional impacts already coordinated for the non-Federal sponsor
Fish and Wildlife Coordination Act (FWCA)	U.S. Fish and Wildlife Service	Request for Fish and Wildlife Coordination Act Report (FWCAR) initiated January 8, 2010	Draft report received October 7, 2010.
Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) – Essential Fish Habitat (EFH)	NOAA-National Marine Fisheries Service, Habitat Conservation Division	EFH consultation initiated January 8, 2010	Letter received October 6, 2010, NMFS, Habitat Conservation Division determined that they do not have any EFH additional consultation recommendations to offer.
Coastal Barrier Resources Act (CBRA)	U.S. Fish and Wildlife Service	CBRA consultation initiated January 13, 2010	Letter received February 22, 20210 indicating USFWS's determination that project is not consistent with the purpose of CBRA.
National Historic Preservation Act (NHPA)	Florida Division of Historic Resources	Cultural resources consultation initiated January 8, 2010	Letter received March 11, 2010 that FLSHPO concurred the action will have no effect on historic properties.
Clean Water Act (CWA)	Florida Department and Environmental Protection (FDEP)	No water quality certification application at this time	Draft 404(b)(1) Evaluation Report prepared. Currently coordinating with the FDEP and non-Federal sponsor
Coastal Zone Management Act	Florida Department and	No application at this time	Currently coordinating with

3.5 FUTURE WITHOUT PROJECT CONDITION

3.5.1 General

Most of the existing shoreline is developed with the exception of state and county lands. Those properties not currently developed will likely be developed in the future. The development will likely be single and multi-family with little commercial trade development. The undeveloped areas are zoned by the County to insure that future development is compatible to neighboring property. Commercial development that may occur will be located on the north side of the beach inland from the shoreline. This development will be limited if the beach system continues to degrade and current development will ultimately be impacted, perhaps irreparably, as additional beach and dune area is lost.

Without restoration, there will be continued degradation of a valuable beach ecosystem and loss of associated habitats and benefits. The habitats will remain particularly vulnerable to wave and storm activity that continually threaten and will prevent the re-establishment of valuable natural resources. Degradation of valuable dune and beach habitat including sea turtle nesting habitat, shorebird foraging and roosting areas, dune habitat that supports various flora and fauna, and general beach ecosystem functions will persist as the area continues to be vulnerable to even minor storm activity.

Continued degradation of the beach system will have a negative effect on the value of the properties located along the beach because of cost to the property owners of increased insurance costs. As the properties experience damage there will be the loss of ability to utilize ones property as well as the loss of rental income from rental property. These losses will have a negative effect on not just the immediate area of the beach but on the general economy of the southern portion of Walton County as tourism in this area will diminish along with the value that it adds to the local economy.

3.5.2 Damages

The Beach-*fx* hurricane and storm damage model was executed to simulate the future without project condition over the study period of analysis for 100 iterations (realizations). The model process is event driven, that is, it processes storm events as they happen. In the first year if there are three storm events, then the model calculates the change in beach morphology from the start year to the time for the first storm. Beach losses and any damages are calculated and triggers are checked to ascertain if any action may be warranted, for example, an emergency nourishment action. If not then the revised beach morphology is adapted for each reach as it responds to the passage of time. It then moves to the next event, a storm, and the process repeats itself until the end of the iteration and the model is reset and another possible future storm event is run. When 100 iterations are complete, summary variables are computed and read into output files to protect them. Table 7 displays the future without project condition by study reach. Table 7A shows average annual damages by type for the future without project condition to illustrate what is being damaged comparatively.

TABLE 7
WITHOUT PROJECT DAMAGES
AVERAGE VALUES – PER 53-YEAR ITERATION (EXCEPT AVERAGE ANNUAL VALUES)

Study Reach	Model Reach	Average Structure Damage	Average Content Damage	Average Total Damage	Average Annual Damages	Average Emergency Nourishment	Average Annual Emergency Nourishment
1	R1-1 to R1-24	$14,138,949	$6,011,169	$20,150,119	$1,082,511	$5,033,773	$270,425
2	R2-1 to R2-6	$9,908	$0	$9,908	$532	$181,819	$9,768
3	R3-1 to R3-26	$19,554,284	$5,266,372	$24,820,659	$1,333,421	$16,633,442	$893,586
4	R4-1 to R4-9	$3,863,133	$1,554,697	$5,417,829	$291,058	$2,942,889	$158,099
5	R5-1 to R5-51	$16,501,429	$4,481,685	$20,983,115	$1,127,259	$18,206,371	$978,091
	All Reaches	$54,067,703	$17,313,923	$71,381,630	$3,834,781	$42,998,294	$2,309,969

TABLE 7A
AVERAGE ANNUAL WITHOUT PROJECT STRUCTURE AND CONTENT DAMAGES BY TYPE

Type	Average Annual Structure Damage	Average Annual Content Damage
Private Access	$6,976	$0
Public Access	$18,796	$0
Commercial	$13,161	$6,191
Gazebo	$48,243	$4,189
Jacuzzi	$682	$0
Small Multi-Family	$49,485	$19,637
Medium Multi-Family	$329,994	$162,168
Large Multi-Family	$305	$14,859
Pool	$74,320	$2,594
Single Family Residential	$1,343,119	$629,710
Walkovers	$689,815	$0
Average Annual Damages	$2,574,895	$839,346

4.0 FORMULATING ALTERNATIVE PLANS

4.1 DEVELOPING MEASURES

Projects are formulated in accordance with policies, principles and procedures contained in Engineering Regulation (ER) 1105-2-100 and related regulations (e.g., ER 200-2-2) describing the planning process developed to implement the Water Resources Council's Principles and Guidelines, and the National Environmental Policy Act. Consideration should be given to structural and nonstructural solutions. Plan formulation should be accomplished systematically to arrive at the best solution, considering all factors, including engineering, economic, environmental, and social. ER 1105-2-100 requires that the effects of alternatives are to be determined and evaluated in terms of four accounts: national economic development (NED); environmental quality (EQ); regional economic development (RED) and other social effects (OSE).

The initial list of measures developed by the study team to address the planning objectives included the following:

- No Action
- Seawalls
- Bulkheads
- Revetments
- Breakwaters
- Groins
- Beach and dune fill
- Land use regulations
- Acquisition (buyouts)
- Relocation

4.2 EVALUATING MEASURES

Coastal protection alternatives can be classified into two groups: Non-structural and structural. Non-structural alternatives can consist of those measures that: control or regulate the use of land and buildings such that damages to property are reduced or eliminated; acquire threatened or damageable property; or, retreat which is relocation of threatened property.

Structural alternatives are composed of those measures that block or otherwise retard erosive coastal processes, or restore or nourish beaches to compensate for erosion. Typically, the hardened structural alternatives consist of seawalls, bulkheads, revetments, breakwaters, or groins. Beach and dune fill is considered a soft structural alternative. In general, seawalls, bulkheads and revetments are shore parallel structures used to retain fill and/or reduce direct wave attack on the backshore. Typical construction materials are timber and steel sheet piles, rock and/or concrete. Breakwaters are also shore parallel structures, typically constructed of rock or concrete, and placed offshore to reduce incoming wave energy. Groins, on the other hand, are

typically shore perpendicular structures used to interrupt the long shore sediment transport to build a protective beach, retard erosion of an existing beach or prevent alongshore transport of sand to some downdrift point. Groins can be constructed of a wide variety of materials. The placement of sand on the beach to provide a larger berm and/or dune and to offset erosion is known as beach or dune fills. Of the structural alternatives, seawalls, bulkheads, revetments, breakwaters and groins are typically expensive to construct. The beach/dune fill option; however, is usually less expensive and more environmentally favorable since it responds to the natural beach environment.

4.3 SCREENING MEASURES

4.3.1 Initial Screening

A matrix was developed to compare and screen the various measures against the initial screening criteria to determine which measures could be carried forward and formulated as alternative solutions to the study needs. The measures were initially screened for:

- Engineering Feasibility
- Economic Feasibility
- Environmental Feasibility

Table 8 displays this matrix and shows what measures demonstrate promise for continued consideration.

Also of concern is assuring that the proposed measures fulfill the stated objectives for the study. A matrix was also developed to compare the success of the various measures against the objectives:

- Reduce shoreline erosion
- Reduce potential for storm damages
- Protect fish and wildlife resources
- Restore beach and dune ecosystem habitats
- Increase recreational opportunities

Table 8A displays the results of the comparison of the measures against the objections.

TABLE 8
INITIAL SCREENING MATRIX

		Non-Structural Measures			Structural Measures					
Screening Criteria	No Action	Regulations	Acquisition	Retreat	Seawall	Bulkhead	Revetment	Breakwater	Groin	Beach Fill
Engineering Feasibility	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic Feasibility	No	No	No	No	No	No	No	No	No	Yes
Environmental Feasibility	No	No	Short Term	Short Term	No	No	No	No	No	Yes

TABLE 8A
OBJECTIVES-MEASURES SUCCESS ASSESSMENT MATRIX

		Non-Structural Measures			Structural Measures					
Objectives	No Action	Regulations	Acquisition	Retreat	Seawall	Bulkhead	Revetment	Breakwater	Groin	Beach Fill
Reduce shoreline erosion	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Reduce potential for storm damages	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Protect fish and wildlife resources	No	Yes	Short Term	Yes	No	No	No	No	No	Yes
Restore beach and dune ecosystem habitats	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Increase recreational opportunities	No	Yes	Yes	Yes	No	No	No	No	No	Yes

4.3.2 Measures Screened

4.3.2.1 Non-Structural Measures

While non-structural alternatives serve to reduce damages to the development or structures that have developed along the beach, they do not reduce land loss or damage to the shoreline and dunes. Regulation of land use may establish oceanfront setback limits or restrict building below a certain elevation; however, the study area is nearly fully developed and implementation of additional land use regulations will not serve to reduce the threat of damage to the existing structures. Additionally, there are already regulations in place for building and development along the shoreline of Walton County to minimize the threat of damage to shoreline structures. The County, along with the State, has established evacuation zones and evacuation routes and has in place procedures to alert affected residents and visitors regarding potential storm threats that could impact the coastal shoreline.

Retreat of the affected structure on the existing property is not practicable. Because of the small size of the existing lots, the structures could not be relocated further from the shoreline nor is there available property to relocate the structures upon. Retreat was therefore not considered a viable option and dropped from further consideration.

Property acquisition was also considered as a storm damage reduction measure. Property acquisition would involve the purchase of the damageable property that is threatened by extra-tropical and tropical storms, and relocating the residents. While the implementation of this non-structural measure will likely exceed the cost of any structural measure it will be analyzed further to determine its relative cost.

4.3.2.2 Structural Measures

Structural alternatives serve to reduce land loss or damage to the shoreline and dunes and as a consequence also reduce damages to the development or structures along the beach. These alternatives include the construction of hard structures and/or beach fill.

In the initial consideration of using hard structures it was determined that there were both engineering and environmental factors that would preclude their use. As there were no concentrated locations of erosion the usage of groins was not appropriate. Other hard structures would also disrupt the normal natural dispersal of material down drift. Additionally, Chapter 62B-33 of the State of Florida's Bureau of Beaches and Coastal Systems - Rules and Procedures for Coastal Construction and Excavation, provides guidance on criteria that must be met for use of coastal structures within the state. Specifically, 62b-33.0051 details coastal armoring and related structures and what constitutes an eligible permitable structure and under what condition structures could be authorized. The use of coastal structures in this case would not be consistent with state policy for a shore-wide solution for Walton County.

Additionally, it is believed that the use of hard structures would have a negative impact on listed species inhabiting the area. It has been demonstrated that a loss of nesting habitat related to placement of coastal structures has had an impact on nesting sea turtles in Florida. Structures not only cause the loss of suitable nesting habitat, but can result in the disruption of coastal processes accelerating erosion and interrupting the natural shoreline migration. Because of the effects on sea turtle nesting habitat believed to be caused by coastal structures, the continued vulnerability of remaining nesting habitat to frequent or successive severe weather events, may impact ability of sea turtle populations to survive and recover. In response to periodic storms, the beach itself moves landward, construction or persistence of structures at their pre-storm locations can result in a major loss of nesting habitat. In addition, the presence of hard coastal structures may interfere with nesting turtle access to the beach, result in a change in beach profile and width (downdrift erosion, loss of sandy berms, and escarpment formation), trap hatchlings, and concentrate predatory fishes, resulting in higher probabilities of hatchling predation. The combination of habitat loss and nesting opportunities resulting from beachfront development and subsequent use of coastal structures such as seawalls, bulkheads, and groins is believed to be a threat to sea turtle survival and recovery and should be avoided were possible.

Coastal structures are known to have a similar affect on beach mouse habitat and various shorebirds known to exist along the project area. The use of seawalls, bulkheads, and groins disrupt the natural dune and beach building processes that are critical to the survival of endangered beach mouse populations and shorebirds. Because of the limited remaining habitat such structures could compromise the ability of certain populations to survive and recover. As with sea turtles, the combination of habitat loss to beachfront development and subsequent use of persistent coastal structures to stabilize the shorelines at their pre-storm locations has resulted in an increased threat to species survival and recovery. In order to preserve the survival and recovery of these species, the use of such coastal structures be avoided.

Based on these considerations, beach fill is the only structural measure that can be implemented and also satisfy the study objectives.

4.4 DEVELOPING ALTERNATIVE PLANS

Of the measures that were screened, those remaining that could be considered for implementation can be used to develop alternatives. After these alternatives are developed, they will be evaluated as to how well they satisfy the planning objectives and avoid the planning constraints, and then compared against each other to determine which provides the greatest benefit for the least cost. The measures remaining after the initial screening are acquisition and beach fill.

4.4.1 Acquisition Alternative

The acquisition alternative would remove damageable property off of the beach and dune area. This would consist of acquiring those damage elements and the front lots in the study area. This alternative would remove all damageable structures from the front

lots and would eliminate storm damage to approximately 81 percent of the approximately 814 damage elements in the study area. This results in about a $57,819,000 reduction of the total average damages and about a $3,106,000 reduction of the average annual damages. The cost of this alternative is significant. For this study area, the typical 50-foot front row lot averages one million dollars each, appraised value. There are approximately 20 lots per sub-reach, multiplied by 117 sub-reaches equals about 2,340 lots. At one million dollars each lot, multiplied by 2,340 lots yields about $2.34 billion dollars in land value. When this land value is added to $1.18 billion in damageable structure value (Note: only the value of the first two floors for multi-storied structures was counted in the damageable structure inventory) the resulting approximate cost is about $3.42 billion dollars. The annual cost of this acquisition alternative would be about $193,303,000.

4.4.2 Beach Fill Alternatives

The study team recognized that the dunes along the Walton County shoreline provide the principal protection for the damageable structures. Likewise, the dunes are protected by the shoreline berm. Berm alternatives were formulated for each reach that would likely to provide a robust berm feature in front of the dune. After the optimized berm alternative was developed for each reach, several dune alternatives were analyzed to optimize the dune width needed to provide significant reduction to hurricane and storm damages. Thus the resulting beach fill alternative is a combination of the optimized berm width and the optimized dune width.

The evaluation of erosion control and storm damage reduction alternatives for evaluation took into account some heuristics and prior experience from similar constructed projects. The PDT decided to follow the process that was successfully implemented in the neighboring and adjacent Bay County, Florida, the Panama City Beaches storm damage and beach erosion protection project. The PDT decided that any alternative plans would not change the existing natural berm or dune height. A range of beach fill alternative plans were formulated by the PDT to evaluate both berm width and dune width alternatives. The evaluation approach adopted was a two-phase process with the first phase of the evaluation optimizing the proposed berm width. The second phase would build on the results of the first phase by optimizing the dune width.

4.4.2.1 Berm Width Optimization Alternatives

Four berm width optimization alternatives were formulated for evaluation. These berm width alternatives were specified as minimum, small, medium and maximum beach fill alternatives. These four alternatives berm widths of 50, 75, 100 and 125 feet were held for all profiles except in reach one profile one (R1P1) whose alternative berm width was 25 feet smaller. For reference purposes, the shoreline template depicting the location of the varying width is shown on Figure 9. The specifications of the four alternatives are shown in Table 9.

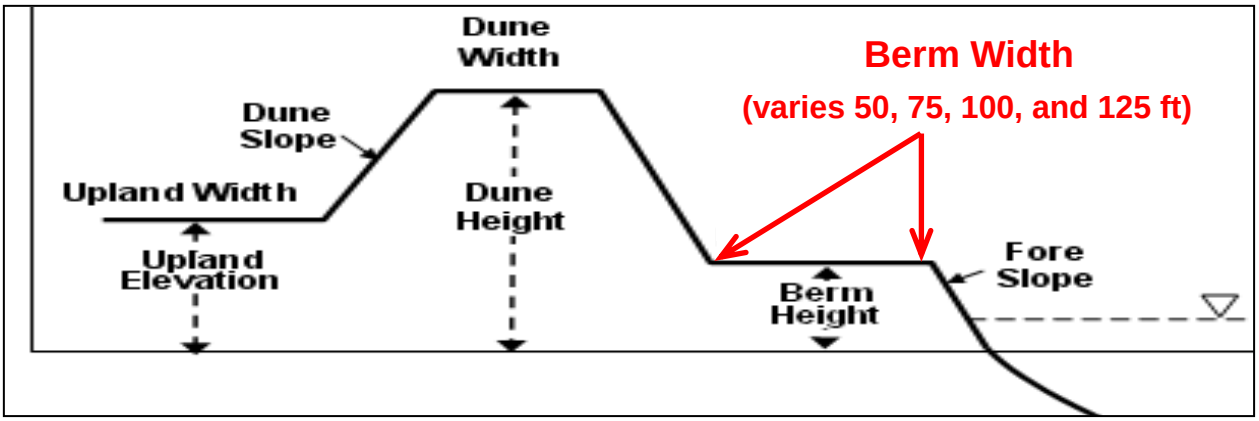


FIGURE 9 – BEACH PROFILE SHOWING VARYING WIDTH OF BERM

TABLE 9
BERM WIDTH OPTIMIZATION
ALTERNATIVES AND SPECIFICATIONS

Reach	Representative Profile	Existing Dune Height (Feet)	Existing Dune Width (Feet)	Alternative Dune Width (Feet)	Alternative Berm Width (Feet)			
					Minimum	Small	Medium	Maximum
1	R1P1	22.2	55	75	25	50	75	100
	R1P2	13.6	100	120	50	75	100	125
3	R3P1	23	75	95	50	75	100	125
	R3P2	12.5	45	65	50	75	100	125
4	R4P1	23	50	70	50	75	100	125
	R4P2	10	82	10	50	75	100	125
5	R5P1	32	185	205	50	75	100	125
	R5P2	24	65	85	50	75	100	125
	R5P3	15.5	50	70	50	75	100	125

4.4.3 Reformulating Beach Fill Alternatives

4.4.3.1 Refining Berm Width Optimization

The berm width optimization runs, that kept the existing dune width constant for the four berm width optimization alternatives, resulted in justified economic reaches that were not very combinable to yield robust beach-fill features. As a result, the PDT reformulated the six alternatives to include additional dune width to test the assumption that protecting the toe of the dune would be of great benefit. These four alternatives were re-run in Beach-*fx* with 20 feet of additional dune width. The results of these runs indicated that the minimum berm template was the alternative with the greatest net

benefits. Another determination from the Beach-*fx* runs of the berm width optimizations was that not all sub-reaches were going to be cost justified or they may not be robust enough for coastal hydrodynamic forces. These short sections cannot be effectively protected or left out when sandwiched between larger justified reaches. When the cost of construction per unit of benefited shore length is not reasonably uniform for the entire project area, the project should be subdivided into elements (construction reaches) within which this condition is met.

4.4.3.2 Formulation of Construction Reaches

Five possible construction reaches were formed as candidates for economic justification. Those five construction reaches were identified, numbered one through five from the west to east formed the basis for subsequent alternative analyses. Table 10 depicts the study model reaches contained within the construction reaches.

TABLE 10
WALTON COUNTY CONSTRUCTION REACHES

Construction Reach	Beginning Model Reach	Ending Model Reach	Model Reach Length (ft)	Model Reach Length (miles)
1	R1-11	R1-16	6,191	1.2
2	R3-2	R3-23	22,980	4.4
3	R4-1	R4-6	6,101	1.2
4	R5-1	R5-21	21,688	4.1
5	R5-30	R5-51	22,319	4.2

4.4.3.3 Berm Width Optimization by Construction Reach

The PDT noted that the Minimum Berm width alternative maximized net benefits but there was not an identified alternative plan that was smaller and, as a consequence, the minimum may not be the optimized berm width. The team formulated a smaller berm width plan called the MiniMin alternative to try and bracket an optimized berm width. In addition the alternative of zero added berm width needed to be analyzed. The MiniMin Alternative features a 10-foot berm width in Profile R1-P1 and a 25-foot berm width in the remaining profiles with a +20 foot dune width. Tables 11, 12 and 13 show the design and results of the Zero, MiniMin and the Minimum alternatives and net benefits by construction reach.

TABLE 11
ZERO, MINIMIN AND MINIMUM DESIGN ALTERNATIVES

Representative Profile	Zero Berm Width	MiniMin Berm Width	Minimum Berm Width
R1P1	0	10	25
R1P2	0	25	50
R2P1	0	25	50
R2P2	0	25	50
R3P1	0	25	50
R3P2	0	25	50
R4P1	0	25	50
R4P2	0	25	50
R5P1	0	25	50
R5P2	0	25	50
R5P3	0	25	50

4.4.3.4 The Optimized Berm Width Alternative

A comparison of the net benefits, Table 12, between the MiniMin and the Minimum Alternative reveals that in construction reach 1 the Minimum alternative maximizes net benefits and the MiniMin alternative maximizes net benefits in Construction reaches 2, 3, 4 and 5. Construction reach 1 is composed of profiles R1P1 and R1P2. R1P1 in the Minimum alternative has a berm width of 25 feet whereas profile R1P1 in the MiniMin alternative has a berm width of 10 feet.

TABLE 12
WALTON COUNTY CONSTRUCTION REACHES BERM WIDTH OPTIMIZATION

Construction Reach	Beginning Model Reach	Ending Model Reach	Net Benefits Zero Berm	Net Benefits MiniMin Berm	Net Benefits Minimum Berm	Net Benefits Small Berm	Net Benefits Medium Berm	Net Benefits Maximum Berm
1	R1-11	R1-16	$435,924	$414,516	$440,993	$311,341	$159,172	$13,458
2	R3-2	R3-23	$904,813	$1,742,843	$1,676,708	$1,287,383	$815,509	$26
3	R4-1	R4-6	$97,911	$166,356	$103,342	$22,924	-$117,384	-$76,562
4	R5-1	R5-21	$710,743	$868,767	$600,593	$176,833	-$208,993	-$611,285
5	R5-30	R5-51	$636,087	$932,571	$645,701	$177,435	-$313,043	-$788,554
Total NED			**$2,785,478**	**$4,125,053**	**$3,467,337**	**$1,975,916**	**$335,261**	**-$1,462,917**

Table 12 shows the Optimized Berm Width Alternative is the Minimum beach fill in construction reach one and the MiniMin beachfill in construction reaches 2 through 5. The optimized berm width alternative, then, is the one with berm widths of 25 feet in all profiles and construction reaches as illustrated in Table 13. The resulting widths and the reaches in which the work can be justified are used in the next phase of analysis.

TABLE 13
MINIMIN AND MINIMUM AND OPTIMIZED BERM WIDTH ALTERNATIVES

Representative Profile	MiniMin Berm Width	Minimum Berm Width	Optimized Berm Width
R1P1	10	25	25
R1P2	25	50	25
R2P1	25	50	25
R2P2	25	50	25
R3P1	25	50	25
R3P2	25	50	25
R4P1	25	50	25
R4P2	25	50	25
R5P1	25	50	25
R5P2	25	50	25
R5P3	25	50	25

Denotes optimized berm width

4.4.4 Evaluating Beach Fill Alternative Plans

4.4.4.1 Optimized Dune Width Alternatives

Having determined the optimal berm width for construction, the next phase of analysis optimizes on added dune width. Added dune width alternatives of 0, 10, 20, 30 and 40 feet were run in Beach-*fx* with the optimized berm width alternative of 25 feet (Optimized berm template of 50 feet, 25 berm width plus 25 feet of advanced nourishment). Table 14 lays out the results of the five dune width optimization alternatives. The maximized net benefit by model reach column identifies the added dune width alternative optimized by Beach-*fx* for each model reach (the constructible dune width column on this table will be discussed in the following section).

TABLE 14
DUNE WIDTH OPTIMIZATION

Model Reach	Summed Net Benefits No added Dune Width	Summed Net Benefits 10-ft added Dune Width	Summed Net Benefits 20-ft added Dune Width	Summed Net Benefits 30-ft added Dune Width	Summed Net Benefits 40-ft added Dune Width	Maximized Added Dune Width by Model Reach	Constructible Added Dune Width
R1-1	-$21,973	-$24,268	-$29,633	-$32,663	-$70,656	+00	
R1-2	-$20,560	-$23,275	-$28,261	-$31,277	-$64,626	+00	
R1-3	-$19,452	-$22,450	-$26,062	-$28,842	-$59,847	+00	
R1-4	-$20,515	-$21,875	-$26,597	-$29,331	-$59,152	+00	
R1-5	-$22,644	-$24,528	-$27,754	-$30,620	-$62,686	+00	
R1-6	-$26,738	-$25,173	-$31,575	-$34,387	-$66,491	+10	
R1-7	-$25,776	-$24,932	-$30,447	-$33,119	-$64,351	+10	
R1-8	-$27,070	-$26,652	-$31,812	-$34,591	-$67,592	+10	
R1-9	-$23,183	-$23,071	-$27,636	-$30,195	-$60,899	+10	
R1-10	-$19,414	-$20,251	-$22,745	-$25,250	-$53,615	+00	
R1-11	$30,826	$56,895	$68,085	$66,491	$34,057	+20	+10
R1-12	-$24,859	-$21,595	-$29,833	-$32,618	-$64,658	+10	+10
R1-13	$163,848	$164,890	$159,465	$156,755	$120,973	+10	+10
R1-14	$74,404	$76,523	$72,382	$69,860	$34,592	+10	+10
R1-15	$108,037	$131,552	$189,573	$212,157	$204,933	+30	+30
R1-16	$108,817	$119,998	$151,449	$162,735	$137,214	+30	+30
R1-17	-$10,947	-$8,672	-$12,337	-$13,249	-$44,213	+10	
R1-18	-$6,686	-$4,787	-$8,185	-$10,136	$12,779	+10	
R1-19	-$16,464	-$11,762	-$16,353	-$16,455	-$44,967	+10	
R1-20	-$18,102	-$14,543	-$17,092	-$16,619	-$41,608	+10	
R1-21	-$23,864	-$24,628	-$28,267	-$30,742	-$60,704	+00	
R1-22	-$22,459	-$22,298	-$26,891	-$29,509	-$59,756	+10	
R1-23	-$22,482	-$24,929	-$28,360	-$31,250	-$65,072	+00	
R1-24	-$18,535	-$19,329	-$25,302	-$28,140	-$58,971	+00	
R3-1	-$6,480	-$1,676	-$523	-$1,133	-$48,529	+20	
R3-2	$60,918	$88,440	$99,635	$105,914	$67,319	+30	+10
R3-3	-$3,637	$2,903	$495	-$467	-$39,895	+10	+10
R3-4	-$8,604	-$8,046	-$11,455	-$12,306	-$36,443	+10	+10
R3-5	-$10,952	-$7,497	-$13,443	-$14,081	-$40,631	+10	+10
R3-6	-$13,879	-$9,546	-$16,724	-$17,106	-$44,795	+10	+10
R3-7	-$12,437	-$9,368	-$15,972	-$16,624	-$44,681	+10	+10
R3-8	$6,269	$10,978	$10,427	$10,154	-$33,177	+10	+10
R3-9	$21,777	$33,172	$32,887	$33,918	-$7,904	+30	+30
R3-10	$54,721	$115,738	$157,575	$194,603	$178,292	+30	+30
R3-11	$29,313	$44,573	$49,252	$53,628	$13,442	+30	+30
R3-12	$46,295	$80,649	$104,132	$127,568	$103,900	+30	+30

TABLE 14 (CONTINUED)
DUNE WIDTH OPTIMIZATION

Model Reach	Summed Net Benefits No added Dune Width	Summed Net Benefits 10-ft added Dune Width	Summed Net Benefits 20-ft added Dune Width	Summed Net Benefits 30-ft added Dune Width	Summed Net Benefits 40-ft added Dune Width	Maximized Added Dune Width by Model-Reach	Constructible Added Dune Width
R3-13	$37,990	$42,943	$42,354	$41,955	$656	+10	+30
R3-14	$107,187	$125,032	$125,659	$128,119	$74,087	+30	+30
R3-15	$53,578	$57,577	$56,864	$56,257	$11,006	+10	+30
R3-16	$42,516	$44,866	$45,067	$44,743	$13,220	+20	+30
R3-17	$70,535	$75,378	$76,840	$77,139	$32,760	+30	+30
R3-18	$76,242	$84,878	$86,728	$88,165	$42,842	+30	+30
R3-19	$77,587	$81,617	$83,045	$82,970	$38,210	+20	+30
R3-20	$239,534	$274,140	$287,533	$294,440	$252,339	+30	+30
R3-21	$90,529	$112,124	$118,304	$123,926	$80,356	+30	+30
R3-22	$60,602	$71,894	$70,982	$72,274	$30,460	+30	+30
R3-23	$45,841	$55,004	$53,541	$54,111	$17,947	+10	+30
R4-1	$57,579	$60,774	$59,376	$59,220	-$1,796	+10	+10
R4-2	$56,114	$69,534	$65,479	$66,614	-$9,366	+10	+10
R4-3	-$5,402	-$1,372	-$6,935	-$7,651	$1,532	+40	+10
R4-4	-$1,736	-$1,313	-$3,208	-$3,895	$1,471	+40	+10
R4-5	$22,248	$25,615	$23,096	$22,401	-$848	+10	+10
R4-6	-$405	$3,772	$3,267	$2,791	-$3,672	+10	+10
R5-1	$101,205	$98,415	$95,873	$95,109	$5,332	+00	+10
R5-2	$70,355	$68,018	$64,932	$63,312	$5,423	+00	+10
R5-3	$37,513	$37,398	$33,074	$31,024	$4,439	+00	+10
R5-4	$11,335	$10,860	$6,833	$3,971	$4,502	+00	+10
R5-5	$1	$3,602	-$1,157	-$3,562	$1,157	+10	+10
R5-6	$140,226	$157,419	$154,409	$151,764	-$14,183	+10	+10
R5-7	$200,024	$214,153	$209,752	$206,797	-$9,729	+10	+10
R5-8	$86,384	$100,229	$95,839	$93,221	-$9,455	+10	+10
R5-9	$12,641	$15,448	$8,646	$6,694	$3,995	+10	+10
R5-10	$16,735	$17,865	$12,965	$11,068	$3,770	+10	+10
R5-11	$22,492	$25,100	$18,724	$16,681	$3,768	+10	+10
R5-12	$19,276	$19,473	$16,094	$14,321	$3,182	+10	+10
R5-13	$17,898	$23,227	$15,965	$13,943	$1,934	+10	+10
R5-14	$15,842	$18,371	$12,358	$10,452	$3,484	+10	+10
R5-15	$22,419	$23,919	$18,097	$15,770	$4,322	+10	+10
R5-16	$25,421	$31,720	$27,972	$26,043	-$2,551	+10	+10
R5-17	$6,949	$10,436	$4,477	$3,815	$2,472	+10	+10
R5-18	$24,250	$25,944	$22,209	$20,851	$2,041	+10	+10
R5-19	$462	$4,253	$70	$647	$392	+10	+10

TABLE 14 (CONTINUED)
DUNE WIDTH OPTIMIZATION

Model Reach	Summed Net Benefits No added Dune Width	Summed Net Benefits 10-ft added Dune Width	Summed Net Benefits 20-ft added Dune Width	Summed Net Benefits 30-ft added Dune Width	Summed Net Benefits 40-ft added Dune Width	Maximized Added Dune Width by Model-Reach	Constructible Added Dune Width
R5-20	-$563	$825	-$3,538	-$5,666	$2,975	+40	+10
R5-21	$135	$985	-$3,266	-$5,468	$3,401	+40	+10
R5-30	$31,359	$32,542	$27,446	$25,763	-$4,716	+10	+10
R5-31	$39,204	$40,628	$34,506	$32,596	$2,163	+10	+10
R5-32	$93,797	$116,901	$120,434	$119,260	$77,242	+20	+10
R5-33	$70,338	$76,230	$72,162	$69,274	$25,221	+10	+10
R5-34	$47,939	$51,558	$46,369	$43,212	-$235	+10	+10
R5-35	$52,939	$56,658	$52,726	$49,924	$8,037	+10	+10
R5-36	$97,937	$124,305	$126,632	$126,125	$83,916	+20	+10
R5-37	$76,094	$79,651	$74,974	$71,484	$28,353	+10	+10
R5-38	$97,013	$107,768	$99,436	$95,873	$48,203	+10	+10
R5-39	$90,626	$91,422	$88,855	$86,031	$41,575	+10	+10
R5-40	$49,424	$47,040	$44,289	$42,296	$11,247	+00	+10
R5-41	$44,150	$42,989	$39,376	$37,311	$6,701	+00	+10
R5-42	$28,280	$28,539	$23,859	$21,635	-$8,858	+10	+10
R5-43	$17,851	$17,377	$13,587	$11,494	-$17,881	+00	+10
R5-44	$3,985	$4,253	-$3	-$2,204	-$26,622	+10	+10
R5-45	-$1,618	-$1,157	-$5,345	-$7,562	-$15,038	+10	+10
R5-46	$621	$6,642	$2,709	$408	-$27,913	+10	+10
R5-47	$2,923	$17,635	$15,037	$13,057	-$1,926	+10	+10
R5-48	-$4,635	-$3,737	-$7,661	-$8,418	-$31,424	+10	+10
R5-49	$5,033	$4,860	$3,240	$2,480	-$20,329	+00	+10
R5-50	$9,987	$9,714	$7,843	$7,514	-$20,651	+00	+10
R5-51	$21,836	$23,141	$19,461	$18,844	-$6,300	+10	+10

LEGEND

CONSTRUCTION TEMPLATE 10 FEET OF ADDED DUNE WIDTH	+10
CONSTRUCTION TEMPLATE 30 FEET OF ADDED DUNE WIDTH	+30
ECONOMICALLY JUSTIFIED MODEL REACHES	

4.4.4.2 Constructible Dune Width Alternative

The best beach fill alternative plan based solely on an economic criterion is based on net excess benefits. The optimization by sub-reach shown in Table 14 describes an alternative with jagged added dune widths within those reaches that have positive net benefits and is shown in the Maximized Added Dune Width by Sub-Reach column; however, a project must also be constructible and coastal engineering and constructability issues would point to a uniform smoothed and connected robust beach fill.

One question that arose while evaluating the results of the dune width optimization results was what would be the smallest segment of beach fill that could be constructed and yet perform adequately. Coastal engineering experience suggests that a beach fill as small as 2,000 feet would perform very poorly due to its small size.

If material is placed irregularly alongshore, i.e. gaps along the placement, then the nearshore contours will be altered by the presence of the fill. Wave refraction over irregular contours will tend to cause a systematic pattern of convergence and divergence of breaking waves. Different wave heights and directions along the beach will produce areas of varying erosion and accretion. If the material is not placed over a sufficient length of beach, the material will diffuse or spread laterally to the adjacent areas and the project will perform poorly. The longer the original fill distance, the longer the material will remain in the original fill area.

Using both engineering and sound coastal engineering principles and previous experience a constructible beach fill plan was formulated. That plan utilized the data in Table 14 to include the following attributes.

In Construction Reach 1, (R1-11 to R1-16), unjustified reach R1-12 was added for constructability reasons. Filling this reach ties R1-11 into the larger neighboring reach which would present a robust beach fill of about 6,000 feet. Dune widths were standardized, 10 feet of added dune width in reaches R1-11 to R1-14 and 30 feet of added dune width for reaches R1-15 and R1-16. This reach, R1-11 to R1-16, with transitions is about 7,191 feet or 1.4 miles.

In Construction Reach 2, (R3-2 to R3-23), the 2000-foot justified segment R3-2 and R3-3 is too small of a beach fill segment and would perform too poorly to provide hurricane and storm damage reduction adequately. Filling the unjustified reaches R3-4 to R3-7 would tie this smaller segment in with the larger segment Reach R3-9 through R3-23. A robust beach fill segment from R3-2 to R3-23 would be constructed. Two uniform dune widths would be constructed, 10 feet of added dune with in reaches R3-2 to R3-8 and 30 feet of added dune width in reaches R3-9 to R3-23. This reach, R3-2 to R3-23, with transitions is about 23,980 feet or 4.5 miles.

In Construction Reach 3, (R4-1 to R4-6), the unjustified reaches R4-3 and R4-4 would be filled to provide a uniform and high performing beach fill. This would also eliminate

the need for transitions that would have been required in the unjustified reaches. The predominate 10 feet of added dune width is recommended for this construction reach. This reach R4-1 to R4-6, with transitions is about 7,100 feet or 1.3 miles.

In Construction Reach 4, (R5-1 to R5-21) reaches R5-1 to R5-4 would receive 10 feet of added dune width based on constructability and engineering performance reasons to match the 10 feet of added dune width optimized for the remainder of this construction segment. This reach, R5-1 to R5-21, with transitions is about 22,690 feet or 4.3 miles.

In Construction Reach 5, (R5-30 to R5-51), unjustified reaches R5-45 and R5-48 would receive full beach fill based on engineering and constructability reasons. In addition R5-1to R5 -4 would be constructed with an added dune width of 10 feet to tie into the higher dune elevation along the adjacent State Recreation Area (see construction drawing F-110 of Appendix A, Section 2, Attachment I) This reach, R5-30 to R5-51, is about 22,320 feet or 4.4 miles.

5.0 COMPARING ALTERNATIVE PLANS

From the alternatives analyzed, three plans were developed to satisfy the study objectives. Those plans are the No Action, Acquisition Alternative, and Beach Fill. The plan that maximizes beneficial contributions to the Nation while satisfying the study objectives is designated as the National Economic Development (NED) Plan. Based on the foregoing analysis, that plan is the beach fill alternative.

5.1 NO ACTION PLAN

The no action plan is essentially a status quo plan. It assumes that no additional actions other than that which occurs currently will be undertaken to provide hurricane storm damage and erosion protection to damageable properties in Walton County. The No Action Alternative uses emergency nourishment as the plan to provide hurricane storm damage and erosion protection to damageable properties in Walton County. There are no costs or benefits associated with this plan.

5.2 NON-STRUCTURAL ACQUISITION PLAN

The acquisition alternative would remove damageable property off of the beach and dune area. This would consist of acquiring those damage elements and the front lots in the study area. This alternative would remove all damageable structures from the front lots and would eliminate storm damage to approximately 81 percent of the approximately 814 damage elements in the study area. This results in about a $3,106,000 reduction of the average annual damages. The approximate cost is about $3.42 billion dollars. The annual cost of this acquisition alternative would be about $193,303,000. The resulting BCR is about 0.02

5.3 NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN

5.3.1 General

In Table 14 the constructible added dune width column identifies the NED Plan. This plan is a robust design is based on economics, engineering performance characteristics, constructability and beach fill uniformity. The reach length of the NED Plan is 79,280 feet, about 15.0 miles without transitions, with transitions it is 84,280 feet about 16.0 miles.

Table 15 summarizes the optimum added dune width within the five construction reaches by representative profile.

TABLE 15
OPTIMUM ADDED DUNE WIDTH – REPRESENTATIVE PROFILE

Construction Reach	Representative Profile	Existing Dune Width	Optimum Added Dune Width	Construction Reach Length w/o transitions (feet)	Construction Reach Length w/o transitions (miles)
CR1	R1P1	55	+10		
	R1P2	100	+30		
				6,191	1.2
CR2	R3P1	76	+10 & +30		
	R3P2	45	+10		
				22,980	4.4
CR3	R4P1	50	+10		
	R4P2	85	+10		
				6,101	1.2
CR4	R5P1	185	+10		
	R5P2	65	+10		
	R5P3	50	+10		
				21,688	4.1
CR5	R5P1	185	+10		
	R5P2	65	+10		
	R5P3	50	+10		
				22,319	4.2

5.3.2 Periodic Nourishment – NED Plan

Periodic nourishment is placement of suitable material on a beach at appropriate intervals of time to maintain the design template. Periodic nourishment plans for Walton County do not include any form of retaining structures that would reduce littoral drift from reaching down-drift beaches.

Beach-*fx* examines all reaches to be nourished to determine if mobilization is warranted. The existing reach profile is compared to the design template, and a nourishment volume is determined. If the total nourishment volume for all reaches exceeds a user-defined threshold, then mobilization and nourishment take place. If nourishment is required, then nourishment time is determined based on placement rates. A start

nourishment and end nourishment event for the first reach are created. At the end nourishment event, the reach profile is set to the design template, and the next reach in processing order is examined, to see if nourishment is required. The process continues until all reaches have been handled. The cost of nourishment, including mobilization and placement costs, is calculated based on nourishment volumes and user-defined cost-related parameters.

Once the optimized beach fill template was determined then GENESIS runs were undertaken to determine the effect of longshore transport on the constructed project. These results were incorporated into the Beach-*fx* model and rerun then re-examined to determine renourishment quantities and cycles.

The results of the Beach-*fx* runs with GENESIS information for the NED Plan alternative revealed that there would be four renourishments. The initial fill and four renourishments make for 5 nourishments in 50 years, therefore a 10-year nourishment cycle.

From the 100 different realizations of alternative futures came the total period of analysis volume of 9,613,000 cy and on average five nourishment cycles, the initial and four renourishments. The initial fill is estimated to require on average 3,273,000 cy and each of the four renourishments averaging 1,585,000 cy each. Renourishment summary statistics are presented in Tables 16 and 17. A frequency distribution of renourishment cycles obtained from 100 possible realizations is produced in Table 18.

5.3.2.1 Comparison With Other Renourishment Projects

With the determination that the renourishment cycle for this project will be a 10-year cycle, it would be prudent to compare this with any adjacent renourishment projects to insure that they will perform in concert with this project. The only adjacent Federal project is Panama City Beach, which is immediately updrift in Bay County. The average renourishment interval of 5 years was found to produce the lowest total average equivalent cost in the 1996 Panama City Beaches, Florida General Reevaluation Report (GRR). However, the Panama City Beaches, Florida Beach Erosion Control and Storm Damage Reduction Project 5-year Monitoring Report showed that the 1998/1999 constructed beach project (R-l to R- 91.5) performed above expectations. The 5-year monitoring data showed that the project had retained 85 percent of the as-built fill within the Federal project limits and suggested that the design standard had been violated only at R-84, R-85 and R-86. The post-construction monitoring supports the notion that the average beach nourishment cycle for the project is much greater than 5-years. In addition, the 2009 limited reevaluation study for Carillon Beach and Pinnacle Port updated the economics to determine whether the currently authorized yet federally un-constructed Carillon Beach and Pinnacle Port portion of the Panama City Beaches, Florida Beach Erosion Control and Storm Damage Reduction project was still economically justified. To calculate erosion, wave attack and inundation benefits the engineering-economic Monte Carlo simulation model, Beach- *fx*, which relates beach profile change to storms, coastal processes and nourishment programs was used. The average periodic nourishment for this reach was determined to be on average every 10 years based on 100 iterations in Beach-*fx*.·

TABLE 16
NED PLAN PERIODIC NOURISHMENT SUMMARY STATISTICS
(VOLUMES IN CUBIC YARDS)

	Average	Standard Deviation
Average Total Nourishment Volume	9,613,000	3,828,971
Average Initial Construction Volume	3,273,000	1,418,378
Average Total Renourishment Volume	6,340,000	3,525,053
Average Number of Renourishment	4	
Average Renourishment Volume	1,585,000	

TABLE 17
NED PLAN PERIODIC NOURISHMENT CONFIDENCE INTERVALS
(VOLUMES IN CUBIC YARDS)

Average Initial Construction Volume	2,639,000	
Standard Deviation	1,418,378	
95% Confidence Interval	1,534,626	2,090,620
90% Confidence Interval	1,579,321	2,045,926
Average Total Renourishment Volume	6,341,000	
Standard Deviation	3,525,053	
95% Confidence Interval	5,182,321	6,564,117
90% Confidence Interval	5,293,399	6,453,038

TABLE 18
NOURISHMENT FREQUENCY DISTRIBUTION
100 POSSIBLE FUTURE REALIZATIONS

Number of nourishment	Number of Occurrences
0	0
1	0
2	1
3	11
4	32
5	30
6	19
7	7
8	0
9	0
10	0

5.3.3 Benefit Analysis –NED Plan

Table 19 presents the Hurricane and Storm Damage Reduction (HSDR) benefits by reach, profile and added dune width for the NED Plan. Total HSDR benefits are about $6,375,000.

TABLE 19
WALTON COUNTY - NATIONAL ECONOMIC DEVELOPMENT PLAN HSDR BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits	Net Benefits
R1-1	R1P1			
R1-2	R1P1			
R1-3	R1P1			
R1-4	R1P1			
R1-5	R1P1			
R1-6	R1P1			
R1-7	R1P1			
R1-8	R1P1			
R1-9	R1P1			
R1-10	R1P1			
R1-11	R1P1	+10	$73,200	$56,895
R1-12	R1P1	+10	$6,724	-$21,595
R1-13	R1P1	+10	$224,969	$164,890
R1-14	R1P1	+10	$144,690	$76,523
R1-15	R1P2	+30	$243,959	$131,552
R1-16	R1P2	+30	$198,584	$119,998
R1-17	R1P2			
R1-18	R1P2			
R1-19	R1P2			
R1-20	R1P2			
R1-21	R1P1			
R1-22	R1P1			
R1-23	R1P1			
R1-24	R1P1			
SUBTOTALS	**CONSTRUCTION REACH 1**		**$892,126**	**$528,263**
R2-1	R2P1			
R2-2	R2P1			
R2-3	R2P2			
R2-4	R2P1			
R2-5	R2P2			
R2-6	R2P1			
R2-7	R2P1			

TABLE 19 (CONTINUED)
WALTON COUNTY - NATIONAL ECONOMIC DEVELOPMENT PLAN
HSDR BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits	Net Benefits
R3-1	R3P1			
R3-2	R3P1	+10	$141,423	$88,440
R3-3	R3P1	+10	$29,953	$2,903
R3-4	R3P2	+10	$5,429	-$8,046
R3-5	R3P2	+10	$7,911	-$7,497
R3-6	R3P2	+10	$7,880	-$9,546
R3-7	R3P2	+10	$12,225	-$9,368
R3-8	R3P1	+10	$48,793	$10,978
R3-9	R3P1	+30	$75,572	$33,918
R3-10	R3P1	+30	$270,209	$194,603
R3-11	R3P1	+30	$105,765	$53,628
R3-12	R3P1	+30	$209,218	$127,568
R3-13	R3P1	+30	$105,096	$41,955
R3-14	R3P1	+30	$231,799	$128,119
R3-15	R3P1	+30	$133,717	$56,257
R3-16	R3P1	+30	$103,195	$44,743
R3-17	R3P1	+30	$163,262	$77,139
R3-18	R3P1	+30	$180,787	$88,165
R3-19	R3P1	+30	$169,918	$82,970
R3-20	R3P1	+30	$396,750	$294,440
R3-21	R3P1	+30	$208,111	$123,926
R3-22	R3P1	+30	$152,143	$72,274
R3-23	R3P1	+30	$120,997	$54,111
R3-24	R3P2			
R3-25	R3P2			
R3-26	R4P1			
SUBTOTALS	**CONSTRUCTION REACH 2**		**$2,880,154**	**$1,541,680**

TABLE 19 (CONTINUED)
WALTON COUNTY - NATIONAL ECONOMIC DEVELOPMENT PLAN
HSDR BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits	Net Benefits
R4-1	R4P1	+10	$71,122	$60,774
R4-2	R4P1	+10	$52,477	$69,534
R4-3	R4P2	+10		-$1,372
R4-4	R4P2	+10		-$1,313
R4-5	R4P1	+10	$33,929	$25,615
R4-6	R4P2	+10	$5,415	$3,772
R4-7	R4P2			
R4-8	R4P1			
R4-9	R4P1			
SUBTOTALS	**CONSTRUCTION REACH 3**		**$162,943**	**$157,010**
R5-1	R5P2	+10	$113,617	$98,415
R5-2	R5P2	+10	$80,091	$68,018
R5-3	R5P2	+10	$47,651	$37,398
R5-4	R5P2	+10	$19,353	$10,860
R5-5	R5P2	+10	$13,386	$3,602
R5-6	R5P1	+10	$175,371	$157,419
R5-7	R5P1	+10	$239,830	$214,153
R5-8	R5P1	+10	$126,180	$100,229
R5-9	R5P2	+10	$25,403	$15,448
R5-10	R5P2	+10	$28,271	$17,865
R5-11	R5P2	+10	$35,413	$25,100
R5-12	R5P2	+10	$28,976	$19,473
R5-13	R5P2	+10	$34,186	$23,227
R5-14	R5P2	+10	$28,753	$18,371
R5-15	R5P2	+10	$34,408	$23,919
R5-16	R5P2	+10	$42,398	$31,720
R5-17	R5P3	+10	$23,700	$10,436
R5-18	R5P2	+10	$36,055	$25,944
R5-19	R5P3	+10	$11,997	$4,253
R5-20	R5P2	+10	$10,537	$825

TABLE 19 (CONTINUED)
WALTON COUNTY - NATIONAL ECONOMIC DEVELOPMENT PLAN
HSDR BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits	Net Benefits
R5-21	R5P2	+10	$11,737	$985
R5-22	R5P3			
R5-23	R5P3			
R5-24	R5P2			
R5-25	R5P2			
R5-26	R5P1			
R5-27	R5P3			
R5-28	R5P3			
R5-29	R5P2			
SUBTOTALS CONSTRUCTION REACH 4			**$1,167,316**	**$907,660**
R5-30	R5P2	+10	$11,702	$32,542
R5-31	R5P2	+10	$22,988	$40,628
R5-32	R5P1	+10	$87,887	$116,901
R5-33	R5P1	+10	$42,941	$76,230
R5-34	R5P1	+10	$27,691	$51,558
R5-35	R5P1	+10	$32,058	$56,658
R5-36	R5P1	+10	$104,824	$124,305
R5-37	R5P1	+10	$29,558	$79,651
R5-38	R5P1	+10	$45,484	$107,768
R5-39	R5P1	+10	$23,597	$91,422
R5-40	R5P2	+10	$11,162	$47,040
R5-41	R5P2	+10	$11,694	$42,989
R5-42	R5P2	+10	$10,664	$28,539
R5-43	R5P2	+10	$9,887	$17,377
R5-44	R5P2	+10	$9,268	$4,253
R5-45	R5P2	+10	$8,952	-$1,157
R5-46	R5P2	+10	$15,341	$6,642
R5-47	R5P2	+10	$24,513	$17,635
R5-48	R5P3	+10	$3,661	-$3,737
R5-49	R5P3	+10	$3,669	$4,860
R5-50	R5P3	+10	$3,626	$9,714
R5-51	R5P3	+10	$4,352	$124,305
SUBTOTALS CONSTRUCTION REACH 5			**$1,272,875**	**$1,076,123**
TOTALS ALL CONSTRUCTION REACHES			**$6,375,413**	**$4,210,736**

5.3.4 NED Plan Costs and Benefits

Modeling with Beach-*fx* began in January 2005 using the post Hurricane Ivan surveys. Post Ivan, the very active 2005 hurricane season sent five named storms to the State of Florida. In the Gulf of Mexico, Hurricane Katrina, which made landfall in Mississippi and several other storms since then, Hurricane Dennis for example, have devastated the beaches of Northwest Florida of which Walton County is no exception. These conditions have changed the morphology of the study area in significant ways since the post Ivan surveys used in the Beach-*fx* modeling.

The Beach-*fx* modeling efforts predicted an initial fill requirement of 2,639,000 cy for the NED Plan. Recent surveys have shown that the erosion activity that has occurred since the post Hurricane Ivan surveys would require an equivalent initial NED placement of about 3,273,000 cy to fill the initial construction template. Renourishments will still be on a 10-year cycle with the renourishment volume of 1,585,000 for the NED Plan.

The FY 2011 initial construction costs are $55,496,000 and a single renourishment FY 2011 cost is $22,517,000. Renourishment costs for each fill are lower that the FY 2011 cost due to present worthing. Total project first cost including Interest during construction for this plan is $91,459,000. The annualized cost including O&M is $4,4474,000. The annualized benefits,$6,391,000 include both HSDR benefits of about $6,375,000 and recreation benefits of about $16,000. The BCR is 1.43 to 1 which yields net benefits of about $1,917,000.

Table 20 summarizes the costs, benefits and other pertinent information on project justification for the NED Plan.

TABLE 20
SUMMARY BENEFITS NED PLAN
WALTON COUNTY, FLORIDA - FEASIBILITY

	FY 2011 Dollars	Category
	$55,496,000	2014 Initial Construction
	$14,434,620	2024 Renourishment
	$9,635,078	2034 Renourishment
	$6,431,393	2044 Renourishment
	$4,292,941	2054 Renourishment
Total Economic First Cost	$90,290,000	
Interest During Construction	$1,168,568	
Total Project Economic First Cost	$91,459,000	
Average Annual Economic First Cost	$4,349,000	
Annual O&M	$124,500	
Total Average Annual Economic Cost	$4,474,000	
Average Annual HSDR Benefits	$6,375,000	
Average Annual Recreation Benefits	$16,000	
Total Average Annual Benefits	$6,391,000	
Benefit-to-Cost Ratio	1.43	
Net Benefits	$1,917,000	

5.4 LOCALLY PREFERRED PLAN (LPP)

5.4.1 General

The PDT met with the non-Federal sponsor and presented the NED Plan. The non-Federal sponsor approved of the plan and committed to supporting that conclusion. When asked if that plan was also the preferred plan, the non-Federal sponsor indicated that they would like to have added to the project the unjustified reaches R1-1 to R1-10. The non-Federal sponsor has just recently constructed a similar project in those reaches. Also they would like to have reaches R1-17 to R1-24 added to the project. The beach fill in the added reaches will match the adjacent beach fill of the NED Plan, a 50-foot berm width and 30-feet of added dune in profile R1P2 and 10-feet of added dune width in profile R1P1. The LPP adds 18,811 feet to construction reach one which gives a total length of 25,002 feet about 4.7 miles. Total reach length of the LPP without transitions is 98,091 feet, about 18.6 miles. With transitions the LPP is 103,091 feet, about 19.5 miles. Table 21 details the features of the LPP.

TABLE 21
LOCALLY PREFERRED PLAN
ADDED REACHES R1-1 TO R1-10 AND R1-17 TO R1-24

Model Reach	Summed Net Benefits No added Dune Width	Summed Net Benefits 10-ft added Dune Width	Summed Net Benefits 20-ft added Dune Width	Summed Net Benefits 30-ft added Dune Width	Summed Net Benefits 40-ft added Dune Width	Maximized Added Dune width by Sub-Reach	Profile	LPP Added Dune Width
R1-1	-$21,973	-$24,268	-$29,633	-$32,663	-$70,656	+00	R1P1	+10
R1-2	-$20,560	-$23,275	-$28,261	-$31,277	-$64,626	+00	R1P1	+10
R1-3	-$19,452	-$22,450	-$26,062	-$28,842	-$59,847	+00	R1P1	+10
R1-4	-$20,515	-$21,875	-$26,597	-$29,331	-$59,152	+00	R1P1	+10
R1-5	-$22,644	-$24,528	-$27,754	-$30,620	-$62,686	+00	R1P1	+10
R1-6	-$26,738	-$25,173	-$31,575	-$34,387	-$66,491	+10	R1P1	+10
R1-7	-$25,776	-$24,932	-$30,447	-$33,119	-$64,351	+10	R1P1	+10
R1-8	-$27,070	-$26,652	-$31,812	-$34,591	-$67,592	+10	R1P1	+10
R1-9	-$23,183	-$23,071	-$27,636	-$30,195	-$60,899	+10	R1P1	+10
R1-10	-$19,414	-$20,251	-$22,745	-$25,250	-$53,615	+00	R1P1	+10
R1-11	$30,826	$56,895	$68,085	$66,491	$34,057	+20	R1P1	+10
R1-12	-$24,859	-$21,595	-$29,833	-$32,618	-$64,658	+10	R1P1	+10
R1-13	$163,848	$164,890	$159,465	$156,755	$120,973	+10	R1P1	+10
R1-14	$74,404	$76,523	$72,382	$69,860	$34,592	+10	R1P1	+10
R1-15	$108,037	$131,552	$189,573	$212,157	$204,933	+30	R1P2	+30
R1-16	$108,817	$119,998	$151,449	$162,735	$137,214	+30	R1P2	+30
R1-17	-$10,947	-$8,672	-$12,337	-$13,249	-$44,213	+10	R1P2	+30
R1-18	-$6,686	-$4,787	-$8,185	-$10,136	$12,779	+10	R1P2	+30
R1-19	-$16,464	-$11,762	-$16,353	-$16,455	-$44,967	+10	R1P2	+30
R1-20	-$18,102	-$14,543	-$17,092	-$16,619	-$41,608	+10	R1P2	+30
R1-21	-$23,864	-$24,628	-$28,267	-$30,742	-$60,704	+00	R1P1	+10
R1-22	-$22,459	-$22,298	-$26,891	-$29,509	-$59,756	+10	R1P1	+10
R1-23	-$22,482	-$24,929	-$28,360	-$31,250	-$65,072	+00	R1P1	+10
R1-24	-$18,535	-$19,329	-$25,302	-$28,140	-$58,971	+00	R1P1	+10

TABLE 21 (CONTINUED)
LOCALLY PREFERRED PLAN
ADDED REACHES R1-1 TO R1-10 AND R1-17 TO R1-24

Model Reach	Summed Net Benefits No added Dune Width	Summed Net Benefits 10-ft added Dune Width	Summed Net Benefits 20-ft added Dune Width	Summed Net Benefits 30-ft added Dune Width	Summed Net Benefits 40-ft added Dune Width	Maximized Added Dune width by Sub-Reach	Profile	LPP Added Dune Width
R3-1	-$6,480	-$1,676	-$523	-$1,133	-$48,529	+20	R3P1	
R3-2	$60,918	$88,440	$99,635	$105,914	$67,319	+30	R3P1	+10
R3-3	-$3,637	$2,903	$495	-$467	-$39,895	+10	R3P1	+10
R3-4	-$8,604	-$8,046	-$11,455	-$12,306	-$36,443	+10	R3P2	+10
R3-5	-$10,952	-$7,497	-$13,443	-$14,081	-$40,631	+10	R3P2	+10
R3-6	-$13,879	-$9,546	-$16,724	-$17,106	-$44,795	+10	R3P2	+10
R3-7	-$12,437	-$9,368	-$15,972	-$16,624	-$44,681	+10	R3P2	+10
R3-8	$6,269	$10,978	$10,427	$10,154	-$33,177	+10	R3P1	+10
R3-9	$21,777	$33,172	$32,887	$33,918	-$7,904	+30	R3P1	+30
R3-10	$54,721	$115,738	$157,575	$194,603	$178,292	+30	R3P1	+30
R3-11	$29,313	$44,573	$49,252	$53,628	$13,442	+30	R3P1	+30
R3-12	$46,295	$80,649	$104,132	$127,568	$103,900	+30	R3P1	+30
R3-13	$37,990	$42,943	$42,354	$41,955	$656	+10	R3P1	+30
R3-14	$107,187	$125,032	$125,659	$128,119	$74,087	+30	R3P1	+30
R3-15	$53,578	$57,577	$56,864	$56,257	$11,006	+10	R3P1	+30
R3-16	$42,516	$44,866	$45,067	$44,743	$13,220	+20	R3P1	+30
R3-17	$70,535	$75,378	$76,840	$77,139	$32,760	+30	R3P1	+30
R3-18	$76,242	$84,878	$86,728	$88,165	$42,842	+30	R3P1	+30
R3-19	$77,587	$81,617	$83,045	$82,970	$38,210	+20	R3P1	+30
R3-20	$239,534	$274,140	$287,533	$294,440	$252,339	+30	R3P1	+30
R3-21	$90,529	$112,124	$118,304	$123,926	$80,356	+30	R3P1	+30
R3-22	$60,602	$71,894	$70,982	$72,274	$30,460	+30	R3P1	+30
R3-23	$45,841	$55,004	$53,541	$54,111	$17,947	+10	R3P1	+30
R4-1	$57,579	$60,774	$59,376	$59,220	-$1,796	+10	R4P1	+10
R4-2	$56,114	$69,534	$65,479	$66,614	-$9,366	+10	R4P1	+10
R4-3	-$5,402	-$1,372	-$6,935	-$7,651	$1,532	+10	R4P2	+10
R4-4	-$1,736	-$1,313	-$3,208	-$3,895	$1,471	+10	R4P2	+10
R4-5	$22,248	$25,615	$23,096	$22,401	-$848	+10	R4P1	+10
R4-6	-$405	$3,772	$3,267	$2,791	-$3,672	+10	R4P2	+10

TABLE 21 (CONTINUED)
LOCALLY PREFERRED PLAN
ADDED REACHES R1-1 TO R1-10 AND R1-17 TO R1-24

Model Reach	Summed Net Benefits No added Dune Width	Summed Net Benefits 10-ft added Dune Width	Summed Net Benefits 20-ft added Dune Width	Summed Net Benefits 30-ft added Dune Width	Summed Net Benefits 40-ft added Dune Width	Maximized Added Dune width by Sub-Reach	Profile	LPP Added Dune Width
R5-1	$101,205	$98,415	$95,873	$95,109	$5,332	+00	R5P2	+10
R5-2	$70,355	$68,018	$64,932	$63,312	$5,423	+00	R5P2	+10
R5-3	$37,513	$37,398	$33,074	$31,024	$4,439	+00	R5P2	+10
R5-4	$11,335	$10,860	$6,833	$3,971	$4,502	+00	R5P2	+10
R5-5	$1	$3,602	-$1,157	-$3,562	$1,157	+10	R5P2	+10
R5-6	$140,226	$157,419	$154,409	$151,764	-$14,183	+10	R5P1	+10
R5-7	$200,024	$214,153	$209,752	$206,797	-$9,729	+10	R5P1	+10
R5-8	$86,384	$100,229	$95,839	$93,221	-$9,455	+10	R5P1	+10
R5-9	$12,641	$15,448	$8,646	$6,694	$3,995	+10	R5P2	+10
R5-10	$16,735	$17,865	$12,965	$11,068	$3,770	+10	R5P2	+10
R5-11	$22,492	$25,100	$18,724	$16,681	$3,768	+10	R5P2	+10
R5-12	$19,276	$19,473	$16,094	$14,321	$3,182	+10	R5P2	+10
R5-13	$17,898	$23,227	$15,965	$13,943	$1,934	+10	R5P2	+10
R5-14	$15,842	$18,371	$12,358	$10,452	$3,484	+10	R5P2	+10
R5-15	$22,419	$23,919	$18,097	$15,770	$4,322	+10	R5P2	+10
R5-16	$25,421	$31,720	$27,972	$26,043	-$2,551	+10	R5P2	+10
R5-17	$6,949	$10,436	$4,477	$3,815	$2,472	+10	R5P3	+10
R5-18	$24,250	$25,944	$22,209	$20,851	$2,041	+10	R5P2	+10
R5-19	$462	$4,253	$70	$647	$392	+10	R5P3	+10
R5-20	-$563	$825	-$3,538	-$5,666	$2,975	+10	R5P2	+10
R5-21	$135	$985	-$3,266	-$5,468	$3,401	+10	R5P2	+10
R5-30	$31,359	$32,542	$27,446	$25,763	-$4,71	+10	R5P2	+10
R5-31	$39,204	$40,628	$34,506	$32,596	$2,163	+10	R5P2	+10
R5-32	$93,797	$116,901	$120,434	$119,260	$77,242	+20	R5P1	+10
R5-33	$70,338	$76,230	$72,162	$69,274	$25,221	+10	R5P1	+10
R5-34	$47,939	$51,558	$46,369	$43,212	-$235	+10	R5P1	+10
R5-35	$52,939	$56,658	$52,726	$49,924	$8,037	+10	R5P1	+10
R5-36	$97,937	$124,305	$126,632	$126,125	$83,916	+20	R5P1	+10
R5-37	$76,094	$79,651	$74,974	$71,484	$28,353	+10	R5P1	+10
R5-38	$97,013	$107,768	$99,436	$95,873	$48,203	+10	R5P1	+10
R5-39	$90,626	$91,422	$88,855	$86,031	$41,575	+10	R5P1	+10
R5-40	$49,424	$47,040	$44,289	$42,296	$11,247	+00	R5P2	+10

TABLE 21 (CONTINUED)
LOCALLY PREFERRED PLAN
ADDED REACHES R1-1 TO R1-10 AND R1-17 TO R1-24

Model Reach	Summed Net Benefits No added Dune Width	Summed Net Benefits 10-ft added Dune Width	Summed Net Benefits 20-ft added Dune Width	Summed Net Benefits 30-ft added Dune Width	Summed Net Benefits 40-ft added Dune Width	Maximized Added Dune width by Sub-Reach	Profile	LPP Added Dune Width
R5-41	$44,150	$42,989	$39,376	$37,311	$6,701	+00	R5P2	+10
R5-42	$28,280	$28,539	$23,859	$21,635	-$8,858	+10	R5P2	+10
R5-43	$17,851	$17,377	$13,587	$11,494	-$17,881	+00	R5P2	+10
R5-44	$3,985	$4,253	-$3	-$2,204	-$26,622	+10	R5P2	+10
R5-45	-$1,618	-$1,157	-$5,345	-$7,562	-$15,038	+10	R5P2	+10
R5-46	$621	$6,642	$2,709	$408	-$27,913	+10	R5P2	+10
R5-47	$2,923	$17,635	$15,037	$13,057	-$1,926	+10	R5P2	+10
R5-48	-$4,635	-$3,737	-$7,661	-$8,418	-$31,424	+10	R5P3	+10
R5-49	$5,033	$4,860	$3,240	$2,480	-$20,329	+00	R5P3	+10
R5-50	$9,987	$9,714	$7,843	$7,514	-$20,651	+00	R5P3	+10
R5-51	$21,836	$23,141	$19,461	$18,844	-$6,300	+10	R5P3	+10

LEGEND

CONSTRUCTION TEMPLATE 10 FEET OF ADDED DUNE WIDTH	+10
CONSTRUCTION TEMPLATE 30 FEET OF ADDED DUNE WIDTH	+30
ECONOMICALLY JUSTIFIED MODEL REACHES	

5.4.2 Periodic Nourishment – Locally Preferred Plan

The results of the Beach-*fx* runs with GENESIS information for the Locally Preferred Plan alternative revealed that there would be four renourishments. The initial fill and four renourishments make for five nourishments in 50-years, therefore a 10-year nourishment cycle.

From the 100 different realizations of alternative futures came the total period of analysis nourishment volume of 11,024,000 cy and five nourishment cycles, the initial and four renourishments. The initial fill is estimated to require on average 3,868,000 cy, and a total 7,157,000 cy for the four renourishments which average 1,789,000 cy each. Renourishment summary statistics are presented in Tables 22 and 23. A frequency distribution of renourishment cycles obtained from 100 possible realizations is produced in Table 24.

TABLE 22
LOCALLY PREFERRED PLAN PERIODIC NOURISHMENT SUMMARY STATISTICS
(VOLUMES IN CUBIC YARDS)

	Average
Average Total Nourishment Volume	11,024,000
Average Initial Construction Volume	3,868,000
Average Total Renourishment Volume	7,157,000
Average Number of Renourishments	4
Average Renourishment Volume	1,789,000

TABLE 23
LOCALLY PREFERRED PLAN PERIODIC NOURISHMENT CONFIDENCE INTERVALS
(VOLUMES IN CUBIC YARDS)

Average Initial Construction Volume	3,152,000	
Standard Deviation	1,599,545	
95% Confidence Interval	1,913,051	2,237,091
90% Confidence Interval	1,862,647	2,287,494
Average Total Renourishment Volume	7,157,000	
Standard Deviation	4,088,020	
95% Confidence Interval	5,388,314	6,990,788
90% Confidence Interval	5,517,131	6,861,970

TABLE 24
NOURISHMENT FREQUENCY DISTRIBUTION
100 POSSIBLE FUTURE REALIZATIONS

Number of Nourishments	Number of Occurrences
0	0
1	0
2	0
3	14
4	34
5	29
6	19
7	4
8	0
9	0
10	0

5.4.3 Summary Benefit Analysis – Locally Preferred Plan

Table 25 represents the LPP benefits.

TABLE 25
WALTON COUNTY - LOCALLY PREFERRED PLAN BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits
R1-1	R1P1	+10	$17,956
R1-2	R1P1	+10	$1,457
R1-3	R1P1	+10	$1,498
R1-4	R1P1	+10	$1,734
R1-5	R1P1	+10	$1,464
R1-6	R1P1	+10	$2,038
R1-7	R1P1	+10	$2,693
R1-8	R1P1	+10	$2,369
R1-9	R1P1	+10	$2,782
R1-10	R1P1	+10	$1,921
R1-11	R1P1	+10	$95,831
R1-12	R1P1	+10	$6,737
R1-13	R1P1	+10	$224,999
R1-14	R1P1	+10	$146,006
R1-15	R1P2	+30	$265,587
R1-16	R1P2	+30	$197,561
R1-17	R1P2	+30	$30,670
R1-18	R1P2	+30	$36,146
R1-19	R1P2	+30	$24,548
R1-20	R1P2	+30	$8,657
R1-21	R1P1	+10	$1,278
R1-22	R1P1	+10	$1,944
R1-23	R1P1	+10	$1,436
R1-24	R1P1	+10	$7,196
R2-1	R2P1		
R2-2	R2P1		
R2-3	R2P2		
R2-4	R2P1		
R2-5	R2P2		
R2-6	R2P1		
R2-7	R2P1		

TABLE 25 (CONTINUED)
WALTON COUNTY - LOCALLY PREFERRED PLAN
BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits
R3-1	R3P1		
R3-2	R3P1	+10	$16,564
R3-3	R3P1	+10	$123,080
R3-4	R3P2	+10	$28,920
R3-5	R3P2	+10	$5,396
R3-6	R3P2	+10	$7,669
R3-7	R3P2	+10	$7,533
R3-8	R3P1	+10	$12,117
R3-9	R3P1	+30	$49,759
R3-10	R3P1	+30	$76,139
R3-11	R3P1	+30	$275,161
R3-12	R3P1	+30	$105,910
R3-13	R3P1	+30	$209,524
R3-14	R3P1	+30	$105,083
R3-15	R3P1	+30	$231,743
R3-16	R3P1	+30	$133,717
R3-17	R3P1	+30	$103,195
R3-18	R3P1	+30	$163,242
R3-19	R3P1	+30	$180,744
R3-20	R3P1	+30	$169,906
R3-21	R3P1	+30	$396,536
R3-22	R3P1	+30	$208,199
R3-23	R3P1	+30	$152,371
R3-24	R3P2		
R3-25	R3P2		
R3-26	R4P1		
R4-1	R4P1	+10	$69,522
R4-2	R4P1	+10	$47,773
R4-3	R4P2	+10	$0
R4-4	R4P2	+10	$0
R4-5	R4P1	+10	$32,221
R4-6	R4P2	+10	$5,415
R4-7	R4P2		
R4-8	R4P1		
R4-9	R4P1		

TABLE 25 (CONTINUED)
WALTON COUNTY - LOCALLY PREFERRED PLAN
BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits
R5-1	R5P2	+10	$113,687
R5-2	R5P2	+10	$80,078
R5-3	R5P2	+10	$47,634
R5-4	R5P2	+10	$19,346
R5-5	R5P2	+10	$13,331
R5-6	R5P1	+10	$174,603
R5-7	R5P1	+10	$239,130
R5-8	R5P1	+10	$125,823
R5-9	R5P2	+10	$25,396
R5-10	R5P2	+10	$28,256
R5-11	R5P2	+10	$35,413
R5-12	R5P2	+10	$28,964
R5-13	R5P2	+10	$34,162
R5-14	R5P2	+10	$28,731
R5-15	R5P2	+10	$34,400
R5-16	R5P2	+10	$42,357
R5-17	R5P3	+10	$23,698
R5-18	R5P2	+10	$36,040
R5-19	R5P3	+10	$11,863
R5-20	R5P2	+10	$10,526
R5-21	R5P2	+10	$11,736
R5-22	R5P3		
R5-23	R5P3		
R5-24	R5P2		
R5-25	R5P2		
R5-26	R5P1		
R5-27	R5P3		
R5-28	R5P3		
R5-29	R5P2		
R5-30	R5P2	+10	$41,615
R5-31	R5P2	+10	$54,424
R5-32	R5P1	+10	$135,413
R5-33	R5P1	+10	$89,447
R5-34	R5P1	+10	$64,991
R5-35	R5P1	+10	$68,957

TABLE 25 (CONTINUED)
WALTON COUNTY - LOCALLY PREFERRED PLAN
BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits
R5-36	R5P1	+10	$147,407
R5-37	R5P1	+10	$98,230
R5-38	R5P1	+10	$123,595
R5-39	R5P1	+10	$108,862
R5-40	R5P2	+10	$57,539
R5-41	R5P2	+10	$54,804
R5-42	R5P2	+10	$39,019
R5-43	R5P2	+10	$26,194
R5-44	R5P2	+10	$11,719
R5-45	R5P2	+10	$8,952
R5-46	R5P2	+10	$15,328
R5-47	R5P2	+10	$24,451
R5-48	R5P3	+10	$6,763
R5-49	R5P3	+10	$23,356
R5-50	R5P3	+10	$29,212
R5-51	R5P3	+10	$41,083
Average Annual Benefits LPP			**$6,542,998**

5.4.4 Locally Preferred Plan Costs and Benefits

Modeling with Beach-*fx* began in January 2005 using the post Hurricane Ivan surveys. During the very active 2005 hurricane season, five named storms affected the State of Florida. In the Gulf of Mexico, Hurricane Katrina, which made landfall in Mississippi and several other storms since then, Hurricane Dennis, for example, have devastated the beaches of Northwest Florida of which Walton is no exception. These conditions have changed the morphology of the study area in significant ways since the post Hurricane Ivan surveys used in Beach-*fx* modeling efforts predicted initial fill requirements of 3,152,000 cy. The NED and the LPP plans maintain the same placement template (see Economic Appendix Figure B-6) but the LPP extends the coverage area to the westernmost limits of the county where the NED Plan could not justify the coverage. Recent surveys have shown that the erosion activity that has occurred since the post Hurricane Ivan surveys would require an equivalent LPP placement of 2,980,000 cy. If the historical long-term erosion rate is applied to the predicted construction timeframe of FY14, then the necessary LPP beach fill initial construction requirements will be 3,868,000 cy. Renourishments will still be on a 10-year cycle and the renourishment volume is 1,789,000 cy for the LPP. The economic benefit period for this project begins with the base year of 2014, and ends at the conclusion of 2063. The project will be fully

constructed in 2014, and will be renourished in 2024, 2034, 2044, and 2054. The final renourishment in 2054 will function through 2063, the last year of the economic benefit evaluation period.

The FY2011 initial construction costs are $63,306,000 and a single renourishment FY 2011 cost is $25,300,000. Renourishment costs for each fill are lower than the FY 2011 cost due to present worthing. Total project cost including interest during construction for this plan is $103,762,000. The average annual construction cost is about $4,934,000 and annual O&M is $168,000 making total average annual costs of$5,102,000. The annualized benefits, $6,559,000, include both HSDR benefits of about $6,543,000 and recreation benefits of about $16,000. The BCR is 1.21 to 1 which yields net benefits of about $1,457,000. Table 26 summarized the costs, benefits and other pertinent information on project justification for the LPP Plan.

TABLE 26
SUMMARY BENEFITS LPP PLAN
WALTON COUNTY, FLORIDA - FEASIBILITY

	FY 2011 Dollars	Category
	$63,306,000	2014 Initial Construction
	$16,218,674	2024 Renourishment
	$10,825,930	2034 Renourishment
	$7,226,285	2044 Renourishment
	$4,922,478	2054 Renourishment
Total Economic First Cost	$102,499,000	
Interest During Construction	$1,263,422	
Total Economic Project First Cost	$103,762,000	
Average Annual Economic First Cost	$4,934,000	
Annual O&M	$168,000	
Total Average Annual Economic Cost	$5,102,000	
Average Annual HSDR Benefits	$6,543,000	
Average Annual Recreation Benefits	$16,000	
Total Average Annual Benefits	$6,559,000	
Benefit-to-Cost Ratio	1.29	
Net Benefits	$1,457,000	

5.5 SYSTEM OF ACCOUNTS

Principles and Guidelines prescribe for an evaluation of project benefits for the final array of alternatives and the selected plan according to the four accounts: National Economic Development (NED), Regional Economic Development (RED), Other Social Effects (OSE), and Environmental Quality (EQ).

The NED benefits were fully and illustratively presented throughout the economic analysis. Regional Economic Development Benefits are calculated using the Economic Impact Forecasting System (EIFS). EIFS is an regional economic impact assessment model that uses economic multipliers and a database of economic and financial statistics by county to measure the economic and financial impact to a community through various increases and/or decreases in economic activity in that community.

The Other Social Effects (OSE) account, would report that there are either no negative impacts on community cohesion or community growth. There will be minor to no appreciable impacts on tax or property values. There will be a small positive impact to front row residents who are likely to incur less impacts from erosion and wave action due to the project.

The evaluation of the System of Accounts is displayed in Table 27.

TABLE 27
SYSTEM OF ACCOUNTS

Problem Area: Walton County, Florida				
Problems ID: Damages suffered by hurricane-induced surge and wave attack; Potential future damages from storm and hurricane events.				
Item	**No Action**	**Acquisition**	**NED Plan**	**LPP Plan**
A. PLAN DESCRIPTION	No Federal Action	Buyout all row one damageable elements and land	Construct a 50-foot beach fill project in five reaches	Construct a 50-foot beach fill project in five reaches
B. IMPACT ASSESSMENT				
1. National Economic Development				
a. Beneficial Impacts				
(1) Damages Prevented	$0	$3,106,000	$6,375,000	$6,543,000
(2) Emergency Costs Avoided	$0	$0	$0	$0
(3) Recreation	$0	$0	$16,000	$16,000
(4) Total Beneficial Impacts	None.	$3,106,000	$6,391,000	$6,559,000
b. Adverse Impacts				
(1) Project Cost	$0	$3,420,000,000	$90,290,000	$102,500,000
(2) Interest During Construction	$0	$32,665,600	$1,168,000	$1, 263,000
(3) Average Annual First Cost	N/A	$193,303,000	$4,349,000	$4,934,000
(4) Annual O&M	$0		$125,000	$168,000
(5) Total Avg. Annual Costs	$0	$193,303,000	$4,474,000	$5,102,000
2. Environmental Quality (EQ)				
(1) Ecosystem Restoration	No ecosystem restoration benefits.	Significantly Increased dune habitat from added dune width	Increased habitat from added dune and berm width	Increased habitat from added dune and berm width
(2) Water Circulation	No anticipated effect on water circulation.	No anticipated effect on water circulation.	No anticipated effect on water circulation.	No anticipated effect on water circulation.
(3) Noise Level Changes	No change in noise levels	No change in noise levels	Temporary increase in noise levels during construction	Temporary increase in noise levels during construction

TABLE 27 (CONTINUED)
SYSTEM OF ACCOUNTS

Problem Area: Walton County, Florida				
Problems ID: Damages suffered by hurricane-induced surge and wave attack; Potential future damages from storm and hurricane events.				
Item	**No Action**	**Acquisition**	**NED Plan**	**LPP Plan**
(4) Public Facilities	N/A	N/A	N/A	N/A
(5) Aesthetic Values	No significant change in aesthetic values	Significant increase to aesthetic improvement	Significant increase to aesthetic improvement	Significant increase to aesthetic improvement
(6) Natural Resources	No impact.	Alternative would result in restoration of coastal marsh resources.	Alternative would result in restoration of coastal marsh resources.	Alternative would result in restoration of coastal marsh resources.
(7) Biological Resources	No impact.	Biological resources would be improved versus the no-action alternative.	Biological resources would be improved versus the no-action alternative.	Biological resources would be improved versus the no-action alternative.
(8) Air Quality	Alternative would have no anticipated effect on air quality	Air emission would be *de minimus*	Air emission would be *de minimus*	Air emission would be *de minimus*
(9) Water Quality	No impact.	No impact.	Temporary negative impacts to water quality due to construction.	Temporary negative impacts to water quality due to construction.
(10) Public Services	Public services to community would continue to be interrupted during storm events	Public services to community would continue to be interrupted during storm events	Public services to community would continue to be interrupted during storm events	Public services to community would continue to be interrupted during storm events
(11) Cultural and Historical Preservation	No impact.	No impact.	No impact.	No impact.
(12) Total Quality of the Environment	No impact.	Environmental quality would be improved.	Environmental quality would be improved.	Environmental quality would be improved.
3. Regional Economic Development (RED)				
(1) Impact on Sales Volume	No impact.	Decrease of **$47,819,840** in sales volume.	Increase of **$171,371,800** in additional sales volume.	Increase of **$180,616,600** in additional sales volume.
(2) Impact on Income	No impact.	Decrease of **$35,723,610** in local income.	Increase of **$31,288,070** in additional local income.	Increase of **$32,975,920** in additional local income.
(3) Impact on Employment	No impact.	Decrease of **1141** jobs.	Increase of **1078** new jobs.	Increase of **1137** new jobs.
(4) Tax Changes	No impact.	Would result in loss of some local tax revenue due to acquisition of properties.	No Change	No Change

TABLE 27 (CONTINUED)
SYSTEM OF ACCOUNTS

Problem Area: Walton County, Florida				
Problems ID: Damages suffered by hurricane-induced surge and wave attack; Potential future damages from storm and hurricane events.				
Item	**No Action**	**Acquisition**	**NED Plan**	**LPP Plan**
4. Other Social Effects (OSE)				
a. Beneficial Impacts				
(1) Security of Life, Health, and Safety	Continued risks to life, health and safety	Major reduction in potential loss of life of persons and property.	No appreciable difference	No appreciable difference
(2) Community Cohesion	No negative impact on community cohesion.	Community would be dispersed and/or relocated	No negative impact on community cohesion.	No negative impact on community cohesion.
(3) Tax Values	No Impact.	Ownership and land use changes would impact tax value	Increase due to enhanced property values	Increase due to enhanced property values
(4) Community Growth	No Impact.	No Impact.	No Impact.	No Impact.
(5) Property Values	No Impact.	Minor temporary negative impact to adjacent properties during acquisition phase.	Minor Positive impact to protected properties.	Minor Positive impact to protected properties.
(6) Displacement of Businesses	N/A	N/A	N/A	N/A
(7) Public Facilities	N/A	Enhances opportunities for additional public facilities for recreation	Minor improvement to recreational activities from increased beach	Minor improvement to recreational activities from increased beach
(8) Injurious Displacement of Farms	N/A	N/A	N/A	N/A
b. Preservation of loss of life	No Impact.	Some reduction in potential loss of life.	No Change	No Change
C. PLAN EVALUATION				
1. Contributions to Planning Objectives				
a. Flood, Hurricane and/or Storm Damage Reduction	No Improvement.	Total reduction in damages at project site and less stress on dune system.	Significant reduction of storm damages and loss of land	Significant reduction of storm damages and loss of land
b. Recovery of lost environmental resources	Continued loss of environmental resources.	Significant opportunity to recover environmental resources negatively impacted in past	Some Recovery of environmental resources through additional dune area for nesting birds, beach mice and turtles	Some Recovery of environmental resources through additional dune area for nesting birds, beach mice and turtles
2. Response to Planning Constraints				
a. Avoid environmental impacts and minimize induced damages	Continued loss of environmental resources.	Positive effect on environmental resources.	Positive effect on environmental resources.	Positive effect on environmental resources.

TABLE 27 (CONTINUED)
SYSTEM OF ACCOUNTS

Problem Area: Walton County, Florida				
Problems ID: Damages suffered by hurricane-induced surge and wave attack; Potential future damages from storm and hurricane events.				
Item	**No Action**	**Acquisition**	**NED Plan**	**LPP Plan**
b. Institutional Acceptability	Not supported by state or local government	Not supported by state or local government	Is supported by local and state governments	Is supported by local and state governments
3. Response to Evaluation Criteria				
a. Acceptability	NO	NO	YES	YES
b. Completeness	NO	YES	YES	YES
c. Effectiveness	NO	YES	YES	YES
d. Efficiency (Cost-Effectiveness; i.e., most efficient use of Federal and Non-Federal Funds)	NO	NO	YES	NO
e. Integration	N/A	N/A	N/A	N/A
f. Reversibility	N/A	NO - land could not be resold for development	YES - project nourishment can be abandoned	YES - project nourishment can be abandoned
4. Stakeholder Preference Score (From MCDA weightings analysis)				
a. Summary Score	N/A	N/A	N/A	N/A
Cluster Group A	N/A	N/A	N/A	N/A
Cluster Group B	N/A	N/A	N/A	N/A
Cluster Group C	N/A	N/A	N/A	N/A
Cluster Group D	N/A	N/A	N/A	N/A
b. Stakeholder Preference	NO	NO	Stakeholder would approve.	Stakeholder Preference
D. Implementation Responsibility	No implementation responsibilities	Joint Federal/Non-Federal implementation responsibility.	Joint Federal/Non-Federal implementation responsibility.	Joint Federal/Non-Federal implementation responsibility.
E. State and other Non-Federal Coordination	No State or other Non-Federal coordination activities	Would require State or other Non-Federal coordination activities	Would require State or other Non-Federal coordination activities	Would require State or other Non-Federal coordination activities
F. Risk Evaluation				
1. Risk and Vulnerabilities				
a. Risk of Failure	N/A	Very low risk of failure	Moderate risk of failure.	Moderate risk of failure.
b. Residual Risk	Residual risk of all actions will remain substantial due to storm surge.	Residual risk of all properties purchased virtually eliminated	Residual risk of all actions will remain substantial due to storm surge.	Residual risk of all actions will remain substantial due to storm surge.
c. Reliability	N/A	This plan would provide a significant degree of reliability to properties purchased. Residents are moved out of harm's way.	This plan would provide a significant degree of reliability, would receive damage from storm events, and would require maintenance.	This plan would provide a significant degree of reliability, would receive damage from storm events, and would require maintenance.

TABLE 27 (CONTINUED)
SYSTEM OF ACCOUNTS

Problem Area: Walton County, Florida				
Problems ID: Damages suffered by hurricane-induced surge and wave attack; Potential future damages from storm and hurricane events.				
Item	**No Action**	**Acquisition**	**NED Plan**	**LPP Plan**
d. Relative Sea Level Rise	Problems will be substantially exacerbated by an increasing relative rise of sea level	This Plan will be minimally impacted by an increasing relative rise of sea level over the period of analysis	This Plan will be minimally impacted by an increasing relative rise of sea level over the period of analysis	This Plan will be minimally impacted by an increasing relative rise of sea level over the period of analysis
e. Risk of Ecosystem Damage	Ecosystem damage will continue to accrue at a rate at least that of recent history with substantial negative outcomes.	Ecosystem damage will continue to accrue at a rate at least that of recent history with substantial negative outcomes.	Ecosystem damage will continue to accrue at a rate at less than that of recent history with less substantial negative outcomes.	Ecosystem damage will continue to accrue at a rate at less than that of recent history with less substantial negative outcomes.
f. Risk to Life and Safety	Significant threats to Life and Safety from storm surge will continue. Damages to front row structures and contents will be substantial.	Significant threats to Life and Safety from storm surge will continue. Damages to front row structures would be eliminated.	Significant threats to Life and Safety from storm surge will continue. Damages to front row structures and contents substantially reduced.	Significant threats to Life and Safety from storm surge will continue. Damages to front row structures and contents substantially reduced.
g. Risk to Mental and Physical Health	N/A	N/A	N/A	N/A
2. Recommendations and Preferences				
a. Federal Recommendation			The NED Plan is the plan that maximizes net benefits	
b. Stakeholder Preference	No clear stakeholder preference indicated, but all action plans preferred to no action plan.			The Locally Preferred Plan provides a higher extent of protection over the NED Plan but is more costly. The sponsor is willing to pay 100 percent of the additional cost for this added extent of protection

6.0 SELECTING A PLAN

Based on plan comparison, as shown in Table 27, it is apparent that implementation of a beach fill plan will satisfy the study objectives and provide hurricane and storm damage reduction and environmental restoration along the coastline of Walton County, Florida. Further, both the NED and LPP beach fill plans were found superior to the Acquisition and No Action plans in each of the System of Accounts. The Acquisition Plan would cost nearly 40 times more than the NED and LPP Plans while providing less economic benefit and the no action plan would provide no economic benefit. The NED Plan would have an annual cost of about $4,474,000 with the LPP annual cost totaling about $5,102,000. The annual benefits of the NED Plan would total about $6,391,000 with the LPP annual benefits totaling about $6,559,000. The BCR of the NED Plan is about 1.43 while the BCR of the LPP is about 1.29. The NED Plan would protect about 15.2 miles of the Walton County shoreline while the LPP would protect about 18.8 miles.

Of the plans considered, the non-Federal sponsor has expressed their desire to implement the LPP. Per ER 1105-2-100, the recommended plan may deviate from the NED plan if the non-Federal sponsor agrees to pay the cost difference between the NED plan and the LPP, the LPP has outputs similar in-kind, and the LPP has benefits that are equal or greater to the NED benefits. A waiver, that the LPP be considered for recommendation, was requested and on 7 February 2012, was approved by the ASA (CW). As such, the LPP is the Tentatively Selected Plan (TSP).

6.1 PLAN DETAILS

6.1.1 NED Plan and TSP for Construction with Renourishments

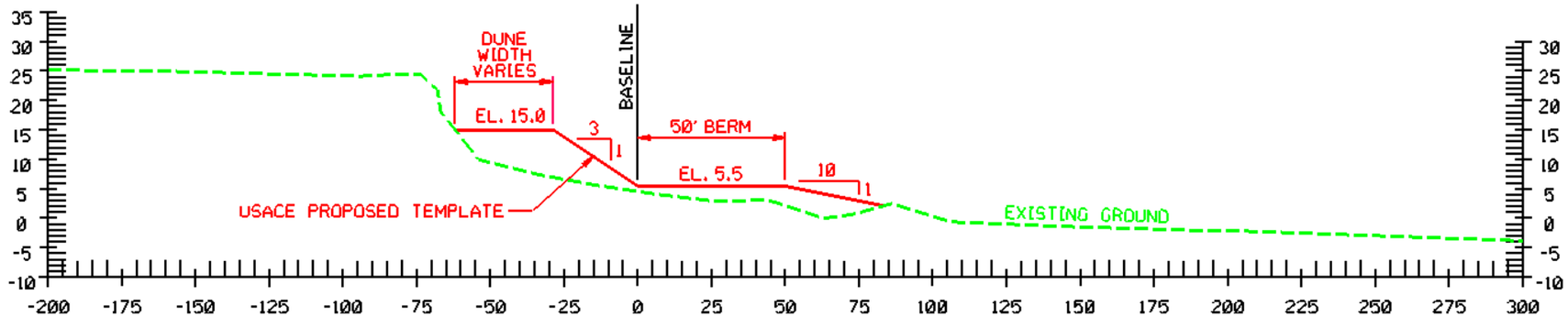
The modeling efforts have predicted initial fill requirements of 2,639,000 cy for the NED Plan and a TSP requirement of 3,152,000 cy. The two plans maintain the same placement template (see Figure 10) but the TSP extends the coverage area to the westernmost limits of the county where the NED Plan could not justify the coverage. If this condition accounts for depletion rates to the predicted construction timeframe of FY14, then the necessary beach fill requirements will be 3,273,000 cy and 3,868,000 cy for the NED and TSP, respectively. Renourishments will still be on a 10-year cycle with renourishment volumes of 1,585,000 and 1,789,000 for the NED and TSP, respectively. Approved borrow sources lie offshore within the State of Florida waters.

6.2 COST SHARE

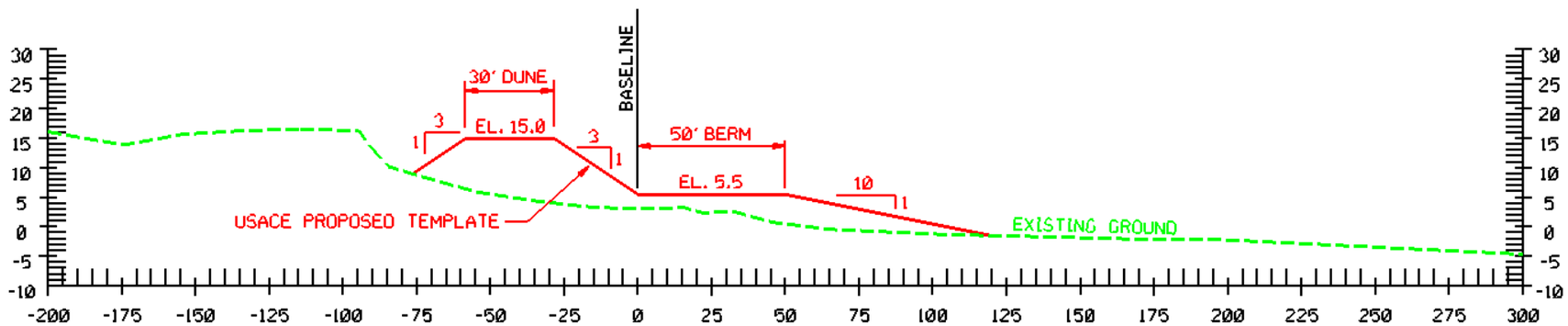
Typical cost share for HSDR projects is 65 percent Federal and 35 percent non-Federal. Adjustment can be made to this ratio based on adequacy of public access and parking, whether private shoreline is being protected, and if any economically unjustified reach is being included in the selected plan. A cost share analysis presented in Table 28 shows that the cost share ratio for the initial construction costs of the NED Plan would be about 33 percent Federal and about 67 percent non-Federal. The renourishment costs were adjusted similarly while at the same time assuring that, per Section 215 of Water Re-

sources Development Act of 1999, the maximum Federal participation in any reach was limited to 50 percent. The resulting cost share for the NED renourishment costs is about 26 percent Federal and about 74 percent non-Federal. Similarly, the cost share analysis presented in Table 29 shows that the cost share ratio for the initial construction costs of the LPP would be about 31 percent Federal and about 69 percent non-Federal. The cost share ratio for the LPP renourishment costs is about 24 percent Federal and about 76 percent non-Federal. The overall cost ratio for both the initial construction costs and the renourishment costs of the NED plan is about 30 percent Federal and about 70 percent non-Federal. The overall cost ratio for both the initial construction costs and the renourishment costs of the LPP is about 28 percent Federal and about 72 percent non-Federal. Tables 30 and 30A shown below, exhibit the differences between the NED Plan and the LPP.

Table 31 demonstrates if a particular reach qualifies for cost share based on adequacy of public access and parking. The location of beach access points is publicly available on the World Wide Web. The analysis of adequate parking along the beaches requires either a beach capacity or peak user day point of view. Since the beach capacity is greater than the peak day visitation, the peak user day analysis is used. The most recent peak day visitation at Walton County beaches, which occurred during the July 4th 2009 holiday, was estimated at 13,537 visits. Assumptions of the analysis are (1) the demand for public parking originates from both resident and non-residents population; (2) beach rentals on the beach that have access to the beach contribute to the supply of parking in absolute parking space terms without turnover; (3) The large county beach access and parking available at Miramar Beach and other such large day use areas, are very popular and highly attended areas. These areas will, on peak day, operate at full parking capacity where the average daily turnover rate on purely public parking is 1.5 times. Assuming 4.5 persons per vehicle, each parking space will accommodate 6.75 visits per day. Surplus and deficits in parking areas in any reach are available to be used within a quarter mile radius of the loci of the parking supply except near the large day use areas whose supply is completely used.



TYPICAL SECTION "A"



TYPICAL SECTION "B"

FIGURE 10. TYPICAL PROJECT SECTIONS TO BE CONSTRUCTED

TABLE 28
NED PLAN COST SHARE FEDERAL AND NON-FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
			65%	0%	50%	65%	65%	0%	50%	65%					
			35%	100%	50%	35%	35%	100%	50%	35%					
1	R1-1	1150	1,150	0	0	0	0	0%	0%	0%		0.0%	0.0000		
2	R1-2	1102	560	0	0	0	0	0%	0%	0%		0.0%	0.0000		
3	R1-3	1044	0	0	0	0	0	0%	0%	0%		0.0%	0.0000		
4	R1-4	1002	102	0	0	0	0	0%	0%	0%		0.0%	0.0000		
5	R1-5	1062	1,062	0	0	0	0	0%	0%	0%		0.0%	0.0000		
6	R1-6	1045	998	0	0	0	0	0%	0%	0%		0.0%	0.0000		
7	R1-7	1003	1,003	0	0	0	0	0%	0%	0%		0.0%	0.0000		
8	R1-8	1061	984	0	0	0	0	0%	0%	0%		0.0%	0.0000		
9	R1-9	1014	984	0	0	0	0	0%	0%	0%		0.0%	0.0000		
10	R1-10	959	100	0	0	0	0	0%	0%	0%	0.0012	0.0%	0.0000	100.00%	
11	R1-11	1021	955	66	0	0	94%	6%	0%	0%	0.0127	0.0%	0.0000	100.00%	Construction Reach One
12	R1-12	1057	1057	0	0	0	100%	0%	0%	0%	0.0132	65.0%	0.0086	35.00%	
13	R1-13	1040	1,040	0	0	0	100%	0%	0%	0%	0.0130	65.0%	0.0084	35.00%	
14	R1-14	1051	1,051	0	0	0	100%	0%	0%	0%	0.0131	65.0%	0.0085	35.00%	
15	R1-15	998	923	75	0	0	92%	8%	0%	0%	0.0124	60.1%	0.0075	39.89%	
16	R1-16	1025	883	142	0	0	86%	14%	0%	0%	0.0128	56.0%	0.0071	43.99%	
17	R1-17	1114	100	0	0	0	0	0%	0%	0%	0.0012	62.3%	0.0080	37.66%	
18	R1-18	1133	1,033	100	0	0	0	9%	0%	0%		0.0%	0.0000		
19	R1-19	1058	1,058	0	0	0	0	0%	0%	0%		0.0%	0.0000		
20	R1-20	961	961	0	0	0	0	0%	0%	0%		0.0%	0.0000		
21	R1-21	952	952	0	0	0	0	0%	0%	0%		0.0%	0.0000		
22	R1-22	1028	1,028	0	0	0	0	0%	0%	0%		0.0%	0.0000		
23	R1-23	1086	956	130	0	0	0	12%	0%	0%		0.0%	0.0000		
24	R1-24	1139	1139	0	0	0	0	0%	0%	0%		0.0%	0.0000		
Construction Reach One Sub Totals													0.0482		6391.2

TABLE 28 (CONTINUED)

NED PLAN COST SHARE FEDERAL AND NON-FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
25	R2-1	495	0	0	0	0	0%	0%	0%	0%					
26	R2-2	936	0	0	0	0	0%	0%	0%	0%					
27	R2-3	2160	0	0	0	0	0%	0%	0%	0%					
28	R2-4	2066	0	0	0	0	0%	0%	0%	0%					
29	R2-5	1001	0	0	0	0	0%	0%	0%	0%					
30	R2-6	10078	0	0	0	0	0%	0%	0%	0%					
31	R2-7	1040	0	0	0	0	0%	0%	0%	0%					
32	R3-1	1147	0	0	100	0	0%	0%	9%	0%	0.0012	0.0%	0.0000	100.00%	*
33	R3-2	1037	838	199	0	0	81%	19%	0%	0%	0.0129	0.0%	0.0000	100.00%	Construction Reach Two * *
34	R3-3	1052	904	148	0	0	86%	14%	0%	0%	0.0131	0.0%	0.0000	100.00%	
35	R3-4	1026	914	112	0	0	89%	11%	0%	0%	0.0128	57.9%	0.0074	42.10%	
36	R3-5	1121	1,121	0	0	0	100%	0%	0%	0%	0.0140	65.0%	0.0091	35.00%	
37	R3-6	1185	1,115	70	0	0	94%	6%	0%	0%	0.0148	0.0%	0.0000	100.00%	
38	R3-7	1156	1,120	36	0	0	97%	3%	0%	0%	0.0144	0.0%	0.0000	100.00%	
39	R3-8	1103	909	194	0	0	82%	18%	0%	0%	0.0137	53.6%	0.0074	46.43%	
40	R3-9	1058	875	183	0	0	83%	17%	0%	0%	0.0132	53.8%	0.0071	46.25%	
41	R3-10	1068	1,068	0	0	0	100%	0%	0%	0%	0.0133	65.0%	0.0086	35.00%	
42	R3-11	1045	794	55	196	0	76%	5%	19%	0%	0.0130	58.8%	0.0076	41.24%	
43	R3-12	1007	824	100	83	0	82%	10%	8%	0%	0.0125	57.3%	0.0072	42.69%	
44	R3-13	1004	716	288	0	0	71%	29%	0%	0%	0.0125	46.4%	0.0058	53.65%	
45	R3-14	1345	960	385	0	0	71%	29%	0%	0%	0.0168	46.4%	0.0078	53.61%	
46	R3-15	1062	997	65	0	0	94%	6%	0%	0%	0.0132	0.0%	0.0000	100.00%	
47	R3-16	732	732	0	0	0	100%	0%	0%	0%	0.0091	0.0%	0.0000	100.00%	
48	R3-17	1017	758	259	0	0	75%	25%	0%	0%	0.0127	0.0%	0.0000	100.00%	
49	R3-18	1039	667	372	0	0	64%	36%	0%	0%	0.0129	0.0%	0.0000	100.00%	
50	R3-19	1036	1,036	0	0	0	100%	0%	0%	0%	0.0129	0.0%	0.0000	100.00%	
51	R3-20	1027	922	0	105	0	90%	0%	10%	0%	0.0128	63.5%	0.0081	36.53%	
52	R3-21	1029	903	126	0	0	88%	12%	0%	0%	0.0128	57.0%	0.0073	42.96%	

TABLE 28 (CONTINUED)
NED PLAN COST SHARE FEDERAL AND NON-FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
53	R3-22	978	978	0	0	0	100%	0%	0%	0%	0.0122	65.0%	0.0079	35.00%	
54	R3-23	855	775	80	100	0	91%	9%	12%	0%	0.0107	0.0%	0.0000	100.00%	
55	R3-24	1115	0	200	100	0	0%	18%	9%	0%	0.0139	4.5%	0.0006	95.52%	
Construction Reach Two Sub Totals													0.0913		23,180.4
56	R3-25	1274	0	200	0	0	0%	16%	0%	0%	0.0159	0.0%	0.0000	100.00%	
57	R3-26	1082	0	100	0	0	0%	9%	0%	0%	0.0135	0.0%	0.0000	100.00%	
58	R4-1	1082	922	160	100	0	85%	15%	9%	0%	0.0135	0.0%	0.0000	100.00%	Construction Reach Three
59	R4-2	1126	970	156	0	0	86%	14%	0%	0%	0.0140	0.0%	0.0000	100.00%	
60	R4-3	982	0	0	982	0	0%	0%	100%	0%	0.0122	0.0%	0.0000	100.00%	
61	R4-4	942	0	0	942	0	0%	0%	100%	0%	0.0117	0.0%	0.0000	100.00%	
62	R4-5	998	786	70	142	0	79%	7%	14%	0%	0.0124	58.3%	0.0072	41.70%	
63	R4-6	971	0	0	971	0	0%	0%	100%	0%	0.0121	50.0%	0.0061	50.00%	
64	R4-7	1061	0	0		100	0%	0%	0%	9%	0.0000	0.0%	0.0000	100.00%	
Construction Reach Three Sub Totals													0.0139		6,300.8
65	R4-8	2119	0				0%	0%	0%	0%					
66	R4-9	2075	0			100	0%	0%	0%	5%	0.0000	0.0%	0.0000	100.00%	*
67	R5-1	993	993	0	100	0	100%	0%	10%	0%	0.0124	0.0%	0.0000	100.00%	Construction Reach Four
68	R5-2	1003	805	198	0	0	80%	20%	0%	0%	0.0125	52.2%	0.0065	47.83%	
69	R5-3	1039	809	230	0	0	78%	22%	0%	0%	0.0129	50.6%	0.0066	49.38%	
70	R5-4	1304	1,224	80	0	0	94%	6%	0%	0%	0.0162	61.0%	0.0099	38.99%	
71	R5-5	1009	773	236	0	0	77%	23%	0%	0%	0.0126	49.8%	0.0063	50.20%	
72	R5-6	1062	858	204	0	0	81%	19%	0%	0%	0.0132	52.5%	0.0069	47.49%	
73	R5-7	1038	1,038	0	0	0	100%	0%	0%	0%	0.0129	65.0%	0.0084	35.00%	
74	R5-8	992	992	0	0	0	100%	0%	0%	0%	0.0124	0.0%	0.0000	100.00%	
75	R5-9	1027	881	146	0	0	86%	14%	0%	0%	0.0128	55.8%	0.0071	44.25%	
76	R5-10	1011	744	129	138	0	74%	13%	14%	0%	0.0126	54.7%	0.0069	45.34%	

TABLE 28 (CONTINUED)

NED PLAN COST SHARE FEDERAL AND NON-FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
77	R5-11	1022	1,022	0	0	0	100%	0%	0%	0%	0.0127	65.0%	0.0083	35.00%	
78	R5-12	1018	578	440	0	0	57%	43%	0%	0%	0.0127	36.9%	0.0047	63.09%	
79	R5-13	1017	965	52	0	0	95%	5%	0%	0%	0.0127	61.7%	0.0078	38.33%	
80	R5-14	1005	876	129	0	0	87%	13%	0%	0%	0.0125	56.7%	0.0071	43.34%	
81	R5-15	1011	744	267	0	0	74%	26%	0%	0%	0.0126	47.8%	0.0060	52.17%	
82	R5-16	1035.2	443	592	0	0	43%	57%	0%	0%	0.0129	27.8%	0.0036	72.17%	
83	R5-17	942.6	824	119	0	0	87%	13%	0%	0%	0.0117	56.8%	0.0067	43.21%	
84	R5-18	999.9	689	311	0	0	69%	31%	0%	0%	0.0125	44.8%	0.0056	55.22%	
85	R5-19	1010.9	719	292	0	0	71%	29%	0%	0%	0.0126	46.2%	0.0058	53.78%	
86	R5-20	1028.6	487	168	374	0	47%	16%	36%	0%	0.0128	0.0%	0.0000	100.00%	*
87	R5-21	1122	684	438	100	0	61%	39%	9%	0%	0.0140	0.0%	0.0000	100.00%	*
88	R5-22	1029.7	0		100		0%	0%	10%	0%	0.0012	0.0%	0.0000	100.00%	
Construction Reach Four Sub Totals													0.1141		21,888.4
89	R5-23	1013	0				0%	0%	0%	0%					
90	R5-24	1022	0				0%	0%	0%	0%					
91	R5-25	1054	0				0%	0%	0%	0%					
92	R5-26	884	0				0%	0%	0%	0%					
93	R5-27	1044	0				0%	0%	0%	0%					
94	R5-28	1059	0				0%	0%	0%	0%					
95	R5-29	987	0	0	100		0%	0%	10%	0%	0.0000	0.0%	0.0000	100.00%	*
96	R5-30	1022	556	466	100		54%	46%	10%	0%	0.0127	0.0%	0.0000	100.00%	Construction Reach Five
97	R5-31	1015	737	278	0		73%	27%	0%	0%	0.0126	0.0%	0.0000	100.00%	
98	R5-32	985	985	0	0		100%	0%	0%	0%	0.0123	0.0%	0.0000	100.00%	
99	R5-33	1025	854	171	0		83%	17%	0%	0%	0.0128	54.2%	0.0069	45.84%	
100	R5-34	1038	936	102	0		90%	10%	0%	0%	0.0129	58.6%	0.0076	41.39%	
101	R5-35	1002	945	57	0		94%	6%	0%	0%	0.0125	61.3%	0.0077	38.70%	

TABLE 28 (CONTINUED)

NED PLAN COST SHARE FEDERAL AND NON-FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
102	R5-36	944	826	118	0		87%	13%	0%	0%	0.0118	0.0%	0.0000	100.00%	
103	R5-37	1020	820	200	0		80%	20%	0%	0%	0.0127	0.0%	0.0000	100.00%	
104	R5-38	1094	945	149	0		86%	14%	0%	0%	0.0136	0.0%	0.0000	100.00%	
105	R5-39	1024	925	99	0		90%	10%	0%	0%	0.0128	0.0%	0.0000	100.00%	
106	R5-40	1010	848	162	0		84%	16%	0%	0%	0.0126	0.0%	0.0000	100.00%	
107	R5-41	1004	274	730	0		27%	73%	0%	0%	0.0125	0.0%	0.0000	100.00%	
108	R5-42	1023	0	1,023	0		0%	100%	0%	0%	0.0127	0.0%	0.0000	100.00%	
109	R5-43	1002	918	84	0		92%	8%	0%	0%	0.0125	0.0%	0.0000	100.00%	
110	R5-44	1001	1,001	0	0		100%	0%	0%	0%	0.0125	0.0%	0.0000	100.00%	
111	R5-45	969	969	0	0		100%	0%	0%	0%	0.0121	0.0%	0.0000	100.00%	
112	R5-46	988	682	306	0		69%	31%	0%	0%	0.0123	44.9%	0.0055	55.14%	
113	R5-47	1031	675	356	0		65%	35%	0%	0%	0.0128	42.5%	0.0055	57.45%	
114	R5-48	1026	1,026	0	0		100%	0%	0%	0%	0.0128	65.0%	0.0083	35.00%	
115	R5-49	1041	1,041	0	0		100%	0%	0%	0%	0.0130	65.0%	0.0084	35.00%	
116	R5-50	1032	862	170	0		84%	16%	0%	0%	0.0129	54.3%	0.0070	45.71%	
117	R5-51	1126	943	83	100		84%	7%	9%	0%	0.0140	58.9%	0.0083	41.12%	
Construction Reach Five Sub Totals													0.0651		22,519.2
	Reach with Transition Zone														
* Designates that all or portion of reach is in a CBRA zone (all work in CRBA zone will be 100% non-Federal funded)															
TOTAL FEDERAL COST SHARE													0.3320		
TOTAL NON FEDERAL COST SHARE													0.6680		
TOTAL CONSTRUCTED PROJECT LENGTH							80,280								80280.0

TABLE 29

TENTATIVELY SELECTED PLAN COST SHARE FEDERAL AND NON FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
			65%	0%	50%	65%	65%	0%	50%	65%					
			35%	100%	50%	35%	35%	100%	50%	35%					
1	R1-1	1250	1,250	0	0	0	100%	0%	0%	0%	0.0127	0.0%	0.0000	100.00%	*
2	R1-2	1102	560	0	542	0	51%	0%	49%	0%	0.0112	0.0%	0.0000	100.00%	*
3	R1-3	1044	0	0	1,044	0	0%	0%	100%	0%	0.0106	0.0%	0.0000	100.00%	*
4	R1-4	1002	102	0	900	0	10%	0%	90%	0%	0.0102	0.0%	0.0000	100.00%	*
5	R1-5	1062	1,062	0	0	0	100%	0%	0%	0%	0.0108	0.0%	0.0000	100.00%	
6	R1-6	1045	998	47	0	0	96%	4%	0%	0%	0.0106	0.0%	0.0000	100.00%	
7	R1-7	1003	1,003	0	0	0	100%	0%	0%	0%	0.0102	0.0%	0.0000	100.00%	
8	R1-8	1061	984	77	0	0	93%	7%	0%	0%	0.0108	0.0%	0.0000	100.00%	
9	R1-9	1014	984	30	0	0	97%	3%	0%	0%	0.0103	0.0%	0.0000	100.00%	
10	R1-10	959	761	198	0	0	79%	21%	0%	0%	0.0097	0.0%	0.0000	100.00%	
11	R1-11	1021	955	66	0	0	94%	6%	0%	0%	0.0104	0.0%	0.0000	100.00%	Construction Reach One
12	R1-12	1057	1,057	0	0	0	100%	0%	0%	0%	0.0107	65.0%	0.0070	35.00%	
13	R1-13	1040	1,040	0	0	0	100%	0%	0%	0%	0.0106	65.0%	0.0069	35.00%	
14	R1-14	1051	1,051	0	0	0	100%	0%	0%	0%	0.0107	65.0%	0.0069	35.00%	
15	R1-15	998	923	75	0	0	92%	8%	0%	0%	0.0101	60.1%	0.0061	39.89%	
16	R1-16	1025	883	142	0	0	86%	14%	0%	0%	0.0104	56.0%	0.0058	44.01%	
17	R1-17	1114	667	447	0	0	60%	40%	0%	0%	0.0113	0.0%	0.0000	100.00%	
18	R1-18	1133	1,033	100	0	0	91%	9%	0%	0%	0.0115	0.0%	0.0000	100.00%	
19	R1-19	1058	1,058	0	0	0	100%	0%	0%	0%	0.0107	0.0%	0.0000	100.00%	
20	R1-20	961	961	0	0	0	100%	0%	0%	0%	0.0098	0.0%	0.0000	100.00%	
21	R1-21	952	952	0	0	0	100%	0%	0%	0%	0.0097	0.0%	0.0000	100.00%	
22	R1-22	1028	1,028	0	0	0	100%	0%	0%	0%	0.0104	0.0%	0.0000	100.00%	
23	R1-23	1086	956	130	0	0	88%	12%	0%	0%	0.0110	0.0%	0.0000	100.00%	
24	R1-24	1039	1039	0	0	0	100%	0%	0%	0%	0.0105	0.0%	0.0000	100.00%	
25	R2-1	495	100	0	0	0	20%	0%	0%	0%	0.0010	13.1%	0.0001	86.87%	
Construction Reach One Sub Totals													0.0327		25,202.3

TABLE 29 (CONTINUED)

TENTATIVELY SELECTED PLAN COST SHARE FEDERAL AND NON FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
26	R2-2	936	0	0	0	0	0%	0%	0%	0%					
27	R2-3	2160	0	0	0	0	0%	0%	0%	0%					
28	R2-4	2066	0	0	0	0	0%	0%	0%	0%					
29	R2-5	1001	0	0	0	0	0%	0%	0%	0%					
30	R2-6	10078	0	0	0	0	0%	0%	0%	0%					
31	R2-7	1040	0	0	0	0	0%	0%	0%	0%					
32	R3-1	1147	0	0	100	0	0%	0%	9%	0%	0.0012	0.0%	0.0000	100.00%	*
33	R3-2	1037	838	199	0	0	81%	19%	0%	0%	0.0129	0.0%	0.0000	100.00%	Construction Reach Two
34	R3-3	1052	904	148	0	0	86%	14%	0%	0%	0.0131	0.0%	0.0000	100.00%	
35	R3-4	1026	914	112	0	0	89%	11%	0%	0%	0.0128	57.9%	0.0074	42.10%	
36	R3-5	1121	1,121	0	0	0	100%	0%	0%	0%	0.0140	65.0%	0.0091	35.00%	
37	R3-6	1185	1,115	70	0	0	94%	6%	0%	0%	0.0148	0.0%	0.0000	100.00%	
38	R3-7	1156	1,120	36	0	0	97%	3%	0%	0%	0.0144	0.0%	0.0000	100.00%	
39	R3-8	1103	909	194	0	0	82%	18%	0%	0%	0.0137	53.6%	0.0074	46.43%	
40	R3-9	1058	875	183	0	0	83%	17%	0%	0%	0.0132	53.8%	0.0071	46.25%	
41	R3-10	1068	1,068	0	0	0	100%	0%	0%	0%	0.0133	65.0%	0.0086	35.00%	
42	R3-11	1045	794	55	196	0	76%	5%	19%	0%	0.0130	58.8%	0.0076	41.24%	
43	R3-12	1007	824	100	83	0	82%	10%	8%	0%	0.0125	57.3%	0.0072	42.69%	
44	R3-13	1004	716	288	0	0	71%	29%	0%	0%	0.0125	46.4%	0.0058	53.65%	
45	R3-14	1345	960	385	0	0	71%	29%	0%	0%	0.0168	46.4%	0.0078	53.61%	
46	R3-15	1062	997	65	0	0	94%	6%	0%	0%	0.0132	0.0%	0.0000	100.00%	*
47	R3-16	732	732	0	0	0	100%	0%	0%	0%	0.0091	0.0%	0.0000	100.00%	*
48	R3-17	1017	758	259	0	0	75%	25%	0%	0%	0.0127	0.0%	0.0000	100.00%	
49	R3-18	1039	667	372	0	0	64%	36%	0%	0%	0.0129	0.0%	0.0000	100.00%	
50	R3-19	1036	1,036	0	0	0	100%	0%	0%	0%	0.0129	0.0%	0.0000	100.00%	
51	R3-20	1027	922	0	105	0	90%	0%	10%	0%	0.0128	63.5%	0.0081	36.53%	
52	R3-21	1029	903	126	0	0	88%	12%	0%	0%	0.0128	57.0%	0.0073	42.96%	

TABLE 29 (CONTINUED)

TENTATIVELY SELECTED PLAN COST SHARE FEDERAL AND NON FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
53	R3-22	978	978	0	0	0	100%	0%	0%	0%	0.0122	65.0%	0.0079	35.00%	
54	R3-23	855	775	80	100	0	91%	9%	12%	0%	0.0107	0.0%	0.0000	100.00%	
55	R3-24	1115	0	200	100	0	0%	18%	9%	0%	0.0139	4.5%	0.0006	95.52%	
Construction Reach Two Sub Totals													0.0913		23,180.4
56	R3-25	1274	0	200	0	0	0%	16%	0%	0%	0.0159	0.0%	0.0000	100.00%	
57	R3-26	1082	0	100	0	0	0%	9%	0%	0%	0.0135	0.0%	0.0000	100.00%	
58	R4-1	1082	922	160	100	0	85%	15%	9%	0%	0.0135	0.0%	0.0000	100.00%	Construction Reach Three
59	R4-2	1126	970	156	0	0	86%	14%	0%	0%	0.0140	0.0%	0.0000	100.00%	
60	R4-3	982	0	0	982	0	0%	0%	100%	0%	0.0122	0.0%	0.0000	100.00%	
61	R4-4	942	0	0	942	0	0%	0%	100%	0%	0.0117	0.0%	0.0000	100.00%	
62	R4-5	998	786	70	142	0	79%	7%	14%	0%	0.0124	58.3%	0.0072	41.70%	
63	R4-6	971	0	0	971	0	0%	0%	100%	0%	0.0121	50.0%	0.0061	50.00%	
64	R4-7	1061	0	0		100	0%	0%	0%	9%	0.0000	0.0%	0.0000	100.00%	
Construction Reach Three Sub Totals													0.0139		6,300.8
65	R4-8	2119	0				0%	0%	0%	0%					
66	R4-9	2075	0			100	0%	0%	0%	5%	0.0000	0.0%	0.0000	100.00%	*
67	R5-1	993	993	0	100	0	100%	0%	10%	0%	0.0124	0.0%	0.0000	100.00%	Construction Reach Four
68	R5-2	1003	805	198	0	0	80%	20%	0%	0%	0.0125	52.2%	0.0065	47.83%	
69	R5-3	1039	809	230	0	0	78%	22%	0%	0%	0.0129	50.6%	0.0066	49.38%	
70	R5-4	1304	1,224	80	0	0	94%	6%	0%	0%	0.0162	61.0%	0.0099	38.99%	
71	R5-5	1009	773	236	0	0	77%	23%	0%	0%	0.0126	49.8%	0.0063	50.20%	
72	R5-6	1062	858	204	0	0	81%	19%	0%	0%	0.0132	52.5%	0.0069	47.49%	
73	R5-7	1038	1,038	0	0	0	100%	0%	0%	0%	0.0129	65.0%	0.0084	35.00%	
74	R5-8	992	992	0	0	0	100%	0%	0%	0%	0.0124	0.0%	0.0000	100.00%	
75	R5-9	1027	881	146	0	0	86%	14%	0%	0%	0.0128	55.8%	0.0071	44.25%	
76	R5-10	1011	744	129	138	0	74%	13%	14%	0%	0.0126	54.7%	0.0069	45.34%	

TABLE 29 (CONTINUED)

TENTATIVELY SELECTED PLAN COST SHARE FEDERAL AND NON FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
77	R5-11	1022	1,022	0	0	0	100%	0%	0%	0%	0.0127	65.0%	0.0083	35.00%	
78	R5-12	1018	578	440	0	0	57%	43%	0%	0%	0.0127	36.9%	0.0047	63.09%	
79	R5-13	1017	965	52	0	0	95%	5%	0%	0%	0.0127	61.7%	0.0078	38.33%	
80	R5-14	1005	876	129	0	0	87%	13%	0%	0%	0.0125	56.7%	0.0071	43.34%	
81	R5-15	1011	744	267	0	0	74%	26%	0%	0%	0.0126	47.8%	0.0060	52.17%	
82	R5-16	1035.2	443	592	0	0	43%	57%	0%	0%	0.0129	27.8%	0.0036	72.17%	
83	R5-17	942.6	824	119	0	0	87%	13%	0%	0%	0.0117	56.8%	0.0067	43.21%	
84	R5-18	999.9	689	311	0	0	69%	31%	0%	0%	0.0125	44.8%	0.0056	55.22%	
85	R5-19	1010.9	719	292	0	0	71%	29%	0%	0%	0.0126	46.2%	0.0058	53.78%	
86	R5-20	1028.6	487	168	374	0	47%	16%	36%	0%	0.0128	0.0%	0.0000	100.00%	*
87	R5-21	1122	684	438	100	0	61%	39%	9%	0%	0.0140	0.0%	0.0000	100.00%	*
88	R5-22	1029.7	0		100		0%	0%	10%	0%	0.0012	0.0%	0.0000	100.00%	
Construction Reach Four Sub Totals													0.1141		21,888.4
89	R5-23	1013	0				0%	0%	0%	0%					
90	R5-24	1022	0				0%	0%	0%	0%					
91	R5-25	1054	0				0%	0%	0%	0%					
92	R5-26	884	0				0%	0%	0%	0%					
93	R5-27	1044	0				0%	0%	0%	0%					
94	R5-28	1059	0				0%	0%	0%	0%					
95	R5-29	987	0	0	100		0%	0%	10%	0%	0.0000	0.0%	0.0000	100.00%	*
96	R5-30	1022	556	466	100		54%	46%	10%	0%	0.0127	0.0%	0.0000	100.00%	Construction Reach Five
97	R5-31	1015	737	278	0		73%	27%	0%	0%	0.0126	0.0%	0.0000	100.00%	
98	R5-32	985	985	0	0		100%	0%	0%	0%	0.0123	0.0%	0.0000	100.00%	
99	R5-33	1025	854	171	0		83%	17%	0%	0%	0.0128	54.2%	0.0069	45.84%	
100	R5-34	1038	936	102	0		90%	10%	0%	0%	0.0129	58.6%	0.0076	41.39%	
101	R5-35	1002	945	57	0		94%	6%	0%	0%	0.0125	61.3%	0.0077	38.70%	
102	R5-36	944	826	118	0		87%	13%	0%	0%	0.0118	0.0%	0.0000	100.00%	
103	R5-37	1020	820	200	0		80%	20%	0%	0%	0.0127	0.0%	0.0000	100.00%	

TABLE 29 (CONTINUED)

TENTATIVELY SELECTED PLAN COST SHARE FEDERAL AND NON FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
104	R5-38	1094	945	149	0		86%	14%	0%	0%	0.0136	0.0%	0.0000	100.00%	
105	R5-39	1024	925	99	0		90%	10%	0%	0%	0.0128	0.0%	0.0000	100.00%	
106	R5-40	1010	848	162	0		84%	16%	0%	0%	0.0126	0.0%	0.0000	100.00%	
107	R5-41	1004	274	730	0		27%	73%	0%	0%	0.0125	0.0%	0.0000	100.00%	
108	R5-42	1023	0	1,023	0		0%	100%	0%	0%	0.0127	0.0%	0.0000	100.00%	
109	R5-43	1002	918	84	0		92%	8%	0%	0%	0.0125	0.0%	0.0000	100.00%	
110	R5-44	1001	1,001	0	0		100%	0%	0%	0%	0.0125	0.0%	0.0000	100.00%	
111	R5-45	969	969	0	0		100%	0%	0%	0%	0.0121	0.0%	0.0000	100.00%	
112	R5-46	988	682	306	0		69%	31%	0%	0%	0.0123	44.9%	0.0055	55.14%	
113	R5-47	1031	675	356	0		65%	35%	0%	0%	0.0128	42.5%	0.0055	57.45%	
114	R5-48	1026	1,026	0	0		100%	0%	0%	0%	0.0128	65.0%	0.0083	35.00%	
115	R5-49	1041	1,041	0	0		100%	0%	0%	0%	0.0130	65.0%	0.0084	35.00%	
116	R5-50	1032	862	170	0		84%	16%	0%	0%	0.0129	54.3%	0.0070	45.71%	
117	R5-51	1126	943	83	100		84%	7%	9%	0%	0.0140	58.9%	0.0083	41.12%	
Construction Reach Five Sub Totals													0.0651		22,519.2
	Reach with Transition Zone														
* Designates that all or portion of reach is in a CBRA zone (all work in CRBA zone will be 100% non-Federal funded)															
TOTAL FEDERAL COST SHARE													0.2560		
TOTAL NON FEDERAL COST SHARE													0.7440		
TOTAL CONSTRUCTED PROJECT LENGTH							98,491								98,491

TABLE 30						
NED AND TSP - COSTS AND COST SHARE						
	NED Plan ($)	Percent	TSP Plan ($)	Percent	Change ($)	Change (%)
Initial Construction Cost	$55,730,000		$63,559,000		$7,829,000	
Federal	$18,558,000	33%	$18,558,000	31%	$0	-2%
Non-Federal	$37,172,000	67%	$45,001,000	69%	$7,829,000	2%
Total Renourishment Cost	$35,729,000		$40,105,000		$4,376,000	0%
Federal	$9,290,000	26%	$9,290,000	24%	$0	-2%
Non-Federal	$26,439,000	74%	$30,495,000	76%	$4,055,000	2%
Total Construction Cost	$91,459,000		$103,664,000		$12,205,000	0%
Federal	$27,486,000	30%	$27,486,000	28%	$0	-2%
Non-Federal	$63,973,000	70%	$74,894,000	72%	$10,922,000	2%
Benefits	$6,391,000		$6,559,000		$168,000.0	
Mitigation	$0.0		$0.0		$0.0	

TABLE 30A						
NED AND TSP AVERAGE ANNUAL EQUIVALENT COSTS AND COST SHARE						
	NED Plan ($)	Percent	TSP Plan ($)	Percent	Change ($)	Change (%)
Initial Construction Cost	$2,650,000		$3,022,000		$372,000	
Federal	$882,000	33%	$882,000	31%	$0	-2.5%
Non-Federal	$1,768,000	67%	$2,140,000	69%	$372,000	2.5%
Total Renourishment Cost	$1,699,000		$1,907,000		$160,000	
Federal	$442,000	26%	$442,000	24%	$0	-2.0%
Non-Federal	$1,257,000	74%	$1,465,000	76%	$160,000	2.0%
Total Construction Cost	$4,349,000		$4,929,000		$356,000	
Federal	$1,307,000	30%	$1,307,000	28%	$0	-2.3%
Non-Federal	$3,042,000	70%	$3,559,000	72%	$356,000	2.3%
OMRR&R	$125,000		$168,000		$43,500	

Table 31															
Parking - Access - Cost Sharing Qualifying															
Sub Reach	**Model Reach**	**MAP ID**	**GIS -Database Access Name**	**GIS - Database Address**	**Large Day Use Public Areas and Access Points**	**Day Use Parking Spaces**	**Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)**	**Peak Day Parking Demand***	**Rental Parking Spaces**	**Visits Rental Parking Will Support (4.5 persons per Vehicle)**	**Total Parking**	**Parking Adequate or Not Adequate**	**Neighboring Reaches Requisite Parking Provided From**	**Access Adequate or Not Adequate**	**Qualify for Cost Sharing Yes/No**
1	R1-1					0	0	55	0	0	0	Not Adequate		Not Adequate	No ***
2	R1-2					0	0	55	22	99	99	Not Adequate		Adequate	No ***
3	R1-3	A1a	Miramar Beach Regional Access W (Parking/Access)	2375 Scenic Gulf Drive	2375 Scenic Gulf Drive	85	574	574	28	126	700	Adequate		Adequate	No ***
4	R1-4	A1b	Miramar Beach Regional Access E (Parking/Access)	2375 Scenic Gulf Drive		85	574	55	15	68	641	Adequate		Adequate	No ***
5	R1-5					0	0	55	16	72	72	Adequate		Adequate	No ***
6	R1-6					0	0	55	18	81	0	Not Adequate		Not Adequate	No ***
7	R1-7					0	0	55	0	0	0	Not Adequate		Not Adequate	No ***
8	R1-8					0	0	55	10	45	0	Not Adequate		Not Adequate	No ***
9	R1-9					0	0	55	3	14	14	Adequate	R1-10	Adequate	No ***
10	R1-10	A2	Scenic Gulf Drive Access ROW (Parking/Access)	Scenic Gulf Drive		100	675	55	33	149	824	Adequate		Adequate	No ***
11	R1-11					0	0	55	16	72	0	Not Adequate		Not Adequate	No
12	R1-12					0	0	55	31	140	140	Adequate		Adequate	Yes
13	R1-13	A3	Gerinimo Street (Access)	735 Scenic Gulf Drive	735 Scenic Gulf Drive	0	0	55	76	342	342	Adequate		Adequate	Yes
14	R1-14					0	0	55	33	149	149	Adequate		Adequate	Yes
15	R1-15	A4	Norwood Drive (Access)	132 Norwood Dirve	132 Norwood Dirve	0	0	55	77	347	347	Adequate		Adequate	Yes

Table 31 (Continued)															
Parking - Access - Cost Sharing Qualifying															
Sub Reach	**Model Reach**	**MAP ID**	**GIS -Database Access Name**	**GIS - Database Address**	**Large Day Use Public Areas and Access Points**	**Day Use Parking Spaces**	**Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)**	**Peak Day Parking Demand***	**Rental Parking Spaces**	**Visits Rental Parking Will Support (4.5 persons per Vehicle)**	**Total Parking**	**Parking Adequate or Not Adequate**	**Neighboring Reaches Requisite Parking Provided From**	**Access Adequate or Not Adequate**	**Qualify for Cost Sharing Yes/No**
16	R1-16	A5	Open Gulf (Access)	213 Open Gulf St.	Open Gulf Street	6	41	55	103	464	504	Adequate		Adequate	Yes
17	R1-17	A6, A7	Sand Trap & Tango De Mer (Parking & Access)	253 Sand Trap Rd & End of Tango De Mer	253 Sand Trap Road	3	20	55	4	18	38	Adequate	R1-16	Adequate	No ***
18	R1-18		Acess at End of Tango De Mer	Acess at End of Tango De Mer	End of Tango De Mer	0	0	55	0	0	0	Adequate	R1-19	Adequate	No ***
19	R1-19					0	0	55	55	248	0	Not Adequate		Not Adequate	No ***
20	R1-20					0	0	55	81	365	0	Not Adequate		Not Adequate	No ***
21	R1-21					0	0	55	146	657	657	Adequate		Adequate	No ***
22	R1-22	A8	Sand Destin Day Use Area (Parking & Access)		San Destin Day Use Area	110	743	743	92	414	1,157	Adequate		Adequate	No ***
23	R1-23					0	0	55	155	698	698	Adequate		Not Adequate	No ***
24	R1-24					0	0	55	0	0	0	Adequate	R1-23	Not Adequate	No ***
25	R2-1					0	0	55	0	0	0				
26	R2-2					0	0	55	0	0	0				
27	R2-3					0	0	55	0	0	0				
28	R2-4					0	0	55	0	0	0				
29	R2-5		State Park (Parking & Access)	719 Top Sail Hill Road		0	0	55	0	0	0				
30	R2-6					0	0	55	0	0	0				
31	R2-7					0	0	55	0	0	0				
32	R3-1	A10	Stallworth Preserve North (Access)	140 Stallworth Blvd.		5	34	55	0	0	34				

Table 31 (Continued)

Parking - Access - Cost Sharing Qualifying

Sub Reach	Model Reach	MAP ID	GIS -Database Access Name	GIS - Database Address	Large Day Use Public Areas and Access Points	Day Use Parking Spaces	Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)	Peak Day Parking Demand*	Rental Parking Spaces	Visits Rental Parking Will Support (4.5 persons per Vehicle)	Total Parking	Parking Adequate or Not Adequate	Neighboring Reaches Requisite Parking Provided From	Access Adequate or Not Adequate	Qualify for Cost Sharing Yes/No
33	R3-2	A11, A12	Beach Highland & Bullard Beach Neighborhood Access (Parking & Access)	127 & 363 Highland Avenue	127 & 363 Highland Avenue	3	20	55	0	0	20	Not Adequate		Adequate	No
34	R3-3					0	0	55	5	23	23	Not Adequate		Adequate	No
35	R3-4					5	34	55	7	32	65	Adequate		Adequate	Yes
36	R3-5	A13	Dune Allen (Parking & Access)	5753 W. Co Hwy 30A	Dune Allen 5753 W. Co Hwy 30A	75	506	506	0	0	506	Adequate		Adequate	Yes
37	R3-6	A14	West Allen (Access)	5605 Co. Hwy 30-A		0	0	55	0	0	55	Not Adequate	R3-5	Adequate	Yes
38	R3-7	A15	Palms Ave W (Parking & Access)	4850 w. Co Hwy 30A		0	0	55	0	0	0	Not Adequate		Adequate	No
39	R3-8	A16a	Palms Ave E (Parking & Access)	4850 w. Co Hwy 30A		0	0	55	12	54	54	Adequate	R3-9	Adequate	Yes
40	R3-9	A16b	Lake Causeway (Access)	5173 Co Hwy 30A	4850 & 4991 & 5605 Co Hwy 30A	15	101	55	0	0	101	Adequate		Adequate	Yes
41	R3-10	A17a, A17b	Gulf Place West and Middle (Access)		4850 w. Co Hwy 30A	5	34	55	0	0	34	Adequate	R3-9	Adequate	Yes
42	R3-11	A17c, A18	Gulf Place East & Ed Walline Regional Beach Access (Parking & Access)	4447 W Co Hwy 30A	4447 W Co Hwy 30A & Gulf Place West Access Point	55	371	55	13	59	430	Adequate		Adequate	Yes
43	R3-12	A19	Spooky lane & Shellseekers (Access and Parking)	92 South Spooky Lane & 4201 W. Co. Rd. Hwy 30-A	92 South Spooky Lane & Gulf Place East Access Point	13	88	55	0	0	88	Adequate		Adequate	Yes

Table 31 (Continued)															
Parking - Access - Cost Sharing Qualifying															
Sub Reach	Model Reach	MAP ID	GIS -Database Access Name	GIS - Database Address	Large Day Use Public Areas and Access Points	Day Use Parking Spaces	Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)	Peak Day Parking Demand*	Rental Parking Spaces	Visits Rental Parking Will Support (4.5 persons per Vehicle)	Total Parking	Parking Adequate or Not Adequate	Neighboring Reaches Requisite Parking Provided From	Access Adequate or Not Adequate	Qualify for Cost Sharing Yes/No
44	R3-13	A20				14	95	55	16	72	167	Adequate		Adequate	Yes
45	R3-14	A21	Gulfview Heights (Parking & Access)	186 Gulfview Heights St	4201 Co. Hwy 30A & 186 Gulf View Heights Street	30	203	55	0	0	203	Adequate		Adequate	Yes
46	R3-15					0	0	55	0	0	0	Adequate	R3-14	Not Adequate	No
47	R3-16					0	0	55	0	0	0	Not Adequate		Not Adequate	No
48	R3-17					0	0	55	0	0	0	Not Adequate		Not Adequate	No
49	R3-18					0	0	55	24	108	0	Not Adequate		Not Adequate	No
50	R3-19					0	0	55	111	500	0	Not Adequate		Not Adequate	No
51	R3-20					0	0	55	23	104	104	Adequate		Adequate	Yes
52	R3-21	A22, A23	Blue Mountain and Gulf Point (Parking & Access)	2365 S Co Hwy 83 & 446 Blue Mountain Road	2365 S. Co Hwy 83 & 446, 590 and 726 Blue Mountain Road	37	250	55	0	0	250	Adequate		Adequate	Yes
53	R3-22	A24	Seagrade Road Neighborhood Access (Access)	590 Blue Mountain Road		0	0	55	0	0	0	Adequate	R3-21	Adequate	Yes
54	R3-23	A25	Blue Lake (Access)	726 Blue Mountain Road		0	0	55	0	0	0	Not Adequate		Adequate	No
55	R3-24					0	0	55	0	0	0				
56	R3-25					0	0	55	0	0	0				
57	R3-26					0	0	55	0	0	0				
58	R4-1	A26	Grayton State Park (Acess & Parking)			0	0	55	0	0	0	Not Adequate		Adequate	No
59	R4-2					0	0	55	0	0	0	Not Adequate		Not Adequate	No

Table 31 (Continued)															
Parking - Access - Cost Sharing Qualifying															
Sub Reach	Model Reach	MAP ID	GIS -Database Access Name	GIS - Database Address	Large Day Use Public Areas and Access Points	Day Use Parking Spaces	Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)	Peak Day Parking Demand*	Rental Parking Spaces	Visits Rental Parking Will Support (4.5 persons per Vehicle)	Total Parking	Parking Adequate or Not Adequate	Neighboring Reaches Requisite Parking Provided From	Access Adequate or Not Adequate	Qualify for Cost Sharing Yes/No
60	R4-3					0	0	55	0	0	0	Not Adequate		Not Adequate	No
61	R4-4					0	0	55	0	0	0	Not Adequate	R4-5	Not Adequate	No
62	R4-5	A27	Ray's Multi-Moutain (Access)	125 Sandy Lane	125 Sandy Lane	12	81	55	0	0	81	Adequate		Adequate	Yes
63	R4-6	A28, A29	Grayton Dunes and Weston (Parking & Access)	288 Garfield St & 208 Holtz Ave	288 Garfield St. & 199 Banfill St.& 208 Holtz Avenue & 913 Main Park Road	82	554	554	0	0	554	Adequate		Adequate	Yes
64	R4-7				91 Boat Ramp Road	0	0	55	0	0	0		R4-6		
65	R4-8	A301, A30B, A30C	Grayton State Park (Acess & Parking)			0	0	55	0	0	0				
66	R4-9					0	0	55	0	0	0				
67	R5-1					0	0	55	0	0	0	Not Adequate		Not Adequate	No
68	R5-2	A31	Van Ness Butler (Parking and Access)	1931 E Co Hwy 30A	Dune Allen 5753 W. Co Hwy 30A & Water Color Park Gargae and Access	100	675	675	11	50	725	Adequate		Adequate	Yes
69	R5-3					0	0	0	0	0	0	Adequate	R5-4	Adequate	Yes
70	R5-4	A32	Seaside (Access and Parking)			60	405	55	0	0	405	Adequate		Adequate	No
71	R5-5	A33	Dogwood/Thyme (Access)	2560 E. Co Hwy 30A	2560 Co Hwy 30A	0	0	55	0	0	0	Adequate	R5-6	Adequate	Yes

Table 31 (Continued)															
Parking - Access - Cost Sharing Qualifying															
Sub Reach	Model Reach	MAP ID	GIS -Database Access Name	GIS - Database Address	Large Day Use Public Areas and Access Points	Day Use Parking Spaces	Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)	Peak Day Parking Demand*	Rental Parking Spaces	Visits Rental Parking Will Support (4.5 persons per Vehicle)	Total Parking	Parking Adequate or Not Adequate	Neighboring Reaches Requisite Parking Provided From	Access Adequate or Not Adequate	Qualify for Cost Sharing Yes/No
72	R5-6	A34, A35, A36	Nightcap, Live Oak, Hickory (Access)	30A at End of Nightcap Street, 2680 E. Co Hwy 30A, 2624 E. Co Hwy 30A	2624, 2680, ~2750 and 2790 Co Hwy 30 A	32	216	55	0	0	216	Adequate		Adequate	Yes
73	R5-7	A37, A38, A39	Hollywood, Azela, Hwy 395 (Access)	2790, 2845, 2920 E. Co. Hwy 30-A	2845 and 2920 Co Hwy 30A	0	0	55	0	0	0	Adequate	R5-6	Adequate	Yes
74	R5-8	A40, A41, A42	Headland, Greenwood, Gardenia (Access)	3020 Co Hwy 30A, 30 & 118 Montgomery	3020 Co Hwy 30A	4	27	55	0	0	27	Not Adequate		Adequate	No
75	R5-9	A43, A44	Dothan and Andalusia (Access)	52 South Andalusia St and South End of Dothan Ave on Montgomery St.	52 South Andalusia St and South End of Dothan Ave on Montgomery St.	0	0	55	0	0	0	Adequate	R5-9	Adequate	Yes
76	R5-10	A45, A46, A47	Santa Clara, Santa Juan, Pelayo & Montego (Parking & Access)	3458, 3512, 3468, & 3576 E. Co Hwy 30A	3458, 3512 and 3576 E. Co Hwy 30A - San Juan & Pelaya Neighborhood G A	20	135	55	0	0	135	Adequate		Adequate	Yes
77	R5-11	A48, A49	Campbell	3694 E Co Hwy 30A		0	0	55	71	320	320	Adequate		Adequate	Yes
78	R5-12	A50	Beachwood villas (Access)	3874 E. Co Hwy 30A	3694 and 3874 E. Co Hwy 30 A - (Campbell Street)	95	641	641	50	225	866	Adequate		Adequate	Yes
79	R5-13	A51	One Seagrove (Access)		57 Seagrove Place	9	61	55	70	315	376	Adequate		Adequate	Yes
80	R5-14	A52	Sugar Cliffs (Access)			0	0	55	137	617	617	Adequate		Adequate	Yes

Table 31 (Continued)															
Parking - Access - Cost Sharing Qualifying															
Sub Reach	Model Reach	MAP ID	GIS -Database Access Name	GIS - Database Address	Large Day Use Public Areas and Access Points	Day Use Parking Spaces	Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)	Peak Day Parking Demand*	Rental Parking Spaces	Visits Rental Parking Will Support (4.5 persons per Vehicle)	Total Parking	Parking Adequate or Not Adequate	Neighboring Reaches Requisite Parking Provided From	Access Adequate or Not Adequate	Qualify for Cost Sharing Yes/No
81	R5-15					0	0	55	0	0	0	Adequate	R5-14	Adequate	Yes
82	R5-16	A53	Ramsgate (Access)	679 Eastern Lake Rd	679 and 491 Eastern Lake Road	0	0	55	2	9	9	Adequate	R5-17	Adequate	Yes
83	R5-17	A54	Eastern Lake (Parking & Access)	28 Lakewood Dr		0	0	55	36	162	162	Adequate		Adequate	Yes
84	R5-18	A55	Port Property (Access)	188 San Roy Rd	188 San Roy Road	6	41	55	0	0	41	Adequate	R5-17, R5-19	Adequate	Yes
85	R5-19	A56	Sugar Dunes (Access)	11 Beachside Drive	11 Beachside Dune - Sugar Dune	16	108	55	0	0	108	Adequate		Adequate	Yes
86	R5-20					10	68	55	51	230	297	Adequate		Adequate	Yes
87	R5-21	A57	Walton Dunes (Access)	258 Beachfront Taril - Walton Dune	258 Beachfront Taril - Walton Dune - Beachside Drive & Deer Lake State Park	0	0	55	9	41	41	Adequate	R5-20, R5-22	Adequate	Yes
88	R5-22					27	182	55	0	0	182				
89	R5-23					0	0	55	0	0	0				
90	R5-24					0	0	55	0	0	0				
91	R5-25					0	0	55	0	0	0				
92	R5-26					0	0	55	0	0	0				
93	R5-27					0	0	55	0	0	0				
94	R5-28					0	0	55	0	0	0				
95	R5-29					0	0	55	0	0	0				
96	R5-30					0	0	55	0	0	0	Not Adequate		Not Adequate	No
97	R5-31					0	0	55	0	0	0	Not Adequate		Adequate	No

Table 31 (Continued)															
Parking - Access - Cost Sharing Qualifying															
Sub Reach	Model Reach	MAP ID	GIS -Database Access Name	GIS - Database Address	Large Day Use Public Areas and Access Points	Day Use Parking Spaces	Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)	Peak Day Parking Demand*	Rental Parking Spaces	Visits Rental Parking Will Support (4.5 persons per Vehicle)	Total Parking	Parking Adequate or Not Adequate	Neighboring Reaches Requisite Parking Provided From	Access Adequate or Not Adequate	Qualify for Cost Sharing Yes/No
98	R5-32	A58	Gulf Lake (Access)	8040 E. Co Highway 30A	8040 E Co Hwy 30A - Gulf Lakes Neighborhood	0	0	55	0	0	0	Not Adequate		Adequate	No
99	R5-33	A59	Sea Breeze (Access)	8286 E. Co Hwy 30A	8286 E. Co. Hwy 30A - Seabreeze Neighborhood B A	0	0	55	13	59	59	Adequate		Adequate	Yes
100	R5-34		Seacrest (Access)	8520 E Co Hwy 30A	Saint Lucia Lane & Rosemary Avenue & 8520 E Co Hwy30A - Seacrest Dr.	10	68	55	4	18	86	Adequate		Adequate	Yes
101	R5-35					100	675	675	6	27	702	Adequate		Adequate	Yes
102	R5-36					0	0	55	0	0	0	Not Adequate		Not Adequate	No
103	R5-37					0	0	55	0	0	0	Not Adequate		Not Adequate	No
104	R5-38					0	0	55	0	0	0	Not Adequate		Not Adequate	No
105	R5-39					0	0	55	0	0	0	Not Adequate		Not Adequate	No
106	R5-40					0	0	55	0	0	0	Not Adequate		Not Adequate	No
107	R5-41					0	0	55	0	0	0	Not Adequate		Not Adequate	No
108	R5-42					0	0	55	13	59	0	Not Adequate		Not Adequate	No
109	R5-43					0	0	55	0	0	0	Not Adequate		Not Adequate	No
110	R5-44					0	0	55	0	0	0	Not Adequate		Not Adequate	No
111	R5-45					0	0	55	0	0	0	Not Adequate		Not Adequate	No

Table 31 (Continued)															
Parking - Access - Cost Sharing Qualifying															
Sub Reach	**Model Reach**	**MAP ID**	**GIS -Database Access Name**	**GIS - Database Address**	**Large Day Use Public Areas and Access Points**	**Day Use Parking Spaces**	**Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)**	**Peak Day Parking Demand***	**Rental Parking Spaces**	**Visits Rental Parking Will Support (4.5 persons per Vehicle)**	**Total Parking**	**Parking Adequate or Not Adequate**	**Neighboring Reaches Requisite Parking Provided From**	**Access Adequate or Not Adequate**	**Qualify for Cost Sharing Yes/No**
112	R5-46	A61	Inlet beach Neighborhood (Access)	188 Winston Lane	188 Winstor lane	105	709	709	0	0	709	Adequate		Adequate	Yes
113	R5-47	A62	Wall Street (Access)	264 South Wall Street	435 West Park Place Ave. & 264 South Wall Street	76	513	513	0	0	513	Adequate		Adequate	Yes
114	R5-48	A63A	Inlet Beach Regional Access West (Parking & Access)	438 South Orange Street Center	438 South Orange Street	67	452	452	0	0	452	Adequate		Adequate	Yes
115	R5-49	A63B	Inlet Beach Regional Access Middle & East (Parking and Access)	438 South Orange Street Center	118 West Park Place Avenue FL #20	67	452	452	0	0	452	Adequate		Adequate	Yes
116	R5-50	A64	Philips Inlet (Access)	202 South Walton Lakeshore Drive	202 South Walton Lakeshore Drive Phillips Inlet Access	15	101	55	0	0	101	Adequate		Adequate	Yes
117	R5-51					0	0	55	0	0	0	Adequate	R5-49, R5-50	Adequate	Yes
TOTALS						1,559	10,523	13537**	1,698	7,641	16,743				

* Assuming Large Public Day Use Area Parking is fully utilized and remainder of parking demand is distributed uniformly throughout the study area

** Peak Day Demand (July 4th)

*** LPP Reaches not economically justified, not eligible for cost sharing

Rental Parking disqualified - No Public Access Available

LPP Construction Reaches

6.3 RESIDUAL DAMAGES

With a project in place to reduce hurricane and storm damage not all damages will be prevented only reduced. It is important to provide information on residual damages to demonstrate project performance and communicate that fact that the project will not eliminate all risks. Table 32 shows the average annual remaining damages provided as output from the Beach-*fx* model runs.

TABLE 32
AVERAGE ANNUAL RESIDUAL DAMAGES - BY REACH
TENTATIVELY SELECTED PLAN

R1-1	$1,923	CONSTRUCTION REACH ONE
R1-2	$1,612	
R1-3	$2,197	
R1-4	$348	
R1-5	$430	
R1-6	$1,081	
R1-7	$1,600	
R1-8	$789	
R1-9	$1,466	
R1-10	$2,364	
R1-11	$31,577	
R1-12	$2,881	
R1-13	$3,704	
R1-14	$2,970	
R1-15	$54,058	
R1-16	$26,066	
R1-17	$1,876	
R1-18	$3,646	
R1-19	$4,544	
R1-20	$5,960	
R1-21	$2,047	
R1-22	$2,985	
R1-23	$1,064	
R1-24	$1,176	
R3-1	$0	CONSTRUCTION REACH TWO
R3-2	$53,074	
R3-3	$5,603	
R3-4	$451	
R3-5	$10,745	
R3-6	$5,766	
R3-7	$4,874	
R3-8	$11,011	

TABLE 32
AVERAGE ANNUAL RESIDUAL DAMAGES - BY REACH
TENTATIVELY SELECTED PLAN

R3-9	$7,620	
R3-10	$59,828	
R3-11	$11,647	
R3-12	$39,648	
R3-13	$1,827	
R3-14	$15,285	
R3-15	$1,765	
R3-16	$821	
R3-17	$1,849	
R3-18	$4,649	
R3-19	$1,037	
R3-20	$12,615	
R3-21	$13,255	
R3-22	$3,675	
R3-23	$2,625	
R4-1	$9,952	CONSTRUCTION REACH THREE
R4-2	$41,990	
R4-3	$0	
R4-4	$0	
R4-5	$67,910	
R4-6	$88,265	
R5-1	$2,764	CONSTRUCTION REACH FOUR
R5-2	$1,365	
R5-3	$15,482	
R5-4	$1,432	
R5-5	$2,229	
R5-6	$9,643	
R5-7	$8,002	
R5-8	$7,205	
R5-9	$2,619	
R5-10	$3,215	
R5-11	$7,131	
R5-12	$4,623	
R5-13	$13,263	
R5-14	$3,858	
R5-15	$3,194	
R5-16	$4,445	
R5-17	$3,143	
R5-18	$4,542	
R5-19	$10,755	
R5-20	$4,287	
R5-21	$3,366	

TABLE 32
AVERAGE ANNUAL RESIDUAL DAMAGES - BY REACH
TENTATIVELY SELECTED PLAN

R5-30	$3,112	CONSTRUCTION REACH FIVE
R5-31	$2,071	
R5-32	$25,530	
R5-33	$5,711	
R5-34	$2,206	
R5-35	$4,215	
R5-36	$19,201	
R5-37	$1,790	
R5-38	$4,991	
R5-39	$627	
R5-40	$269	
R5-41	$909	
R5-42	$412	
R5-43	$852	
R5-44	$7,534	
R5-45	$35,862	
R5-46	$5,953	
R5-47	$9,480	
R5-48	$276	
R5-49	$8,397	
R5-50	$1,108	
R5-51	$3,716	
Total	$896,936	

6.4 RISK AND UNCERTAINTY

Analysis of shore protection projects has moved from the traditional deterministic approach to a more comprehensive probabilistic, risk-based methodology. Shore protection projects are now formulated to provide economical protection for storm and erosion prone areas, selecting the plan that maximizes net economic benefits consistent with acceptable risk and functional performance. The technical task of any risk-based analysis is to balance the risk of design exceedance with damages prevented, uncertainty of storm characteristics with design accommodations, and to provide for safe, predictable performance. Risk-based analysis enables risk issues and uncertainty in critical data to be explicitly included in project formulation and evaluation. The uncertainties associated with the sequencing of storms and natural recovery and those associated with storm damages and erosion losses can now take on a very large number of values. Evaluating the effects of each sequence of storms becomes a life cycle analysis problem and many lifecycles must be evaluated in order to quantify the distribution of economic losses both without a shore protection project and with each alternative formulated. The use of the lifecycle approach helps explain the evaluation

process for erosion and nourishment much more easily since the lifecycle approach is more realistic and more closely mimics the dynamic coastal conditions.

A major design consideration for this project was to incorporate risk and uncertainty as an integral part of the formulation process. Chapter 6 of ER 1105-2-100, entitled “Risk-Based Analysis for Evaluation of Hydrology/Hydraulics and Economics in Shore Protection Studies” specifies the analysis requirements for shore protection projects, the fundamental requirement being that all shore protection analysis adopt a life cycle approach. The Beach-Fx model which was used for this study incorporates the life cycle approach into the formulation process.

6.4.1 Residual Risks

The proposed beachfill plan would greatly reduce average annual storm damages. The tentatively selected plan, will reduce combined wave and erosion damages by 75.2%. Some wave and erosion damages will still occur, estimated to average about $897,000 per year over the 50-year period of analysis. The project is designed to protect mainly against storm waves and storm-induced erosion, two major categories of storm damage. The project will not prevent any damage from bay side flooding from saltwater that will flow into Choctawhatchee Bay through East Pass Inlet. Structures will continue to be subject to damage from hurricane winds and windblown debris. Damages from flooding and winds will decrease as older structures are replaced with those meeting floodplain ordinances and wind hazard building construction standards. But even new construction is not immune to damage, especially from severe storm events. Also, the condition of the project at the time of storm occurrence can affect the performance of the project for that event. The proposed beachfill reduces damages, but does not have a specific design level. In other words, the project is not designed to fully withstand a certain category of hurricane or a certain frequency storm event. The project purpose is storm damage reduction, and the berm-and-dune is not designed to prevent loss of life. Loss of life is prevented by the existing procedures of evacuating completely well before expected hurricane landfall and removing the residents from harm’s way.

6.4.2 Risk and Uncertainly in Relative Sea Level Rise Assumptions

The Corps planning guidance, specifically Water Resource Policies and Authorities Incorporating Sea-Level Change Considerations in Civil Works Programs EC 1165-2-212 and Appendix E, Section IV, Paragraph E-24 of the Guidance Notebook ER 1105-2-100, requires that potential relative sea level rise be taken into consideration for coastal or estuarine projects at the feasibility level of study and recommends, given the uncertainty of future sea level rise estimates, preference be given to developing strategies that are robust over the entire range of potential sea level rise rates versus those that perform well only over a limited range of potential sea level rise rates.

Systematic long-term tide elevation observations suggest that the elevation of oceanic water bodies is gradually rising and this phenomenon is termed ‘sea level rise.’ The rate of rise is neither constant with time nor uniform over the globe. In addition to

elevation of oceanic water bodies, is the gradual depression or uplifting of land surface along the coast, which becomes an additional factor in the relationship between the land's elevation over time, and that of changing sea levels. Because portions of the coast of the Florida panhandle is affected by subsidence and global sea level rise (adjusted for local conditions), these factors combine (and are referred to in this analysis) in a single element of "relative" sea level rise. Relative sea level (RSL) rise at a given location, then, is simply the change in mean sea level at that location with respect to an observer standing on or near the shoreline.

Sea-level change can cause a number of impacts in coastal and estuarine zones, including changes in shoreline erosion and changes in storm and flood damages. Sea level rise rates over time are the subject of many predictions. Historically, relative sea level rise has been determined by fitting a linear relationship to monthly mean or annual mean sea level, either of which is computed from tide gage observations. The slope of the fitted line gives the rate of sea level rise at the location of the tide gage. The computed rate includes the rate of subsidence or uplift of the location upon which the tide gage is founded, and thus the computed RSL rates may be extended locally or regionally to areas with similar geotechnical and tidal conditions.

Project performance in this study effort was evaluated for both an extrapolation of the observed historic rate plus subsidence, which resulted in RSL rise over a 50-year planning horizon of approximately 0.3 ftand also for higher rates than that historically observed, as required by the EC 1165-2-212, equivalent to up to approximately 2.4 feet over a 50-year planning horizon. The recession rate due to sea level rise based on extrapolation of the historic observed rate of 0.4 ft/yr is not significant when compared to the historical averaged shoreline change of roughly 2.4 ft/yr. The influence of current sea level rise on the project is relatively low as compared to other factors causing erosion (waves, currents, winds and storms). An analysis of shoreline change rate over the time period of 1973 to 2004 indicates that the magnitude of the short-term storm-induced erosion, which was as high as 12.4 ft/year during Hurricane Ivan has a much greater affect along the beaches of Walton County than those indicated by the natural long term shoreline trends.

The tentatively selected plan is not a hard structure and adjusts to natural forces. The project is designed to include a significant amount of sacrificial sand in the advance nourishment berm. The optimization of the advance nourishment was performed with a conservative background erosion rate of 5 ft/yr combined with the effects of 46 historic storms with 12 variants of the astronomical tide at the time of landfall. The estimated projected average rate of shoreline recession due to accelerated sea-level rise over the next 50 years based on this analysis would not exceed the 5 ft/yr background erosion rate used in the optimization of the advance nourishment berm. Based on this and the estimated average renourishment interval of every10 years the projected accelerated rise in sea level would not be expected to overwhelm the project before the next nourishment of sand.

An increase in potential shoreline recession as the beach profile attempts to re-establish in response to a rise in sea level would result in increased volume losses from the design template. The additional volume of sand that may be needed to maintain the shoreline could increase on average by approximately 1.3 cy/ft/yr above the standard deviation of the mean nourishment volume under the high modified NRC Curve III RSL scenario.

Regardless of the rate of RSL rise, the beach fill project would be monitored and renourished on average every 10 years. Monitoring data provides input to determining the details of each renourishment of the beach. If an accelerated RSL rise occurs, erosion volumes increase and renourishment volumes will increase, shortening the life of designated borrow areas. A Limited Reevaluation Report (LRR) on borrow sources would be conducted to investigate additional borrow sources should this occur. All alternative plans contain a 5.5-foot NGVD berm elevation and all would be affected similarly by accelerated RSL rise. Therefore, no change to the tentatively selected plan by accelerated RSL is expected other than possible minor modifications of the berm and dune elevation. There is no expectation that accelerated RSL would result in selection of other major categories of alternative plans such as the nonstructural plan or hard structure plans.

6.4.4 Risk and Uncertainly in Project Reliability

The coastal processes results (i.e. changes in dune height, dune width, berm width, upland width, and cross-shore profiles of erosion) of the project over the simulated life cycle were reviewed to determine its robustness under various simulated plausible storms. Under the smaller simulated events the project primarily undergoes beach berm erosion with little to no dune escarpments; however, under larger simulated storm events (i.e. Hurricane Ivan, Opal, Eloise, etc.) substantial beach berm erosion and escarpment of the constructed dune occurs as a result of the associated higher water levels and waves. In all simulations the project acts as the first line of defense receiving the brunt of the damage, while protecting the existing dune feature. It is important to put emphasis on the fact that the project is a dynamic feature that will continuously undergo changes, both seasonally and annually. The condition of the project at the time of storm occurrence can affect the performance of the project for that event. In addition, as discussed under the risk and uncertainty in the storm climate section the size of the storm as well as the sequencing of events (how quickly one event occurs after another) and natural beach recovery can also greatly affect the project performance and thus reliability. The tentatively selected plan would provide a significant degree of reliability; however, as anticipated damage to the project from storm events will occur and maintenance of the project will be required.

6.4.5 Risk to Life and Safety

As previously stated under residual risk the project purpose is storm damage reduction. The berm-and-dune is not designed to prevent loss of life. Loss of life is prevented by the existing procedures of evacuating completely well before expected hurricane landfall

and removing the residents from harm's way. The erratic nature and unpredictability of hurricane path and intensity require early and safe evacuation. This policy should be continued both with and without the storm damage reduction project.

6.5 VALUE ENGINEERING

Per ER 1110-2-1150, a value engineering (VE) study shall be performed on the earliest document available that satisfies the functional requirements of the project and includes a MCACES cost estimate. While all feasibility efforts are directed to define a project that most economically provides the desired project outputs, a VE study can assure that the project design captures that goal and/or may suggest alternatives that could enhance the project. A VE review of the material in this draft report was conducted by a review team on September 22, 2010. The review team did not suggest any changes to consider for incorporating into this report.

7.0 TENTATIVE RECOMMENDATION

Based on the conclusions of this study, after having given consideration to all significant aspects in the overall public interest, including environmental, social, and economic effects; and engineering feasibility; I recommend the implementation of the tentatively selected plan, which consists of five construction reaches for hurricane and storm damage reduction along the shoreline of Walton County, Florida, which will be composed of a 50-foot berm width, a 25-foot berm and an additional 25 feet of advanced nourishment in all construction reaches and will also feature added dune width in all construction reaches of either 10 or 30 feet, with such modifications thereof as in the discretion of the Commander, USACE, may be advisable. Figures 11A-11C display the proposed construction reaches along with the study (model) reaches. Summary benefits of the tentatively selected plan are presented in Table 33.

TABLE 33
SUMMARY BENEFITS TSP
WALTON COUNTY, FLORIDA - FEASIBILITY

	FY 2011 Dollars	Category
	$63,306,000	2014 Initial Construction
	$16,218,674	2024 Renourishment
	$10,825,930	2034 Renourishment
	$7,226,285	2044 Renourishment
	$4,922,478	2054 Renourishment
Total Economic First Cost	$102,499,000	
Interest During Construction	$1,263,422	
Total Economic Project First Cost	$103,762,000	
Average Annual Economic First Cost	$4,934,000	
Annual O&M	$168,000	
Total Average Annual Economic Cost	$5,102,000	
Average Annual HSDR Benefits	$6,543,000	
Average Annual Recreation Benefits	$16,000	
Total Average Annual Benefits	$6,559,000	
Benefit-to-Cost Ratio	1.29	
Net Benefits	$1,457,000	

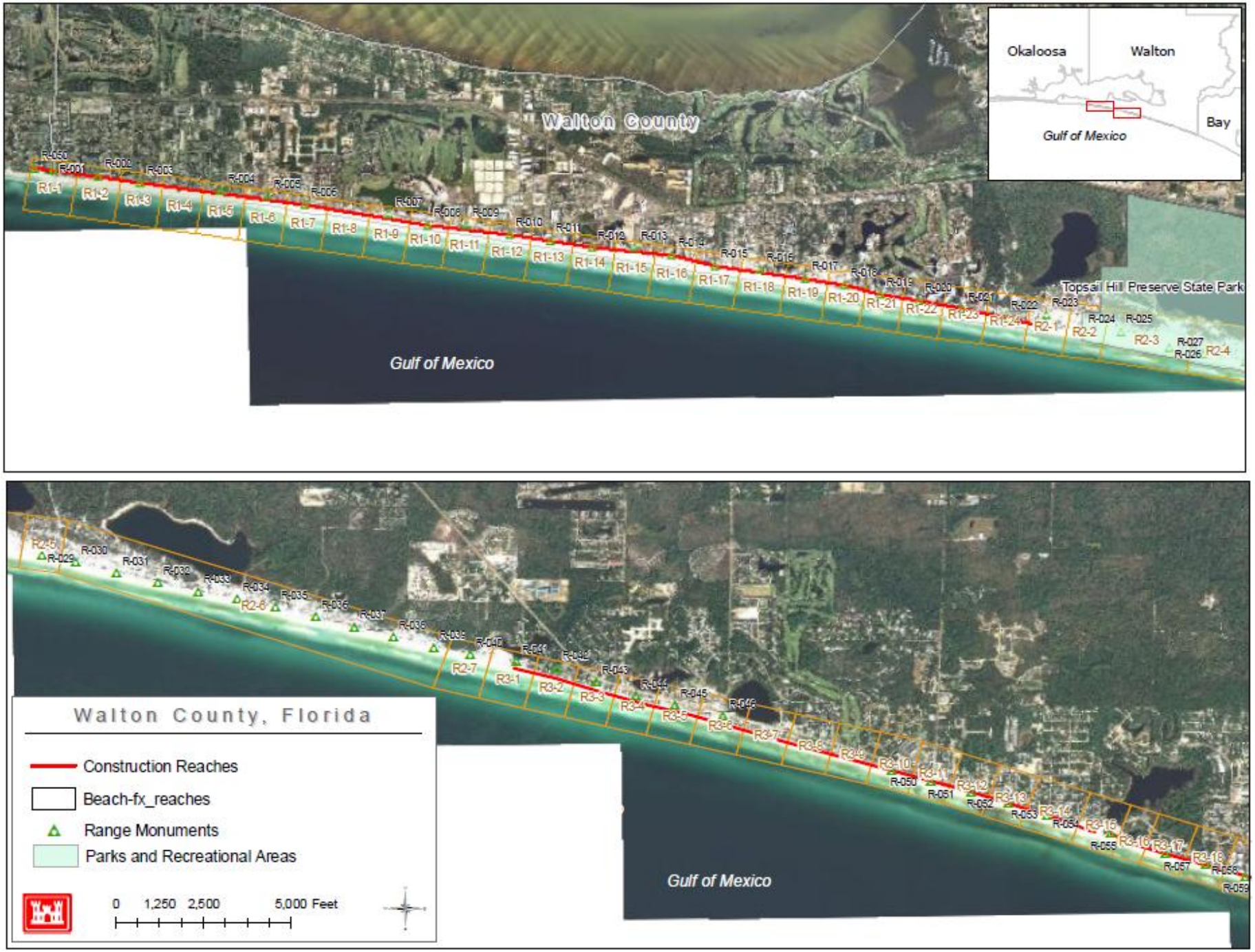


FIGURE 11A. CONSTRUCTION AND STUDY REACHES

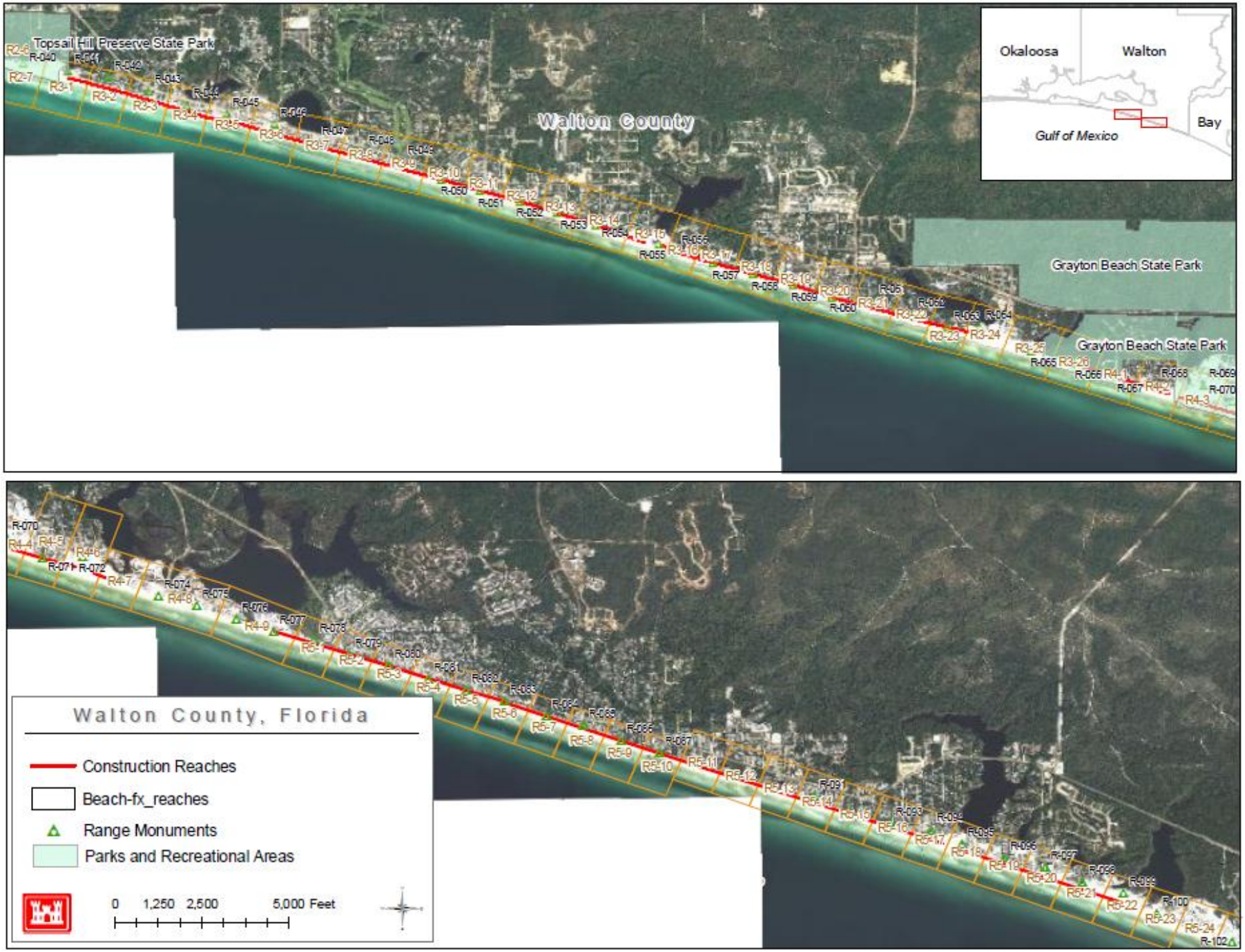


FIGURE 11B. CONSTRUCTION AND STUDY REACHES

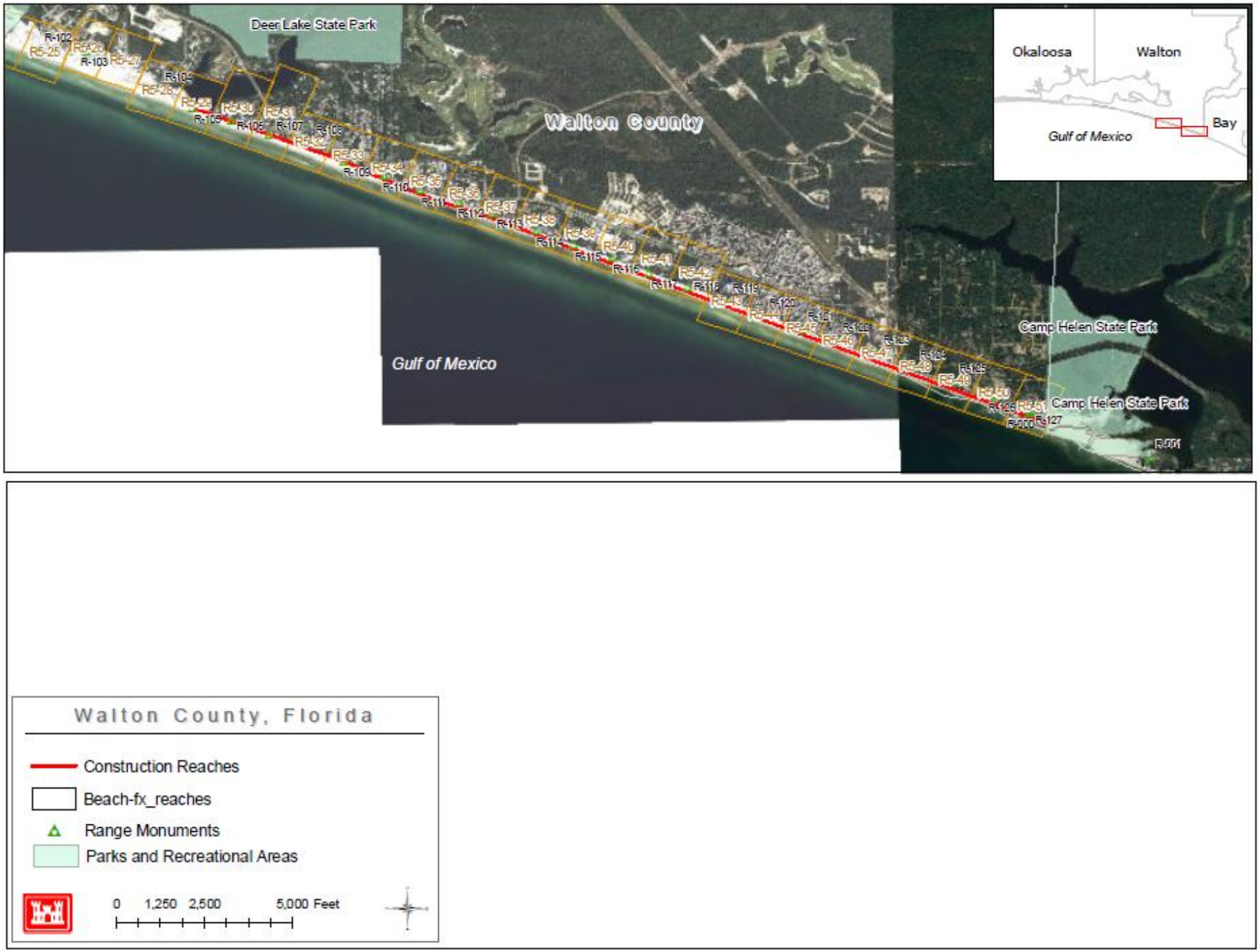


FIGURE 11C. CONSTRUCTION AND STUDY REACHES

The construction of the proposed project shall be contingent on the project sponsor giving written assurances satisfactory to the Secretary of the Army that it will satisfy its responsibilities of local cooperation as detailed in a fully coordinated Project Partnership Agreement (PPA) package (to include the non-Federal sponsor's financing plan) prepared subsequent to the approval of the feasibility phase and will reflect the recommendations of this Feasibility Study. The non-Federal sponsor has indicated support of the recommendations presented in this Feasibility Study and desires to execute a PPA for the tentatively selected plan. The non-Federal sponsor will:

a. Provide 35 percent of initial project costs assigned to hurricane and storm damage reduction, plus 50 percent of initial project costs assigned to protecting undeveloped public lands, plus 50 percent of initial project costs assigned to recreation, plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits and as further specified below:

   (1) Enter into an agreement which provides, prior to execution of the project partnership agreement, 25 percent of design costs;
   (2) Provide, during the first year of construction, any additional funds needed to cover the non-federal share of design costs;
   (3) Provide all lands, easements, and rights-of-way, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the initial construction, periodic nourishment, operation, and maintenance of the project;
   (4) Provide, during construction, any additional amounts as are necessary to make its total contribution equal to 35 percent of initial project costs assigned to hurricane and storm damage reduction plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits and 50 percent of periodic nourishment costs assigned to hurricane and storm damage reduction plus 100 percent of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits;
   (5) Provide 100 percent of the total project costs that reflect the difference between the National Economic Development (NED) Plan and the Locally Preferred Plan (LPP);

b. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance

with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

c. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal Sponsor, now or hereafter, owns or controls for access to the project for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the non-Federal Sponsor of responsibility to meet the non-Federal Sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

d. Hold and save the United States free from all damages arising from the initial construction, periodic nourishment, operation, maintenance, repair, replacement, and rehabilitation of the project and any project-related betterments, except for damages due to the fault or negligence of the United States or its contractors;

e. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, and other evidence is required, to the extent and in such detail as will properly reflect total costs of construction of the Project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

f. Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended, 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the initial construction, periodic nourishment, operation, and maintenance of the project; however, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal Sponsor with prior specific written direction, in which case the non-Federal Sponsor shall perform such investigations in accordance with such written direction;

g. Assume, as between the Federal Government and the non-Federal Sponsor, complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands,

easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the project;

h. Agree that, as between the Federal Government and the non-Federal Sponsor, the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the project in a manner that will not cause liability to arise under CERCLA;

i. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by (42 U.S.C. 4601 – 4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the initial construction, periodic nourishment, operation, and maintenance of the project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

j. Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army," and all applicable Federal labor standards and requirements, including but not limited to, 40 U./S.C. 3141 – 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying, and enacting without substantial change the provisions of the Davis- Bacon Act (formerly 40 U.S.C. 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 et seq.) and the Copeland Anti-Kickback Act (formerly 40 U.S. C. 276c et seq.);

k. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires the non-Federal interest to participate in and comply with applicable Federal floodplain management and flood insurance programs, prepare a floodplain management plan within one year after the date of signing a Project Cooperation Agreement, and implement the plan not later than one year after completion of construction of the project;

l. Provide the non-Federal share of that portion of the costs of mitigation and data recovery activities associated with historic preservation, that are in excess of 1 percent of the total amount authorized to be appropriated for the project, in accordance with the cost sharing provisions of the agreement;

m. Participate in and comply with applicable Federal floodplain management and flood insurance programs;

n. Do not use Federal funds to meet the non-Federal sponsor's share of total project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is authorized.

o. Prevent obstructions of or encroachment on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) which might reduce the level of protection it affords, hinder operation and maintenance or future periodic nourishment, or interfere with its proper function, such as any new developments on project lands or the addition of facilities which would degrade the benefits of the project;

p. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

q. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the project;

r. For so long as the project remains authorized, the non-Federal Sponsor shall ensure continued conditions of public ownership, access, and use of the shore upon which the amount of Federal participation is based;

s. Provide, keep and maintain the recreation features, and necessary access roads, parking areas, and other associated public use facilities, open and available to all on equal terms;

t. At least twice annually and after storm events, perform surveillance of the beach to determine losses of nourishment material from the project design section and provide the results of such surveillance to the Federal Government;

u. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 22130, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the Non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

v. Provide, during construction, 100 percent of the total recreation costs that exceed an amount equal to 10 percent of the sum of the Federal share of total flood damage reduction costs and the Federal share of total ecosystem restoration costs;

w. Agree to participate in and comply with applicable Federal floodplain management and flood insurance programs; and,

x. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a non-Federal interest to prepare a floodplain management plan within one year after the date of signing a project cooperation agreement, and to implement such plan not later than one year after completion of construction of the flood damage reduction features.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding." However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Steven J. Roemhildt
Colonel, Corps of Engineers
District Commander

PLATES

Plates No. 1-11

Photos: Pre-Ivan, Post Ivan, and Post Dennis

Coastal Bluff Erosion Near Hotel, Seagrove Beach, FL: Vegetation was removed from the bluff face by Hurricane Ivan. At the left center of the post-Dennis image, a pile of sand and debris is seen at the foot of the bluff.

PLATE 1

Coastal Bluff Erosion Near Homes, Seagrove, FL: During Hurricane Ivan, coastal erosion at the base of the bluff destroyed stairways. Bluff erosion continued during Hurricane Dennis.

PLATE 2

Coastal Bluff Erosion Near Town Homes: Seagrove, FL: During Hurricane Ivan, vegetation was removed from the steep bluff face. The bluff was eroded landward during Hurricane Dennis threatening structures near the bluff edge.

PLATE 3

Hurricane Ivan

Before

After

Hurricane Ivan

Before

After

PLATE 5

Hurricane Ivan

Before

After

Hurricane Dennis

Before

After

Hurricane Dennis

Before

After

Hurricane Dennis

Before

After

Post Dennis

Post Dennis

APPENDIX A

ENGINEERING DESIGN

APPENDIX A
SECTION 1

HYDRAULIC CONSIDERATIONS

WALTON COUNTY, FLORIDA
HURRICANE AND STORM DAMAGE REDUCTION
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GENERAL

Description of Study Area. Walton County is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida, Figure A-1-1. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet. The western two-thirds of Walton County are comprised of a coastal peninsula extending from the mainland, and the eastern third is comprised of mainland beaches. Choctawhatchee Bay lies north of the peninsula. Walton County includes 11.9 miles of state-designated critically eroding areas and three State of Florida park areas that cover approximately six miles of the 26 mile shoreline.

The Walton County shoreline is characterized by high dune elevations partly due to the presence of Pleistocene bluffs formed as a result of an exposed submarine berm formed during inundation of the Florida Peninsula during that geologic period. Primary dune elevations in Walton County range from 11.5 to 44.5 feet North American Vertical Datum, 1988 (NAVD88) and average 25.5 feet. Along the mid-section of Walton County, Bluff elevations exceed 60 feet in height, Figure A-1-2A. Bluff erosion and undercutting occur in this area due to the interface of relatively low flat beaches and the bluff toe. An unusual attribute of the Walton County shoreline is the presence of coastal dune lakes. These lakes are rare worldwide and are almost exclusive to the Gulf Coast within the United States. The lakes are about five feet deep and intermittently breach the dune system and discharge directly into the Gulf of Mexico, Figure A-1-2B.

Mild winters and warm hot summers characterize the project area, with an average in excess of 280 days a year of sunshine. The average daily temperature is 67 degrees Fahrenheit and the average water temperature is about 70 degrees Fahrenheit. The months from June through November constitute the hurricane storm season, and this area is subject to tropical storm and strong hurricane conditions. The highest period of rainfall occurs during the storm season, with an average annual rainfall of 64 inches.

Purpose of Study. The purpose of this study is to assess the needs for hurricane and storm damage reduction and opportunities for environmental restoration and protection for the 26 miles of shoreline in Walton County, Florida.

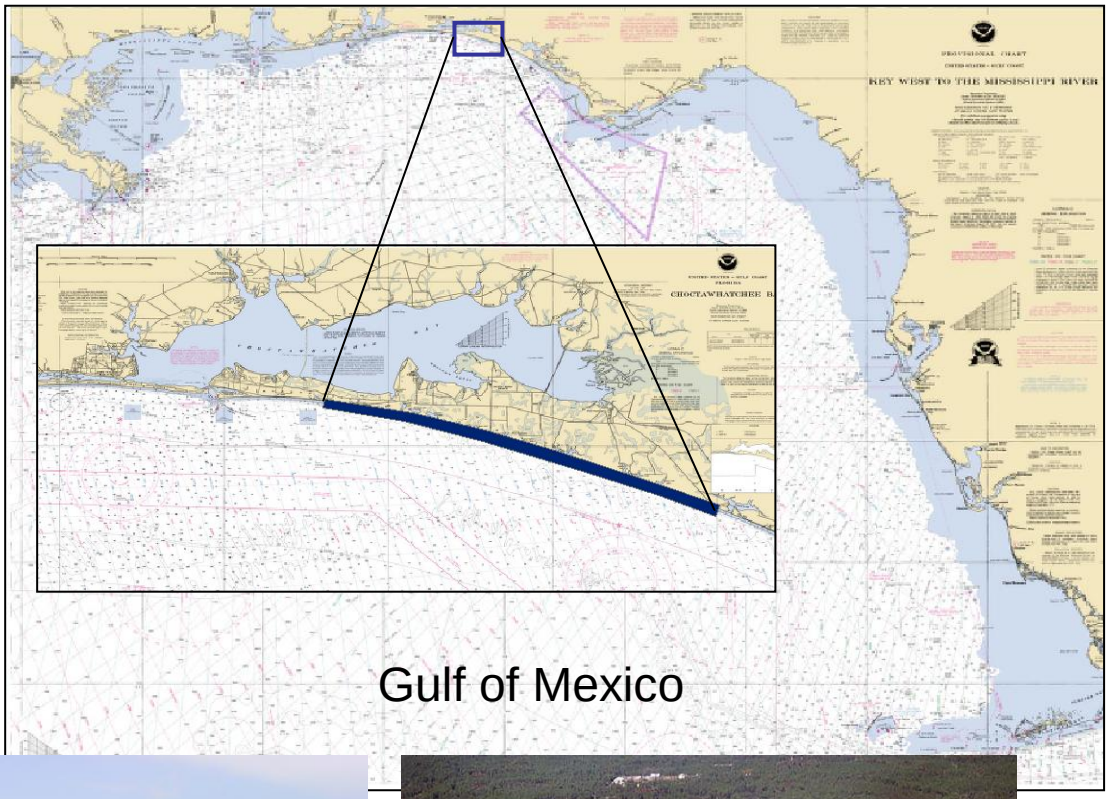

FIGURE A-1-2A. HIGH BLUFFS WESTERN WALTON COUNTY

FIGURE A-1-2B. COASTAL DUNE LAKE

Previous Studies and Reports. Previous investigations and reports have been completed for the area. The most recent studies pertinent to the erosion problems at Walton County are summarized below:

(1) "State of the Beaches" of Walton County, Florida 2002, Walton County Tourism Development Council. This report presents data, analysis, and recommendation for managing the Florida coastline. Specific emphasis is placed on determining trends in beach width and explaining the physical and coastal processes that cause the changes.

(2) Beach Management Feasibility Study for Walton County and Destin Florida, Taylor Engineering, Inc., April 2003. The purpose of this study was to determine the most technically feasible and financially acceptable alternatives for protecting 9.2 miles of "critically eroding shoreline." The feasibility study is a six-part study funded by Walton County.

NATURAL FORCES

Winds and Waves. Waves and winds provide important sediment transport mechanisms along the open coast of Walton County. Waves, primarily driven by local wind patterns, transport sand both cross-shore and longshore within the subaqueous regions. Winds provide the primary wave-generating mechanism and directly transport sand on and off the dry beach.

Wind and wave information for the study area were obtained from the U.S. Army Corps of Engineers (USACE) Wave Information Study (WIS) hindcast database (USACE 1995). The WIS hindcast provides wave height, wave period, wave direction, wind speed, and wind direction for a series of output stations along the Gulf of Mexico. Datasets are available for the periods 1956 to 1975, 1976 to 1995, and 1980 to 1999. The 1976 to 1995 and 1980 to 1999 hindcasts included tropical storms. The recently completed 1980 to 1999 hindcast applied an updated version of the hindcast numerical model, state-of-the-art wind fields, and a higher resolution grid allowing higher resolution bathymetry and additional output stations (USACE 2004); therefore, hindcast data for this study were obtained from the 1980 to 1999 dataset. Data from Stations 179, 180, and 181 were used in this study. Figure A-1-3 shows the locations of WIS stations in the study area and Table A-1-1 provides the station number, coordinates, and water depth. Percent occurrence tables of wind and wave statistics are summarized in Attachment I Tables 1, 2, and 3 for WIS Stations 179, 180, and 181, respectively. For the 1980 to 1999 hindcast, the mean wave height is approximately 2.6 feet (0.8 meters) for all stations. Wave heights exceed 2.6 feet (0.8 m) approximately 25 percent of the time. Although the largest percentages of waves are from the south to southeast, the maximum wave heights greater than 10 feet (3.1 meters) originate from south-southeast to west. Although winds blow from a wide variety of directions; typical prevailing winds are from the east. Overall, wind speeds are less than 25 miles per hour (mph).

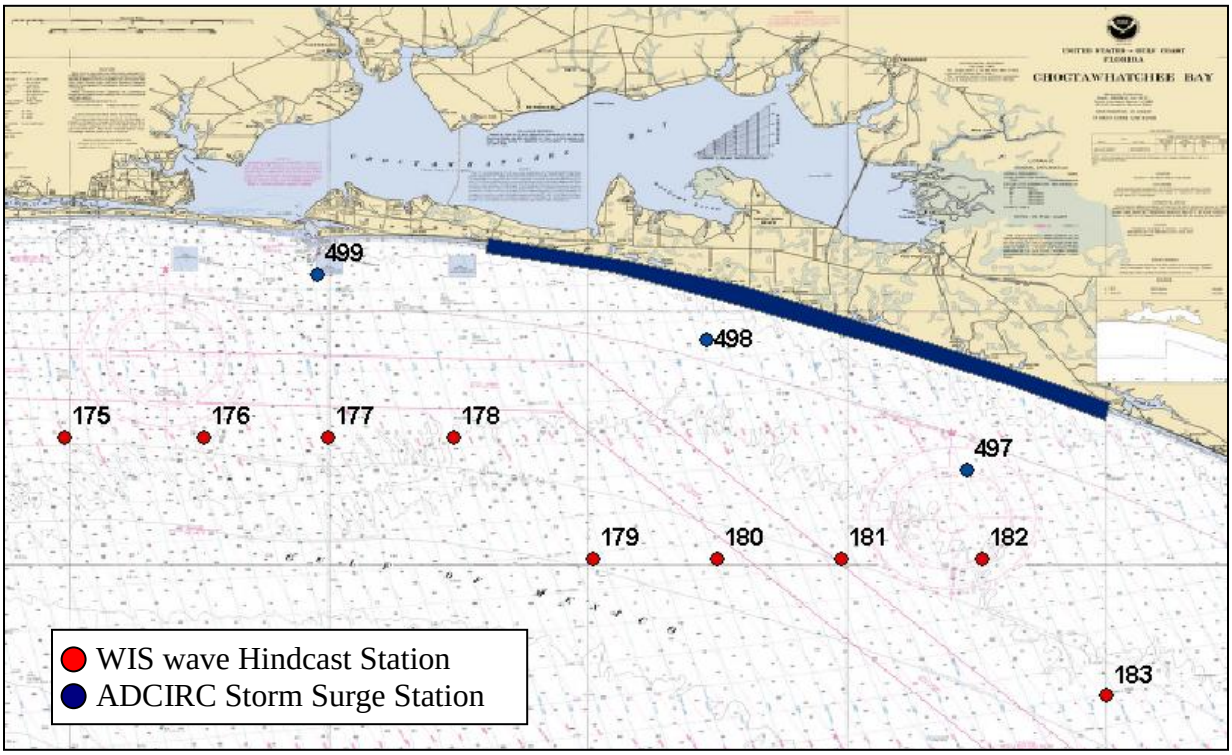

Figure A-1-3. WIS and ADCIRC Stations in the Walton County Vicinity

Table A-1-1. WIS Stations In Walton County Vicinity

Station Number	Latitude (Deg)	Longitude (Deg)	Water Depth (ft)
179	30.17 N	86.33 W	92
180	30.17 N	86.25 W	102
181	30.17 N	86.17 W	102

Tides. Tides in the region are diurnal. The maximum and minimum water levels under average conditions can approach 2.6 and 0 feet, respectively. The Mean High Water (MHW) elevation was obtained from the Land Boundary Information System (LABINS) database, which provides MHW elevations at numerous locations throughout the study area. The MHW value representative of the entire project area was determined by averaging the tidal datum elevations at representative locations. The MHW for Walton County is +0.63 feet referenced to the North American Vertical Datum of 1988 (NAVD88) (+1.04 feet National Geodetic Vertical Datum of 1929 (NGVD29)). The Mean Low Water (MLW) elevation for Walton County is -0.62 feet NAVD88 (-0.21 ft NGVD29).

Storm Surge. The major threats to the shoreline of Walton County are surge and waves caused by tropical depressions, tropical storms, and hurricanes. Storm surge is defined as the rise of the ocean surface above its astronomical tide level due to storm forces. The increased elevation is attributable to a variety of factors, which include waves, wind shear stress, and atmospheric pressure. An estimate of these water level changes is essential to the design of the berm and dune elevations in the beach fill area. Higher water elevations will increase the potential for recession, long-term erosion, and overwash due to severe waves.

Peak storm surge values for 10, 20, 50, and 100-year return period storms were developed by Dean et al., (1990) by combining historical hurricane statistics with numerical model simulations. The resulting storm surge values for various return periods provided in Table A-1-2 include components of astronomical tide, wind stress, barometric pressure, and dynamic wave set-up.

Recent Storm History. Table A-1-3 lists the hurricanes which have impacted the Walton County area since 1975. This table does not include tropical storms. Descriptions of the storms causing the greatest damage in recent years are described below:

2 August 1995 - Hurricane Erin. Hurricane Erin was the first storm of any strength to impact the Florida Panhandle in 10 years. The eye of the hurricane came ashore near Pensacola on August 3, 1995, and the strongest winds were measured near Fort Walton Beach. Erin was a Category 2 hurricane at landfall. Erin moved inshore quickly and dissipated in Mississippi. Reports listed Erin as causing minor beach erosion with some inland flooding; however, for the Florida Panhandle, Erin's effects resulted in severe erosion along the beaches.

4 October 1995 - Hurricane Opal. Hurricane Opal made landfall on October 4, 1995 as a Category 3 hurricane, but it could have been worse. Before landfall, Opal was a Category 4 hurricane. The unique aspect from Opal was that it moved quickly and rapidly increased strength within hours. The maximum winds at landfall were estimated to be 115 mph in Walton County. Opal caused extensive damage to Walton County's beaches due to storm surge and breaking waves.

Table A-1-2. Storm Surge Values For Return Periods, Walton County

Return Period (years)	Walton County Storm Surge (ft-NAVD88)		
	East	Middle	West
10	3.4	3.4	3.6
20	5.8	6.1	6.5
50	8.5	9.4	9.4
100	10.1	10.8	11.0

Table A-1-3. Walton County Significant Storm History, 1975-2004

Storm	Date	Landfall	Estimated Category at Landfall
Hurricane Eloise	October 1975	Walton County, Florida	H3
Hurricane Frederic	September 1979	Mobile County, Alabama	H3
Hurricane Elena	September 1985	Harrison County, Mississippi	H3
Hurricane Erin	July 1995	Santa Rosa County, Florida	H2
Hurricane Opal	October 1995	Santa Rosa County, Florida	H3
Hurricane Danny	July 1997	Baldwin County, Alabama	H1
Hurricane Earl	August 1998	Bay County, Florida	H1
Hurricane Georges	September 1998	Harrison County, Mississippi	H2
Hurricane Ivan	September 2004	Baldwin County, Alabama	H3

3 September 1998 - Hurricane Earl. Although Hurricane Danny made landfall in Alabama in 1997, the next hurricane that really impacted Walton County was Hurricane Earl. Similar to Hurricane Erin in 1995, Earl was just the beginning. Earl made landfall near Panama City, Florida as a Category 1 hurricane on September 3, 1998. The strongest winds remained well to the east and southeast of the center which resulted in the highest storm surge values in the Big Bend area of Florida, well away from the center. The vastness of Earl caused beach erosion in Walton County and stopped the recovery of the beaches since Hurricane Opal in 1995.

28 September 1998 - Hurricane Georges. Hurricane Georges made landfall during mid-morning of September 25, 1998 in Key West, Florida with maximum winds of 104 mph. After moving away from Key West, Georges turned more to the northwest, then north-northwest, and again made landfall near Biloxi, Mississippi on the morning of September 28th with estimated maximum sustained winds of 103 mph. After landfall, the system meandered around southern Mississippi and was downgraded to a tropical storm on the afternoon of the 28th. While Georges was a small Category 1 storm, it caused extensive damage to Walton County's beaches. Since Earl had made landfall less than four weeks earlier, the beaches were already in a damaged condition. Georges created substantial storm surge and breaking wave heights in the Gulf. Fortunately for Walton County, no buildings were destroyed.

16 September 2004 - Hurricane Ivan. Hurricane Ivan made landfall as a 120 mph hurricane (Category 3 storm) on September 26, 2004 just west of Gulf Shores, Alabama. The diameter of the eye was 40-50 nautical miles (nm) which resulted in some of the strongest winds occurring over a narrow area near the southern Alabama-western Florida panhandle border. After Ivan moved across the barrier islands of Alabama, the hurricane turned north-northeastward across eastern Mobile Bay and weakened into a tropical storm over central Alabama. The entire coast of Walton County sustained major beach and dune erosion. Major dune recession occurred throughout the county leaving a number of locations with the upland habitable development located at or within close proximity to high dune-bluff escarpments.

Nearshore Currents. The primary currents in the nearshore region are wave-induced longshore currents. These currents are driven by the transformation of obliquely incident waves in the surfzone. The magnitude of the longshore current is generally greatest in the region immediately landward of the point of depth-induced wave breaking, and is primarily a function of the local wind and wave climate. The longshore currents are primarily from east to west. There have been no direct measurements of longshore currents in the study area.

Sea Level Rise. Systematic long-term tide observations suggest that the elevation of oceanic water bodies is gradually rising and this phenomenon is termed 'sea level rise.' The rate of rise is neither constant with time nor uniform over the globe. Present estimates of recent (over about the last 100 years) global average, or eustatic, sea level rise are varied but the average value is about 2 millimeters per year (mm/yr). There is uncertainty as to the future rate of sea level rise, how much sea level will rise at any particular location, what the primary drivers really are and whether the rate of rise will be relatively constant or accelerate.

Planning Guidance Notebook ER-1105-2-100 (Appendix E, Section IV.E-24.k) recommends the Curve III of the 1987 National Research Council (NRC) report *Responding to Changes in Sea Level: Engineering Implications*, or more definitive information, be used as the eustatic (global) component of relative sea level rise (RSL) for future high scenario estimates. In addition, the Water Resource Policies and Authorities Incorporating Sea-Level Change Considerations in Civil Works Programs EC 1165-2-212 recommends that alternatives be evaluated using "low," "intermediate," and "high" rates of future sea-level change.

The Walton County Project is located along the Florida Panhandle between Pensacola and Panama City (Figure A-1-4). The observed historic relative rate of sea level rise along Walton County as indicated by the nearby locations is shown in Table A-1-4. The trend for Pensacola is based on continuous data for 83 years with a standard error of 0.26 mm/yr; while the trend for Panama City is based continuous data of only 33 years with a larger standard error of 0.83 mm/yr. Based on a longer time series with less uncertainty Pensacola would be the preferred station to use as an indicator of the regional trend for the Walton County project. To confirm this, a comparative analysis of the simultaneous observed monthly means was performed using monthly mean sea levels downloaded from the National Oceanic and Atmospheric Administration (NOAA) web-site relative to Mean Sea Level (MSL) datum for the latest Nation Tidal Datum Epoch. Using spreadsheet software plot functions and the linear trend functions, linear trends were computed for each monthly mean data set showing minor differences giving confidence in a regional trend (Figure A-1-5).

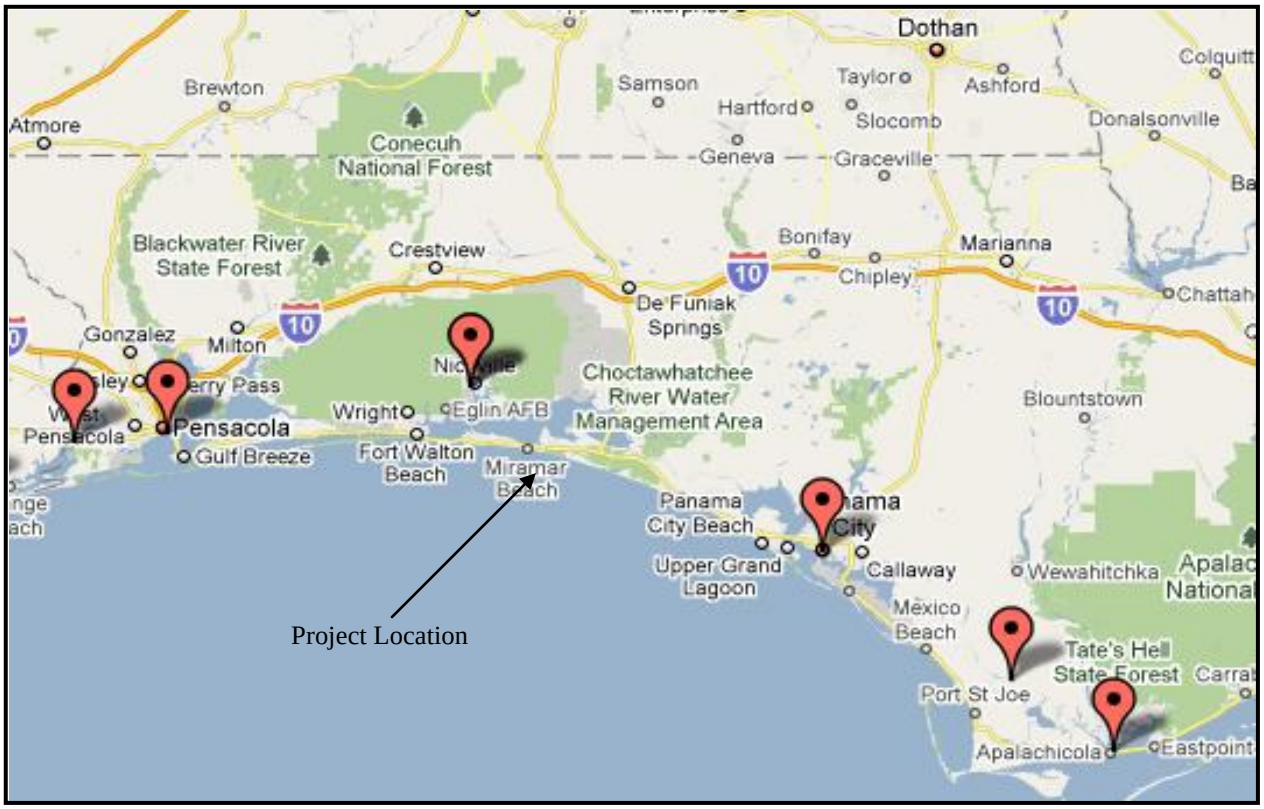

Figure A-1-4. Project Location in Relationship to Pensacola and Panama City Tide Stations

Table A-1-4. RELATIVE SEA LEVEL RISE RATES

Station Name	First Year	Record Length	MSL Trend (mm/yr)	Std. Error (mm/yr)
Panama City	1973	33	0.78	0.83
Pensacola	1923	83	2.10	0.26

Source: NOAA Tides and Currents Sea Level Online

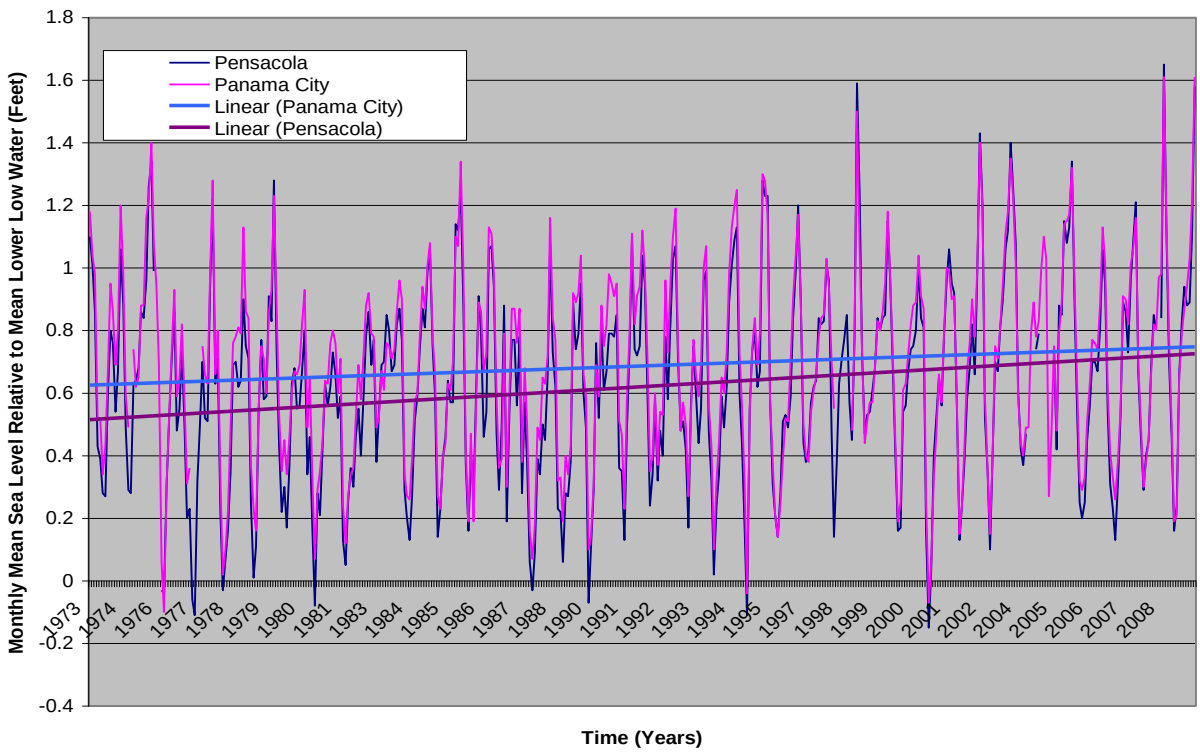

Figure A-1-5. 1967- 2008 Monthly Mean Sea Level

Since the local relative sea level trend at Pensacola can be used as the regional sea level trend for Walton County, the modified NCR Curves can be adjusted to take into account local sea level trends. The NOAA-derived relative sea level trend from the tide station at Pensacola is 2.10 mm/yr and is the sum of the global rate of sea level rise (1.7 mm/yr) plus the local sea level trend (due to the vertical land motion and other long term oceanographic change). Subtracting 1.7 mm/yr from 2.10 mm/yr gives an estimated local (and regional) sea level trend L(t) of 0.4 mm/yr. The global coefficient of 0.0017 is modified by adding L(t) of 0.0004 to get the adjusted NRC curves tailored to the Walton County region.

$$E(t) = 0.0017t + L(t) + bt^2$$

Table A-1-5 shows extrapolated RSL for the period 2014-2064 based on historic rates derived NOAA's Tides and Currents Sea Level Online records (Table A-1-5). Table A-1-6 and Figure A-1-6 shows extrapolated estimates of RSL for the period of 2014 -2064 based the modified NRC curves I, II and III.

Table A-1-5. Potential Relative Sea Level Rise Assuming Observed Rates Persist, 2064

Pensacola	
Meters	**Feet**
0.1	0.3

Table A-1-6. Relative Sea Level Rise Estimates by the modified NRC (1987) Methods, 2064

	Pensacola	
Basis	**meters**	**Feet**
Curve I	0.2	0.8
Curve II	0.4	1.5
Curve III	0.6	2.1

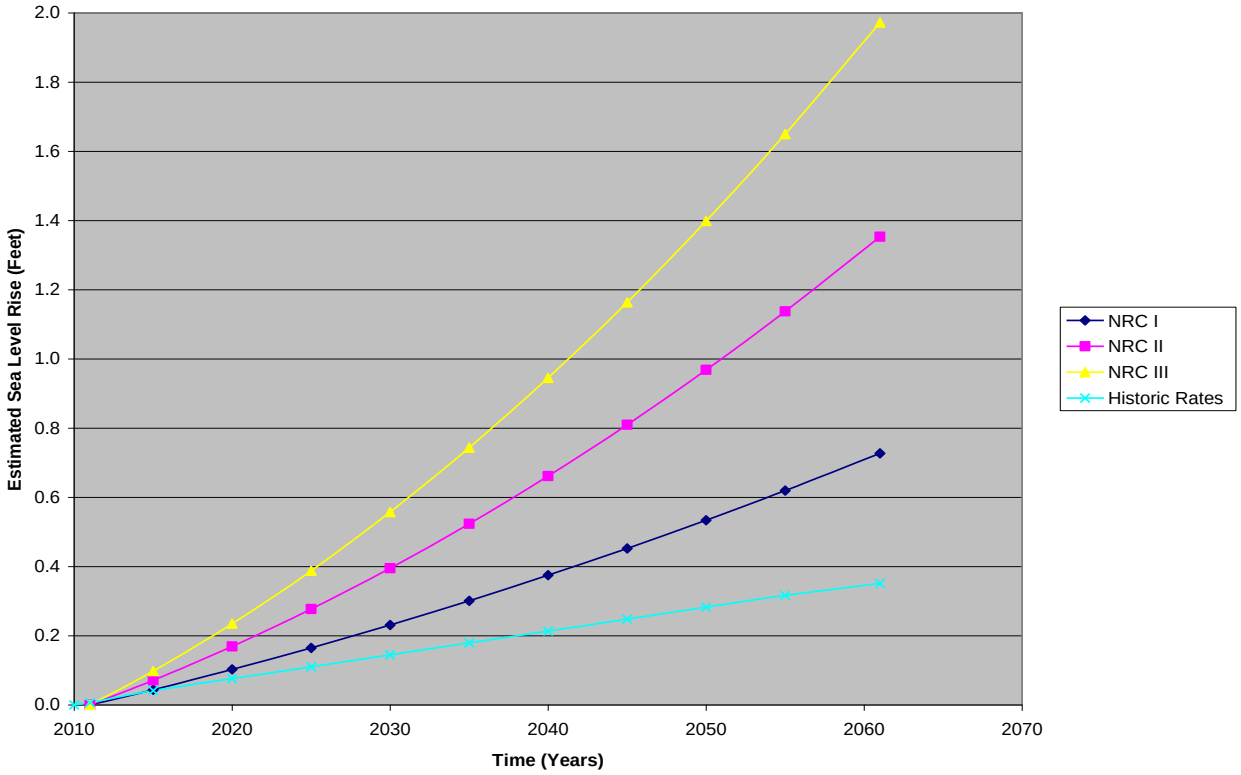

Figure A-1-6. Pensacola, Florida Extrapolated Sea Level Change From Observed Historic Rates and Modified NRC (1987) Sea Level Rise Scenarios

As seen in Figure A-1-6, projected sea level increases at the project location in year 2064could be on the order of 0.8 ft, 1.5 ft, or 2.1 ft based on the modified NRC curves I, II and III respectively; however, the historic trends (as shown in Figure A-1-6) indicate that the project would only be subject to a 0.3 ft increase in sea level from present day to the year 2064.

Project Sensitivity to Sea Level Rise. As relative sea level rises, the shoreline will be subjected to increased flooding and profile recession. Bruun (1962) proposed a formula for estimating the rate of potential shoreline recession based on the local rate of sea level rise. This methodology also includes consideration of local topography and bathymetry. Bruun's approach assumes that with a rise in sea level, the beach profile will attempt to re-establish the same bottom depths relative to the surface of the sea that existed before the sea level rise. As a result, the beach profile shape relative to the mean water level will re-establish itself. If the longshore littoral transport in and out of a given shoreline area is equal, then the quantity of material required to reestablish the nearshore slope must be derived from erosion of the shore. Shoreline recession resulting from sea level rise can be estimated using Bruun's Rule, as defined below and is summarized in Table A-1-7.

$$x = ab/(h+d)$$

where,

x = shoreline recession (in feet) attributable to sea level rise.
h = elevation of shoreline above NAVD (+5.5 feet berm).
d = depth contour beyond which there is no significant sediment motion (34 feet).
b = horizontal distance of the active beach profile berm elevation to the depth contour d (average 2,176 feet).
a = specified relative sea level rise for time period t.

Table A-1-7. Average Increased Shoreline Recession Rates Based On RSL Estimates (2014-2064)

Basis	Pensacola Meters/yr	Pensacola Feet/yr
Continued Observed Rates (Low)	0.12	0.4
Modified NRC Curve I (Intermediate)	0.24	0.8
Modified NRC Curve II	0.45	1.5
Modified NRC Curve III	0.65	2.4

As seen in Table A-1-7, projected average shoreline recession rates over the project design life at the location could increase on the order of 0.4, 0.8, 1.5 or 2.4 ft/yr under extrapolation of observed historic trends in RSL estimates and the modified NRC curves I, II and III respectively. The recession rate due to sea level rise based on extrapolation of the historic observed rate of 0.4 ft/yr is not significant when compared to the historical averaged shoreline change of roughly 2.4 ft/yr. The influence of current sea level rise on the project is relatively low as compared to other factors causing erosion (waves,

currents, winds and storms). An analysis of shoreline change rate over the time period of 1973 to 2004 indicates that the magnitude of the short-term storm-induced erosion, which was as high as 12.4 ft/year during Hurricane Ivan has a much greater affect along the beaches of Walton County than those indicated by the natural long term shoreline trends.

The proposed beach nourishment project is not a hard structure and adjusts to natural forces. Nourishment is designed to include a significant amount of sacrificial sand in the advance nourishment berm. The optimization of the advance nourishment was performed with a conservative background erosion rate of 5 ft/yr. The estimated projected average rate of shoreline recession due to accelerated sea-level rise over the next 50 years based on this analysis would not exceed the 5 ft/yr background erosion rate used in the optimization of the advance nourishment berm. Based on this and the estimated average renourishment interval of every10 years the projected accelerated rise in sea level would not overwhelm the project before the next nourishment of sand.

An increase in potential shoreline recession as the beach profile attempts to re-establish in response to a rise in sea level would result in increased volume losses from the design template. The volume of sand that would be needed to maintain the shoreline in response to accelerated sea level can be estimated from the following equation and is shown in Table A-1-8:

$$V = (d + h)*x$$

d = depth contour beyond which there is no significant sediment motion (34 feet).
h = elevation of shoreline above NAVD (+5.5 feet berm).
x = shoreline recession (in feet) attributable to sea level rise.

Table A-1-8. Estimated Volume to Maintain the Shoreline Due To Accelerated Sea Level Rise

	Volume (cy/ft)		
	Low Observed Long Term Rates	Intermediate Modified NRC Curve I*	High Modified NCR Curve III*
2024 Renourishment	5	5	17
2034 Renourishment	5	6	13
2044 Renourishment	5	7	29
2054 Renourishment	5	9	35

Note: * Estimated volume rates are the rates above the volume required under the Low Observed LongTerm Rates

Additional potential volume increases to account of accelerated sea level rise above the standard deviation of the mean renourishment volumes as predicted by BeachFX may occur under the high modified NRC Curve III RSL scenario. Under the high modified

NRC Curve III RSL scenario an estimated additional volume of approximately 1.3 cy/ft/yr above the standard deviation of the mean nourishment volume was determined.

Potential Adaptation Strategies. The tentatively selected plan was determined based on simulations that incorporated the observed rate of sea level rise. Given the uncertainty as to the future rate of sea level rise, potential adaption strategies to ensure optimum project performance over the life of the project include:

Monitoring the response to sea-level changes at Walton County to provide documentation.

Adding additional volume of sand during renourishments to compensate for significant accelerated sea level rise beyond the current observed rate.

Adding coarser than native sand to reduce the volume requirements that maybe necessary to compensate for increased volumes as a result of significant accelerated sea level rise beyond the current observed rate.

SHORELINE CONDITIONS

Surveys and Imagery. A compilation of historical data was available in the study area. To monitor the 26 miles of shoreline encompassing Walton County, the Florida Department of Environmental Protection (FDEP) periodically collects beach profile data along 127 transects at approximately 1000 ft spacing (Figure A-1-7). The available beach profile datasets from 1977 to 1998 are listed in Table A-1-9. During the spring of 2004, beach profile data were collected through this study, the Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX) collected airborne coastal mapping data with the Compact Hydrographic Airborne Rapid Total Survey (CHARTS) system (Wozencraft and Millar 2005) providing high resolution bathymetric and topographic data (Figure A-1-8), and aerial photography were collected by the FDEP.

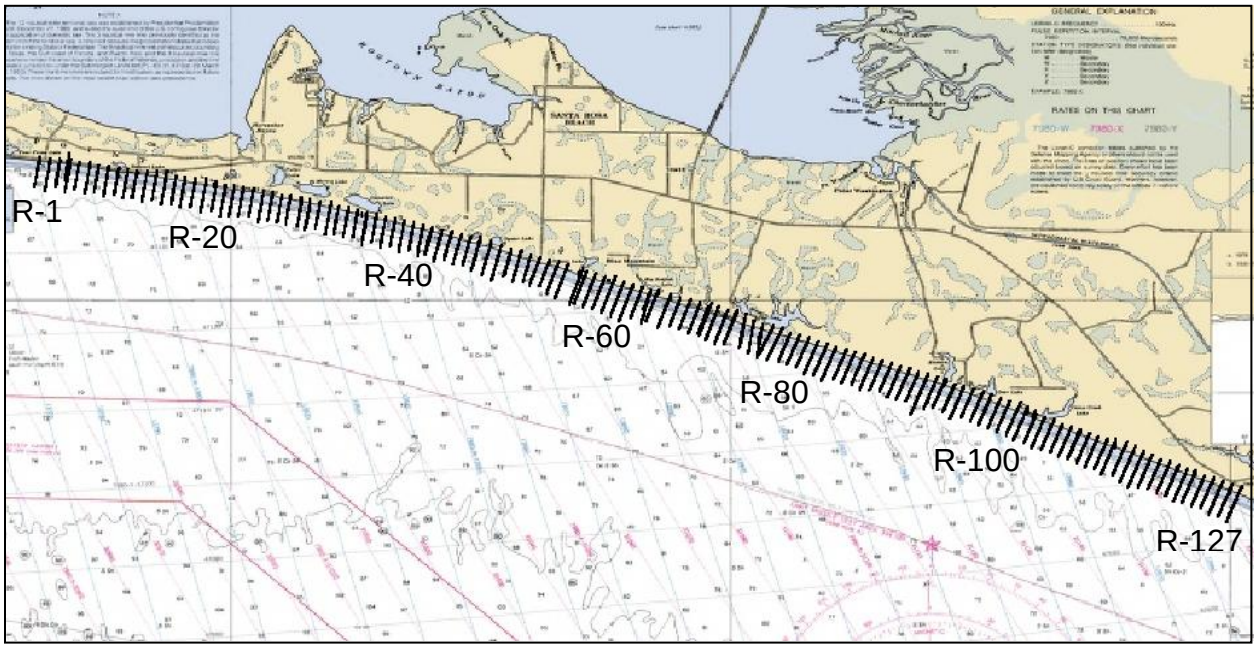

Figure A-1-7. FDEP Beach Profile Survey Layout For Walton County

TABLE A-1-9. Available Survey and Mapping Data

Beach Profiles	Lidar Survey	Aerial Photography
1975		
1981		
1984		
1987		
1993		
1994		
1995		
1996		
1997		
1998		
2004 May	2004 May	2004 May
2004 November	2004 November	

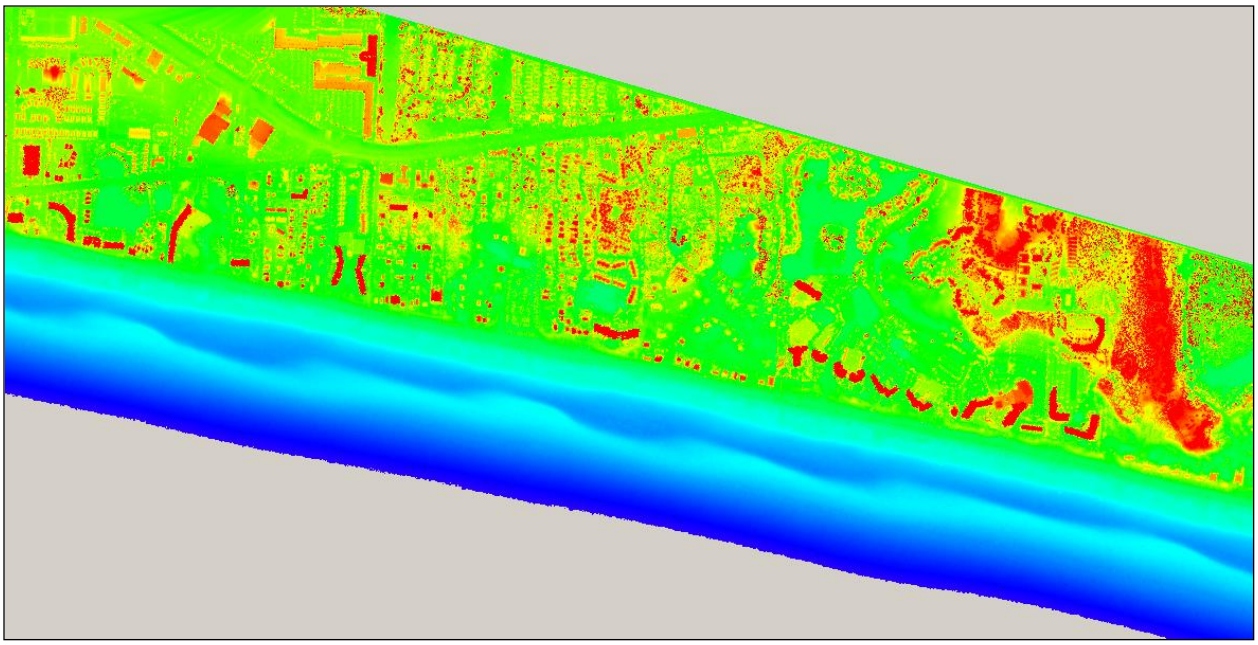

Figure A-1-8. CHARTS Continuous High-Resolution Survey Coverage

The beach profiles were collected coincident with the 127 FDEP transects at approximately 1000-foot intervals. The profiles extended landward to encompass structures (houses etc.) and the back of dune, and seaward to a depth of closure approximately 3,000 feet offshore. The CHARTS surveys provided a seamless survey of the project area with bathymetric lidar data at approximately 16-ft horizontal spacing and topographic lidar at approximately 3-ft horizontal spacing. The surveys covered from the waterline landward to about 1,640 feet, and where water clarity permitted, seaward to about 3,200 feet offshore. Because of the high resolution data and coverage of the CHARTS surveys and a datum issue with the beach profiles collected in 2004, 2004 beach profiles were extracted from the May 2004 CHARTS surveys for this study. These datasets were used to update the study information to existing conditions; however, in September 2004 Hurricane Ivan made landfall as a Category 3 storm in Gulf Shores, Alabama, approximately 90 miles to the west of Walton County. The Walton County shoreline experienced severe erosion as a result of the hurricane. Therefore, post-Hurricane Ivan Charts surveys collected in November 2004 were used to revise the existing conditions for this study.

Study Reaches and Representative Profiles. The Walton County upland cross section is defined by dune elevations ranging from +9.5 to + 33 ft NAVD88 and a natural berm elevation of +5.5 ft NAVD88. The study region was divided into five study reaches based on structural development and state park areas as shown in Figure A-1-9. Table A-1-10 lists the reach number, FDEP range monuments bounding each reach, approximate shoreline distance each reach encompasses, and local beaches and state park areas within each reach. The historical and 2004 beach surveys were used to develop 11 representative profiles which characterize the existing condition for the five study reaches. The 11 representative profiles were developed through examination and

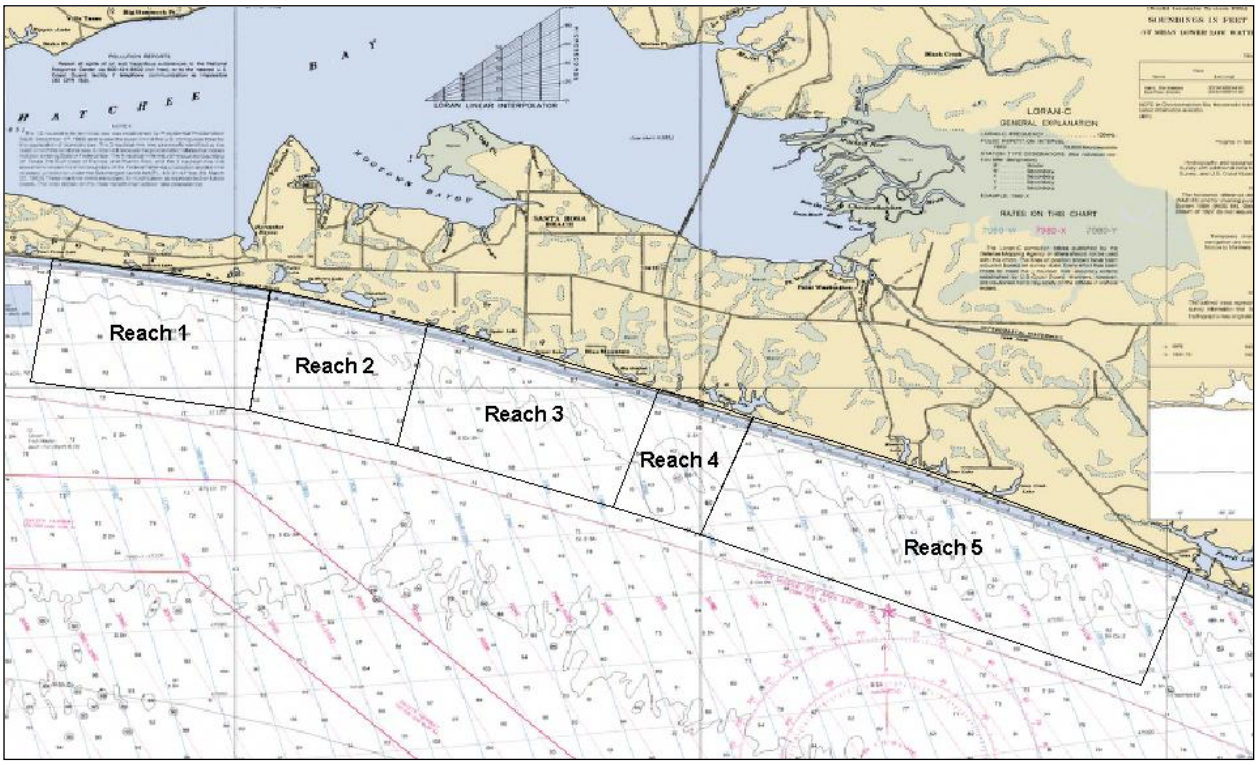

Figure A-1-9. Walton County Study Reaches

TABLE A-1-10
WALTON COUNTY REACHES

Reach	FDEP Range Monuments	Distance (miles)	Local Communities	State Parks
1	R-1 to R-22	5.2	Miramar Beach	
2	R-23 to R-40	3.4		Topsail Hill State Preserve
3	R-41 to R-66	5.2	Dune Allen Beach Santa Rosa Beach Blue Mountain Beach	
4	R-67 to R-77	2.6	Grayton Beach	Grayton Beach State Recreational Preserve
5	R-78 to R-127	9.2	Seaside Seagrove Beach Rosemary Beach Inlet Beach	Deer Lake State Park

analysis of the geomorphic characteristics of the upper (dune and berm) and lower (subaqueous) portions of the 127 profiles using the Beach Morphology Analysis Package (BMAP) (Sommerfeld et al. 1994). The point of delineation between upper and lower profile was defined at an elevation of +0.63 ft NAVD88, the MHW elevation. The representative profiles were identified based primarily on similarity in shape of the upper beach profile (dune height and width, berm width, foreshore beach slope, and profile volume) and shape of the offshore profile. Because significant erosion occurred due to Hurricane Ivan in September 2004, the representative profiles were revised using the post-Ivan data to characterize the upper portion of the beach and to include the post-Ivan data in the submerged portion of the beach. The resulting representative profiles for each study reach are shown in Figures A-1-10 through A-1-14. Figure A-1-15 shows the areas characterized by each representative profile and Table A-1-11 lists the study reach, representative profile, and the FDEP survey monuments characterized by the representative profile. The representative profiles were used as input into the storm damage modeling described below, for existing conditions and will be combined with design templates to characterize the with-project condition for selected design alternatives.

Historic MHW Shoreline Analysis

Taylor Engineering (2003) examined the historical shoreline behavior to identify regions of shoreline accretion and erosion. Shoreline changes generally indicate subaerial or dry beach behavior. The historical MHW shoreline position data set included the years 1871-1872, 1934-1945, 1955-1956, 1969-1970, 1973, 1975, 1981, 1984, 1987, and 1993-1998. The FDEP provided all data for the analysis. Analysis indicates a stable or accreting shoreline in Walton County in the absence of severe storms. The FDEP recognized the questionable quality and limited potential usefulness of all data generated prior to 1972 due to source problems. Beach profile surveys from 1972 to 1998 are reliable.

The MHW shoreline changes, calculated with linear regression, represent four periods: the pre-Hurricane opal intermediate-term (1973-1995), the post-Hurricane Opal short-term (1995-1998), the intermediate-term (1973-1998), and the long-term (1872-1998) periods. Figure A-1-16 illustrates the MHW changes at every FDEP monument in Walton County.

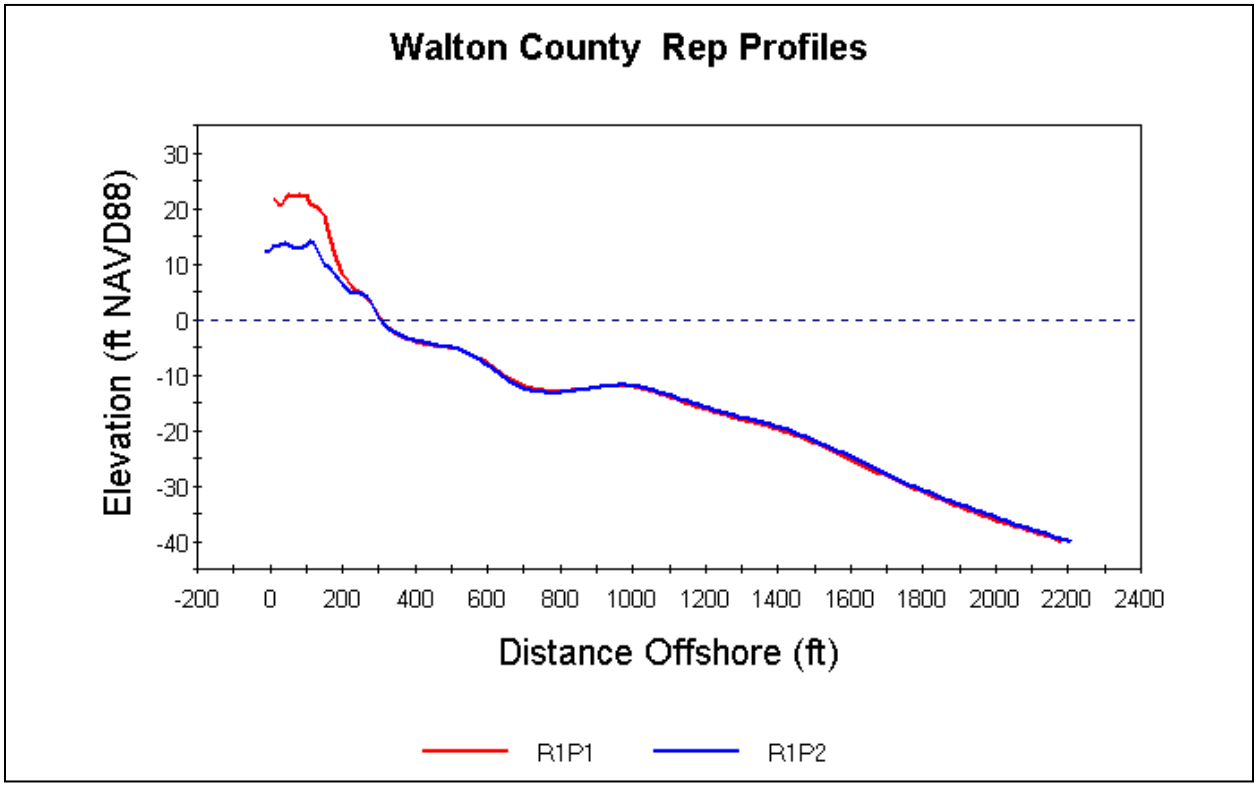

Figure A-1-10. Representative Beach Profiles For Reach 1, R1 To R22

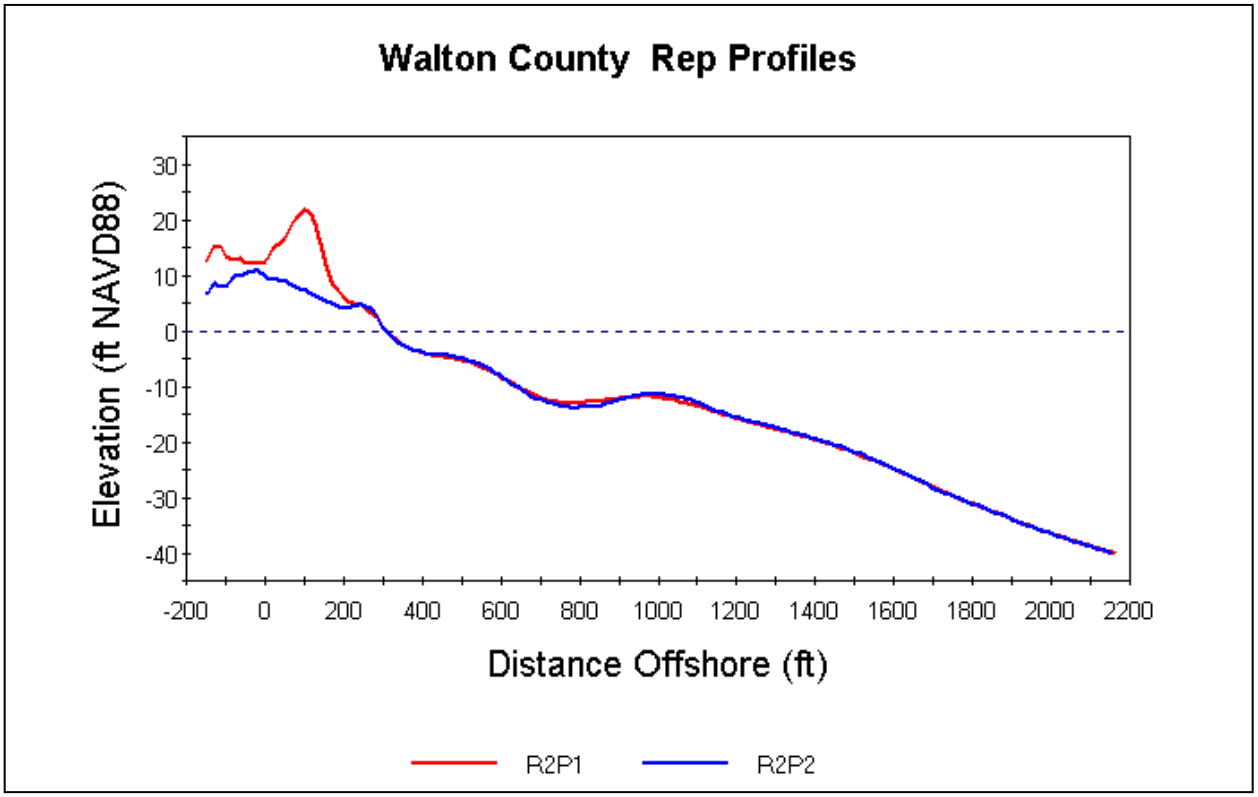

Figure A-1-11. Representative Beach Profiles For Reach 2, R23 To R40

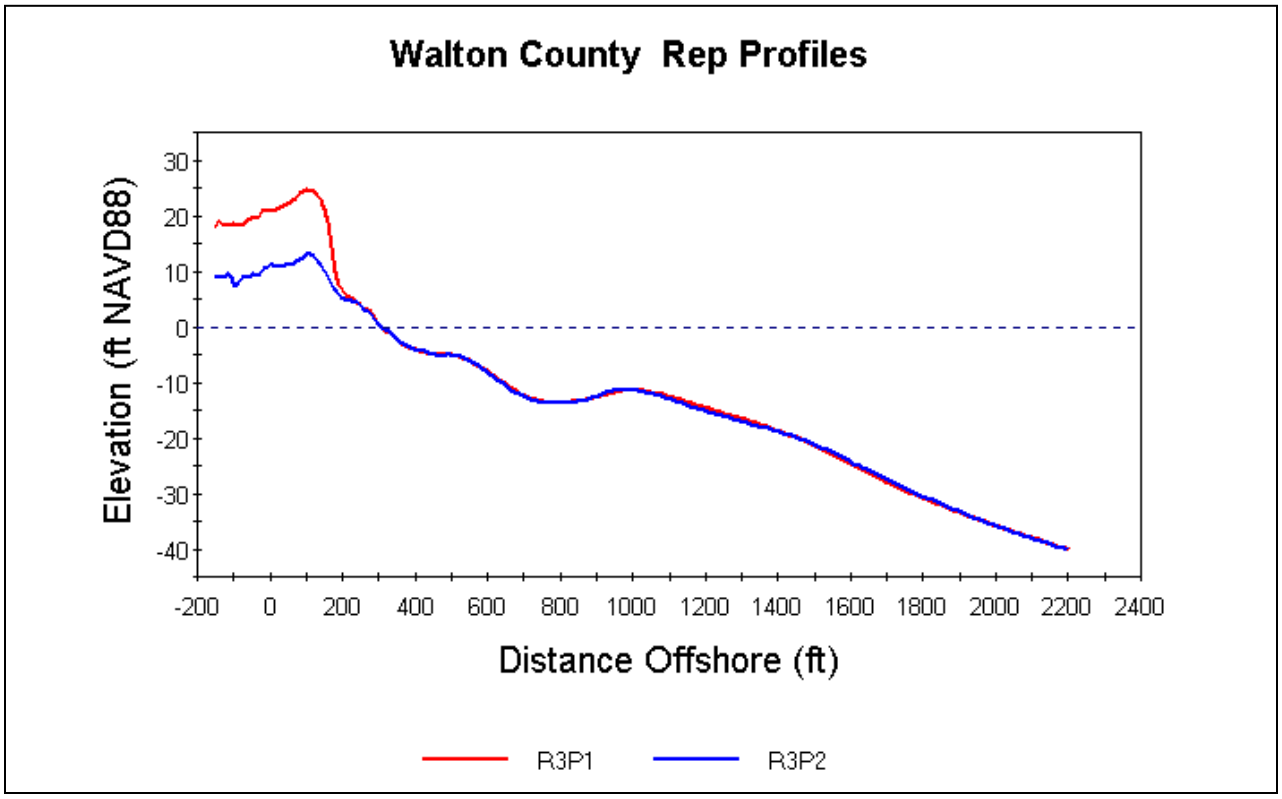

Figure A-1-12. Representative Beach Profiles For Reach 3, R42 To R66

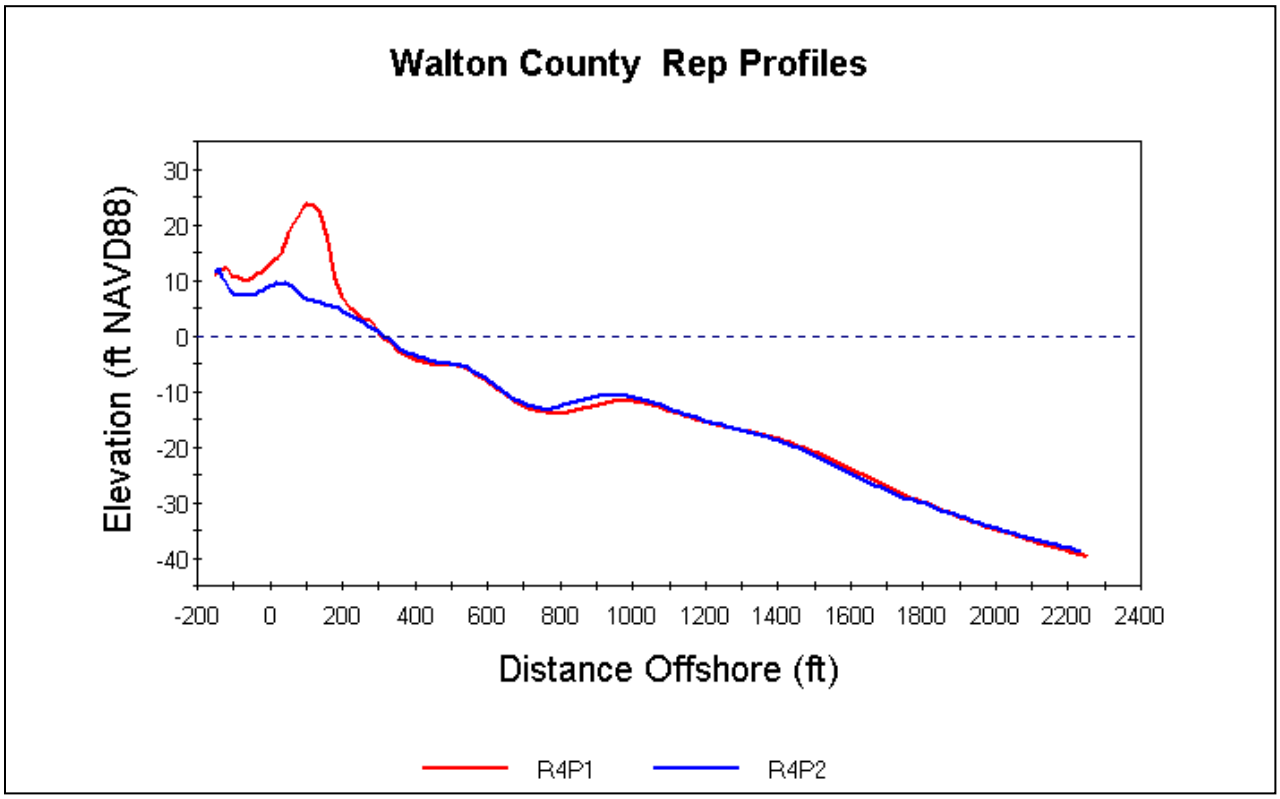

Figure A-1-13. Representative Beach Profiles For Reach 4, R67 To R77

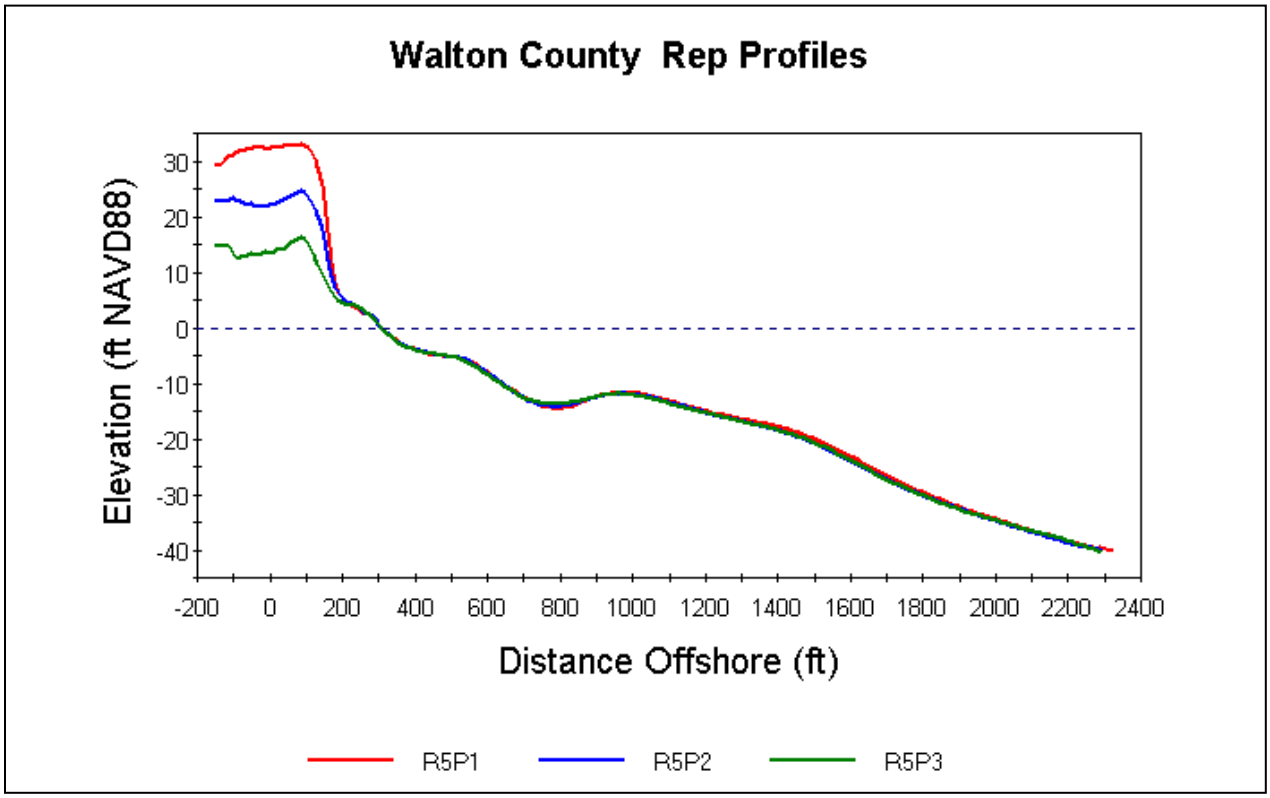

Figure A-1-14. Representative Beach Profiles For Reach 5, R78 To R127

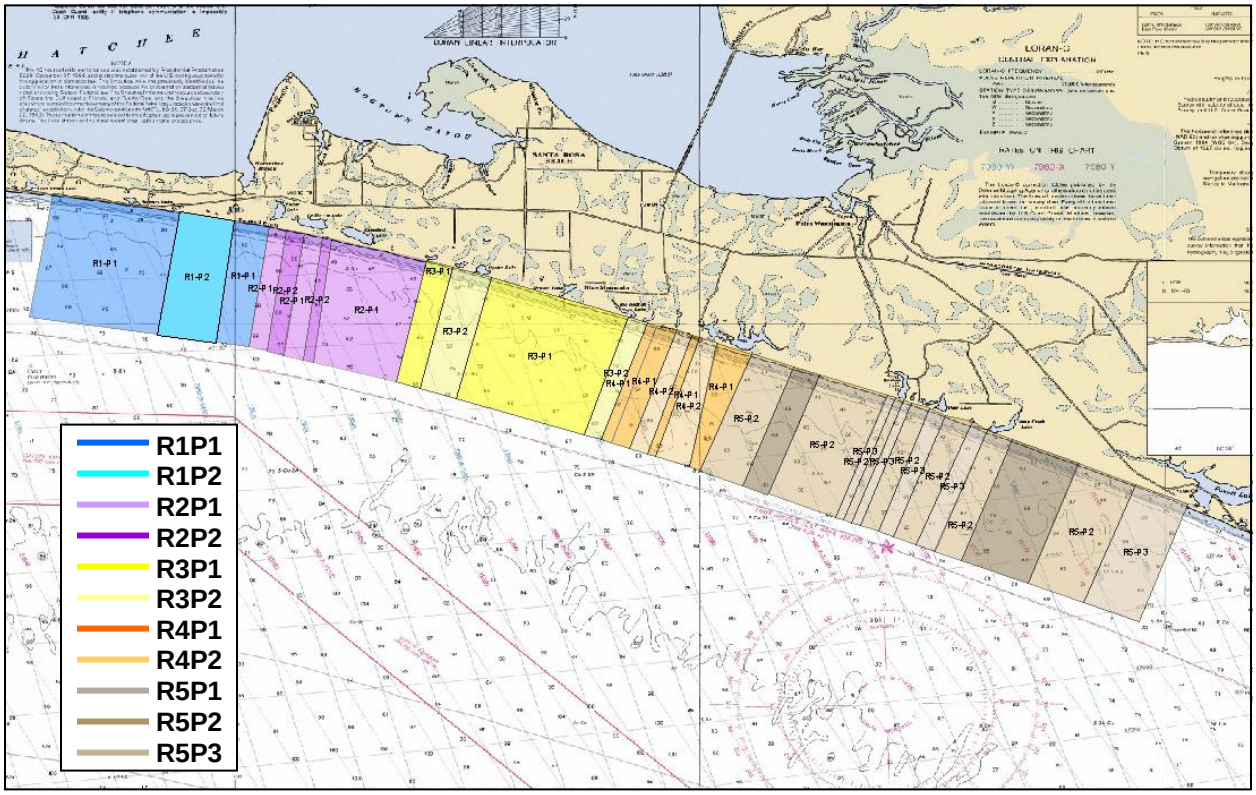

Figure A-1-15. Distribution of Representative Beach Profiles

Table A-1-11. Representative Profiles Characterizing Walton County Shoreline

Reach	Representative Profile	FDEP Monuments
1	R1P1	R1-R12, R19-R22
	R1P2	R13-R18
2	R2P1	R23-R24, R27-R28, R30-R40
	R2P2	R25-R26, R29
3	R3P1	R41-R43, R48-R63
	R3P2	R44-R47, R64-R65
4	R4P1	R66-R68, R71, R74-R77
	R4P2	R69-R70, R72-R73
5	R5P1	R83-R85, R103, R108-R115
	R5P2	R78-R82, R86-R93, R95, R97-R98, R101-R102, R105-R107, R116-R123
	R5P3	R94, R96, R99-R100, R103a-R104, R124-R127

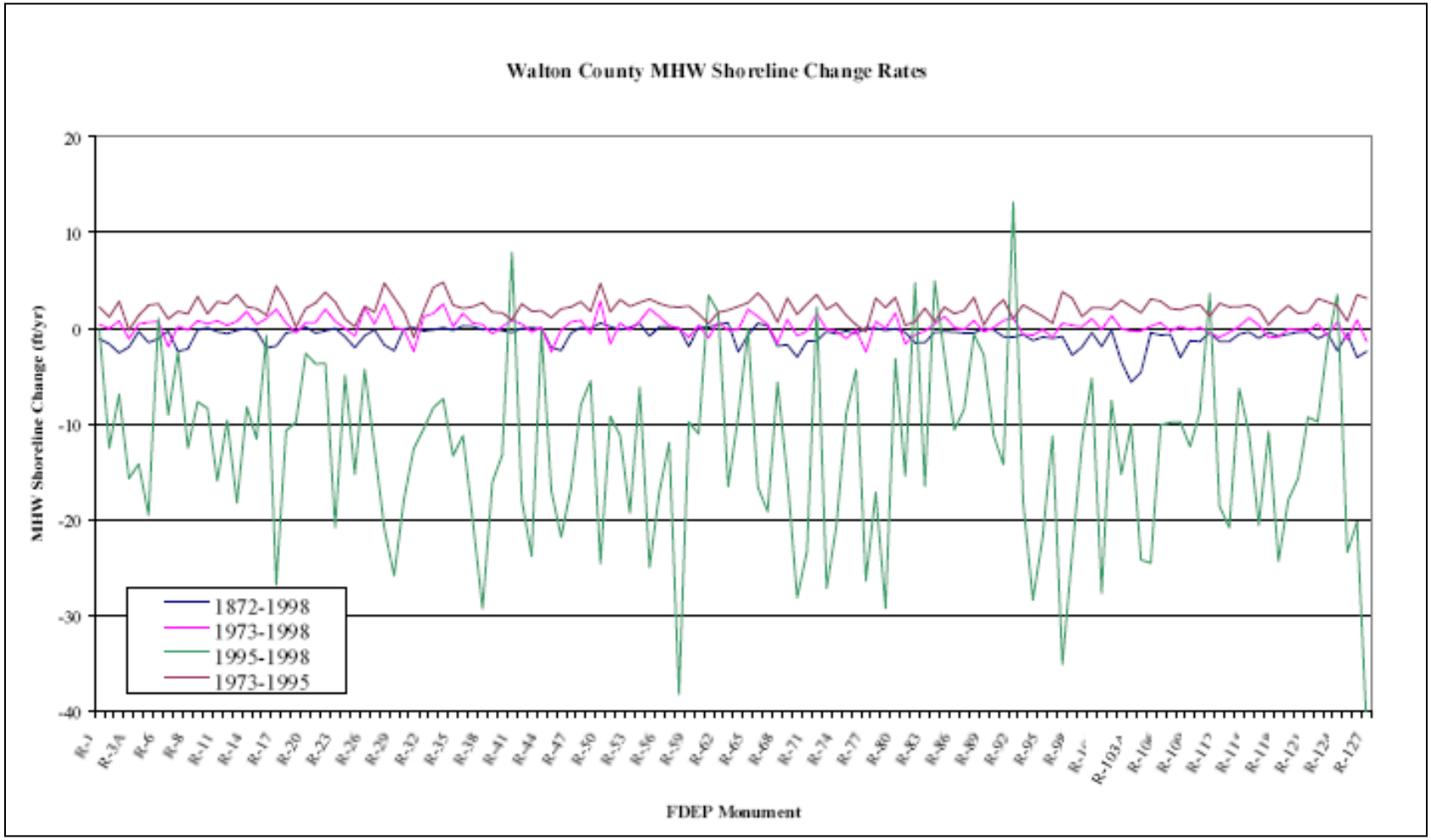

Figure A-1-16. Walton County MHW Shoreline Change Rates

The MHW shoreline experienced similar trends over the Walton County region. In the intermediate term before Hurricane Opal, the shoreline advanced. From 1995-1998, the shoreline receded severely over the region due to the impacts of Hurricane Opal and subsequent storms. Overall, from 1973-1998 the shoreline advanced slightly in every reach except from FDEP monuments R-41 to R-47 and R-109 to R-127. From 1972-1998, the shoreline receded over the region except from FDEP monuments R-48 to R-54.

Sediment Budget

A sediment budget delineates sediment transport pathways and magnitudes. Establishment of the sources and magnitudes of accreted sand and the magnitude and transport direction of eroded sand require such delineation. Net sediment transport results from complex interacting mechanisms such as wave action, tidal currents, sediment physical characteristics, mechanical bypassing operations, Aeolian processes, and vegetation-associated sediment trapping. Development and calibration of a process-based model to simulate such transport falls outside the capability of current coastal engineering models. As an alternative, this sediment budget analysis employs a simple but efficient box model approach that takes into account the fundamental equation for conservation of sediment volume.

Sediment Budget Development. This study builds on prior sediment budgets developed for Walton County (Taylor Engineering, 2003) which applied three surveys: 1973 (the earliest comprehensive survey), 1995 (pre-Hurricane Opal survey), and 1998 (the latest comprehensive survey at the time of the 2003 study) for analysis. Thus, the 2003 study developed sediment budgets for the periods 1973–1995, 1995–1998, and 1973–1998.

Recent bathymetric survey data for Walton County include May/June (pre-Hurricane Ivan) and October/November (post-Hurricane Ivan) 2004 surveys at all FDEP monuments (R1 – R127). These data sources include both upland surveys by standard surveying techniques and offshore surveys with a fathometer out approximately 3000 ft. Also, two USACE CHARTS Lidar surveys (May and November 2004) cover the entirety of Walton County. The proximity in time of the May and November USACE surveys to the May/June and October/December FDEP surveys allows comparison of the two surveys (traditional versus LIDAR data acquisition techniques) and provides a convenient check of the data. This study also applies the 1995 FDEP pre-Hurricane Opal survey allowing analysis for the periods 1995–May 2004, May 2004–November 2004, and 1995–November 2004.

An examination of Walton County's geomorphology and general characteristics was conducted to define representative sub areas or cells. This study applies two sets of beach reaches to delineate the cells within the Walton County sediment budget. Analysis A defines 10 reaches identical to those in Taylor Engineering (2003) and Analysis B defines 5 reaches developed by the USACE Mobile District. The 2003 Beach Management Feasibility Study for Walton County (Taylor Engineering, 2003) defined 10 reaches based on profile geomorphology (dune or bluff profiles), shoreline

orientation, nature of upland development (existence of structures encroaching on the active beach profile region), and state-designated critical erosion areas (see Table A-1-12 and Figure A-1-17). The sediment budget analysis defined the subaerial and subaqueous regions of each reach as distinct cells. Thus, 20 cells comprise Walton County for sediment budget computations in Analysis A. Analysis B divides Walton County based on proposed beach nourishment project areas, as shown in Table A-1-13. Based on available data, the net change in volume over the period of interest for each of these cells establishes the sediment loss or accumulation in the cell.

Unfortunately, the spatial availability of data, not the limiting values of topographic and bathymetric change, governs the landward and seaward boundaries. The monument locations define the landward limits of the profile surveys. Unlike the Taylor Engineering (2003) study which contained overwash estimates for Hurricane Opal, the current analysis does not include overwash estimates given the limited availability of recent high quality aerial photographs. For this study the -35 ft NGVD contour defines the seaward limit of reliable profile data; however, the profiles show erratic convergence which indicates that the depth of closure, or the limiting depth of significant sediment movement, lies seaward of the survey limits. Thus, the volume calculations exclude some volume of sand. Notably, the Taylor Engineering (2003) study applies a limiting offshore contour of -38 ft. The following paragraph describes the method used to compute sediment transport through the -35 ft NGVD contour.

The sediment budget assumes all longshore transport occurs below MHW; therefore, longshore transport pathways connect subaqueous cells only. Magnitudes and directions of sediment transport are assigned to the defined pathways. A closed landward boundary is applied that does not allow sediment transport across the boundary. The littoral transport analysis (Taylor Engineering, 2003) provided the net transport magnitude and direction at the longshore boundaries of each reach. The cross-shore transport at the MHW shoreline equaled the net volume change in the adjacent subaerial cell. The net transport at the offshore boundary balanced the net volume change in the adjacent subaqueous cell with the longshore transport entering and exiting the cell and the cross-shore transport at the MHW shoreline.

Errors in Sediment Budget Calculations. Difficulties inherent to development of the sediment budget development were described previously; however, the two concurrent surveys that apply different survey techniques (traditional versus LIDAR) allow comparison and data verification. Comparison of the concurrent surveys indicated a general offset in the offshore region for both the May and November surveys. Standard datum and unit conversion errors could not explain the differences. Comparison of the 2004 survey data with prior surveys indicated that the 2004 LIDAR surveys provide the best convergence at depths greater than approximately 15 ft (Figures A-1-18 through A-1-20). In the surfzone, nearshore, and upland the 2004 traditional survey data proved a better match with prior surveys. These trends indicate a significant bias in the data sets and generally occurred at FDEP monuments across Walton County. For these reasons the sediment budget calculations apply profiles that merge the onshore portion of the traditional surveys with the offshore portion from the concurrent LIDAR surveys (Figures A-1-21 through A-1-23). The profiles typically merged at approximately -10 ft NAVD88 in a location with adequate convergence.

Table A-1-12. Walton County Reaches: Analysis A

Reach	FDEP Monument Range	Critical Erosion Area[1]	Nature of Upland Development
1	R-1 to R-19	WCE1	Developed
2	R-19 to R-23	WCE1	Developed
3	R-23 to R-41	-	Natural
4	R-41 to R-48	WCE2	Developed
5	R-48 to R-55	WCE2	Developed
6	R-55 to R-64	WCE3	Developed
7	R-64 to R-80	WCE4	Natural
8	R-80 to R-98	WCE5	Developed
9	R-98 to R-109	-	Natural
10	R-109 to R-127	WCE6, WCE7	Developed

[1]State-designated as of June 2005; erosion area limits not coincident with reach limits

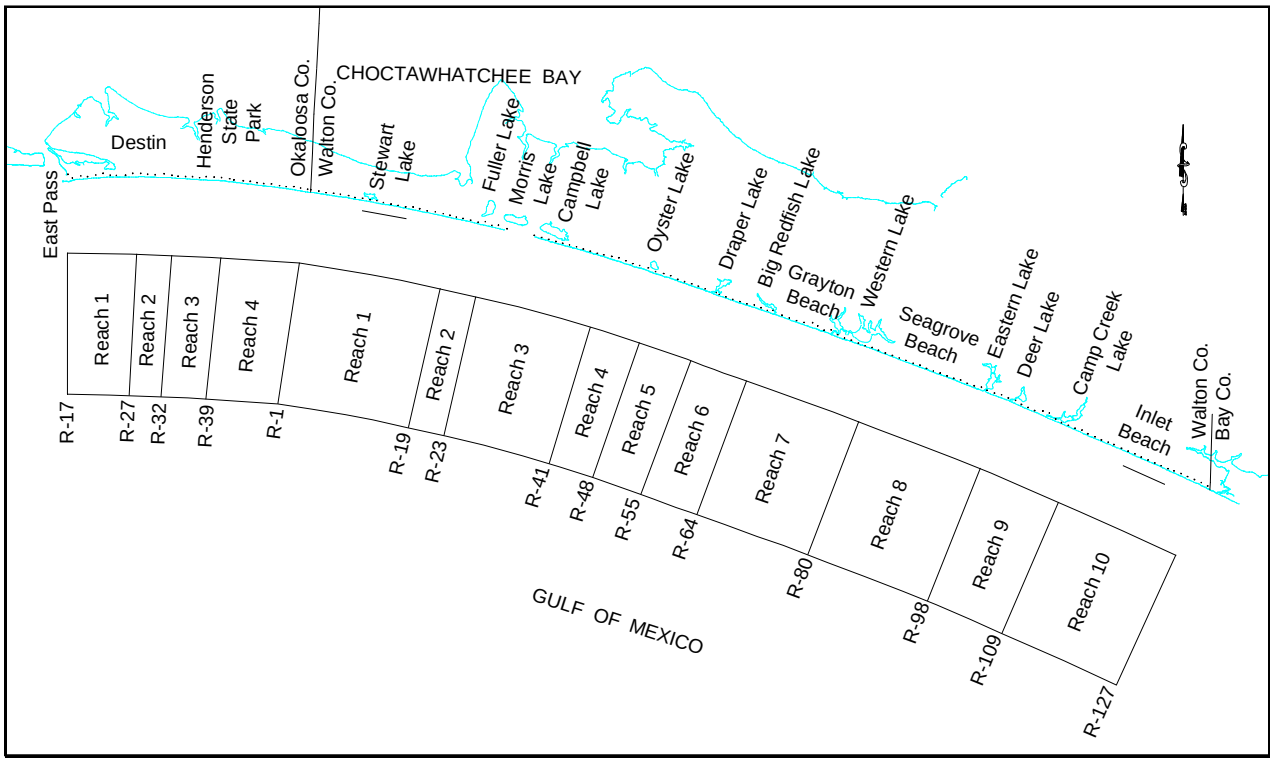

Figure A-1-17. Walton County Reaches: Analysis A

Table A-1-13. Walton County Reaches: Analysis B

Reach	FDEP Monument Range	Classification
1	R-1 to R-23	Proposed Beach Nourishment Area 1
2	R-23 to R-41	Topsail Hill State Preserve
3	R-41 to R-66	Proposed Beach Nourishment Area 2
4	R-66 to R-77	Grayton Beach State Recreation Area
5	R-77 to R-127	Proposed Beach Nourishment Area 3

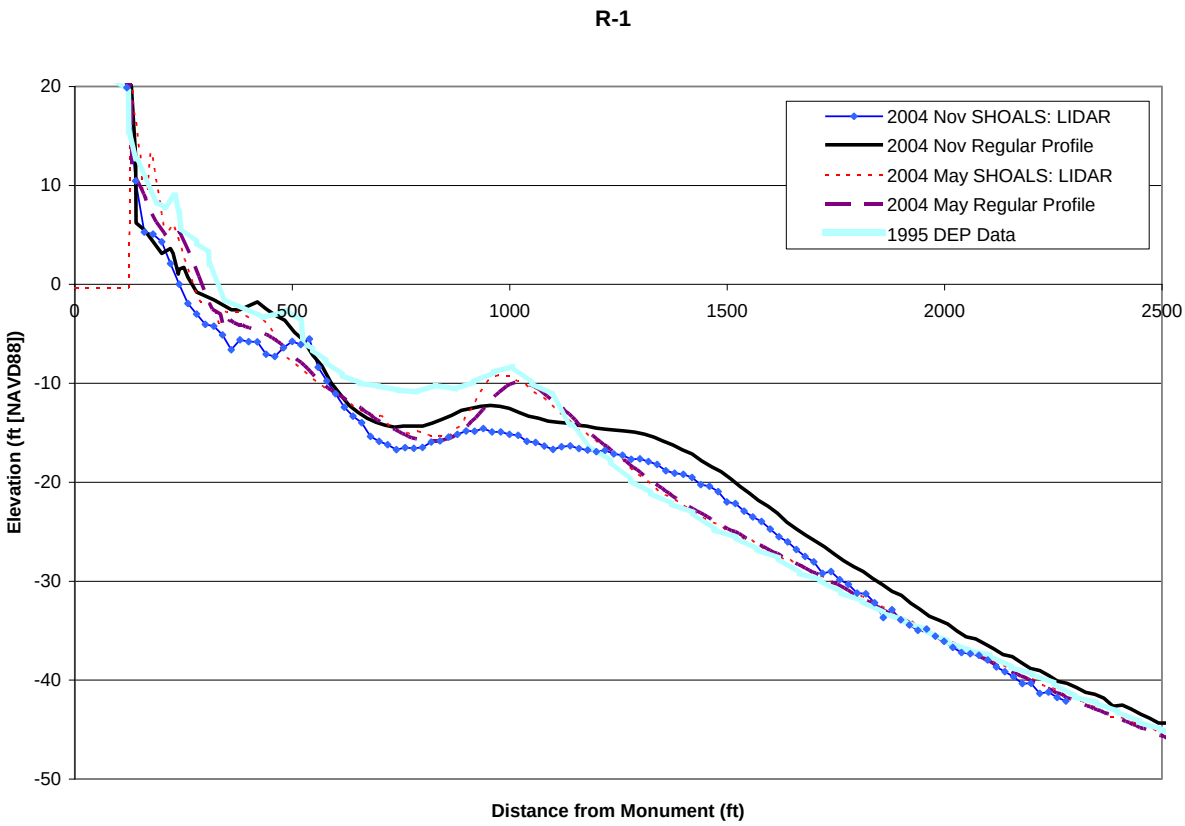

Figure A-1-18. Comparison of Recent Profile Data at R-1

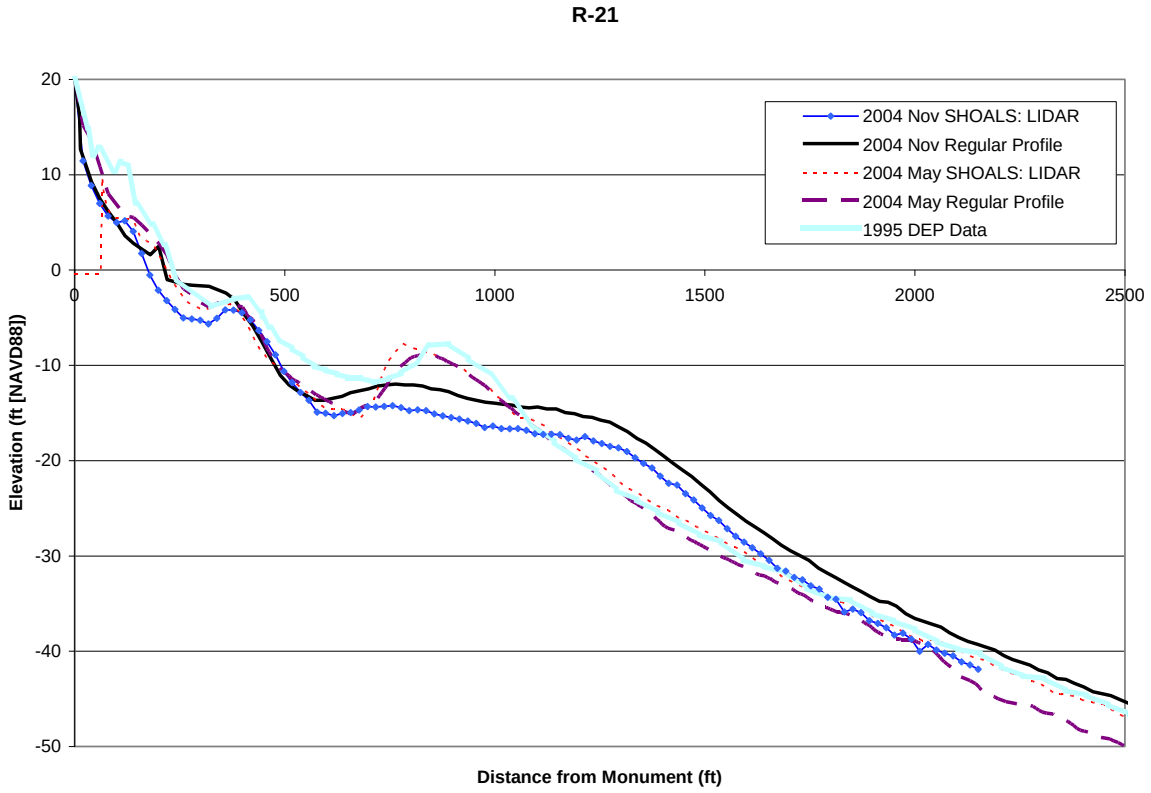

Figure A-1-19. Comparison of Recent Profile Data at R-21

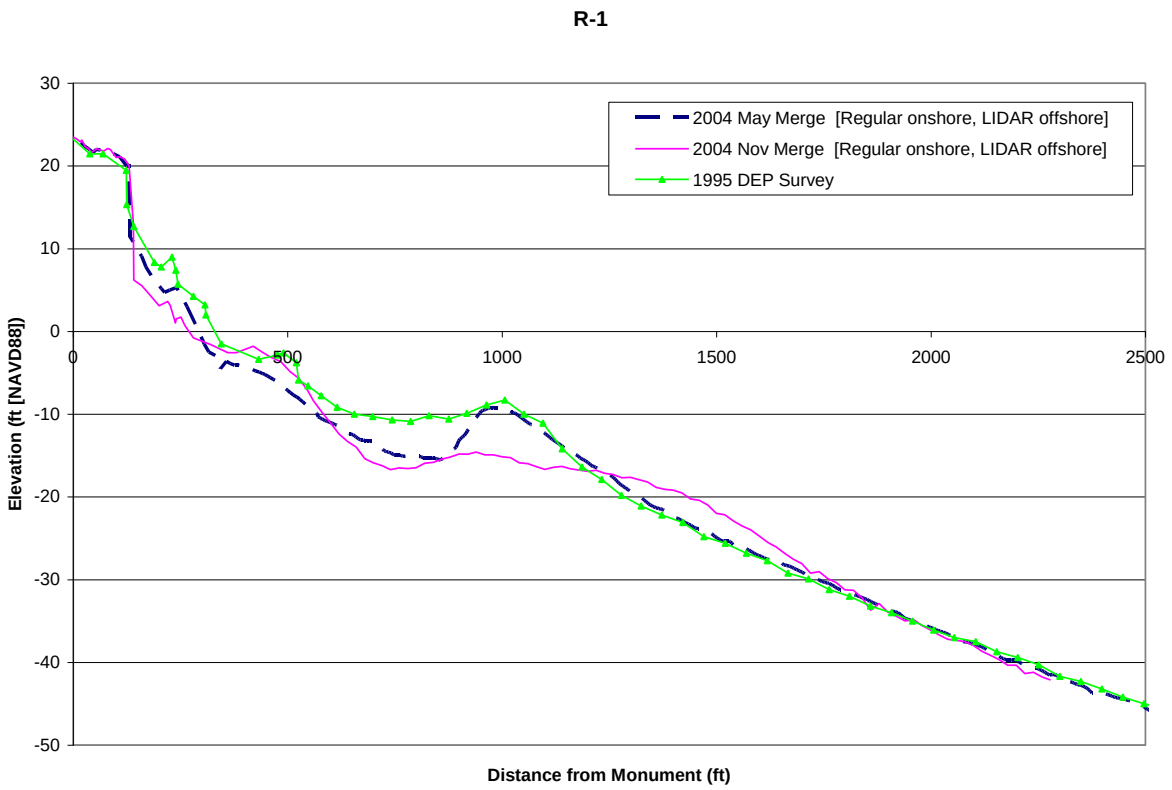

Figure A-1-20. Comparison of Merged Profile Data at R-1

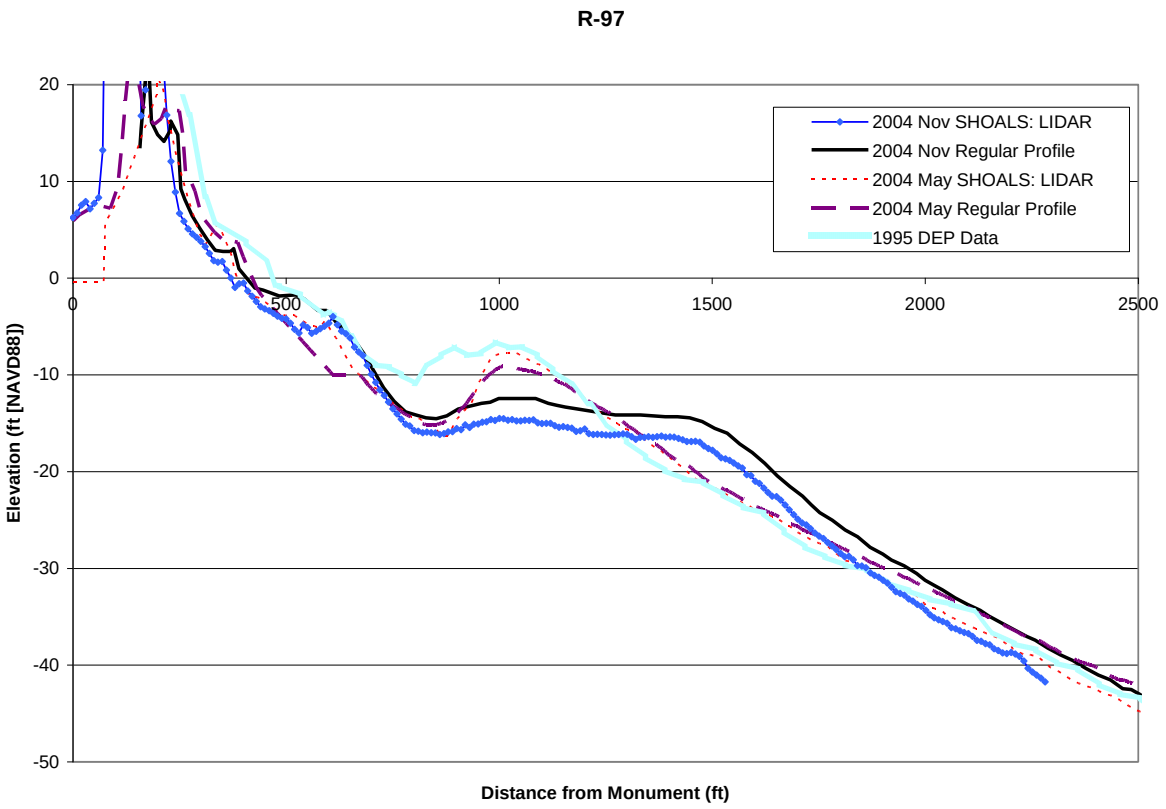

Figure A-1-21. Comparison of Recent Profile Data at R-97

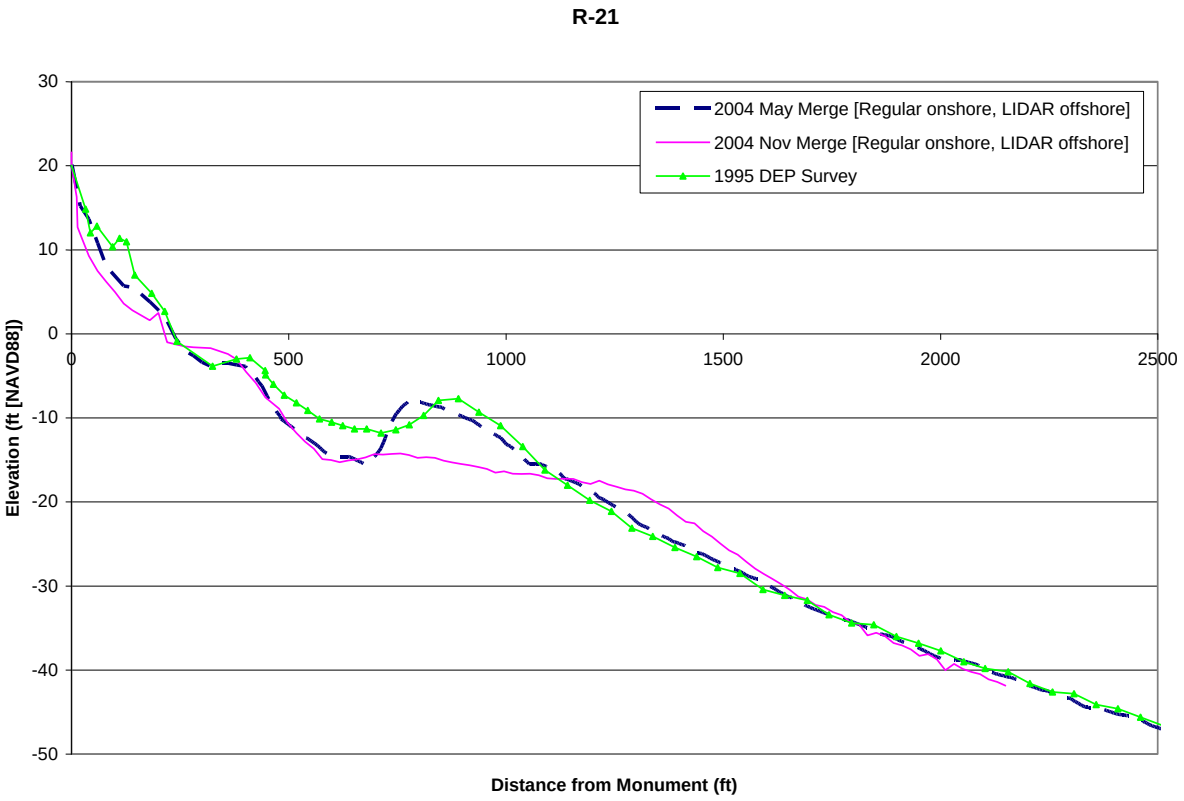

Figure A-1-22. Comparison of Merged Profile Data at R-21

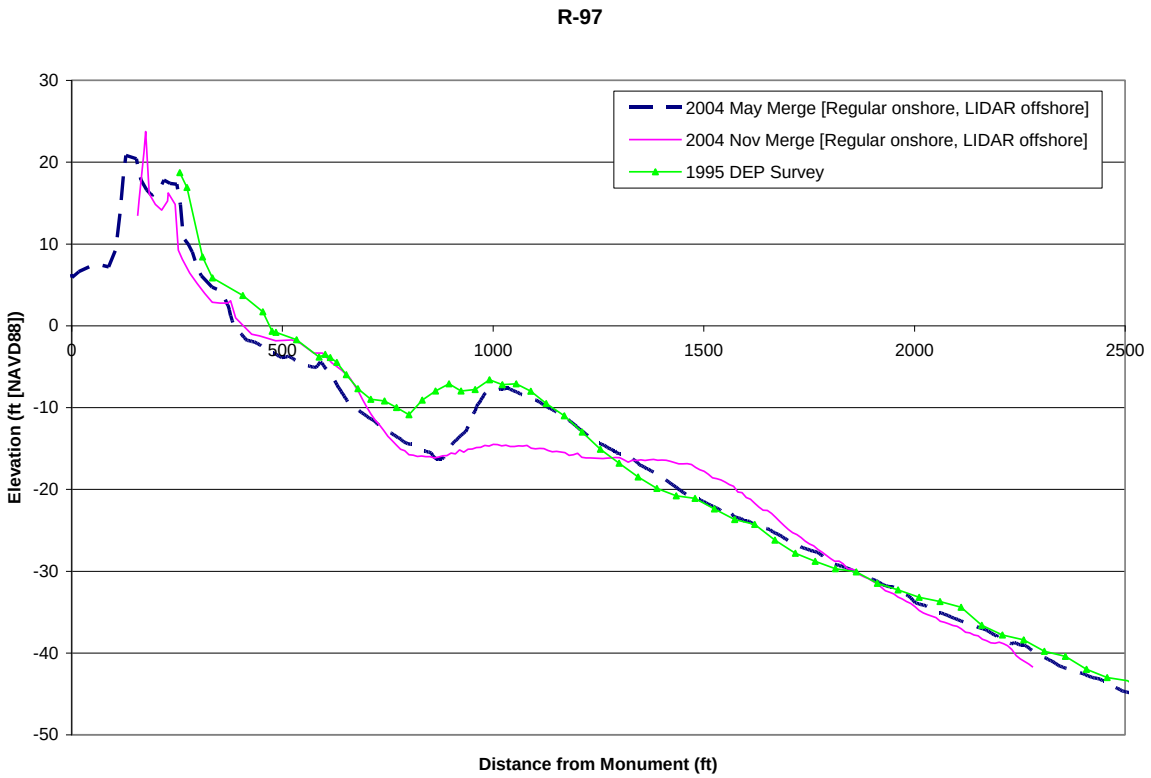

Figure A-1-23. Comparison of Merged Profile Data at R-97

The sediment budgets developed provide estimates of sediment transport pathways and magnitudes for delineated areas in Walton County. Similar to all sediment budgets, limitations in data availability and quality introduce potentially significant uncertainty in the quantities developed within the sediment budget.

Sediment Budget for Walton County and Destin. Figures A-1-24 through A-1-26 illustrate the Walton County sediment budgets (in cy/yr) for 1995 to May 2004, May 2004 to November 2004, and 1995 to November 2004 for the 10 reaches delineated in Analysis A. Figures A-1-24A through A-1-26A present sediment budget values in cy/ft/yr. Dividing the total volume change within each reach by the reach length facilitates comparison between reaches of different lengths. The tables present the results in cy/yr with the exception of the May 2004 to November 2004 figure, which present results in cy. Following the same conventions, Figures A-1-27 through A-1-29 illustrate the Walton County sediment budgets (in cy/yr) for 1995 to May 2004, May 2004 to November 2004, and 1995 to November 2004 for the five reaches delineated in Analysis B. Figures A-1-27A through A-1-29A present sediment budget values in cy/ft/yr.

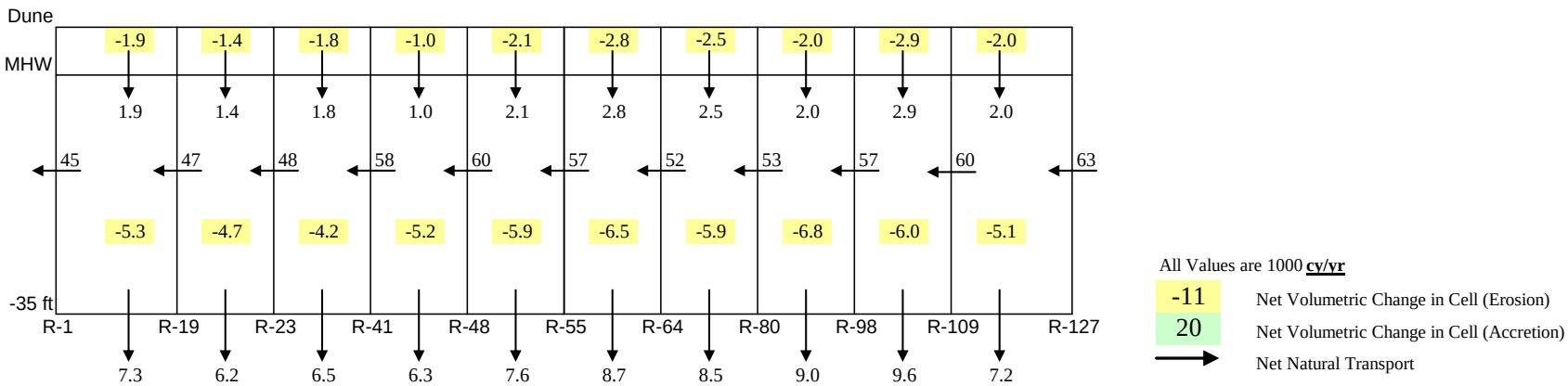

Figure A-1-24. May 1995 – May 2004 Sediment Budget For Walton County, Analysis A

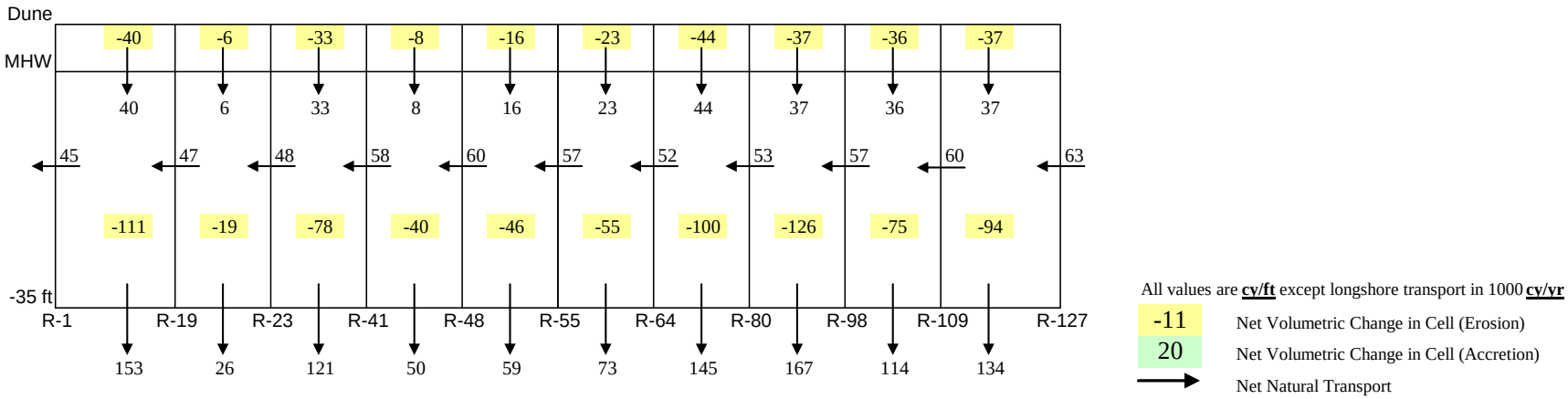

Figure A-1-24A. May 1995 – May 2004 Sediment Budget For Walton County, Analysis A In cy/ft

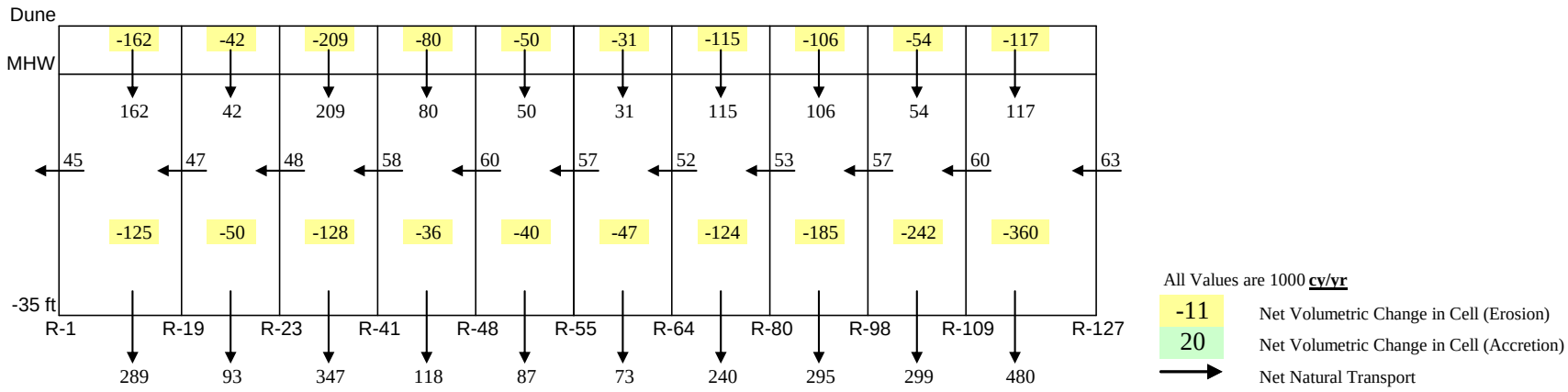

Figure A-1-25. May 2004 – November 2004 Sediment Budget For Walton County, Analysis A

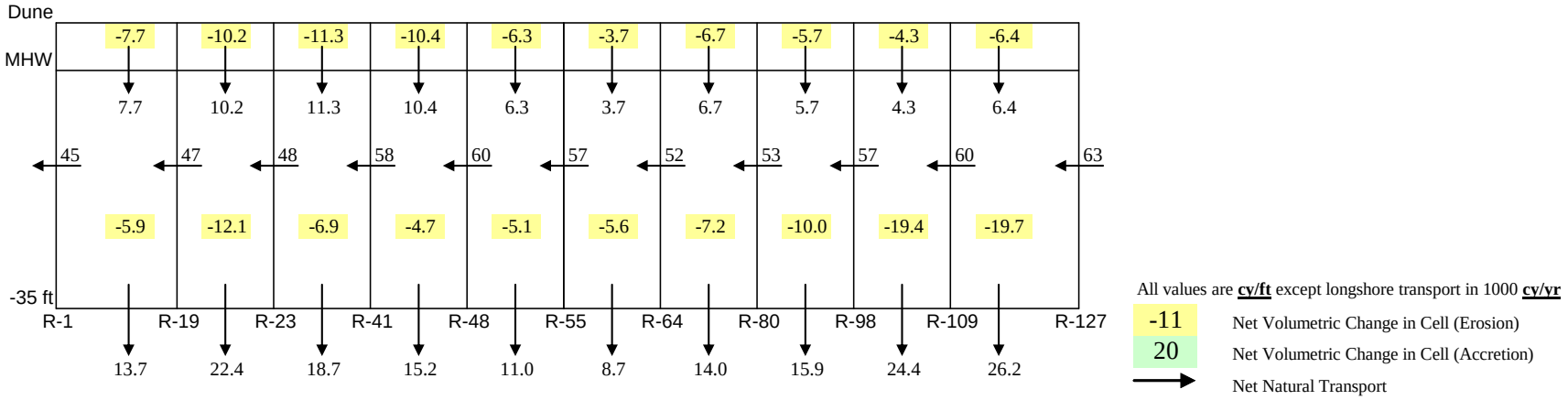

Figure A-1-25A. May 2004 - November 2004 Sediment Budget For Walton County, Analysis A in cy/ft

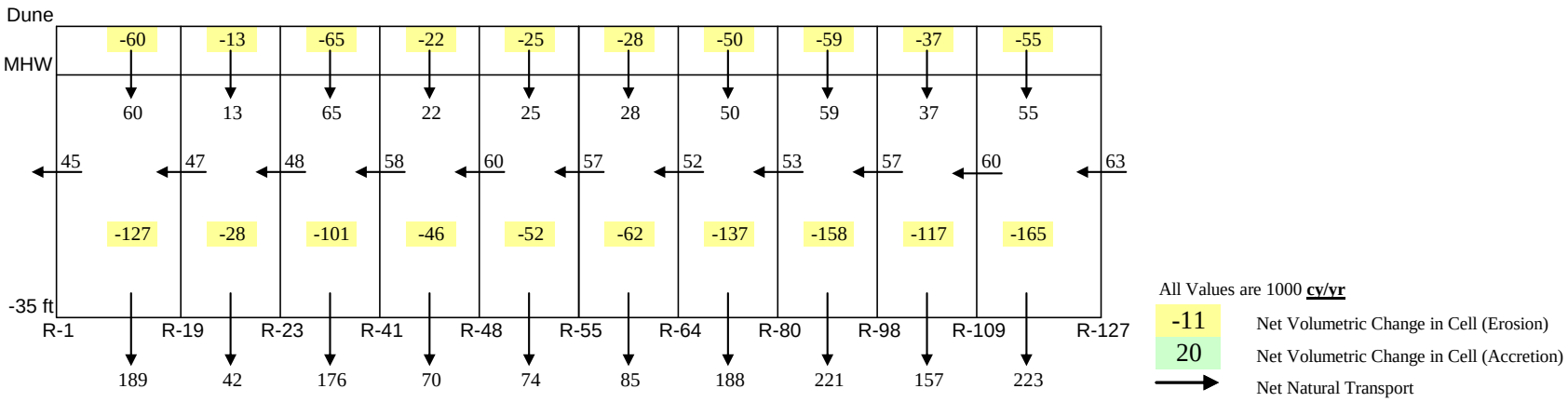

Figure A-1-26. May 1995 – November 2004 Sediment Budget For Walton County, Analysis A

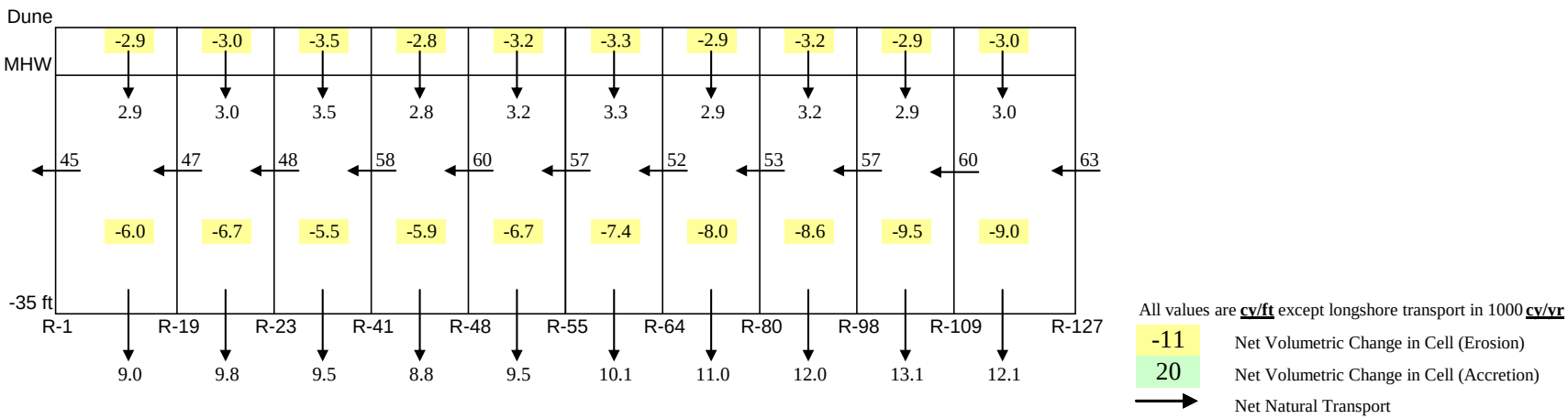

Figure A-1-26A. May 1995 – November 2004 Sediment Budget For Walton County, Analysis A in cy/ft

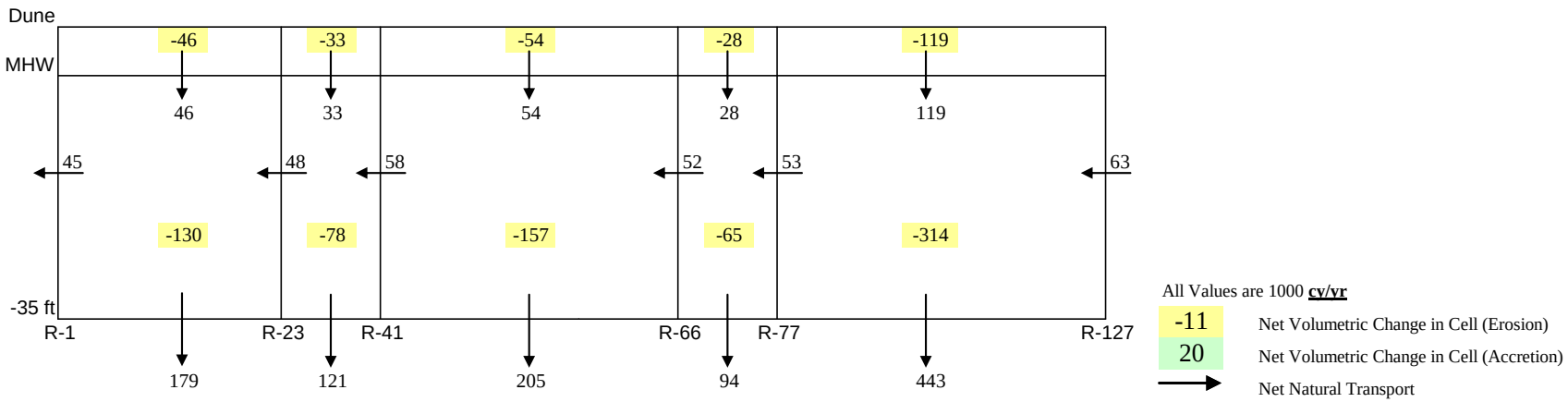

Figure A-1-27. May 1995 – May 2004 Sediment Budget For Walton County, Analysis A

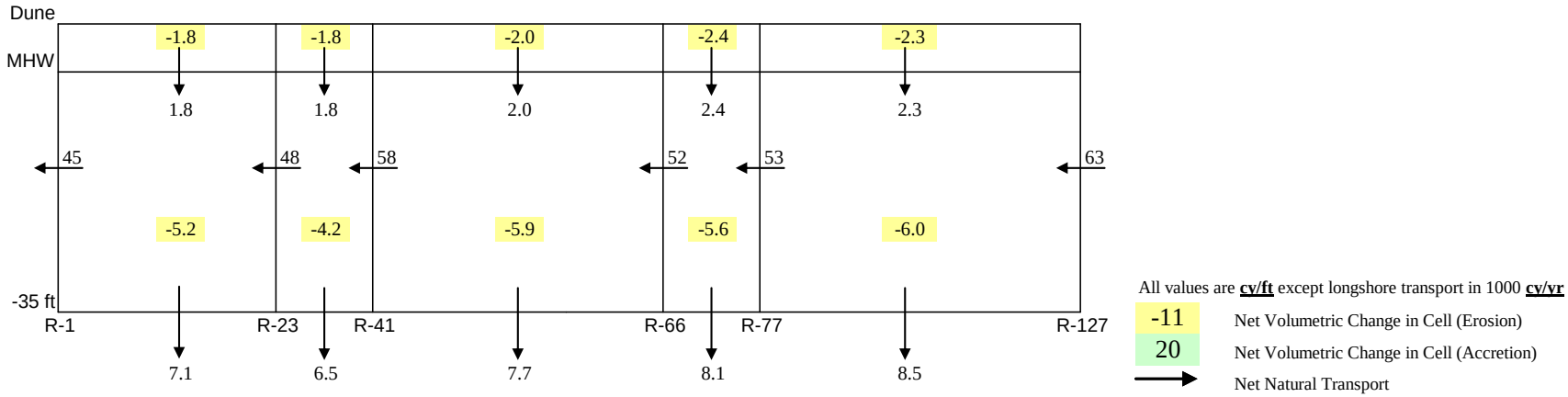

Figure A-1-27A. May 1995 – May 2004 Sediment Budget For Walton County, Analysis A in cy/ft

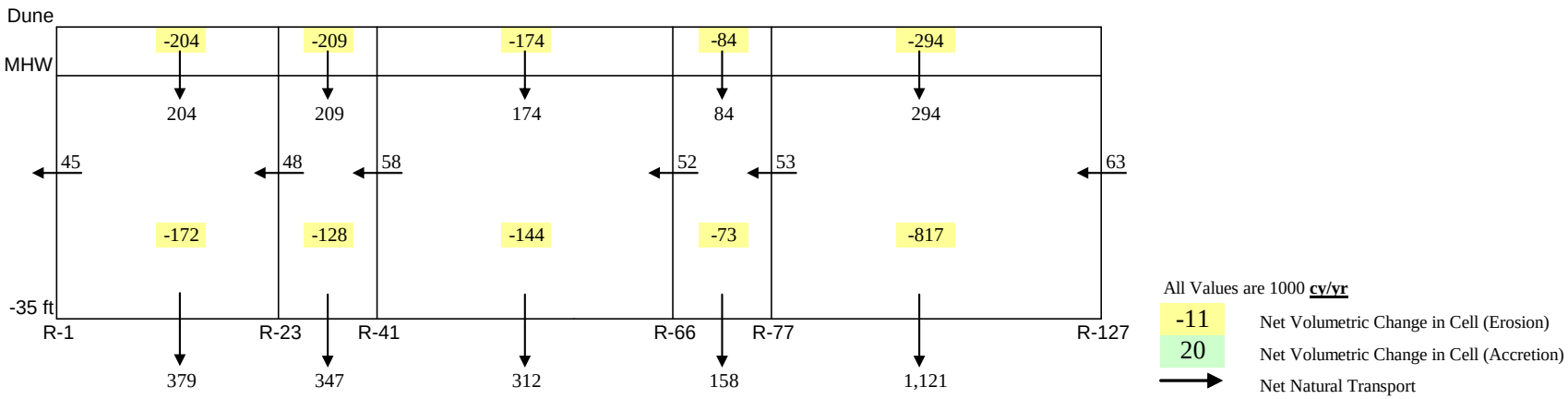

Figure A-1-28. May 2004 – November 2004 Sediment Budget For Walton County, Analysis A

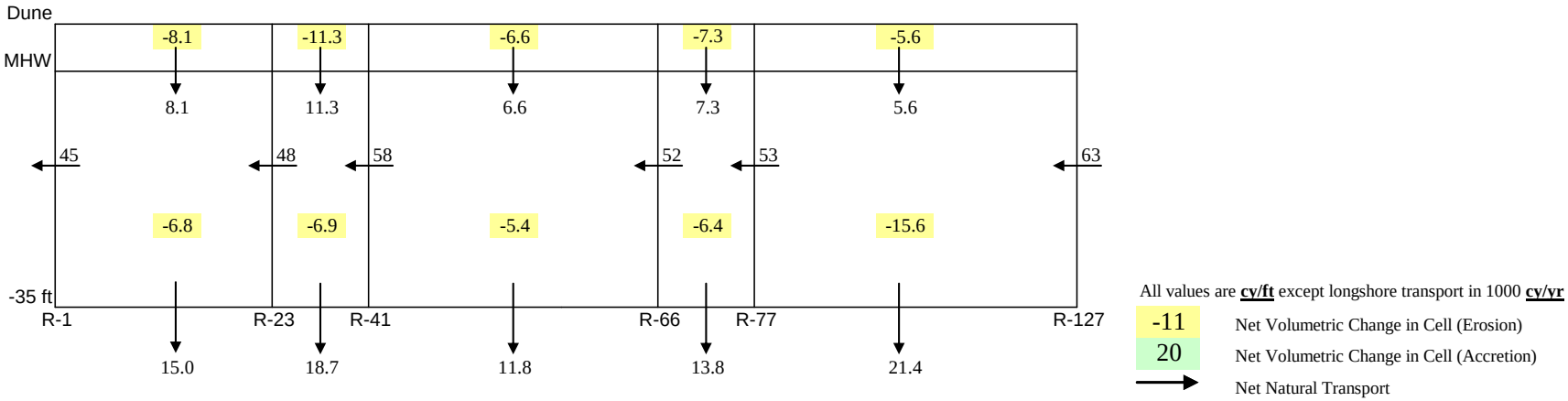

Figure A-1-28A. May 2004 – November 2004 Sediment Budget For Walton County, Analysis A in cy/ft

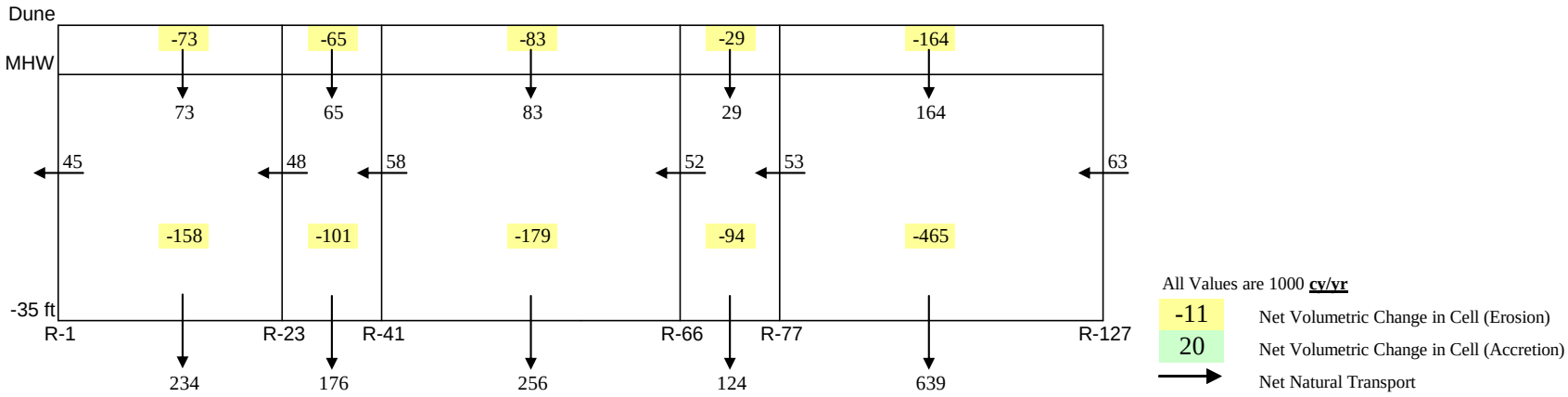

Figure A-1-29. May 1995 – November 2004 Sediment Budget For Walton County, Analysis A

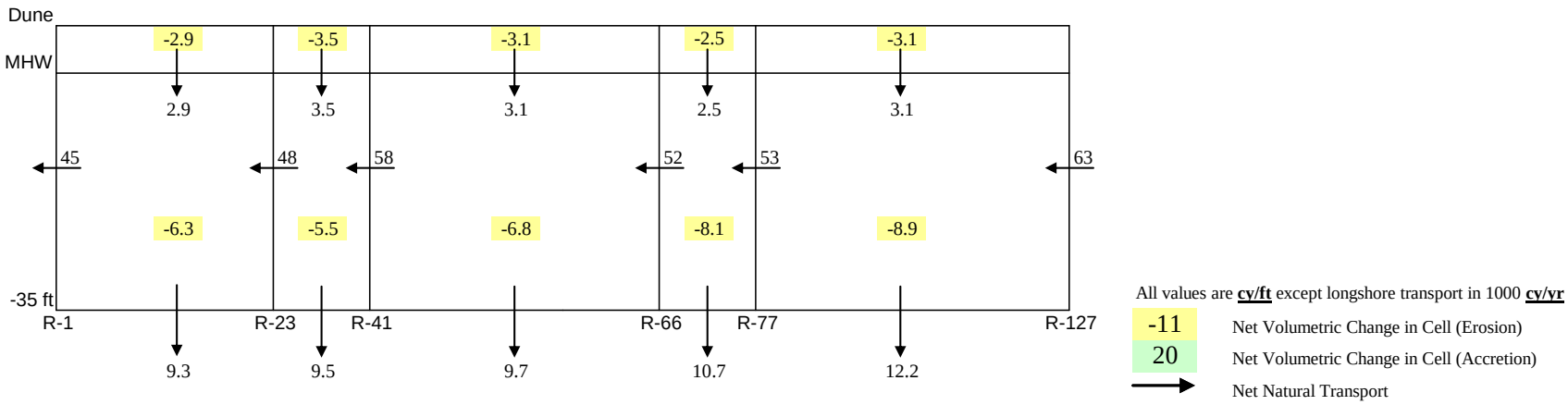

Figure A-1-29A. May 1995 – November 2004 Sediment Budget For Walton County, Analysis A in cy/ft

Numbers in the center of each cell represent the net volume change in that polygon; numbers highlighted in yellow indicate erosion and green highlights indicate accretion. Vertical arrows indicate net cross-shore transport magnitudes and direction, and horizontal arrows indicate net longshore transport. Recall, arrows represent net values of sediment transport; thus, every arrow represents the vector sum of two arrows acting in opposite directions. For example, the net 63,000 cy/yr passing monument R-127 represents two sediment transport rates - a larger rate directed westward and a smaller rate directed eastward. The difference in the rates defines the net transport presented in the sediment budget. Note the transport through the offshore boundary represent losses associated with storm-induced erosion.

In Walton County, all reaches experienced similar trends of net erosion for all subaerial beach and subaqueous regions for the three periods examined. Figure A-1-26 presents the sediment budget for May 1995 to November 2004. Wave induced transport carried the majority of the eroded material seaward of the -35 ft contour. During the 1995 to May 2004 period a number of severe storms, including Hurricanes Opal (1995), Danny (1997), Earl (1998), and Georges (1998) affected Walton County. As noted, this analysis does not include overwash, a common process during severe storms; inclusion of overwash in sediment budget computations would decrease the calculated volumes of sand transported offshore the -35-ft NGVD contour. For the short-term period encompassing Hurricane Ivan (Florida Panhandle landfall September 17, 2004) from May 2004 to November 2004, every cell experienced net erosion (Figure A-1-25). This pattern does not fit the typical storm-induced profile changes of subaerial erosion and subaqueous accretion, a pattern generally evident in Walton County after the impact of Hurricane Opal in 1995 (Taylor Engineering, 2003). The current calculations suggest catastrophic sediment losses, greater than 2.3 million cy across the -35-ft NGVD contour over the May to November 2004 analysis period. The May 1995 (pre-Hurricane Opal) to November 2004 (post-Hurricane Ivan) sediment budget (Figure A-1-26) illustrates the erosive effects from storm activity over the past nine years.

Figures A-1-27 through A-1-29 present sediment budgets for the 1995 to May 2004, May 2004 to November 2004, and 1995 to November 2004 analysis periods with the results delineated by the five reaches of Analysis B. Notably, Analysis B simply presents the volume change data of the prior three figures with different longshore limits for the reaches. Figures A-1-27 through A-1-29 indicates similar features with erosion indicated in every cell for the three analysis periods. Attachment II includes volume change tables and plots for the 1995 to May 2004, May 2004 to November 2004, and 1995 to November 2004 periods.

GENESIS SHORELINE CHANGE MODELING

GENESIS Model. The Generalized Model for Simulating Shoreline Change (GENESIS) (Hanson and Kraus 1989) is an elaborate one-line numerical model which simulates changes in shoreline position due to spatial and temporal gradients in longshore sediment transport. One-line sediment transport models, after the theory first outlined by Pelnard-Considere (1956), typically consider the beach profile to retain an

equilibrium shape, which shifts landward or seaward parallel to itself. Given this consideration, the position of only one contour requires monitoring. Thus, sediment motion occurs uniformly over the entire active profile confined between two well-defined limiting elevations: the top of the active berm and the depth of closure.

GENESIS simulates changes in shoreline position due to the presence and combinations of beach fills and hard nearshore structures such as groins, jetties, seawalls, and breakwaters. The model allows for sand bypassing around and through groins and jetties, accommodates wave diffraction by long groins (i.e., jetties) and offshore breakwaters, and wave transmission through breakwaters. Wave conditions, which drive the model, consist of wave height, period, and direction and can originate from multiple sources. Boundary conditions are required at the two lateral boundaries (shoreline ends), and shoreline evolution depends directly on their specification. Model application typically occurs phases for site-specific locations: calibration, verification, and predictive simulations. Calibration runs establish site-specific parameters. Verification simulations assure accurate calibration of the model. Predictive simulations estimate the performance of any proposed beach fill or structural modifications.

Model Theory. GENESIS considers longshore sediment transport due to breaking waves only. The dynamic equation or the statement of the longshore sand transport rate, Q, is expressed as

$$Q = H_b^2 C_{g,b} \left(a_1 \sin 2\theta_b - a_2 \cos\theta_b \frac{\partial H_b}{\partial x}\right) \tag{1}$$

where H_b is the breaking wave height, $C_{g,b}$ the breaking wave group velocity, x the longshore direction, and θ_b the angle of breaking waves referenced to the shore-perpendicular direction. The first term in parenthesis considers sediment transport generated by the longshore component of the breaking wave energy flux (e.g., Inman and Bagnold, 1963). The second term modifies the transport rate to account for longshore gradients in breaking wave height. The nondimensional parameters, a_1 and a_2, are defined by

$$a_1 = \frac{K_1}{16(s-1)(1-p)(1.4116)^{5/2}} \tag{2}$$

and

$$a_2 = \frac{K_2}{8(s-1)(1-p)\tan\beta(1.1416)^{7/2}} \tag{3}$$

where K_1 and K_2 are empirical nondimensional constants (calibration parameters), s is the specific gravity of sand (~2.65), p is the in-place sediment porosity (~0.4), and tan β is the average nearshore bottom slope. Using the root mean square (rms) wave height in their calculations, Komar and Inman (1970) recommended K_1 = 0.77; Kraus et al. (1982) suggested K_1 = 0.58 on the basis of sand tracer experiments; Bodge and Kraus (1991) suggested K_1 = 0.32; and Hanson and Kraus (1989) recommended K_2 = 0.5 –

1.0 K_1; however, given the many approximations and assumptions inherent in the model, the nondimensional coefficients serve as calibration parameters. The factor 1.1416 in Equations 2 and 3 converts input significant wave heights to root mean square (rms) values. Notably, the second term (K_2) is typically much smaller than the first term (K_1), except near diffracting structures.

GENESIS then requires a second equation, the continuity equation (a statement of the conservation of sand):

$$\frac{dy}{dt} + \frac{1}{h_* + B}\frac{dQ}{dx} = 0 \qquad (4)$$

where y is the position of the shoreline, and B and h_* are the berm elevation and the depth of closure. Equation 4 simply calculates shoreline advance (accretion) or retreat (erosion) depending on the difference of sand entering and exiting each grid cell.

The internal wave model in GENESIS, which assumes parallel bottom contours, refracts, shoals, and diffracts (if necessary) the given offshore waves to the breaker line. In cases where the modeled reaches exhibit complex offshore bathymetry, and given the degree of sophistication required, a more comprehensive external wave model (e.g., STWAVE; Resio, 1988) can simulate the wave climate to an arbitrary nearshore reference line. From there, the internal wave model of GENESIS takes over the remaining wave transformation calculations.

GENESIS Model Setup. To represent the shoreline behavior at the extents of Walton County, the GENESIS model domain was laterally extended to locations where edge effects would not affect model results. Ideally, the lateral extents of the model domain should occur at the terminal points of littoral cells with known transport rates. The eastern lateral boundary of the model domain occurs at FDEP monument R-34 in Bay County, Florida, approximately 7.0 miles from the eastern edge of Walton County. The western lateral boundary lies at East Pass near R-17 in Okaloosa County, Florida, approximately 6.3 miles from the western edge of Walton County. The GENESIS model grid consists of 1336 cells with 150 ft spacing for a total length of 38.0 miles. Aside from the site-specific model parameters, GENESIS requires measured shoreline positions and wave data to calibrate and verify the model setup.

Shoreline Data. Finding concurrent shoreline data for the entire model domain proved difficult given the domain encompassed parts or all of three counties. The GENESIS model applies FDEP monitoring data for the input shoreline locations. All cases during the calibration and verification applied shoreline data from Bay and Okaloosa Counties for the closest time possible to the relevant Walton County survey. Table A-1-14 presents the survey dates for the shoreline data for calibration and verification. A calibration period of July 1984 to July 1995 and a verification period from March 1996 to March 1998 provide the best combination of the relevant parameters: length of record, storm history, data record in main region of interest (Walton County), and data record in bordering counties. All data uniformly reference NAVD88.

Table A-1-14. FDEP Survey Dates For Calibration and Verification Shoreline Data

		Florida County		
		Bay	**Walton**	**Okaloosa**
Calibration	Start	Sep-84	Jul-84	Jul-84
	End	Aug-95	May-95	Apr-95
Verification	Start	Jan-96	Mar-96	Mar-96
	End	Jun-97	Jan-98	Mar-98

Analysis of recent shoreline position data indicates a stable or accreting shoreline in Walton County in the absence of severe storms. Taylor Engineering (2003) presents a regression analysis performed with shoreline position data from 1973 to 1995, a period of generally mild storm events, which documents the stable shoreline trend. Since 1995, a number of severe storms, including Hurricanes Opal, Earl, Georges, and Ivan, have affected Walton County. These hurricanes caused significant shoreline changes generally through cross-shore sediment transport; a process not modeled within GENESIS.

Choosing calibration and verification periods with little hurricane activity allows modeling of transport mainly in the longshore direction; the direction of transport for which GENESIS was designed. GENESIS generates shoreline positions for each 150 ft grid cell from the measured shoreline data. The shoreline measurements generally have a longshore spacing of approximately 1,000 ft (every FDEP monument) or every 3,000 ft (every third FDEP monument).

Wave Data. The WIS hindcast provided the time series of offshore wave conditions (wave height, period, and direction) for the GENESIS model. The 1980-1999 WIS hindcast data for Station 180, located at 30.17°N, 86.25°W, and positioned in deep water (102 ft depth) is unaffected by the complex nearshore bathymetry. Longshore bars that weld onto the shoreline in Walton County can cause significant variability of the shoreline position in the longshore direction. The presence of these bars can alter the bathymetry and therefore affect wave propagation in the nearshore zone. WIS data were obtained for the calibration and verification periods of July 1984 to July 1995 and March 1996 to March 1998, respectively. Table A-1-15 presents the wave height, wave period, and wave direction bands applied in this study.

External Wave Model. Successful modeling of longshore transport requires accurate wave transformation of the offshore data. If the offshore bathymetry is irregular, an external wave model may be applied to provide a better representation of wave transformation before wave breaking. The external wave model calculates wave transformation over the actual (irregular) bathymetry from the offshore reference depth to a user-defined nearshore reference line that lies seaward of the breaking zone. For this study the depth of WIS station 180 defines 102 ft as the offshore reference depth with the nearshore reference line defined as 19.7 ft. GENESIS then calculates the transformation, assuming straight and parallel bottom contours, from the user-defined reference depth to the breaking point.

Table A-1-15. Wave Modeling Study Bins

Bins for Wave Modeling Study		
Wave Height, H (ft)	**Wave Period, T (s)**	**Wave Direction, (deg)**
H < 33	T < 3.3	-90 < Dir < -45
	3.9 < T < 4.5	-45 < Dir < -25
	4.5 < T < 5.5	-25 < Dir < -10
	5.5 < T < 7.5	-10 < Dir < 0
	7.5 < T < 10	0 < Dir < 10
	10.0 < T < 12.5	10 < Dir < 25
	12.5 < T < 15.0	25 < Dir < 45
		45 < Dir < 90

The external wave model Steady-State Spectral Wave (STWAVE) model (Smith et al., 2001) was applied to transform the wave field from WIS Station 180 to a depth outside the breaking zone. The Nearshore Evolution Modeling System (NEMOS) suite of programs within the Coastal Engineering Design and Analysis System (CEDAS) software coupled the STWAVE and GENESIS modeling. The STWAVE grid extends outside the lateral boundaries of the GENESIS domain (i.e., east of R-34 in Bay County and west of East Pass in Okaloosa County) to remove edge effects. Figure A-1-30 presents the GENESIS and STWAVE modeling domains.

The STWAVE model grid contains bathymetry data from the May 2004 USACE CHARTS lidar survey in the nearshore and from the U.S. East Coast Advanced Circulation (ADCIRC) Model (USACE, 2002) in the offshore. The CHARTS data, while extending to depths over 55 ft for most longshore locations, provide the benefits of encompassing the entire three county domain into a single survey. Filtering the CHARTS data to a more manageable level reduced the resolution of the data. Merging the CHARTS and ADCIRC data created a uniform transition between data sets.

The STWAVE grid consists of 405 and 1509 cells in the cross-shore and longshore directions, respectively. A uniform spacing of 150 ft in the cross-shore and longshore directions defines the grid, with an orientation of 20 degrees clockwise from North to best match the general regional contours and landform.

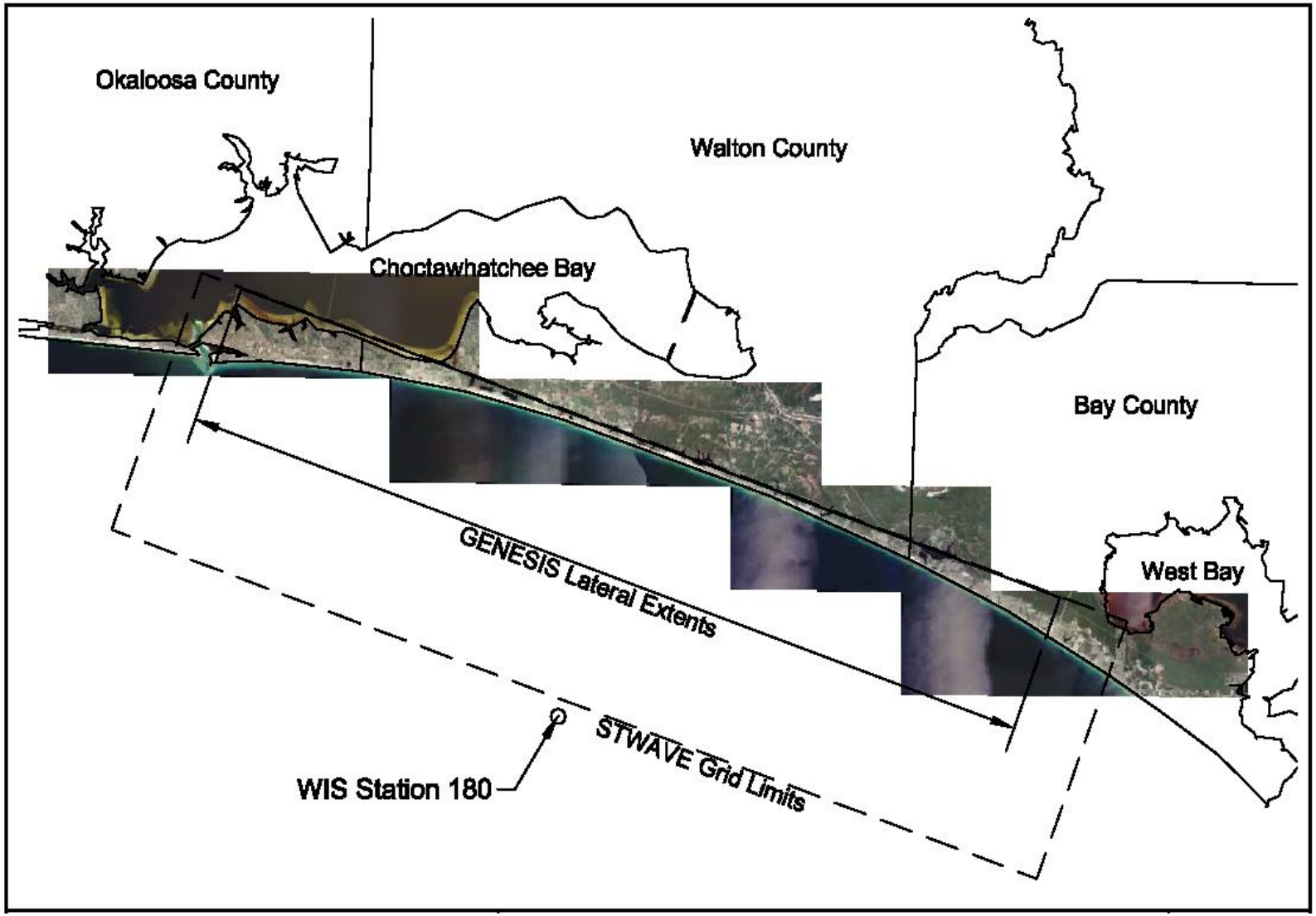

Figure A-1-30. GENESIS and STWAVE Modeling Domains

Calibration/Verification. Model calibration and verification establishes the site-specific model parameters for the predictive simulations. A shoreline without an historical trend, erosive or accretive, presents a challenging environment for a one-line shoreline change model such as GENESIS: numerous forcings can result in no shoreline movement. Matching accepted longshore transport rates within the model domain provides an alternative to matching shoreline positions in the case of a relatively stable shoreline such as Walton County in the absence of storm events (Mark Gravens, personal communication). For this study the calibration and verification procedures compare the longshore transport rates from the published Walton County sediment budget (Taylor Engineering, 2003) with the GENESIS results. Comparing the average longshore transport rates within 10 reaches provides a means to compare the predictive capability of the GENESIS model to historical values. GENESIS provides the net, gross, easterly, and westerly longshore transport values at each cell within the model domain.

Site-Specific Model Parameters. Review of beach profile and sediment characteristic data from Walton County (Taylor Engineering, 2003) formed the basis for selecting some of the site-specific model parameters. Selected model parameters, which characterize the Walton County domain, include a median sand grain size, D_{50} , of 0.30 mm, a berm height of 5.0 ft-MHW, and a depth of closure of -30.0 ft-MHW. Notably, the selected values represent average conditions for Walton County, as GENESIS requires a single value of grain size, berm height, and depth of closure to characterize the entire domain. The GENESIS model grid (containing 1336 grid cells, each 150 ft wide) extends from R-34 in Bay County, Florida westward to East Pass (R-17) in Okaloosa County, Florida. The eastern extent of the model grid features a pinned boundary condition. The western extent of the model grid features an open boundary condition with the eastern jetty set to 10 percent permeability. Transport coefficients K_1 and K_2 represent the tuning parameters. Hanson and Kraus (1989) indicate K_2 typically falls between 0.5 to 1.0 times the value of K_1. Transport parameters of K_1 = 0.2 and K_2 = 0.1 served as initial values.

Model Results. An extensive and iterative calibration and verification process optimized the transport coefficients K_1 and K_2 within the Walton County extents (R-1 to R-127). The calibration process compared the GENESIS longshore transport to values from the published sediment budget. Comparing the GENESIS estimated shoreline positions to historical data for the calibration period provided a secondary consideration. Initial modeling was unable to match the published longshore transport values or capture the historical shoreline trends. The initial modeling varied the transport coefficients K_1 and K_2, berm height, depth of closure, lateral boundary conditions, grain size, and the influence of the external wave model in an attempt to match the regional behavior.

After numerous iterations, applying a regional contour trend within GENESIS attempted to match the sediment budget values of longshore transport. In the absence of any obstructing elements, a one-line model (such as GENESIS) will evolve toward a straight line given enough time. Adding a regional contour trend in GENESIS reflects the effect of features and processes that the model does not otherwise represent. The concave

curvature of the existing Walton County shoreline required inserting the regional contour, which matches the persistent, regional shape.

Table A-1-17 presents the GENESIS longshore transport estimates with K_1 = 0.13 and K_2 = 0.1 including a regional contour trend for the calibration period July 1984 to July 1995. The two transport coefficient values and the particular regional contour trend produced the best comparison with the data from the sediment budget and measured shoreline data. The longshore transport coefficients and regional contour trend were chosen after much iteration based on the longshore transport and shoreline position errors, with more consideration given to the longshore transport values. Table A-1-16 lists the published longshore transport by reach for comparison and the difference between the sediment budget and GENESIS values. The GENESIS predicted longshore transport values agree well with the data from the sediment budget for each of the 10 longshore reaches that comprise Walton County.

The GENESIS model produces an average absolute shoreline error of 20.5 ft for the calibration period. Figure A-1-31 shows the measured shoreline change during the calibration period versus the shoreline change predicted by GENESIS. The GENESIS predicted final shoreline position follows several of the shoreline advance/retreat trends in the longshore direction; however, the magnitude of the GENESIS shoreline changes indicates less shoreline advance, or even retreat. Overall, shoreline measurements for the calibration period indicate an average 1.8 ft/yr accretion for Walton County. The GENESIS predictions indicate an average 0.55 ft/yr accretion, indicating significantly less shoreline advance during the calibration period. Historical data and local storm history suggest that a significant portion of the measured shoreline advancement may result from cross-shore sediment movement, a process GENESIS does not model. Significant variation in the measured and modeled shoreline positions required the application of a 30-point smoothing filter (twice) for the measured and final calculated shoreline positions; this procedure, commonly performed on shoreline position data, removes shoreline variation or noise in the longshore direction.

Judging the GENESIS model and parameters applied to develop Table A-1-16 and Figure A-1-31 as acceptable, after thorough comparison with historical data, the published sediment budget for Walton County, and other modeling iterations, the model was employed for the verification stage.

The model verification period spanned from March 1996 to March 1998. Applying the site-specific parameters developed in the calibration phase (K_1 = 0.13, K_2 = 0.1, and regional contour) to the verification period provides additional confirmation of the modeling capability of the GENESIS model. Table A-1-17 presents the GENESIS longshore transport estimates for the verification period. The table lists the published longshore transport by reach for comparison and the difference between the sediment budget and modeled values. The GENESIS predicted longshore transport values compare reasonably well with the data from the sediment budget, similar to the calibration results, for each of the 10 longshore reaches. On average, a slight over estimation of the longshore transport exists for this period.

Table A-1-16. Genesis Longshore Transport Results With Regional Contour

		GENESIS	Data from	Absolute Difference
Reach	**Monuments**	**Average by Reach**	**Sed Budget**	**Measure-Sed Budget**
		[m^3*1000]	**[m^3*1000]**	**Change (m^3*1000)**
1	R-1 to R-19	37.9	35.2	2.7
2	R-19 to R-23	40.0	36.7	3.3
3	R-23 to R-41	47.5	44.4	3.1
4	R-41 to R-48	47.5	45.9	1.6
5	R-48 to R-55	45.1	43.6	1.5
6	R-55 to R-64	44.1	39.8	4.4
7	R-64 to R-80	43.6	40.5	3.0
8	R-80 to R-98	45.4	43.6	1.8
9	R-98 to R-109	49.3	45.9	3.4
10	R-109 to R-127	51.9	48.2	3.7
Average of 10 Reaches		45.2	42.4	

Table A-1-17. Genesis Longshore Transport Results With Regional Contour (K_1=0.13, K_2=0.1) For Verification Period (March 1996 To March 1998)

		GENESIS	Data From	Absolute Difference
Reach	**Monuments**	**Average by Reach**	**Sediment Budget**	**Measure Sediment Budget**
		(m^3*1000)	**(m^3*1000)**	**Change (m^3*1000)**
1	R-1 to R-19	35.5	35.2	0.3
2	R-19 to R-23	35.3	36.7	1.4
3	R-23 to R-41	46.2	44.4	1.9
4	R-41 to R-48	46.3	45.9	0.4
5	R-48 to R-55	44.3	43.6	0.7
6	R-55 to R-64	41.1	39.8	1.3
7	R-64 to R-80	41.5	40.5	0.9
8	R-80 to R-98	43.1	43.6	0.5
9	R-98 to R-109	48.6	45.9	2.7
10	R-109 to R-127	50.8	48.2	2.6
Average of 10 Reaches		43.3	42.4	

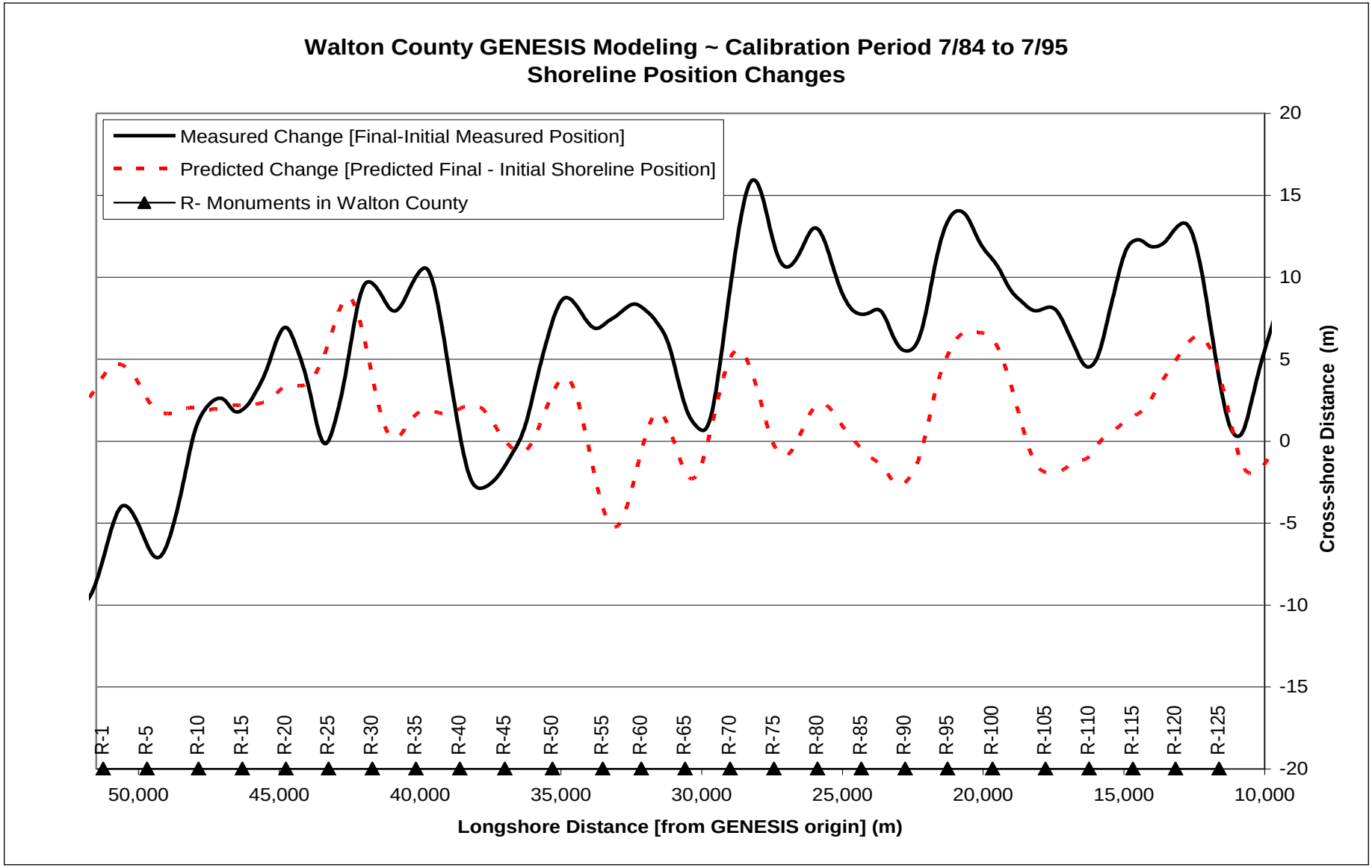

Figure A-1-31. MEASURED vs. GENESIS Predicted Shoreline Change: Calibration Period (7/84 TO 7/95) With K_1=0.13, K_2=0.1

The GENESIS model produces an average absolute shoreline error of 15.5 ft for the verification period. Figure A-1-32 shows the measured shoreline change during the verification period versus the shoreline change GENESIS predicted. The predicted final shoreline position matches many of the shoreline advance/retreat trends in the longshore direction. The most significant deviations in the predicted versus measured values occur in the western portion of Walton County (R-100 to R-127) with the GENESIS model predicting more erosion than measured.

Overall, shoreline measurements for the verification period indicate an average 2.4 ft/yr of erosion for Walton County. The GENESIS predictions indicate accretion with an average advance of 2.3 ft/yr. As in the calibration period results, application of a 30-point smoothing filter removed shoreline position noise in the longshore direction. The verification modeling was deemed satisfactory based on the reasonable agreement between the predicted longshore transport values and the sediment budget values, and combined with the fair agreement of the shoreline positions.

GENESIS Modeling. The calibrated and verified GENESIS model allows prediction of future without project conditions and future with project conditions in the Walton County project area. Shoreline modeling in the absence of any beach project in the study area allows estimation of the future shoreline positions: future without project conditions. Insertion of MHW shoreline extensions to represent the planform of a beach fill allows simulation of future with-project conditions in GENSIS. A May 2004 USACE CHARTS survey supplied the shoreline data applied as the initial condition. The CHARTS survey has the benefit of encompassing the entire GENESIS domain (all of Walton County and parts of Bay and Okaloosa counties) in a single survey.

Representative Wave Conditions. The calibrated and verified GENESIS model for Walton County simulated representative wave forcing within the project domain. Applying the entire 20-year WIS record (1980 to 1999) as the offshore wave forcing established a year with average wave conditions. This analysis provides longshore transport (net, gross, left, and right) predictions for each year in the wave record. Comparing the resulting longshore transport predictions within each reach to the values from the sediment budget allows the selection of the most representative wave-year. Table A-1-18 presents the net longshore transport estimates within each reach for each year from 1980 to 1999. The last column lists the values from the sediment budget for comparison. Comparison of the yearly average values within each reach, as well as the gradients between reaches, indicates that the wave-year from January 1, 1993 to December 31, 1993 most closely matches the values from the sediment budget. Thus, the predictive GENESIS models repeat the wave conditions from January 1, 1993 to December 31, 1993 for the length of the predictive run.

Future Without Project Shoreline Position. Figure A-1-33 presents the predicted shoreline change following five years of representative wave conditions. The results indicate significant scatter in the shoreline positions, even with a 30-point moving filter applied. The average shoreline change within the project area measures 0.51 ft/yr indicating slight accretion; however; this average value masks the prevalence of the shoreline fluctuations that generally fall within +/- 6.56 ft/yr.

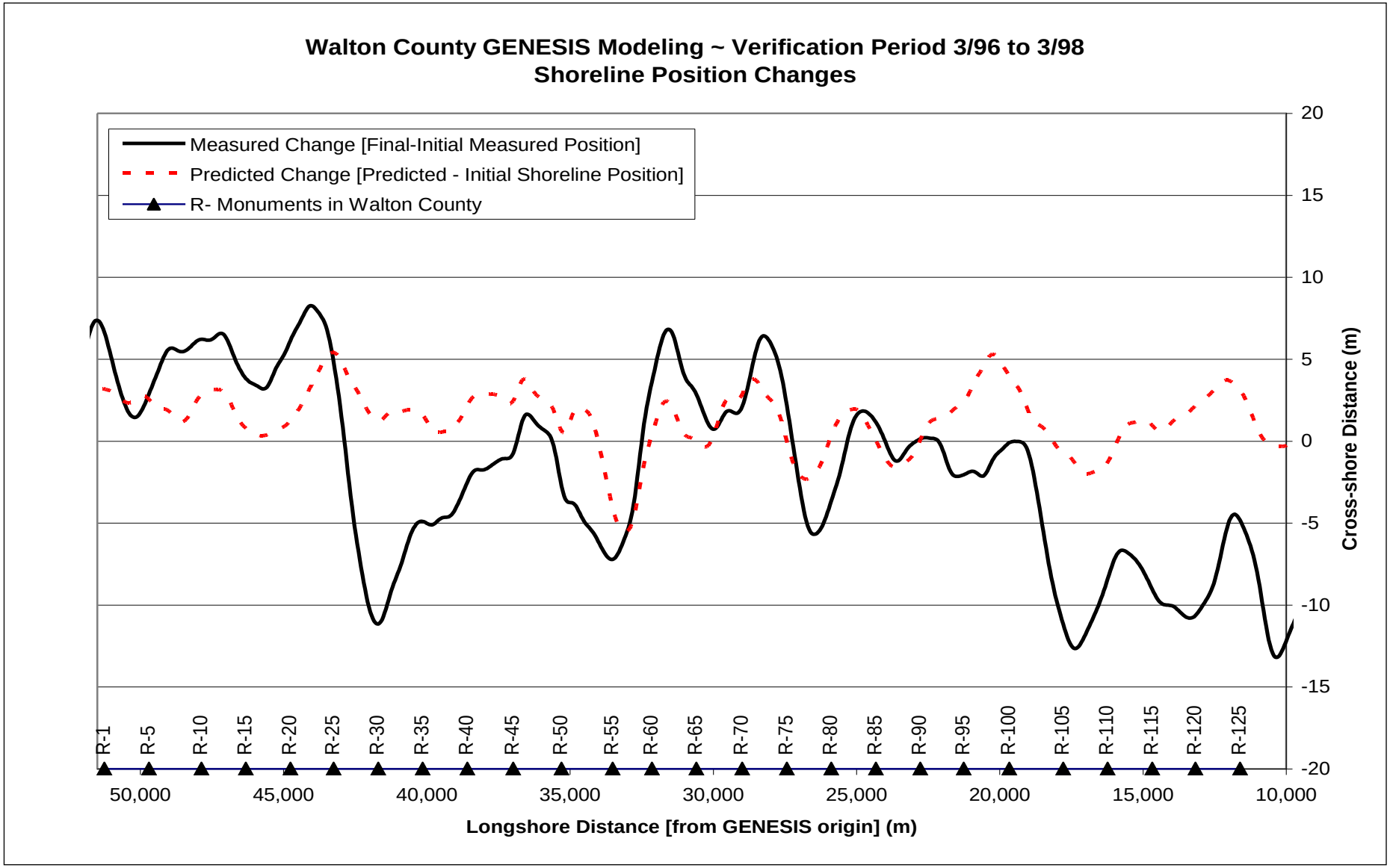

Figure A-1-32. MEASURED vs. GENESIS Predicted Shoreline Change: Verification Period (3/96 To 3/98) With K_1=0.13, K_2=0.1

Table A-1-18. GENESIS Longshore Transport Estimates For Representative Wave-Year Analysis

	Reprentative Wave-Year Analysis ~ Longshore Transport Average by Reach																				
NET TRANSPORT	[m^3*1000]																				Data from
end date (annual)	80_1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Sed Budget
																					[m^3*1000]
R-1 to R-19	33	47	82	104	34	79	32	29	49	17	35	35	22	38	39	58	45	22	76	47	35
R-19 to R-23	35	49	83	106	35	84	34	30	51	20	35	38	23	39	41	61	47	24	82	49	37
R-23 to R-41	43	58	90	118	41	99	40	35	59	28	39	46	29	46	50	71	55	32	96	55	44
R-41 to R-48	43	59	91	118	41	96	41	35	60	29	39	46	29	45	49	70	56	32	91	55	46
R-48 to R-55	41	55	88	113	39	92	39	32	57	28	38	44	27	43	46	68	53	30	88	52	44
R-55 to R-64	39	55	89	114	38	89	38	32	56	26	37	42	26	42	45	67	52	28	87	53	40
R-64 to R-80	38	54	87	111	38	90	38	31	56	26	37	42	26	41	46	66	51	28	87	52	41
R-80 to R-98	41	56	87	113	39	94	39	32	57	28	37	44	27	43	48	68	53	30	89	53	44
R-98 to R-109	45	61	91	121	43	101	43	35	62	33	39	48	30	46	52	73	58	35	95	56	46
R-109 to R-127	47	64	94	125	44	108	44	36	64	35	40	50	32	48	56	77	61	36	103	59	48
average	41	56	88	114	39	93	39	33	57	27	38	44	27	43	47	68	53	29	89	53	42

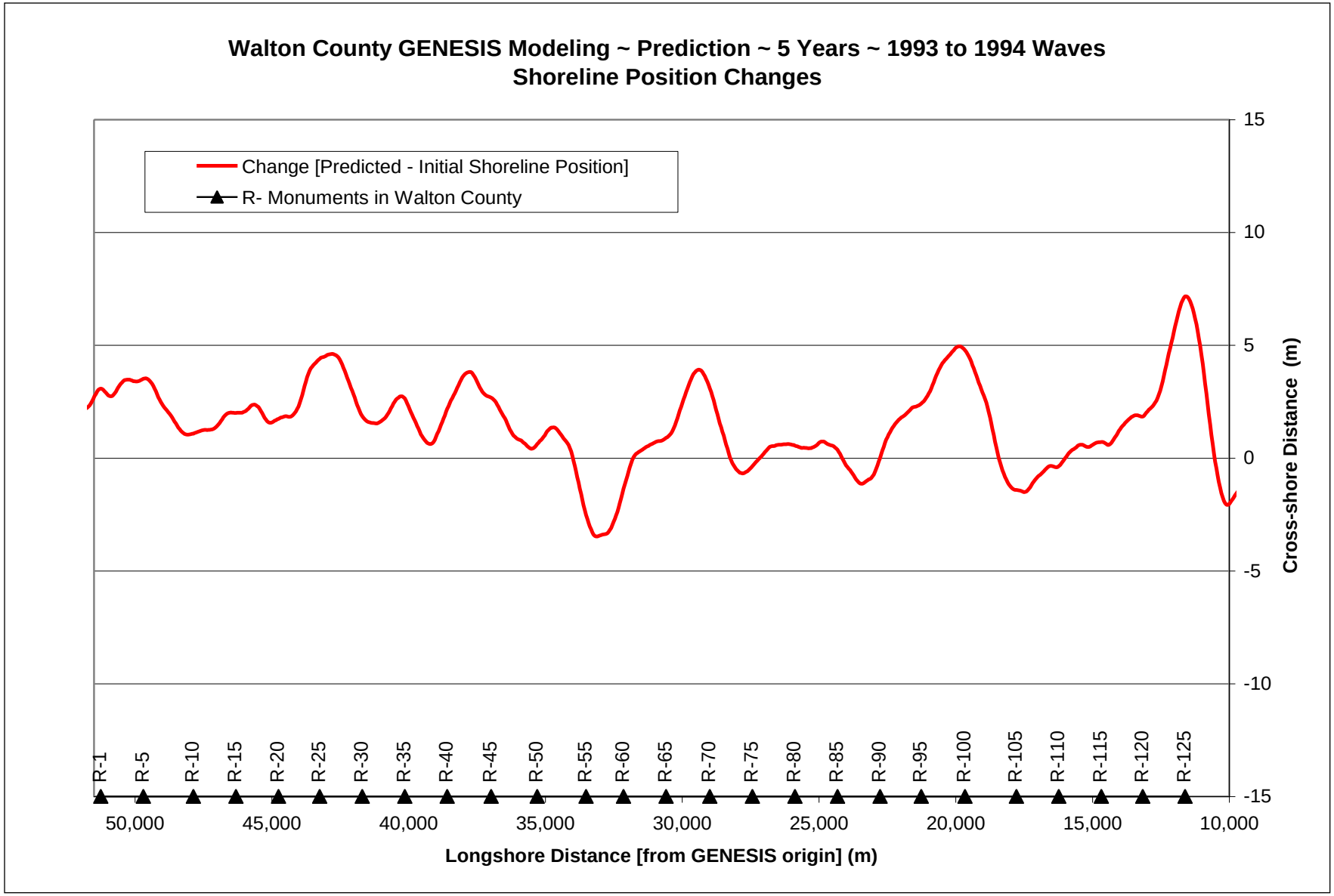

Figure A-1-33. GENESIS Predicted Shoreline Change For Future Without Project Modeling

The formulation of GENESIS, being a longshore transport model, does not include the significance of cross-shore sediment transport due to tropical or extra-tropical storms. The large waves generated by these storms would initiate shoreline changes in GENESIS; however, these changes would result from gradients in the longshore transport and not from the cross-shore sediment transport processes known to play a significant role in the storm-induced shoreline changes. Recent history has shown the considerable role of storms on shoreline change in Walton County. Therefore, to estimate the future without project shoreline conditions, one should apply a method that more completely includes the effects of tropical and extra-tropical storms.

Future Without Project Shoreline Data Assessment. Viewing historical shoreline position data provides another analytic tool to estimate future conditions based on historical data that include the effects of prior storms and the natural response that follows. Examining historical shoreline position data generally indicates dry beach behavior. The existence and availability of shoreline data, as compared to less prevalent but more useful beach profile data, makes examination of beach changes over many time periods useful.

Taylor Engineering (2003) provides MHW shoreline changes, calculated with linear regression, for four periods: the pre-Hurricane Opal intermediate-term (1973 - 1995), the post-Hurricane Opal short-term (1995 - 1998), the intermediate-term (1973 - 1998), and the long-term (1872 - 1998) periods. MHW for Walton County lies at +0.63 ft NAVD88 (+1.1 ft NGVD). Briefly, the pre-Hurricane Opal intermediate-term indicates slight accretion for almost all of Walton County with the majority of the accretion from 1985 to 1995, a period of recovery with few storms. The post-Hurricane Opal short-term period indicates significant erosion for all of Walton County following the major storm.

Including the most recent shoreline position data for Walton County from May 2004 and November 2004 allows assessment of the impact of Hurricane Ivan on shoreline conditions in Walton County. Applying a linear regression analysis of the shoreline position data for time periods including the 2004 data indicates the shoreline behavior over time with different forcing (storm histories) to discern trends caused by storms and periods of recovery characterized by minor storm activity. Table A-1-19 lists the six time periods evaluated with a linear regression analysis in this study: October 1973 to May 1995, October 1973 to May 2004, October 1973 to November 2004, May 1995 to May 2004, May 1995 to November 2004, and May 2004 to November 2004. Shoreline advancement and relatively small storm impacts generally characterize the October 1973 to May 1995 period. The May 1995 to May 2004 period contains the impacts of Hurricanes Opal and Georges and recovery. The May 2004 to November 2004 period contains the effects of Hurricane Ivan. Attachment III presents the shoreline change values for each FDEP monument in Walton County and each period from the regression analysis.

Table A-1-19. Periods Evaluated with Linear Regression Analysis of Shoreline Data

Period	1973 October		1995 May		2004 May		2004 November
1	←	—	→				
2	←	—	→				
3			←	—	→		
4			←	—	→		
5					←	—	→
6					←	—	→

Applying an averaging approach developed the future without project shoreline change rates. The shoreline behavior in Walton County made this averaging necessary for several reasons. First, periodic hurricane events cause significant shoreline erosion through mainly cross-shore sediment transport, which leaves the developed shoreline vulnerable to subsequent storms. Given enough time, cross-shore and longshore transport processes can result in shoreline recovery following large-scale erosion. The averaging procedure represents an attempt to include periods of storm activity (October 1973 to November 2004, May 1995 to May 2004) and periods of recovery (October 1973 to May 1995) to illustrate how Walton County's beaches function during different time periods.

Averaging with a moving five-point average of the shoreline positions (applied twice) removed much of the longshore variability in the shoreline position found in the Walton County data. The five-point moving average covers a longshore distance of approximately 5,000 ft as the shoreline measurements occur approximately every 1000 ft or every FDEP monument. For comparison, the 30-point filter applied in the GENESIS modeling covers 4,500 ft with a grid spacing of 150 ft. As stated, the extreme variation or noise in the shoreline positions may result from longshore bars welding to the shoreline. Having filtered the data in the longshore direction and across several periods, the future without project conditions represents realistic estimates of future shoreline trends with behavior suitable for subsequent numerical modeling.

Figure A-1-34 presents the future without project shoreline change rates. These rates contain the longshore (five-point filter) and time period interval averaging. The shoreline change rates fall generally within +/- 1 ft/yr. The figure also includes the 1973 to 2004 November regression analysis results to demonstrate the significant longshore variability in the data. The dashed line reveals the effect of including the five-point filters. Averaging the October 1973 to November 2004, October 1973 to May 1995, and 1995 May to 2004 May period regression values results in the interval average value. Based on many iterations and simulations, this interval average value presents a realistic future without project shoreline change trend. The interval average values indicate similar shoreline change rate magnitudes when compared to a FDEP analysis that lists rates of +/- 0.5 ft/yr from 1872 to 1997/98 for all locations in Walton County.

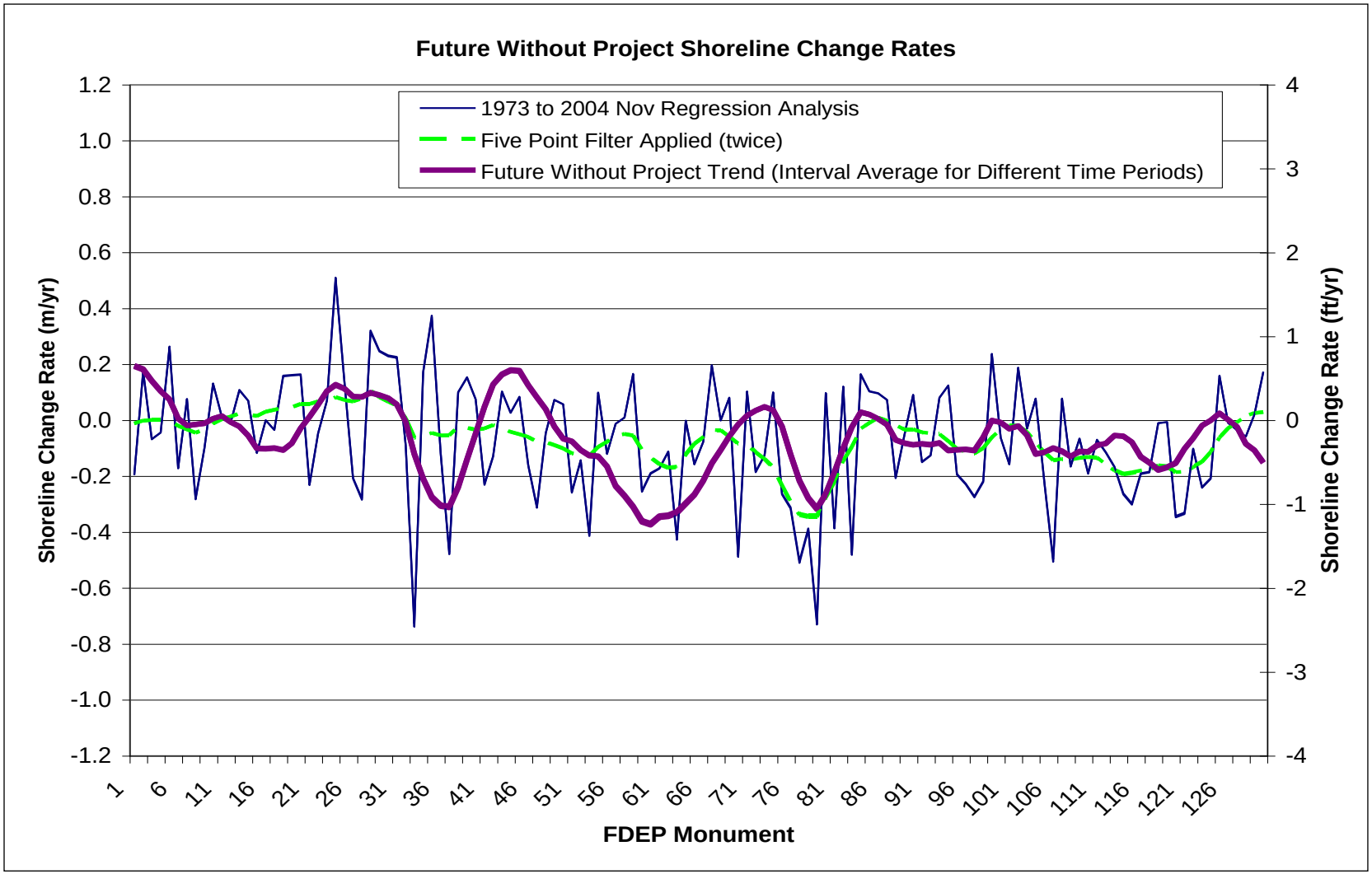

Figure A-1-34. Future Without Project Shoreline Change Rates From Measured Data

Future With-Project Shoreline Position. The USACE Mobile District provided the proposed beach fill planforms to evaluate in GENESIS: the National Economic Development (NED) plan and the locally preferred (LP) plan. Table A-1-20 presents details of the plans and indicates five proposed main construction reaches in the Walton County project area. The two plans allow evaluation of different beach fill configurations within the five main construction reaches. With the exception of Construction Reach 1, the LP plan matches the NED plan. All construction reaches apply a 25 ft (7.62 m) berm width extension and 25 ft (7.62 m) of advance nourishment. With the exception of transition areas, the GENESIS model applies a continuous MHW extension between R-monuments. The GENESIS simulations apply a 450-ft (137.2 m) transition at the ends of each beach fill segment.

Application of the representative wave conditions allowed evaluation of the design beach planform response at five-year intervals. The five-year interval represents the renourishment cycle of the federal Panama City Beach Shore Protection Project in Bay County, Florida, immediately east of Walton County. The with-project analysis simulated nine five-year intervals in GENESIS to evaluate beach planform spreading over a 53-year period of analysis. The design beach fill template, including advance nourishment, provided the initial shoreline position at the start of the analysis. The initial shoreline position for each subsequent five-year analysis combined the design beach fill template including advance nourishment with the final shoreline position of the preceding five-year interval. This procedure “renourishes” the design template and accounts for the shoreline accretion areas outside of the project caused by longshore spreading of the beach fill. As the beach fill evolves with time, the initial shoreline near the project transitions (and outside the construction reach) includes greater amounts of material lost from the design planform.

Figure A-1-35 presents the GENESIS predicted shoreline position relative to the without-project shoreline position for the NED plan. To demonstrate the modeling procedure, Figure A-1-35 only presents results for the first two five-year simulations - labeled as 5 Year and 10 Year shorelines. The results demonstrate the lateral spreading (diffusion) that occurs near the beach fill transitions. As the project evolves, areas outside of the design beach fill template receive sediment from the lateral spreading. For narrow reaches between beach fills, such as R-99 or R-105, the lateral spreading quickly causes the shoreline to advance almost 16 ft (5 m).

Figure A-1-36 presents the GENESIS predicted shoreline positions for each of the nine five-year simulations for the NED plan. The results demonstrate the lateral spreading (diffusion) that occurs near the beach fill transitions. As the project evolves, areas outside of the design beach fill template receive sediment from the lateral spreading and several areas (in-between nourished segments) have shorelines that advance over 16 ft (5 m) due to the lateral spreading of beach fill material.

Table A-1-20. Proposed Beach Fill Planforms for NED and LP Plans

FDEP Monument	Rep. Profile	Const. Reach	Exist Dune Width (ft)	Exist Berm Width (ft)	NED Dune Width (ft)	NED Berm Width (ft)	Scenario 6 NED Alt 1rev	LP Dune Width (ft)	LP Berm Width (ft)	Scenario 8 Local Preferred
										transition
R-1	R1P1							65	50	fill
R-2 to R-6	R1P1							65	50	fill
R-7	R1P1							65	50	fill
R-8	R1P1						transition	65	50	fill
R-9	R1P1	CR1	55	20	65	50	fill	65	50	fill
R-10 to R-13	R1P1	CR1	varies	varies	65	50	fill	varies	50	fill
R-14	R1P2	CR1	100	40	130	50	fill	130	50	fill
R-15	R1P2						transition	130	50	fill
R-16	R1P2							130	50	fill
R-17 to R-21	R1P2							varies	50	fill
R-22	R1P1							65	50	fill
R-23	R2P1									transition
R-41	R3P1						transition			transition
R-42	R3P1	CR2	75	50	85	50	fill	85	50	fill
R-43 to R-46	R3P1	CR2	varies	50		50	fill	varies	50	fill
R-47	R3P2	CR2	45	50	55	50	fill	55	50	fill
R-48	R3P1	CR2	75	50	85	50	fill	85	50	fill
R-49 to R-62	R3P1	CR2	75	50	105	50	fill	105	50	fill
R-63	R3P1	CR2	75	50	105	50	fill	105	50	fill
R-64	R3P2						transition			transition
R-66	R4P1						transition			transition
R-67	R4P1	CR3	50	35	60	50	fill	60	50	fill
R-68 to R-71	R4P1	CR3	varies	varies	varies	50	fill	varies	50	fill
R-72	R4P2	CR3	85	110	95	50	fill	95	50	fill
R-73	R4P2						transition			transition
R-77	R4P1						transition			transition
R-78	R5P2	CR4	65	52	75	50	fill	75	50	fill
R-79 to R-97	R5P2	CR4	varies	varies	varies	50	fill	varies	50	fill
R-98	R5P2	CR4	65	52	75	50	fill	75	50	fill
R-99	R5P3						transition			transition
R-105	R5P2						transition			transition
R-106	R5P2	CR5	65	52	75	50	fill	75	50	fill
R-107 to R-126	R5P2	CR5	varies	varies	varies	50	fill	varies	50	fill
R-127	R5P3	CR5	50	65	60	50	fill	60	50	fill
							transition			transition

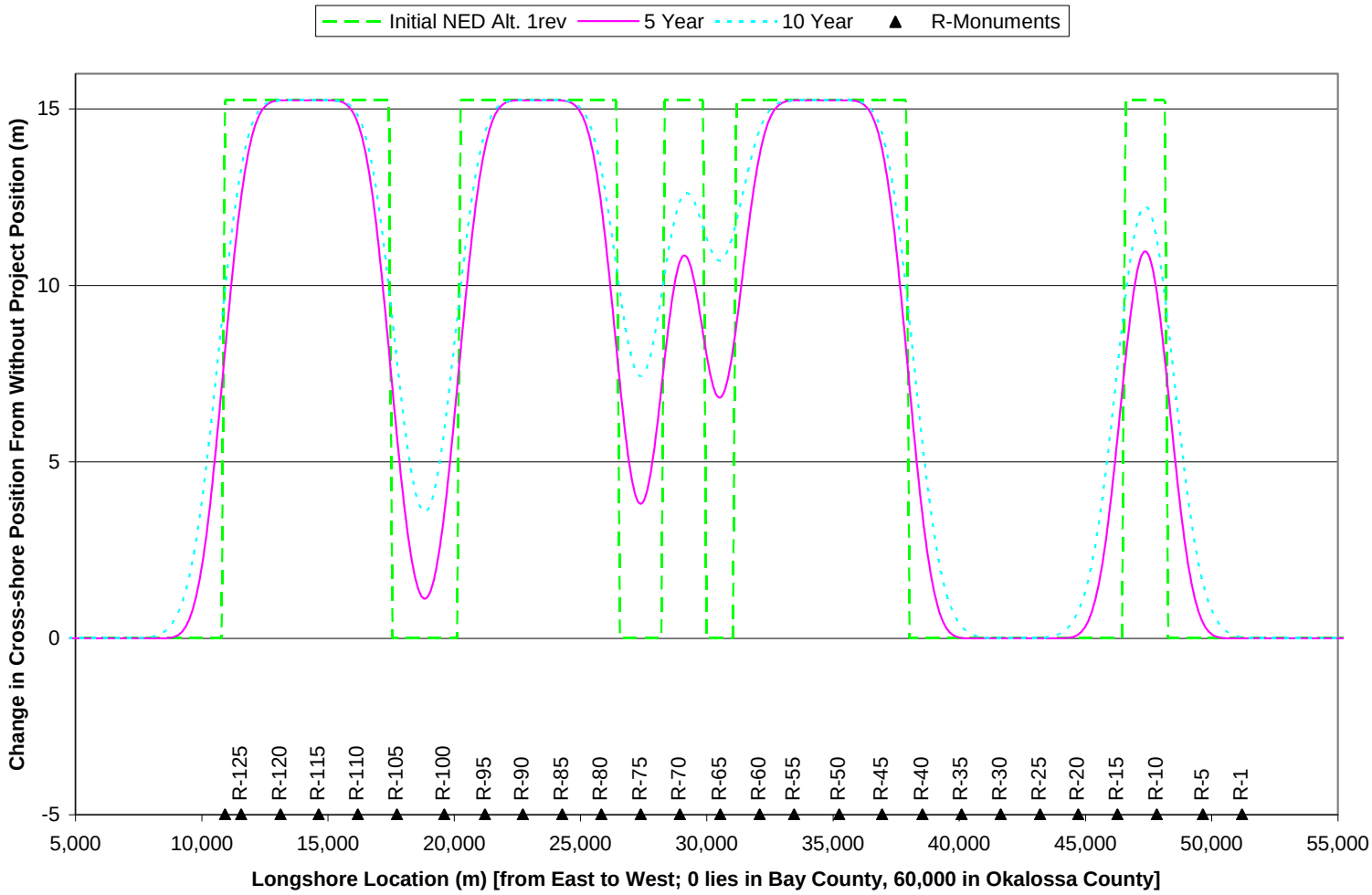

Figure A-1-35. GENESIS Predicted Shoreline Positions for Future With-Project Modeling - NED Plan

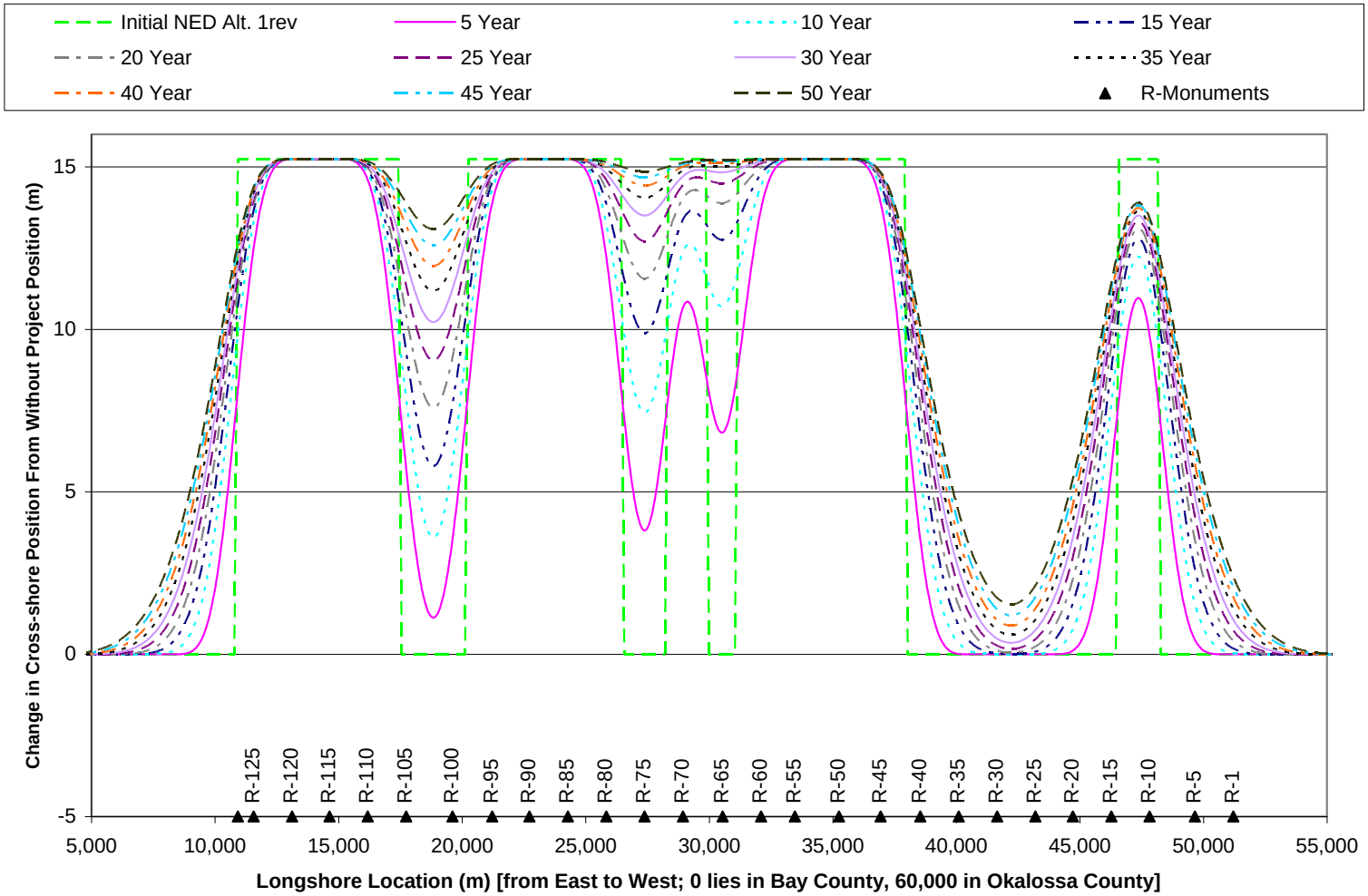

Figure A-1-36. GENESIS Predicted Shoreline Positions - Future With-Project Modeling NED Plan

Figure A-1-37 presents the predicted shoreline change (m/yr) for each of the nine simulations of five-year project evolution for the NED plan. The shoreline change compares the without-project evolution and the with-project for each five-year simulation. The figure clearly indicates that in comparison to the without-project simulations, the erosion occurs only near the transitions at the end of the beach fill segment. The plot also indicates that erosion decreases with each successive renourishment. The shoreline change rates diminish rapidly after the second renourishment with shoreline change rates generally less than 1.5 ft/yr (0.5 m/yr) near the transitions. The location of the erosion and the diminishing erosion rates with time follow standard coastal engineering theory and observations of constructed projects.

Figure A-1-38 presents the GENESIS predicted shoreline positions for each of the nine five-year simulations for the LP plan. With the exception of a longer beach fill in Construction Reach 1, the LP plan features the same planform as the NED Plan. The results demonstrate the lateral spreading (diffusion) that occurs near the beach fill transitions. Similar to Figure A-1-33 for the NED plan, as the project evolves, areas outside of the design beach fill template receive sediment from the lateral spreading and several areas (in-between nourished segments) have shorelines that advance over 1.5 ft (5 m).

Figure A-1-39 presents the predicted shoreline change (m/yr) for each of the nine simulations of five-year project evolution for the LP plan. The shoreline change compares the without-project evolution with the with-project for each five-year simulation. The figure clearly indicates that erosion occurs only near the transitions at the end of beach fill segment and that erosion decreases with each successive renourishment.

The GENESIS results allow estimation of the volume of material required to renourish the design template after each five-year simulation. The GENESIS results provide the cross-shore and longshore extents of material required. Application of berm height and depth of closure values (assigned in the GENESIS model) provides the vertical extent for the renourishment volume calculation. The GENESIS model applies a combined berm height and depth of closure value equal to 34.4 ft (10.5 m). For the NED and LP plans, Figure A-1-40 plots the percentage of the renourishment volume to the initial placement volume for each of nine simulations of five-year project evolution. Overall, because of the longer beach fill in Construction Reach 1, the LP plan has the smallest percentage of the renourishment to initial volume (and the highest initial and renourishment volume requirement).

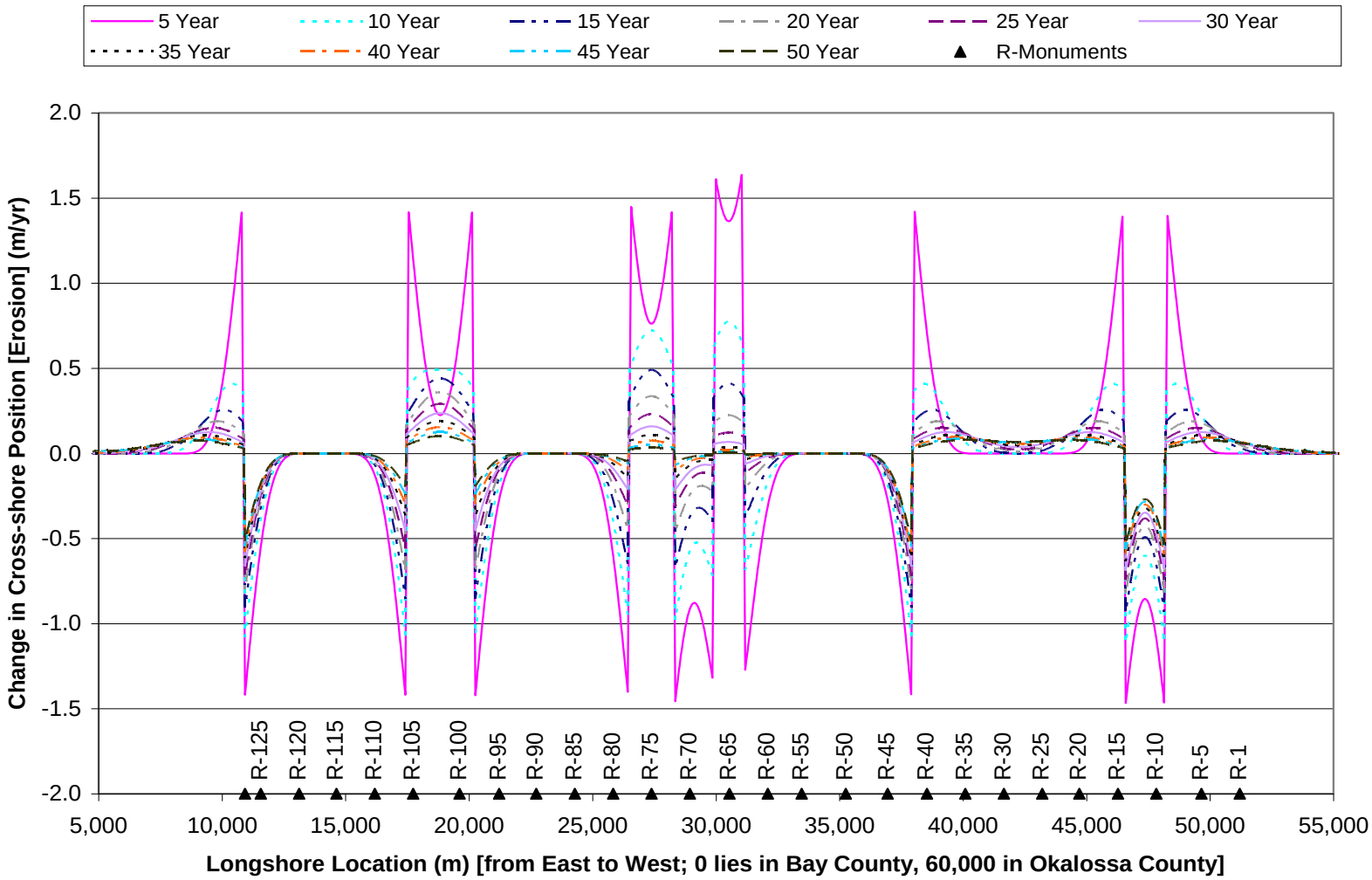

Figure A-1-37. GENESIS Predicted Shoreline Position Changes - Future With-Project NED Plan

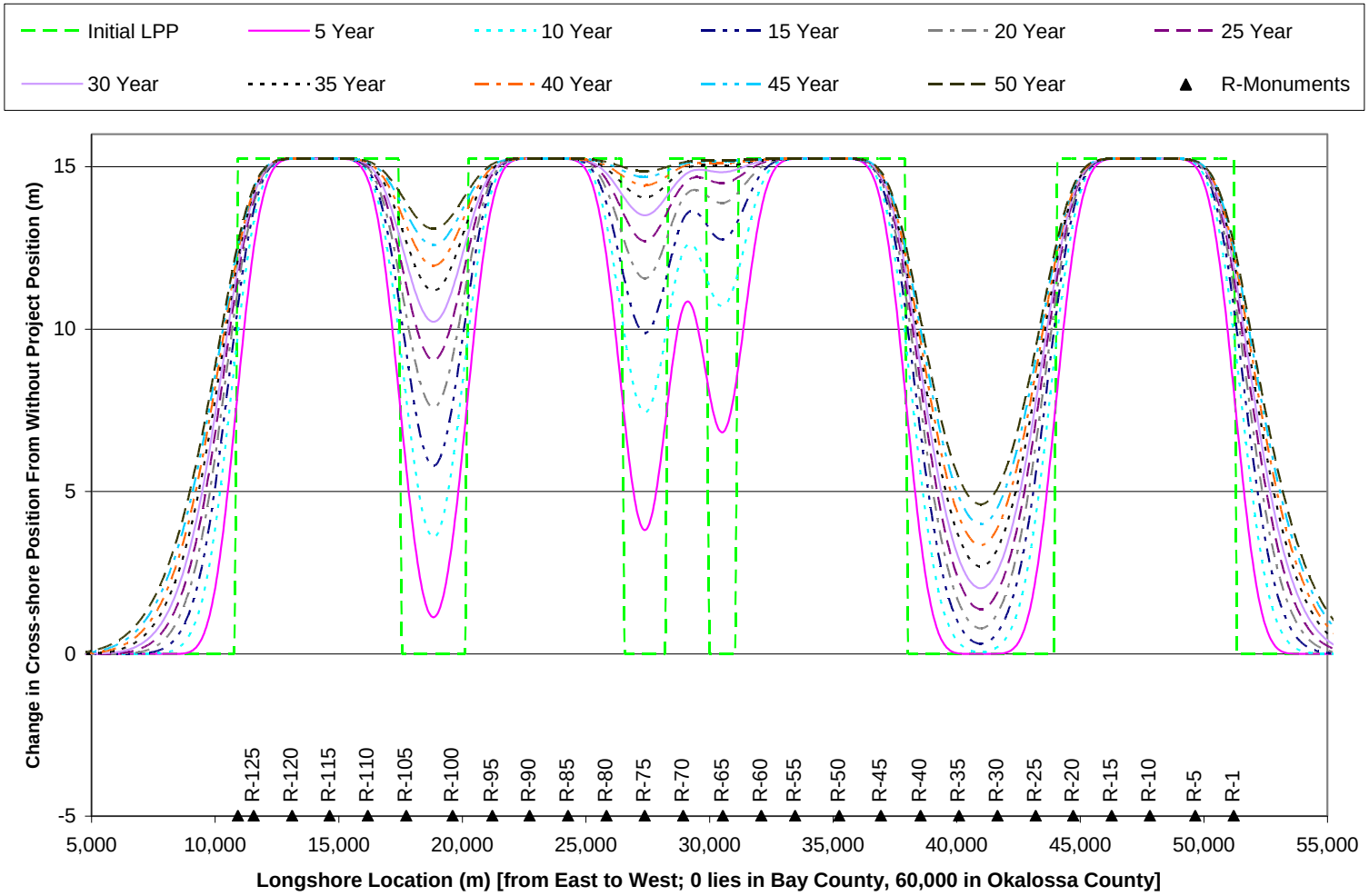

Figure A-1-38. GENESIS Predicted Shoreline Positions - Future With-Project Modeling LP Plan

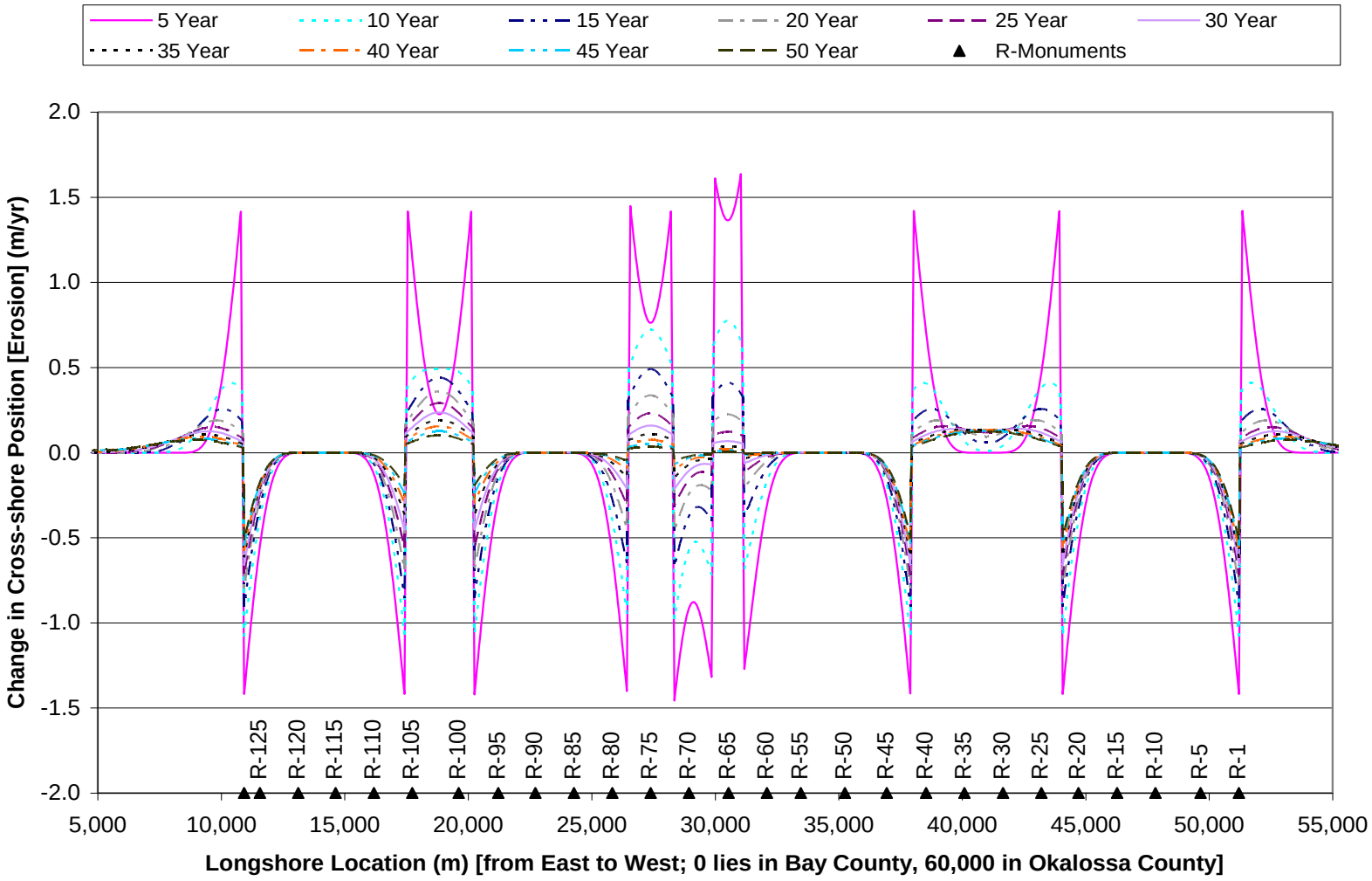

Figure A-1-39. GENESIS Predicted Changes in Shoreline Position - Future With-Project Modeling LP Plan

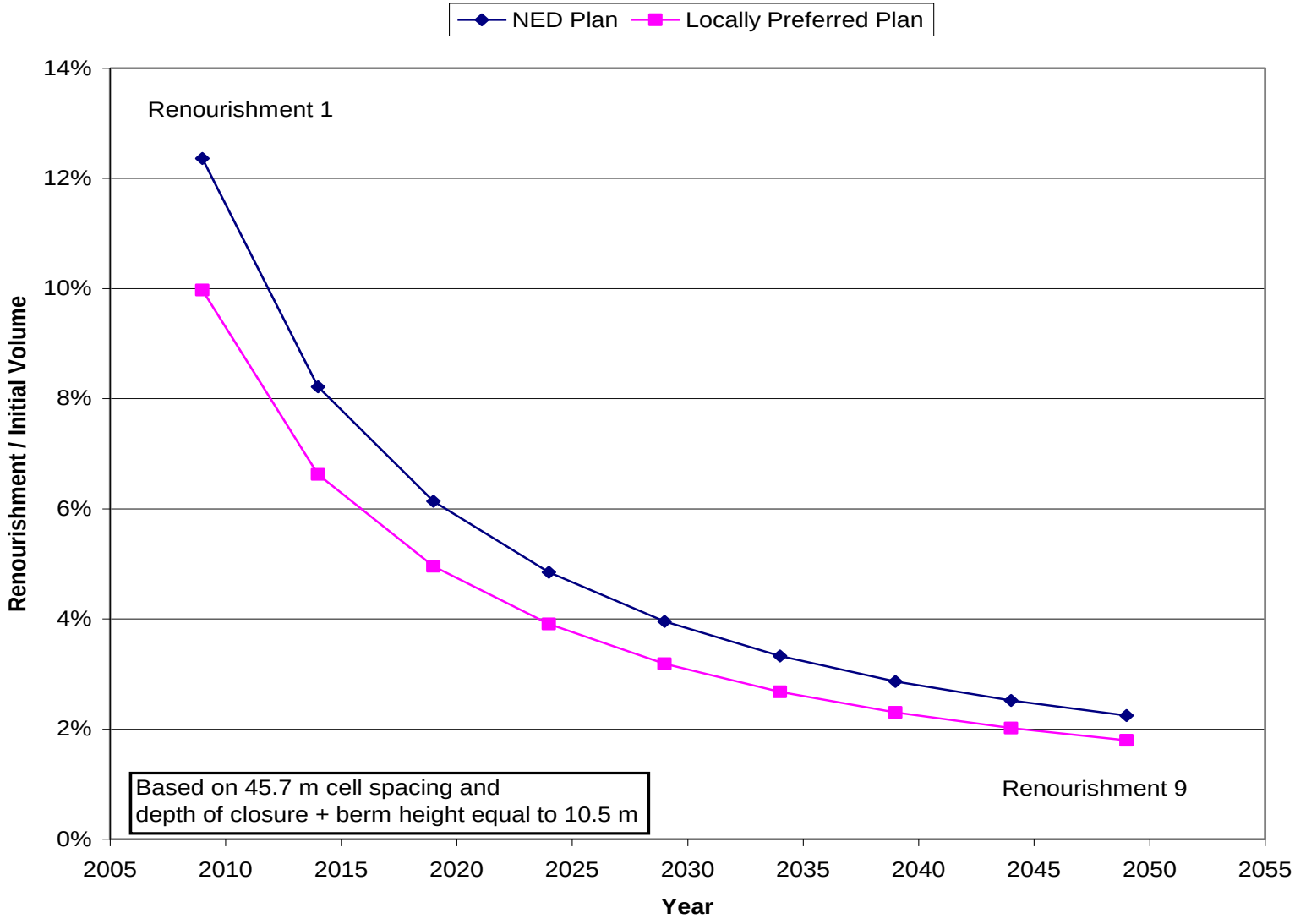

Figure A-1-40. GENESIS Predicted Percentage of Renourishment to Initial Volume for NED and LP Plans

The formulation of GENESIS, a longshore transport model, does not include the significance of cross-shore sediment transport due to tropical or extra-tropical storms. The large waves generated by these storms would initiate shoreline changes in GENESIS; however, these changes would result from gradients in the longshore transport and not from the cross-shore sediment transport processes known to play a significant role in the storm-induced shoreline changes. Recent history has shown the considerable role of storms on shoreline change in Walton County. Therefore, to estimate the future without-project shoreline conditions, one should apply a method that more completely includes the effects of tropical and extra-tropical storms.

Storm Induced Beach Profile Change. An important task of this study was to develop a capability to numerically simulate storm-induced beach profile change within the Walton County study area. This capability will allow the estimation of storm impacts such as, erosion distance (distance from 0 NGVD88 on initial profile to landward-most point of 1 ft vertical erosion/accretion), erosion volume above 0 NGVD, and other measures of storm impact. The modeled responses are subsequently processed using the USACE Beach-*fx* model, an engineering-economic Monte Carlo simulation model that relates beach profile change to storms, coastal processes, and nourishment programs for economic evaluation.

Storm-Induced BEAch CHange Model (SBEACH). SBEACH (Larson and Kraus 1989a; Larson, Kraus, and Byrnes 1990) is a numerical simulation model for predicting beach, berm, and dune erosion due to storm waves and water levels. A basic assumption of the SBEACH model is that profile change is produced solely by cross-shore processes, resulting in a redistribution of sediment across the profile with no net gain or loss of material. Longshore transport processes are assumed to be uniform and therefore can be neglected in the calculation of beach profile change. These assumptions are expected to be valid for short-term storm-induced profile response on open coasts away from tidal inlets and coastal structures. SBEACH was initially formulated using data from prototype-scale laboratory experiments and further developed and verified based on field measurements from four sites (Coastal and Hydraulics Laboratory's (CHL) Field Research Facility (FRF) at Duck, North Carolina; Manasquan and Point Pleasant Beach, New Jersey; and Torrey Pines, California) (Larson and Kraus 1989a, Larson, Kraus, and Byrnes 1990) and sensitivity testing (Larson and Kraus 1989a, 1989b). The SBEACH model calculates macroscale beach profile change using an empirical morphologic approach with emphasis on beach and dune erosion. In model simulations, the beach profile progresses to an equilibrium state as a function of the initial profile condition (including median grain size and shoreward boundary conditions) and storm conditions (wave height, period, and direction; wind speed and direction; and water level). The model predicts profile response to storms including wave over-topping and dune lowering (Kraus and Wise 1993, Wise and Kraus 1993). Model improvements including the implementation of a random wave model for wave transformation and sediment transport and the dune overwash algorithm are documented in SBEACH Report 4 (Wise, Smith, and Larson 1996) together with extensive model validation with data collected in both the laboratory and the field.

The SBEACH model is an empirically-based model of beach profile change that was developed with the expressed aim of replicating the dynamics of macroscale features dune and berm erosion using standard data available in most engineering applications (Larson and Kraus 1989a). Much of the following discussion is taken directly from SBEACH Reports 1 (Larson and Kraus 1989a), 2 (Larson, Kraus, and Byrnes 1990), and 4 (Wise, Smith and Larson 1996).

As discussed by Larson and Kraus (1989b), a fundamental assumption in the study of beach profile change is the existence of an equilibrium beach profile, which will be attained for a given beach if exposed to constant wave and water level conditions for a sufficient length of time. The idea is that a profile in the equilibrium state will dissipate all incoming wave energy without significant net change in shape (i.e., a constant rate of energy dissipation across the profile). Without an equilibrium profile, the beach would continue to erode or accrete (given adequate sediment supply) if exposed to the same wave and water level conditions. On a microscale level, equilibrium profiles do not exist in nature or the laboratory because waves, water level, water temperature, and other conditions cannot be held perfectly fixed for duration sufficient for the profile to attain equilibrium. Also, wave turbulence and breaking introduce randomness into the microscale sand motion, resulting in small continuous adjustments of the profile; however, on a macroscale level, equilibrium profile shapes have been approached in which no significant systematic net sand transport occurs. Primary factors controlling the shape of an equilibrium profile include waves, water levels, and beach characteristics (e.g., grain size and distribution).

SBEACH calculates a sediment transport parameter based on a simple analytical expression for the equilibrium beach profile shape developed by Dean (1977), which uses the concept of constant dissipation of wave energy per unit water volume,

$$h = A x^{2/3} \qquad (5)$$

where

- h = water depth (m)
- A = shape parameter, shown by Dean (1977) and Moore (1982) to be dependent on grain size ($m^{1/3}$)
- x = cross-shore coordinate (m)

For a profile evolving during a storm, where a bar normally forms in the vicinity of the break point, Equation 5 is expected to apply only to that portion of the surf zone shoreward of the bar where strong turbulence is present and energy dissipation is related to the breaking wave height and water depth. If wave reformation occurs, several areas along the profile may exist in which profile change is controlled by energy dissipation per unit volume and the profile in these areas is expected to be well approximated by Equation 5.

If a beach profile is not in equilibrium with the existing wave and water level climate, SBEACH redistributes sediment across-shore to produce an equilibrium profile shape in which incident wave energy is dissipated without causing further significant net

sediment movement. As a beach profile approaches an equilibrium shape dictated by the incident waves, the net cross-shore transport rate decreases asymptotically to approach zero at all points along the profile. This is an idealized situation, which never happens in nature during storm events due to constantly changing conditions and complex microscale processes.

Criteria for predicting whether a beach will erode or accrete through cross-shore sand transport processes typically include one parameter characterizing the incident wave condition and another parameter involving some property of the sediment (grain size or fall speed) and/or beach slope. In development of SBEACH, the deepwater wave steepness H_o/L_o, in which H_o is the deepwater wave height and L_o the deepwater wave length, and the dimensionless fall speed parameter H_o/wT, in which w is the fall speed of the sediment and T is the wave period, were found to give a reasonable distinction between profiles exhibiting mainly bar (offshore directed transport) and berm (onshore directed transport) formation. The criterion for distinguishing erosion and accretion in SBEACH is determined by,

$$\frac{H_o}{L_o} = M \left(\frac{H_o}{wT} \right)^3 \qquad (6)$$

in which $M = 0.00070$ was empirically determined, based on a large field data set of documented erosional and accretionary beach change events (Kraus, Larson, and Kriebel 1991). If the left side of Equation 6 is less than the right side, the profile is predicted to erode; otherwise, accretion is predicted.

Based on nearshore wave dynamics and the physical characteristics of sediment transport under various flow conditions, four different zones of transport were introduced (Larson, Kraus, and Sunamura 1988; Larson and Kraus 1989a):

a. Zone I: From the seaward depth of effective sand transport to the break point (pre-breaking zone).
b. Zone II: From the break point to the plunge point (breaker transition zone).
c. Zone III: From the plunge point to the point of wave reformation or to the swash zone (broken wave zone).
d. Zone IV: From the shoreward boundary of the surf zone to the shoreward limit of wave runup (swash zone).

Relationships for cross-shore sediment transport rates were developed for each of the four zones based on physical considerations and analysis of large wave tank data, and are used in SBEACH as follows:

Zone I: $q = q_b \, e^{-\lambda_1 (x - x_b)} \qquad x_b < x \qquad (7a)$

Zone II: $q = q_p \, e^{-\lambda_2 (x - x_p)} \qquad x_p < x \le x_b \qquad (7b)$

Zone III:

$$q = K\left(D - D_{eq} + \frac{\varepsilon}{K}\frac{dh}{dx}\right), \quad if\ D > \left(D_{eq} - \frac{\varepsilon}{K}\frac{dh}{dx}\right)$$

$$q = 0\,, \qquad if\ D \le \left(D_{eq} - \frac{\varepsilon}{K}\frac{dh}{dx}\right) \qquad x_z \le x \le x_p \tag{7c}$$

Zone IV: $$q = q_z\left(\frac{x - x_r}{x_z - x_r}\right) \qquad x_r < x < x_z \tag{7d}$$

Where

- q = net cross-shore sand transport rate (cu m/year)
- $\delta_{1,2}$ = spatial decay coefficients in Zones I and II, respectively (m^{-1})
- x = cross-shore coordinate, directed positive offshore (m)
- K = sand transport rate coefficient (quartic m/N)
- D = wave energy dissipation per unit water volume (N-m/cu m-sec)
- D_{eq} = equilibrium wave energy dissipation per unit water volume, related to equilibrium profile shape (N-m/cu m-sec)
- γ = slope-related sand transport rate coefficient (sq m/sec)
- h = still-water depth (m)

The subscripts *b*, *p*, *z*, and *r* stand for quantities evaluated at the break point, plunge point, end of surf zone, and runup limit, respectively. The equilibrium wave energy dissipation per unit water volume, D_{eq}, is calculated based on equilibrium profile theory and is related to wave and profile characteristics. The decay coefficient in Zone I was empirically related to median grain size, D_{50}, and breaking wave height H_b as follows,

$$\lambda_1 = 0.4\left(\frac{D_{50}}{H_b}\right)^{0.47} \tag{8}$$

For Zone II, limited data suggest that

$$\lambda_2 = 0.2\lambda_1 \tag{9}$$

In calculating the sediment transport rate in Zones I and II, the transport rate is first determined at the plunge point, and then the exponential decay rates are applied seaward in the respective zones. Changes in the beach profile are calculated at each time-step from the distribution of the cross-shore transport rate and the equation of mass conservation of sand,

$$\frac{\partial q}{\partial x} = \frac{\partial h}{\partial t} \tag{10}$$

where *t* is time, and the other variables are defined previously.

Dune erosion due to overwash of the dune crest is simulated in SBEACH based on four basic principles: (a) overwash occurs if the calculated limit of runup exceeds the dune

crest; (b) overwash causes landward movement of sediment up and over the dune crest; (c) the magnitude of onshore transport occurring during overwash is proportional to (1) the magnitude of transport at the landward boundary of the surf zone and (2) the extent by which calculated runup exceeds the dune crest; and (d) the landward limit of overwash depends on subaerial profile volume and geometry in a similarity relationship described by Wise, Smith, and Larson (1996).

The above relationships for sediment transport in the four profile zones were generalized to random waves by treating the random wave field as a collection of individual waves. A criterion for predicting net transport direction is developed based on the assumption that the random wave field follows a Rayleigh distribution in deep water. Under the assumption of linearity in transport and no wave-wave interactions, the transport rate produced by random waves is obtained by computing the transport rate for each individual wave and averaging over all waves according to

$$q = \frac{1}{N} \sum_{i=1}^{N} q_i \qquad (11)$$

The random wave model and its implementation in SBEACH introduce a summation of the form shown in Equation 11 into the sediment transport relationships given in Equation 7. For details related to other complexities introduced by the random wave model the reader is referred to Report 4 in the SBEACH documentation series (Wise, Smith, and Larson 1996). Other detailed information on the SBEACH model formulation, development, and use can found in SBEACH Reports 1, 2, and 3 (Larson and Kraus 1989a; Larson, Kraus, and Byrnes 1990; and Rosati, Wise, Kraus, and Larson 1993).

SBEACH Model Calibration. Calibration of the SBEACH model was performed for Walton County using available pre and post Hurricane Ivan data. Model calibration is conducted to determine optimal model settings for the project region and to provide a measure of model accuracy in reproducing observed profile change for a given time period. Model settings obtained through the calibration will be used in model simulations of storm erosion for the without- and with-project conditions.

Calibration Data. Required input data for model calibration include pre- and post-storm beach profiles, time histories of storm waves and water levels, and median sediment grain size. Hurricane Ivan made landfall in Gulf Shore, Alabama on September 16, 2004. USACE CHARTS surveys were collected over coastal Alabama and the Florida Panhandle in May 2004 establishing the pre-Ivan survey dataset. CHARTS surveys were collected over the same area after Hurricane Ivan in November 2004. Pre and post-Hurricane Ivan beach profiles coincident with the 127 FDEP survey monument transects were extracted from the CHARTS datasets. Profile lines R-10, R-50, and R-102 from Reaches 1, 3, and 5 were used in the SBEACH model calibration.

To obtain wave information for model calibration, pre and post hurricane Ivan data from the National Data Buoy Center (NDBC) Stations 42039 and 42040 were evaluated.

Station 42039 is located approximately 115 nautical miles (nm) east, southeast of Pensacola, Florida, and Station 42040 is located approximately 64 nm south of Dauphin Island, Alabama. Wave height, wave period (dominant and average), and wave direction are plotted in Figure A-1-41 for both stations. As shown in Figure A-1-41, Station 42040 failed just prior to the peak of the storm; therefore, only wave information from Station 40239 was used for calibration. Time series of deep water wave height, period, and direction were transformed to a 50 ft water depth, using the WIS Phase III transformation technique, to provide storm conditions for the Walton County vicinity. Corresponding water-levels were obtained from the National Oceans Service (NOS) tide station 8729840 located at Pensacola, Florida. The Hurricane Ivan storm conditions (13 September to 19 September 2004) used for model calibration are plotted in Figure A-1-42. The peak wave height was approximately 25 feet and peak water level was approximately 5.5 feet.

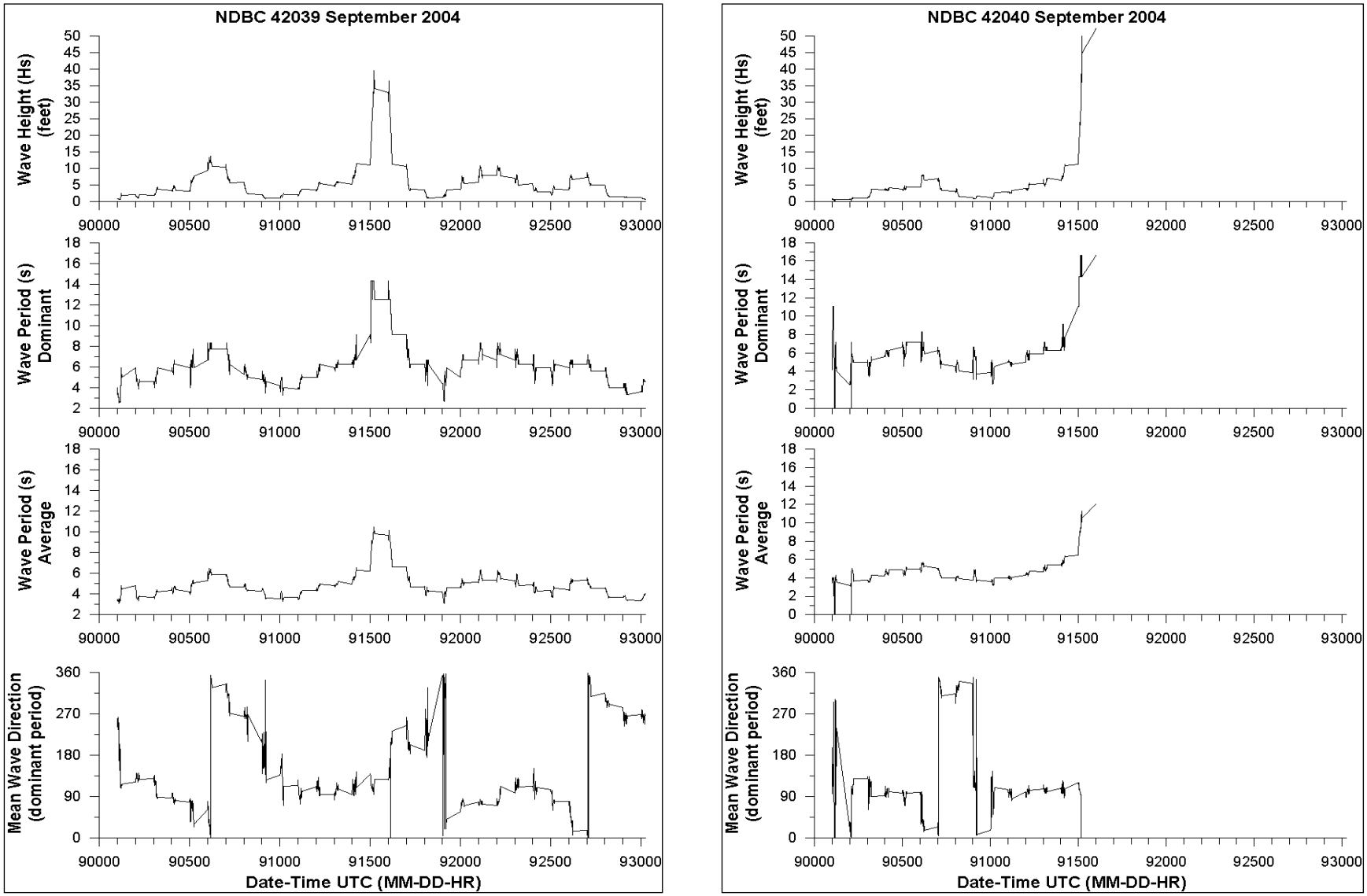

Figure A-1-41. NDBC Buoy 42039 and 42040 Offshore Wave Data - Hurricane Ivan

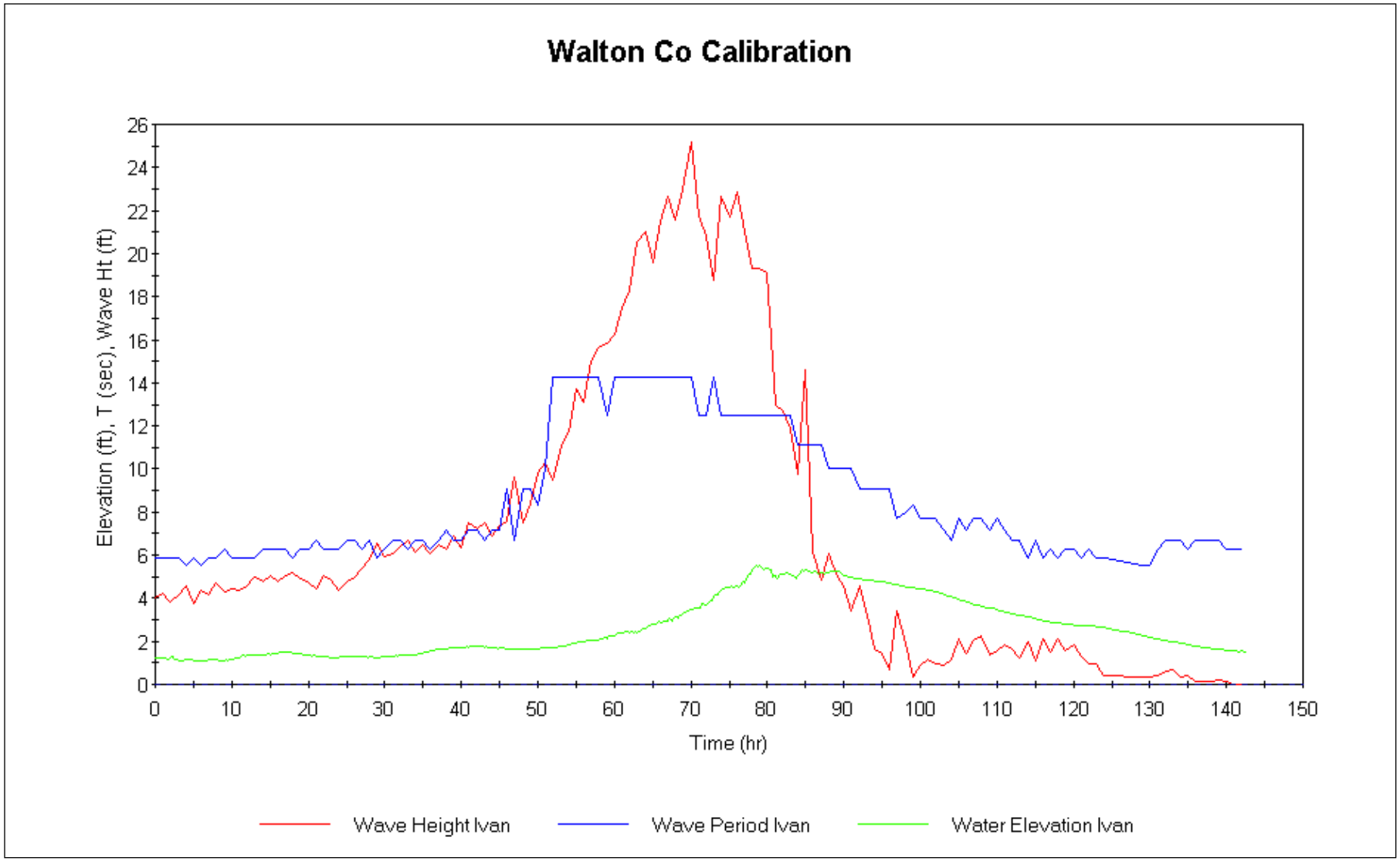

Figure A-1-42. Environmental Forcing For SBEACH Calibration (Hurricane Ivan: 13 September Through 19 September 2004)

Model Setup. The SBEACH model was configured to simulate Hurricane Ivan from September 13, 2004 0000 hours through September 19 2004 1100 hours (total of 142 hours) using a two minute time step. A variable grid was set up across the profiles with 5 ft grid spacing over the subaerial beach, 10 ft spacing over the surf zone, and 25 ft spacing for the region offshore of the breaker line.

Calibration. SBEACH calibration parameters include sediment transport rate coefficient (K), coefficient for slope-dependent transport term (ε), and depth of foreshore (DFS). The sediment transport rate coefficient is the primary calibration parameter and controls the rate at which the profile erodes towards an equilibrium shape. The slope-dependent transport term coefficient controls the effect of local profile slope on the transport rate. The depth of foreshore defines the transition depth between surf zone and swash zone, and influences profile response on the upper profile.

Simulations were performed using a range of values for each calibration parameter to determine optimal values. The final selected calibration parameter values are: K = 1.0 10^{-6} m^4/N, ε = 0.002 m^2/sec, and DFS = 1 ft. A median sediment grain size of 0.33 mm was used in the calibration simulations based on previous sediment analysis conducted by Taylor Engineering (Taylor Engineering, 2003).

Figures A-1-43, A-1-44, and A-1-45 show calibration results for profiles R-10, R-50, and R-102, respectively. The SBEACH results compare well with the measurements in the dry or upper portion of the beach, corresponding to the area of damages to be quantified in this study. The model reasonably reproduced the erosion of the dune and berm. The post Hurricane Ivan measurements show that the bar feature eroded or moved offshore during the storm; however, comparisons for the submerged offshore portion of the profile show that the model under predicted the erosion of the bar. The overall quality of the calibration results is reasonable since the storm impacts to the upper portion of the beach are the focus of this study.

Environmental Forcing Parameters for Tropical Storm Events. Primary environmental forcing parameters required for input to the SBEACH model include a time series of total water level (tide plus surge) together with a concurrent time history of wave conditions. In this study, a total of 46 historical hurricane events were identified and used to characterize the storm climatology within the Walton County study area. With the exception of Hurricane Ivan, the ADCIRC model (Luettich et al., 1994; Westerink et al., 1992) was used to estimate the storm surge associated with the individual historical storm event. Wave information was obtained from the WIS wave hindcast and NDBC Station 40239 for Hurricane Ivan conditions.

Representation of Astronomical Tides. Astronomical tides were estimated using tidal constituents generated from a harmonic analysis of ADCIRC generated tidal elevations (Scheffner 1994) at ADCIRC Stations 497 and 498 located along the Walton County Study area (Figure A-1-3). A 20-year equilibrium tide was generated and analyzed in order to estimate the average values of the tidal amplitude for Spring, Neap, and mean tidal conditions. ADCIRC Station 497 is located offshore of the eastern

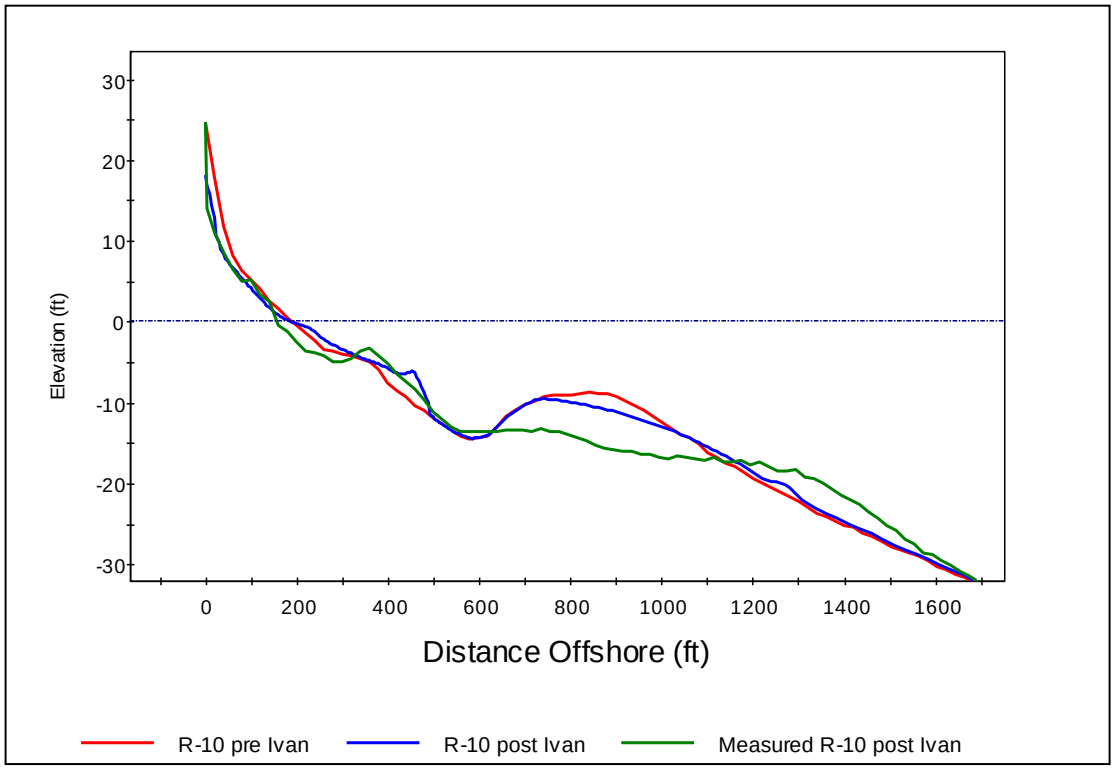

Figure A-1-43. SBEACH Calibration Profile R-10

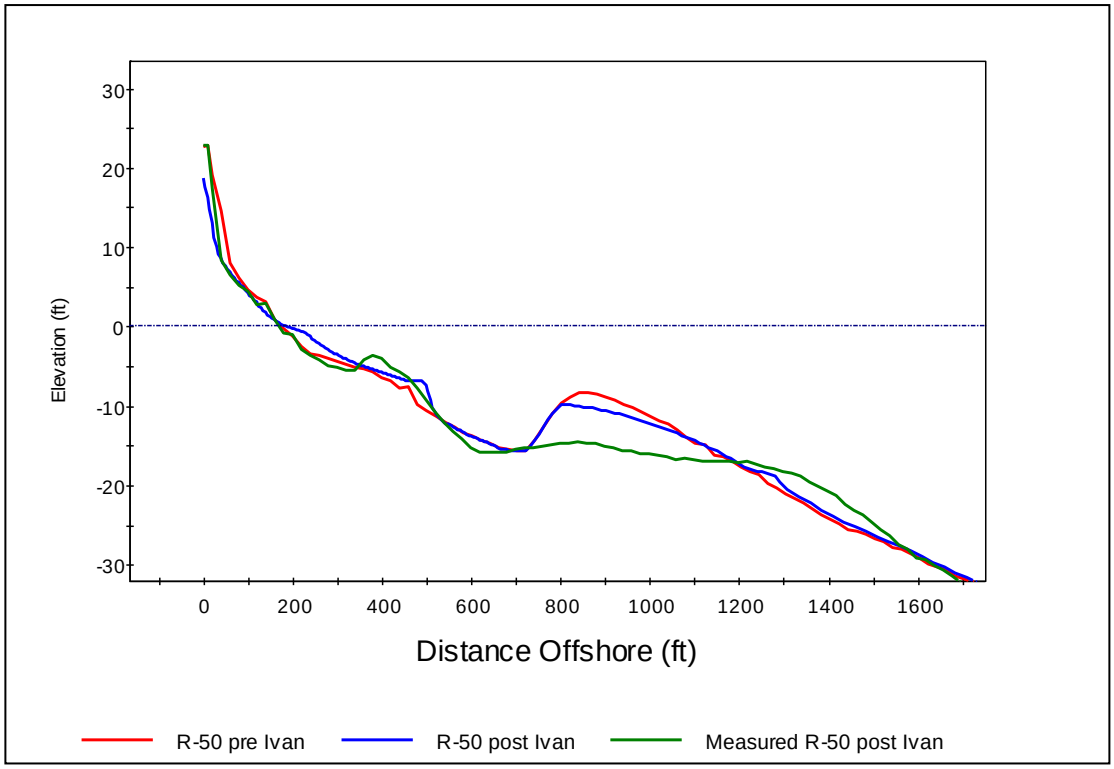

Figure A-1-44. SBEACH Calibration Profile R-50

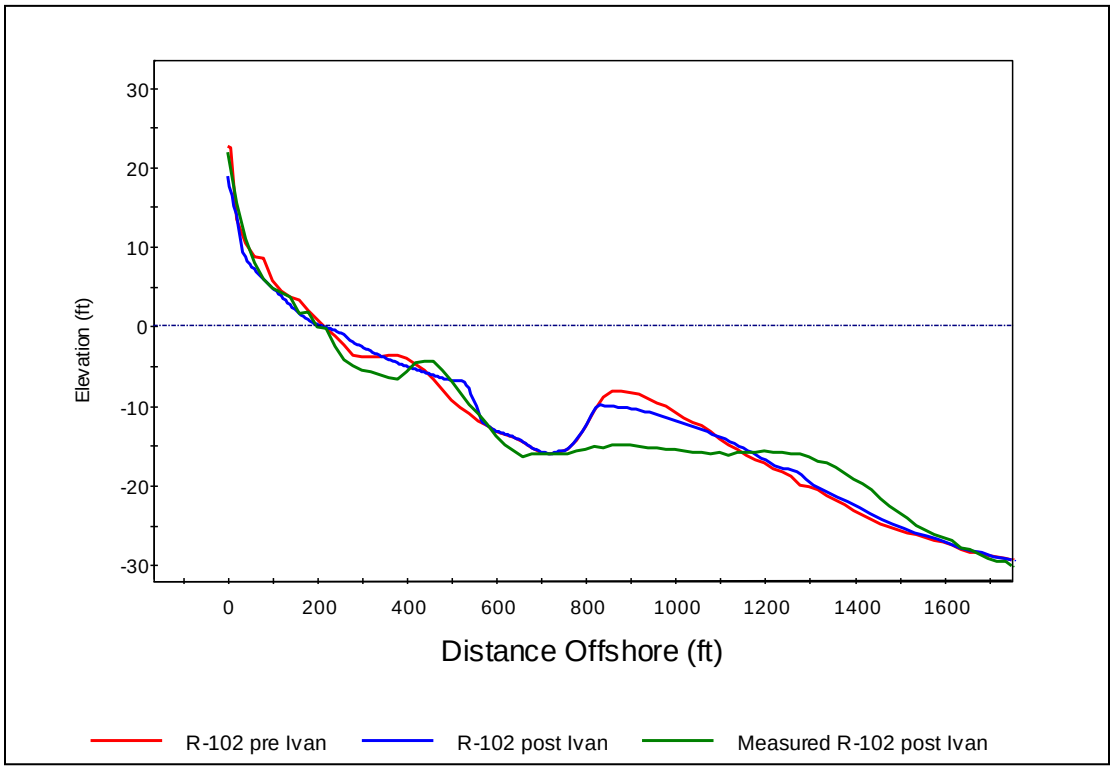

Figure A-1-45. SBEACH Calibration Profile R-102

portion of Walton County and used for Reaches 4 and 5, and Station 498 is located offshore of the western portion of Walton County and used for Reaches 1, 2, and 3. The mean tidal amplitude was estimated as a simple arithmetic mean of all the maximum tidal amplitudes in the 20-year equilibrium tide record. The average Spring tidal amplitude was estimated as the arithmetic mean of the largest 25 percent of the maximum tidal amplitudes. The average Neap tidal amplitude was estimated as the arithmetic mean of the smallest 25 percent of the maximum tidal amplitudes.

To best account for the influence of total still water level (tide plus surge) on erosion calculations within SBEACH, each storm surge (from ADCIRC calculations) was combined with tidal ranges corresponding to Spring, Mean, and Neap conditions. Furthermore, each storm surge was combined with four different phases of the tidal cycle by aligning the peak storm surge with high tide (Phase 1), mean falling tide (Phase 2), low tide (Phase 3), and mean rising tide. The tide phases are illustrated in Figure A-1-46. Figure A-1-47 provides an example of the procedure using the Spring tidal range at Station 498 and the ADCIRC-calculated surge time history for Hurricane Georges which occurred in September 1998.

Representation of Tropical Storm Events. Storm surge time series were obtained from the USACE Dredging Research Program (DRP) tropical storm database (Scheffner et al, 1994), which consists of storm surge elevation and current hydrographs corresponding to selected WIS and nearshore stations along the East and

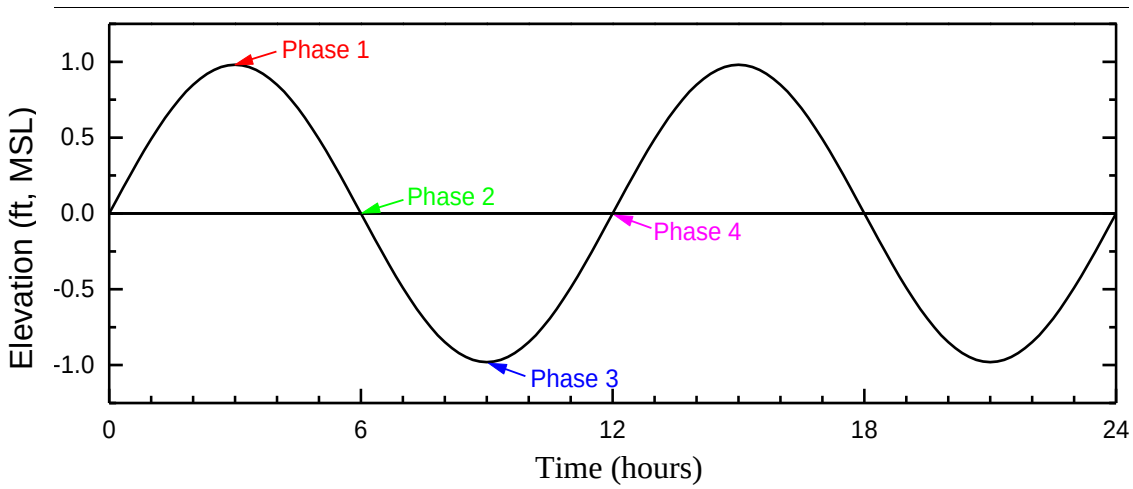

Figure A-1-46. Four Tide Phases of Tidal Cycle

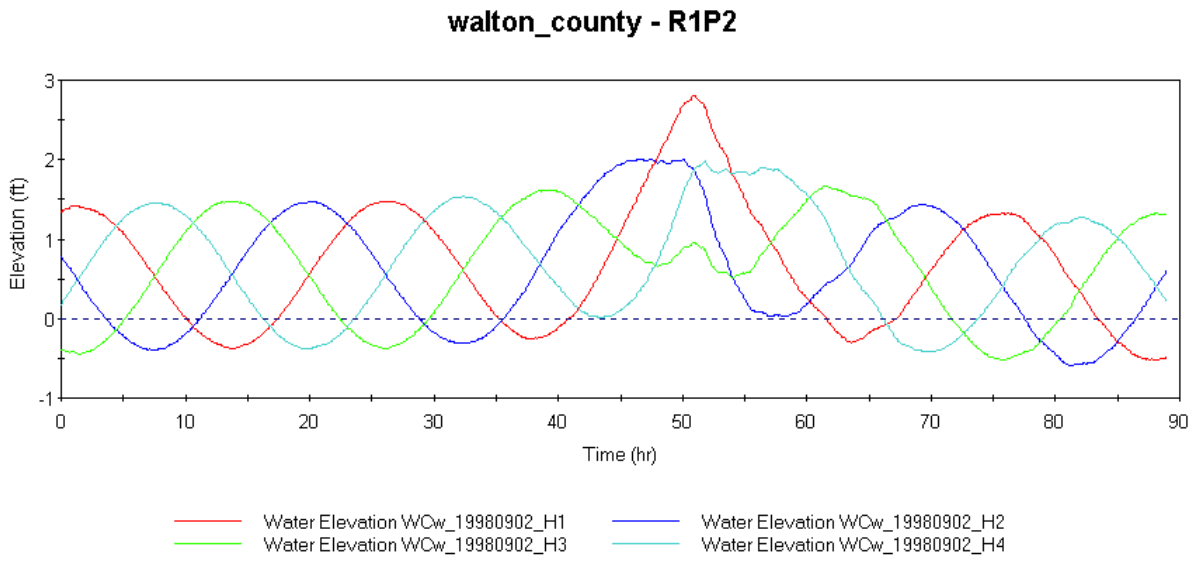

Figure A-1-47. Applied Tide Phase Sequencing, Spring Tidal Range

Gulf coasts of the United States and Puerto Rico. The database was originally constructed by numerically simulating 134 historically based hurricanes that have impacted the eastern and Gulf coasts of the United States during the period 1886 to 1989. The source of data for these simulations is the National Oceanic and Atmospheric Administration's National Hurricane Centers HURDAT (HURricane DATabase), described by Jarvinen, Neumann, and Davis (1988). The storm surge database was updated to include hurricanes from 1990 through 2001.

Figure A-1-3 on page A-1-4 displays the station locations where ADCIRC storm surge data are available in the vicinity of Walton County. The offshore nodes correspond to the WIS stations with the corresponding nearshore station locations selected to provide most accurate storm surge values. Stations 497 and 498 were utilized for this study. Significant tropical events were extracted from the database based on storm surge values exceeding select threshold conditions. For the 100-plus years of coverage, 46 events were identified using a minimum storm surge threshold of one foot. Time series of storm surge were coupled with astronomical tide data to serve as input to the Storm-Induced Beach Change (SBEACH) model for storm damage assessment. By combining the 46 storm events with the three tidal ranges at four different tidal phases results in a total of 552 storm events for input to SBEACH.

SBEACH Simulations. SBEACH model simulations were performed to develop the existing condition, future without project, and with project shoreline response database for subsequent input for the Beach-*fx* model. Beach-*fx* is an engineering-economics Monte Carlo simulation model used to develop statistics on probable benefits and costs of shore protection alternatives. The model simulates coastal engineering processes resulting in shoreline change due to storms and derives damages based on those coastal engineering processes.

Without Project Conditions. A true beach profile is complex. For purposes of Beach-*fx* modeling, a simplified beach profile represented by key points is used, Figure A-1-48. The simplified profile represents a single trapezoidal dune, with a horizontal berm. The submerged profile is represented by either a detailed series of points, or an approximate functional representation. Some of the values of the profile are taken as constant, i.e. they do not vary with the storm response. The beach variables that are taken as changing with storms are dune width, dune height, berm width, and upland elevation. The constant values are upland elevation, dune slope, berm height, foreslope, and shape of the submerged profile. Thus, in response to a given storm, the berm can be eroded or accreted (change in berm width), the dune can change height and/or width, and can translate landward or seaward (change in upland width). The 11 representative beach profiles were simplified to meet the requirements of the Beach-*fx* model. The resulting configurations of the simplified beach profiles are provided in Table A-1-21. Comparisons of the representative and simplified beach profiles for Reaches 1 through 5 are plotted in Figures A-1-49 through A-1-53.

SBEACH simulations were conducted to develop a database of pre-generated beach profile responses to storms, for a range of storms and profiles, for Walton County.

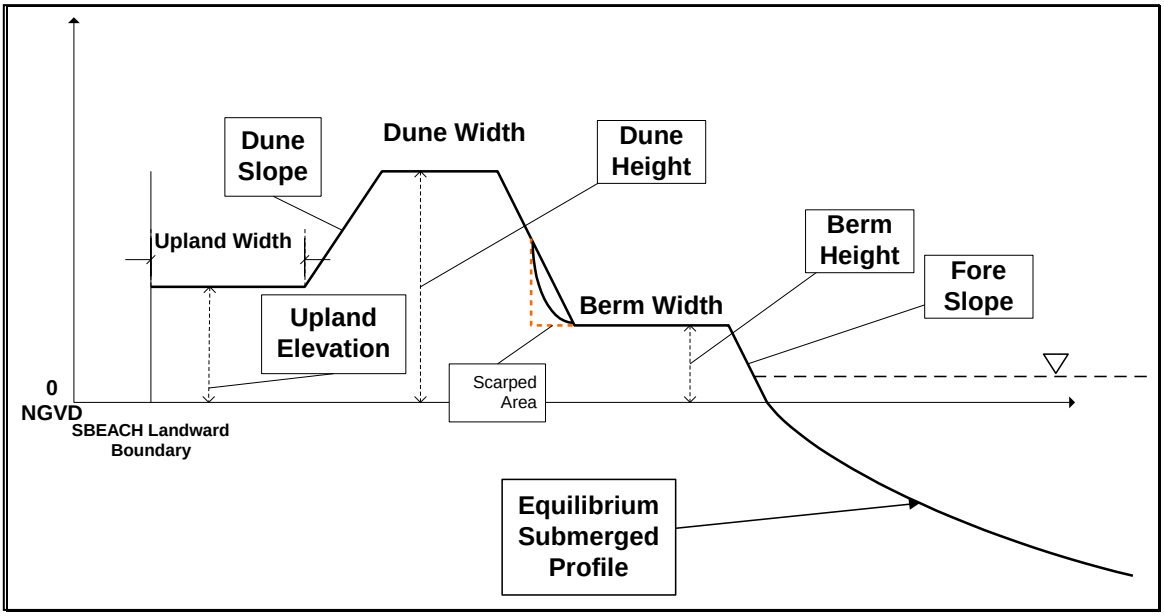

Figure A-1-48. Simplified Beach Profile For Beach-*Fx* Model

Table A-1-21. Simplified Beach Profile Configurations, Existing Conditions

Profile	Dune Height (ft)	Dune Width (ft)	Berm Height (ft)	Bern Width (ft)	Upland Elevation (ft)	Upland Width (ft)	Dune Slope	Foreshore Slope	Maximum FEMA Dune Width (ft)	Maximum FEMA Berm Width (ft)
R1P1	22.2	55.0	5.5	23.0	21.0	298.0	0.143	0.087	70.0	30.0
R1P2	13.6	100.0	5.5	40.0	12.1	298.0	0.091	0.087	130.0	70.0
R2P1	21.0	50.0	5.5	69.0	13.0	195.0	0.143	0.087	50.0	80.0
R2P2	10.0	70.0	5.5	85.0	9.5	273.0	0.029	0.087	70.0	110.0
R3P1	23.0	76.5	5.5	50.0	20.0	286.0	0.350	0.087	95.0	70.0
R3P2	12.5	45.0	5.5	50.0	10.5	218.0	0.111	0.087	80.0	90.0
P4P1	23.0	50.25	5.5	35.0	11.0	182.0	0.341	0.087	50.0	60.0
R4P2	10.0	82.0	5.5	110.0	10.0	300.0	0.556	0.087	82.0	110.0
R5P1	32.0	183.25	5.5	40.0	27.0	267.5	0.286	0.087	190.0	50.0
R5P2	24.0	64.0	5.5	52.0	22.5	306.5	0.235	0.087	78.0	70.0
R5P3	15.5	49.0	5.5	65.5	13.5	262.0	0.133	0.087	70.0	90.0

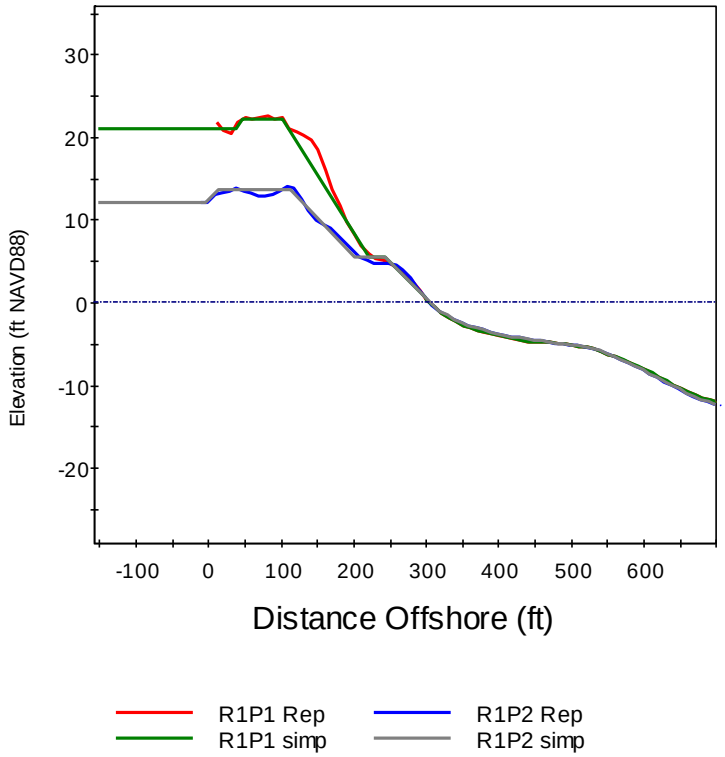

Figure A-1-49. Simplified Representative Beach Profiles - Reach 1

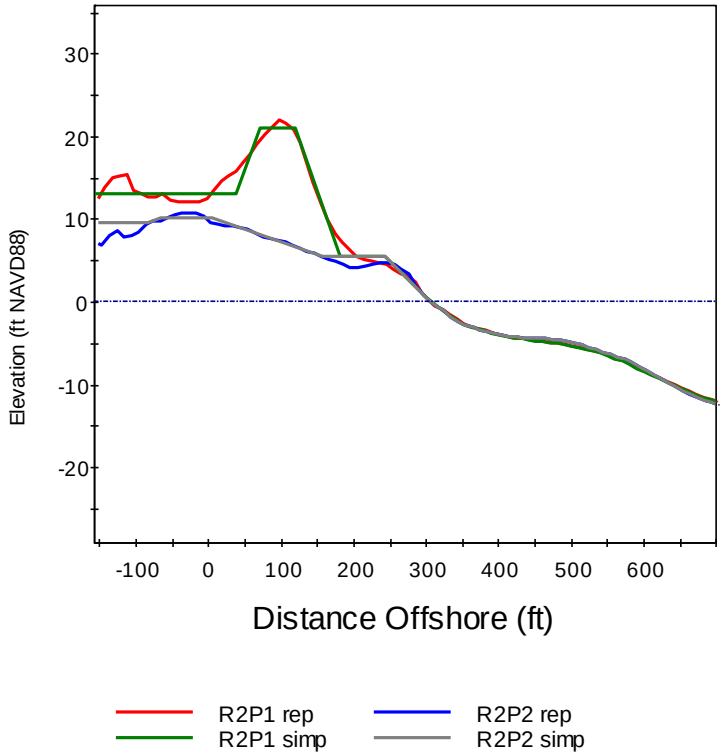

Figure A-1-50. Simplified Representative Beach Profiles - Reach 2

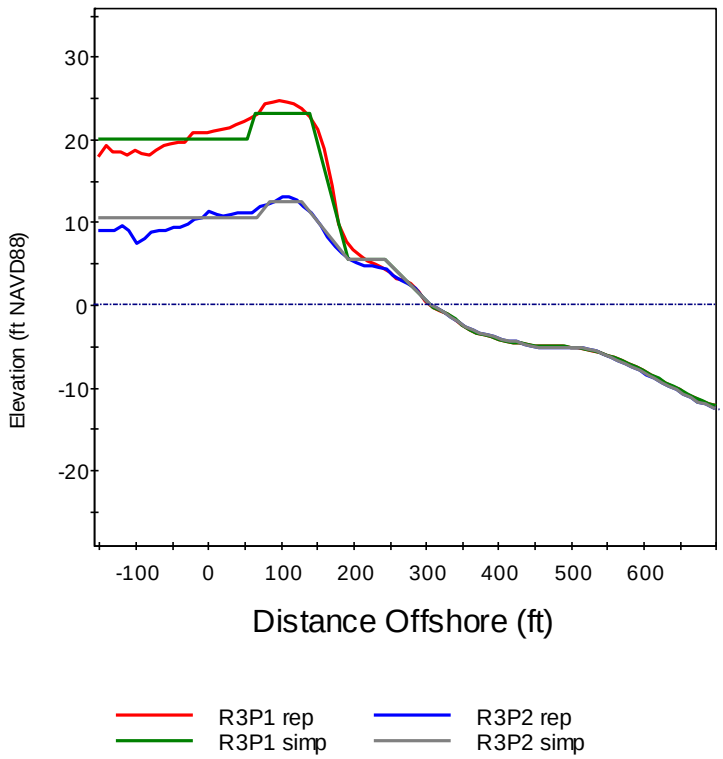

Figure A-1-51. Simplified Representative Beach Profiles - Reach 3

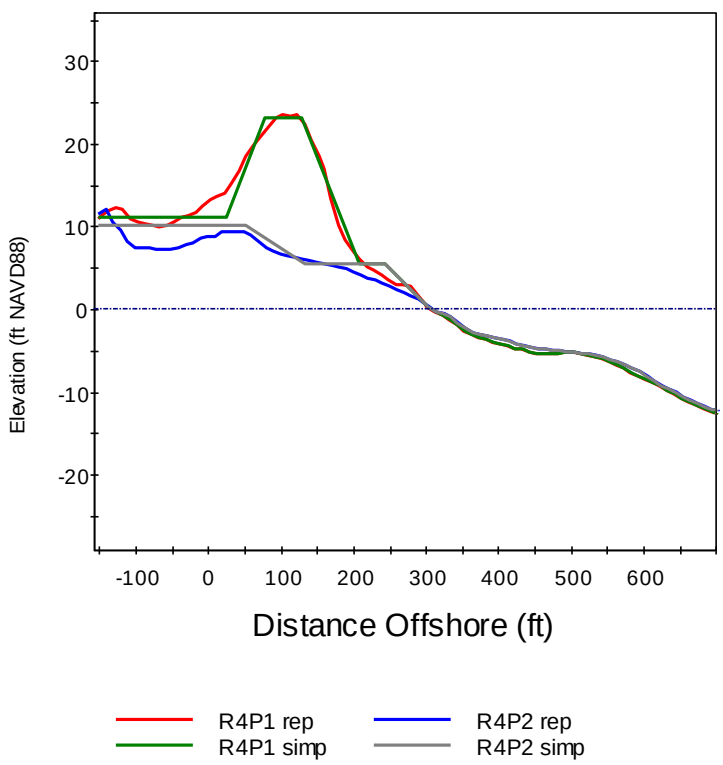

Figure A-1-52. Simplified Representative Beach Profiles - Reach 4

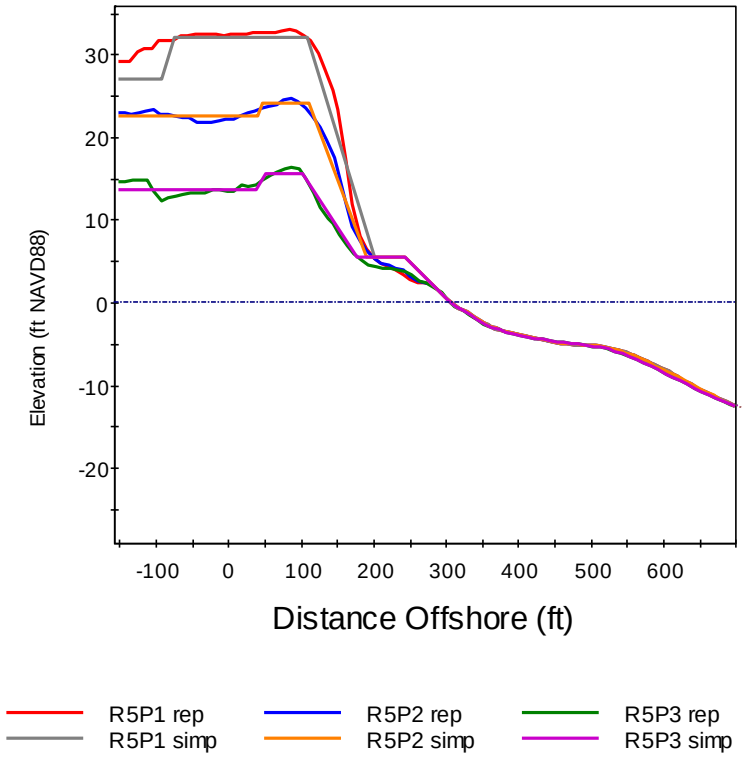

Figure A-1-53. Simplified Representative Beach Profiles - Reach 5

The 11 simplified beach profiles were modified for various berm and dune configurations as listed in Table A-1-22. Approximately 436 dune and berm configurations were generated to represent existing conditions. Maximum dune and berm widths were determined based on volumes provided by the Federal Emergency Management Agency (FEMA) post-Hurricane Ivan emergency beach nourishment. FEMA funded the placement of an average of 6 to 8 cy per linear foot of shoreline at specific locations. This study assumes the FEMA emergency nourishment volumes are placed over the entire domain, and emergency placement will be implemented once the existing post-Hurricane Ivan shoreline conditions are reached. Dune widths were modeled in 5 to 10 ft increments from the maximum emergency nourishment width to the existing width. For each dune width, associated berm widths were modeled in 10 ft increments from the maximum emergency nourishment width to a zero berm width (Figure A-1-54). The SBEACH simulations were conducted to predict the response of each dune and berm configuration to the 552 storms developed for this study. Approximately 240,000 SBEACH simulations were conducted to develop the shoreline responses for the Beach-*fx* shoreline response database.

With Project Conditions. The with period of analysis of 53 years from January, 2010 through and including all of the year 2062, and there are three pre-project base years, 2010 through 2012. Therefore, to estimate the future with project conditions, Beach-*fx* simulations were run for a 53-year period of analysis. The dune and berm widths for the with project simulations were determined based on the results of the without project

Table A-1-22. Existing Condition SBEACH Dune/Berm Configurations

Representative Profile	Dune Width (ft)	Berm Width (ft)											
R1P1	55	0	10	20	30								
	60	0	10	20	30								
	65	0	10	20									
	70	0	10	20									
R1P2	100	0	10	20	30	40	50	60	70				
	105	0	10	20	30	40	50	60	70				
	110	0	10	20	30	40	50	60					
	115	0	10	20	30	40	50	60					
	120	0	10	20	30	40	50						
	125	0	10	20	30	40	50						
	130	0	10	20	30	40							
R2P1	30	0	10	20	30	40	50	60	70	80			
	40	0	10	20	30	40	50	60	70	80			
	50	0	10	20	30	40	50	60	70	80			
R2P2	20	0	10	20	30	40	50	60	70	80	90	100	110
	30	0	10	20	30	40	50	60	70	80	90	100	110
	40	0	10	20	30	40	50	60	70	80	90	100	110
	50	0	10	20	30	40	50	60	70	80	90	100	110
	60	0	10	20	30	40	50	60	70	80	90	100	110
	70	0	10	20	30	40	50	60	70	80	90	100	110
R3P1	75	0	10	20	30	40	50	60	70				
	80	0	10	20	30	40	50	60	70				
	85	0	10	20	30	40	50	60					
	90	0	10	20	30	40	50	60					
	95	0	10	20	30	40	50						
R3P2	45	0	10	20	30	40	50	60	70	80	90		
	50	0	10	20	30	40	50	60	70	80			
	55	0	10	20	30	40	50	60	70	80			
	60	0	10	20	30	40	50	60	70				
	65	0	10	20	30	40	50	60	70				
	70	0	10	20	30	40	50	60					
	75	0	10	20	30	40	50	60					
	80	0	10	20	30	40	50						

Table A-1-22 (Continued). Existing Condition SBEACH Dune/Berm Configurations

Representative Profile	Dune Width (ft)	Berm Width (ft)											
R4P1	30	0	10	20	30	40	50	60					
	40	0	10	20	30	40	50	60					
	50	0	10	20	30	40	50	60					
R4P2	35	0	10	20	30	40	50	60	70	80	90	100	110
	45	0	10	20	30	40	50	60	70	80	90	100	110
	55	0	10	20	30	40	50	60	70	80	90	100	110
	65	0	10	20	30	40	50	60	70	80	90	100	110
	75	0	10	20	30	40	50	60	70	80	90	100	110
	85	0	10	20	30	40	50	60	70	80	90	100	110
R5P1	185	0	10	20	30	40	50						
	190	0	10	20	30	40							
R5P2	65	0	10	20	30	40	50	60	70				
	70	0	10	20	30	40	50	60					
	75	0	10	20	30	40	50	60					
	80	0	10	20	30	40	50						
R5P3	50	0	10	20	30	40	50	60	70	80	90		
	55	0	10	20	30	40	50	60	70	80			
	60	0	10	20	30	40	50	60	70	80			
	65	0	10	20	30	40	50	60	70				
	70	0	10	20	30	40	50	60	70				

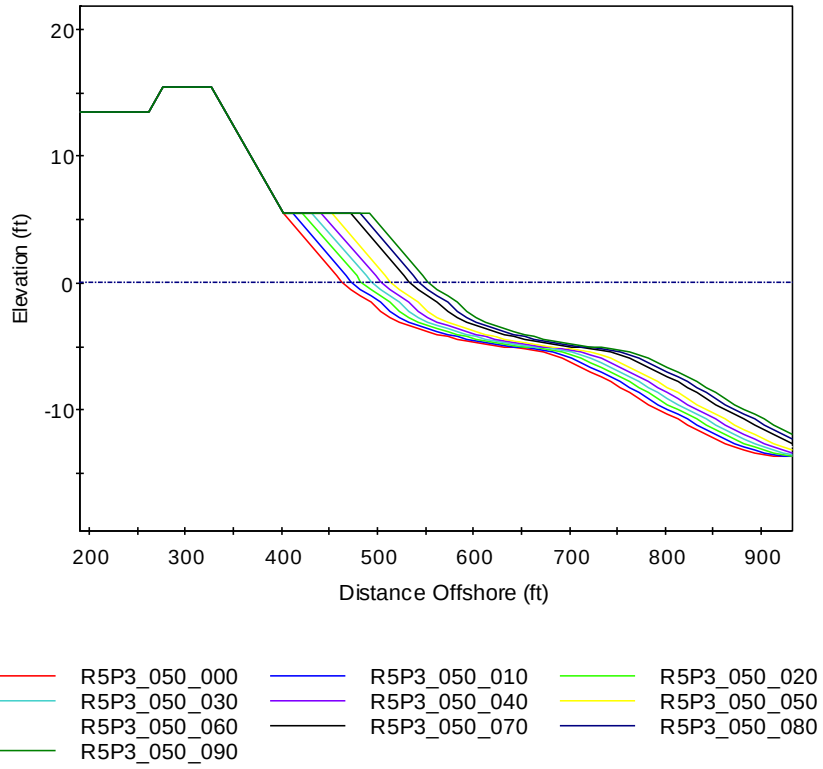

Figure A-1-54. Example SBEACH Dune and Berm Configurations For SRD

simulations. R1P1 required a minimum design berm width of 25 ft and the remaining profiles would require a minimum berm width of 50 ft. Dune widening was necessary for representative profiles R4P1 and R4P2; however, the existing dune widths were used for the remaining representative profiles. The with-project berm and dune widths were further refined to determine the NED and LP plans through the Beach-*fx* modeling as described in detail in Appendix B - Economic Investigations. For the with-project SBEACH simulations, the additional berm and dune configurations were generated to evaluate the increased dune and berm widths for the with project alternative conditions, Table A-1-23. Similar to the without project conditions, dune widths were modeled in 5 to 10 ft increments, and for each dune width, associated berm widths were modeled in 10 ft increments. Approximately 645 dune and berm configurations were generated, and approximately 356,000 SBEACH simulations were conducted to predict the response of the with project conditions to the 552 storms. The initial and predicted responses of each dune and berm configuration were incorporated into the shoreline response database for subsequent Beach-*fx* model simulations as described in detail in Appendix B - Economic Investigations.

Table A-1-23. With-Project Condition SBEACH Dune/Berm Configurations

Representative Profile	Dune Width (ft)	Berm Width (ft)													
R1P1	55		40	50	60	70	80	90	100	110	110	120	130	140	150
	60		40	50	60	70	80	90	100	110	110	120	130	140	150
	65	30	40	50	60	70	80	90	100	110	110	120	130	140	150
	70	30	40	50	60	70	80	90	100	110	110	120	130	140	150
R1P2	100				80	90	100	110	120	130	140	150	160	170	180
	105				80	90	100	110	120	130	140	150	160	170	180
	110			70	80	90	100	110	120	130	140	150	160	170	180
	115			70	80	90	100	110	120	130	140	150	160	170	180
	120		60	70	80	90	100	110	120	130	140	150	160	170	180
	125		60	70	80	90	100	110	120	130	140	150	160	170	180
	130	50	60	70	80	90	100	110	120	130	140	150	160	170	180
R3P1	75			80	90	100	110	120	130	140	150	160	170	180	
	80			80	90	100	110	120	130	140	150	160	170	180	
	85		70	80	90	100	110	120	130	140	150	160	170	180	
	90		70	80	90	100	110	120	130	140	150	160	170	180	
	95	60	70	80	90	100	110	120	130	140	150	160	170	180	
R3P2	45					100	110	120	130	140	150	160	170	180	
	50				90	100	110	120	130	140	150	160	170	180	
	55				90	100	110	120	130	140	150	160	170	180	
	60			80	90	100	110	120	130	140	150	160	170	180	
	65			80	90	100	110	120	130	140	150	160	170	180	
	70		70	80	90	100	110	120	130	140	150	160	170	180	
	75		70	80	90	100	110	120	130	140	150	160	170	180	
	80	60	70	80	90	100	110	120	130	140	150	160	170	180	
R4P1	30	0	10	20	30	40	50	60	70	80	90	100	110	120	130
		140	150												
	40	0	10	20	30	40	50	60	70	80	90	100	110	120	130
		140	150												
	50	0	10	20	30	40	50	60	70	80	90	100	110	120	130
		140	150												
	60	0	10	20	30	40	50	60	70	80	90	100	110	120	130
		140	150												
	70	0	10	20	30	40	50	60	70	80	90	100	110	120	130
		140	150												

Table A-1-23 (Continued). With-Project Condition SBEACH Dune/Berm Configurations

Representative Profile	Dune Width (ft)	Berm Width (ft)													
R4P2	35	120	130	140	150	160	170	180							
	45	120	130	140	150	160	170	180							
	55	120	130	140	150	160	170	180							
	65	120	130	140	150	160	170	180							
	75	120	130	140	150	160	170	180							
	85	120	130	140	150	160	170	180							
R5P1	185		60	70	80	90	100	110	120	130	140	150	160	170	180
	190	50	60	70	80	90	100	110	120	130	140	150	160	170	180
R5P2	65			80	90	100	110	120	130	140	150	160	170	180	
	70		70	80	90	100	110	120	130	140	150	160	170	180	
	75		70	80	90	100	110	120	130	140	150	160	170	180	
	80	60	70	80	90	100	110	120	130	140	150	160	170	180	
R5P3	50			100	110	120	130	140	150	160	170	180			
	55		90	100	110	120	130	140	150	160	170	180			
	60		90	100	110	120	130	140	150	160	170	180			
	65	80	90	100	110	120	130	140	150	160	170	180			
	70	80	90	100	110	120	130	140	150	160	170	180			

BEACH-F*X* MONTE CARLO SIMULATION MODEL

Because Federal participation in Hurricane and Storm Damage Reduction Projects requires a favorable economic justification, or the benefits exceed the costs, a suitable economic analysis must take into account the probabilistic nature of storm-associated damage to structures. This damage is a function of structure location and character, storm intensity, and the degree of protection provided by the natural or constructed beach. Thus, meteorological and coastal processes are significant in determining the damages. The Walton County study is a test case for the Beach-*fx* model recently developed by the USACE. The Beach-*fx* model is an engineering-economic Monte Carlo simulation model that relates beach profile change to storms, coastal processes, and nourishment programs. The model relies on a pre-computed shoreline response database (SRD) of beach profile responses to storms for a range of storms and profiles. SBEACH was used to predict beach profile response to a suite of plausible tropical storm events derived from the historical record of tropical storms impacting the Walton County area (Attachment I-A, Table 1-A). When the Beach-*fx* model is run for multiple iterations, statistics on probable benefits and costs of various shore protection alternatives can be calculated and used for the economic evaluation.

Beach-*fx* Overview. The Beach-*fx* model is an event-driven life cycle Monte Carlo simulation model. A shore protection project life cycle (i.e. 50 years) is simulated by determining the beach and structure response to a set of storms (the events driving the process). The associated damages are determined for each structure that is modeled. This simulation is repeated for many different sets of storms, and the results averaged. Input data to the model is stored in databases, and, wherever possible, information needed to localize, parameterize, and modify model behavior is also stored as data (datA-1-driven modeling).

Beach-*fx* simulates beach response over time as storms, natural recovery, and management methods alter the beach profile. Events of interest (storms, beach nourishment) take place at calculated times. As each event takes place, the model simulates the physical and economic responses associated with that event. Structural damages include losses due to flooding, erosion, and wave impact. Simplified beach profiles, as defined by key data points, are tracked as the beach profile evolves over time.

The model makes use of a SRD that is a pre-generated set of beach profile responses to storms, for a range of storms and profiles. The model uses “plausible storms”, based on historic storms, as initiating events (Attachment I-A, Table I-A). The shoreline modification due to a storm is determined through use of a shoreline response model. The SBEACH (Larson and Kraus 1989), a cross-shore storm response model was used in this study. The SRD contains information on the input (pre-storm) profile, the storm, and the response (post-storm) profile, for many combinations of storms and pre-storm profiles. The Monte Carlo simulation model then reads information from the SRD as needed to determine shoreline change following a storm event.

As each storm is processed, the shoreline response is determined, and a post-storm beach configuration is calculated, as well as profiles of maximum water level, wave height, and erosion during the storm. This information is used to determine economic damages, based on empirical curves (damage functions) relating the percentage loss of value of structure and contents to "damage-driving parameters" calculated from the aforementioned profiles and characteristics of the structure. The nature of the data used by the model is shown in Figure A-1-55.

The key features of the model, described in more detail in the following sections, are: 1) Representation Framework of Beach and Structures, 2) Storm generation methodology. 3) Shoreline response database (SRD) construction and use, 4) Damage Calculations, 5) Nourishment, and 6) User Interface.

Representative Framework of Beach and Structures. The overall unit of analysis is the "project", a shoreline area for which the analysis is to be performed. The project is divided, for purposes of analysis, into reaches, which are contiguous, morphologically homogeneous areas. The structures on a reach are referred to as Damage Elements (DEs), and are located on lots. All locations are geospatially referenced by state plane coordinates, as shown schematically in Figure A-1-56, in which a shoreline is linearized into reaches. For this study, the Walton County shoreline was divided into 117 reaches for the Beach-*fx* model.

Each reach is associated with a beach profile describing the shape of the cross-shore profile, and the beach composition. Thus, within a project, multiple reaches can share the same profile. The profile is the basic unit of beach response.

For purposes of Beach-*fx* modeling, a simplified beach profile, represented by key points, is used, as shown in Figure A-1-48. The simplified profiles used for the Beach-fx modeling are detailed in Table A-1-21. The five project reaches, the Beach-*fx* reach number and reach name, and the associated representative or simplified beach profile are provided in Table A-1-24.

The model uses a set of pre-developed "plausible storms", as described in Representation of Tropical Storm Events of this report. Each storm is processed through SBEACH, for a variety of different input profiles, with the results stored in the SRD. Within SBEACH, a storm is represented as time histories of wave height, wave period, and total water elevation (tide plus surge). Optionally, wave direction and wind speed and direction can also be specified, but these capabilities are not used in the current effort. Thus, it is necessary to have time series representing the storm history for each of the plausible storms. A total of 552 storms were developed for this study . (Table I-A)

Shoreline Response Database (SRD). The Shoreline Response Database (SRD) is a relational database used to pre-store results of SBEACH runs for all plausible storms, and a range of pre-defined profiles, as expressed by ranges of berm width, dune width, and dune height. Two kinds of results are stored: changes in berm width, dune width, dune height, and upland width, and cross-shore profiles of erosion, wave height, and water depth.

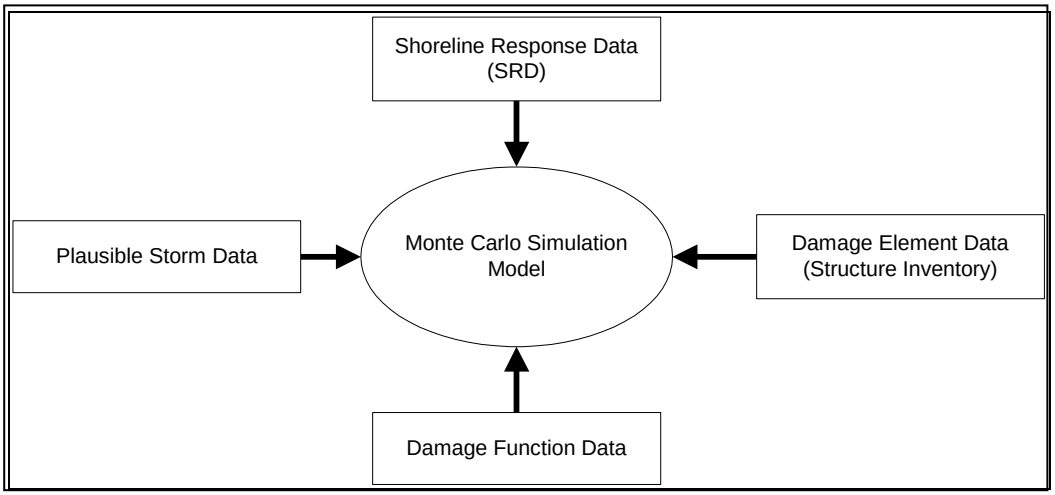

Figure A-1-55. Data Used By The Beach-*Fx* Model

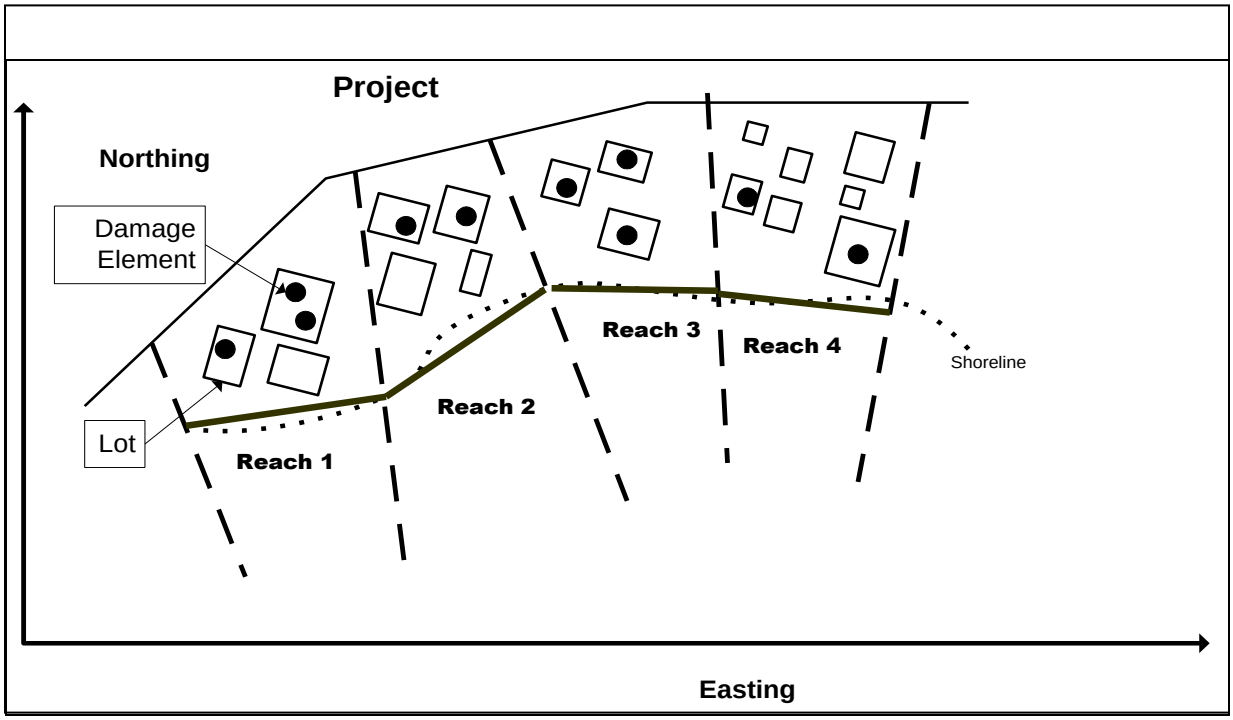

Figure A-1-56. Beach-*Fx* Model Representation

Table A-1-24. Project Reaches, Beach-Fx Reaches, Representative Profiles

Project Reach	Reach Number	Beach-fx Reach Name	Representative Profile
Reach 1	1	R1-1	R1P1
	2	R1-2	R1P1
	3	R1-3	R1P1
	4	R1-4	R1P1
	5	R1-5	R1P1
	6	R1-6	R1P1
	7	R1-7	R1P1
	8	R1-8	R1P1
	9	R1-9	R1P1
	10	R1-10	R1P1
	11	R1-11	R1P1
	12	R1-12	R1P1
	13	R1-13	R1P1
	14	R1-14	R1P1
	15	R1-15	R1P2
	16	R1-16	R1P2
	17	R1-17	R1P2
	18	R1-18	R1P2
	19	R1-19	R1P2
	20	R1-20	R1P2
	21	R1-21	R1P1
	22	R1-22	R1P1
	23	R1-23	R1P1
	24	R1-24	R1P1
Reach 2	25	R2-1	R2P1
	26	R2-2	R2P1
	27	R2-3	R2P2
	28	R2-4	R2P1
	29	R2-5	R2P2
	30	R2-6	R2P1
	31	R2-7	R2P1
Reach 3	32	R3-1	R3P1
	33	R3-2	R3P1
	34	R3-3	R3P1
	35	R3-4	R3P2
	36	R3-5	R3P2
	37	R3-6	R3P2
	38	R3-7	R3P2

Table A-1-24 (Cont'd). Project Reaches, Beach-Fx Reaches, Representative Profiles

Project Reach	Reach Number	Beach-fx Reach Name	Representative Profile
Reach 3	39	R3-8	R3P1
	40	R3-9	R3P1
	41	R3-10	R3P1
	42	R3-11	R3P1
	43	R3-12	R3P1
	44	R3-13	R3P1
	45	R3-14	R3P1
	46	R3-15	R3P1
	47	R3-16	R3P1
	48	R3-17	R3P1
	49	R3-18	R3P1
	50	R3-19	R3P1
	51	R3-20	R3P1
	52	R3-21	R3P1
	53	R3-22	R3P1
	54	R3-23	R3P1
	55	R3-24	R3P2
	56	R3-25	R3P2
	57	R3-26	R4P1
	58	R4-1	R4P1
	59	R4-2	R4P1
	60	R4-3	R4P2
Reach 4	61	R4-4	R4P2
	62	R4-5	R4P1
	63	R4-6	R4P2
	64	R4-7	R4P2
	65	R4-8	R4P1
Reach 5	66	R4-9	R4P1
	67	R5-1	R5P2
	68	R5-2	R5P2
	69	R5-3	R5P2
	70	R5-4	R5P2
	71	R5-5	R5P2
	72	R5-6	R5P1
	73	R5-7	R5P1
	74	R5-8	R5P1
	75	R5-9	R5P2
	76	R5-10	R5P2
	77	R5-11	R5P2
	78	R5-12	R5P2

Table A-1-24 (Cont'd). Project Reaches, Beach-Fx Reaches, Representative Profiles

Project Reach	Reach Number	Beach-fx Reach Name	Representative Profile
Reach 5	79	R5-13	R5P2
	80	R5-14	R5P2
	81	R5-15	R5P2
	82	R5-16	R5P2
	83	R5-17	R5P3
	84	R5-18	R5P2
	85	R5-19	R5P3
	86	R5-20	R5P2
	87	R5-21	R5P2
	88	R5-22	R5P3
	89	R5-23	R5P3
	90	R5-24	R5P2
	91	R5-25	R5P2
	92	R5-26	R5P1
	93	R5-27	R5P3
	94	R5-28	R5P3
	95	R5-29	R5P2
	96	R5-30	R5P2
	97	R5-31	R5P2
	98	R5-32	R5P1
	99	R5-33	R5P1
	100	R5-34	R5P1
	101	R5-35	R5P1
	102	R5-36	R5P1
	103	R5-37	R5P1
	104	R5-38	R5P1
	105	R5-39	R5P1
	106	R5-40	R5P2
	107	R5-41	R5P2
	108	R5-42	R5P2
	109	R5-43	R5P2
	110	R5-44	R5P2
	111	R5-45	R5P2
	112	R5-46	R5P2
	113	R5-47	R5P2
	114	R5-48	R5P3
	115	R5-49	R5P3
	116	R5-50	R5P3
	117	R5-51	R5P3

The SRD is site and study specific, that is, it is created for each shore protection study. The SRD, once generated, is used as a 'lookup table' by the Monte Carlo simulation. Within the Monte Carlo simulation, the shoreline modifications are tracked continuously by the simplified profile representation (primarily dune width and height and berm width). The driving force for profile change is the list of plausible storms. These plausible storms are then used to create SBEACH input, which is run against a range of profiles that is expected to cover the range of natural and managed profiles.

For each such pair (storm and profile), both simplified and detailed SBEACH results are stored in the SRD. The output of SBeach for a given run is an ascii file that describes the initial, final, maximum, and minimum cross-shore profiles, and the water and wave heights along the cross-shore. This file must be post-processed by software that extracts the values of changes in berm width, dune width, and dune height, and stores the information in the SRD. Approximately 596,000 (240,000 without project and 356,000 with project) storm and profile pairs were created for this study.

The Monte Carlo simulation uses the same set of storms that were used to create the SRD. As a given storm event from the simulated sequence takes place, the current profile is used to look up the results that are associated with that storm in the SRD for the profile that is 'closest' to the pre-storm profile as tracked in the simulation. These results are then used to define the post-storm profile, to track volume changes, and to determine within-storm erosion, wave heights and water elevations due to the storm along the cross-shore profile.

Damage Calculations. As shown in Figure A-1-56, a hierarchy exists within a reach, such that damage elements (a generalization of the term 'structures') are located on lots located in the reach. Each damage element is geographically referenced, and characterized as to usage, construction type, foundation type, value of contents, value of structures, and ground and first floor elevation. Because the location of the DE is known, the position of the DE (in the cross-shore) with regard to the water depth, wave, and erosion profiles is known, so that each of these parameters can be calculated at the DE location. These values are then used to calculate "damage-driving parameters", which vary by the type of damages and the structure and foundation type.

Following each storm event, damages are calculated for each reach, lot, and damage element. The storm event determines the water level and erosion profiles, which are obtained from lookups in the SRD. These response profiles exist at the profile (and thus the reach) level, and are constant for all DE's within a reach.

Three "factors" are thus available in the form of percent- damage caused by flood, erosion, and wave. These are then used to calculate a combined impact. This combined impact is used to reduce the current value of the damage element. The total of all damages (reductions in value) is the economic loss that can be mitigated by shore protection projects.

Overall Processing. Processing starts with a storm event. Storm event sequences are generated based on seasonal probabilities of tropical/extratropical storms. For each season of each year of simulation, a Poisson probability distribution is used to determine the number of storms of each type that occur in the given season. Then, using a bootstrap sampling with replacement approach, storms are selected from the plausible storm set for the appropriate storm type and season. The timing of each such storm is chosen randomly within the storm season, with a minimum storm inter-arrival time to preclude two storms being too close in time. This approach allows for the generation of any desired number of sequences of plausible storms. Each storm event of the generated sequence is processed in order. For each storm event, all profiles are processed in turn. For each profile, all reaches using the profile are processed.

Reach processing involves determination of the post-storm and post-recovery berm width, dune width, and dune height, through lookup into the SRD, choosing the information that best fits the pre-storm reach configuration. Post-storm berm width recovery is applied. For each lot within the reach, and for each damage element within the lot, wave, flooding, and erosion damages are calculated.

Nourishment Event. Planned and emergency nourishment are based on design templates and nourishment cycles. Nourishment cycles are defined as periodic (i.e. every three years). An order of reach nourishment is defined in the database, as well as reach-level design templates (dune width/height, berm width), and placement rates. Emergency nourishment occurs when a defined minimum dune/berm width is reached in the simulation. The emergency nourishment dune and berm width triggers and the associated emergency fill widths are provided in Table A-1-25.

Table A-1-25. Emergency Nourishment Triggers and Templates

	Emergency Nourishment Trigger			Emergency Template		
Rep Profile	**Dune Height**	**Dune Width**	**Berm Width**	**Dune Height**	**Dune Width**	**Berm Width**
R1P1	0	56	0	22.2	69.7	6.3
R1P2	0	100	0	13.6	128.3	11.7
R2P1	0	0	0	0	0	0
R2P2	0	0	0	0	0	0
R3P1	0	45	0	12.5	79.0	16.0
R3P2	0	76.5	0	23.0	95.0	31.5
R4P1	0	0	0	0	0	0
R4P2	0	0	0	0	0	0
R5P1	0	65	0	24.0	78.5	38.5
R5P2	0	184.3	0	32.0	190.3	34.0
R5P3	0	50	0	15.5	69.5	46.0

All reaches to be nourished are examined, to determine if mobilization is warranted. The existing reach profile is compared to the design template, and nourishment volume is determined. If the total nourishment volume for all reaches exceeds a user-defined threshold, then mobilization and nourishment take place.

If nourishment is required, then nourishment time is determined based on placement rates. A start nourishment and end nourishment event for the first reach are created. At the end nourishment event, the reach profile is set to the design template, and the next reach in processing order is examined, to see if nourishment is required. The process continues into all reaches have been handled.

Cost of nourishment, including mobilization and placement costs, is calculated based on nourishment volumes and user-defined cost-related parameters.

Beach-f*x* Calibration. For the coastal processes simulations, the Beach-fx model was calibrated to the historic shoreline erosion rates developed through the shoreline analysis conducted for this study. A historic erosion rate was calculated for each Beach-*fx* reach. Numerous simulations were conducted to evaluate adjustments to an applied historic erosion rate. The applied erosion rates were adjusted with constant adjustments over the entire domain. Results of the simulations indicated adjustments were necessary at the project reach level. All simulations were run using a zero percent recovery factor for the dune height and width and a 90 percent recovery factor for the berm width. Additional testing was conducted to ensure a sufficient number of iterations were run which reproduced repeatable predictions. The analysis indicated that 500 iterations for the 53-year period of analysis were sufficient for the coastal processes simulations. A comparison of the historic shoreline erosion rates and the Beach-*fx* model predicted historic shoreline erosion for each Beach-*fx* model reach is plotted in Figure A-1-57.

Future Without Project Conditions. The period of analysis is 53 years from January, 2010 through and including all of the year 2062, and there are three pre-project base years, 2010 through 2012. Therefore, to estimate the future without project conditions, Beach-*fx* simulations were run for a 53-year period of analysis for project Reaches 1, 3, 4, and 5. Reach 2 was not simulated since beach nourishment will not be conducted in the State Park area. Table A-1-26 lists project reach, Beach-*fx* reach number and name, the corresponding representative beach profile, and the associated existing condition beach profile configurations (dune height, dune width, berm width, and upland width) input to the Beach-*fx* model.

The future without project conditions were then averaged over the Beach-*fx* reaches comprising each of the 11 representative profiles. For each representative profile, the corresponding dune height, dune width, and berm width for the existing and future without project (53-year) condition are tabulated in Table A-1-27. Over the 53-year period of analysis, the dune height and width are maintained in Reaches 1, 3, and 5 due to the emergency nourishment triggers applied in the Beach-*fx* simulations. Because emergency nourishment is only applied to the dune, the berm retreats as indicated in Table A-1-27. Emergency nourishment was not applied to Reach 4, which encompasses the state park area, resulting in both dune and berm retreat. Table A-1-27 indicates that significant berm erosion occurs over the entire Walton County shoreline.

Future With Project Conditions. The with project period of analysis is 53 years from January, 2010 through and including all of the year 2062, and there are three pre-project base years, 2010 through 2012. Therefore, to estimate the future with project conditions, Beach-*fx* simulations were run for a 53-year period of analysis. The dune and berm widths for the with project simulations were determined based on the results of the without project simulations. The with project analysis is described in detail in Appendix B - Economic Investigations.

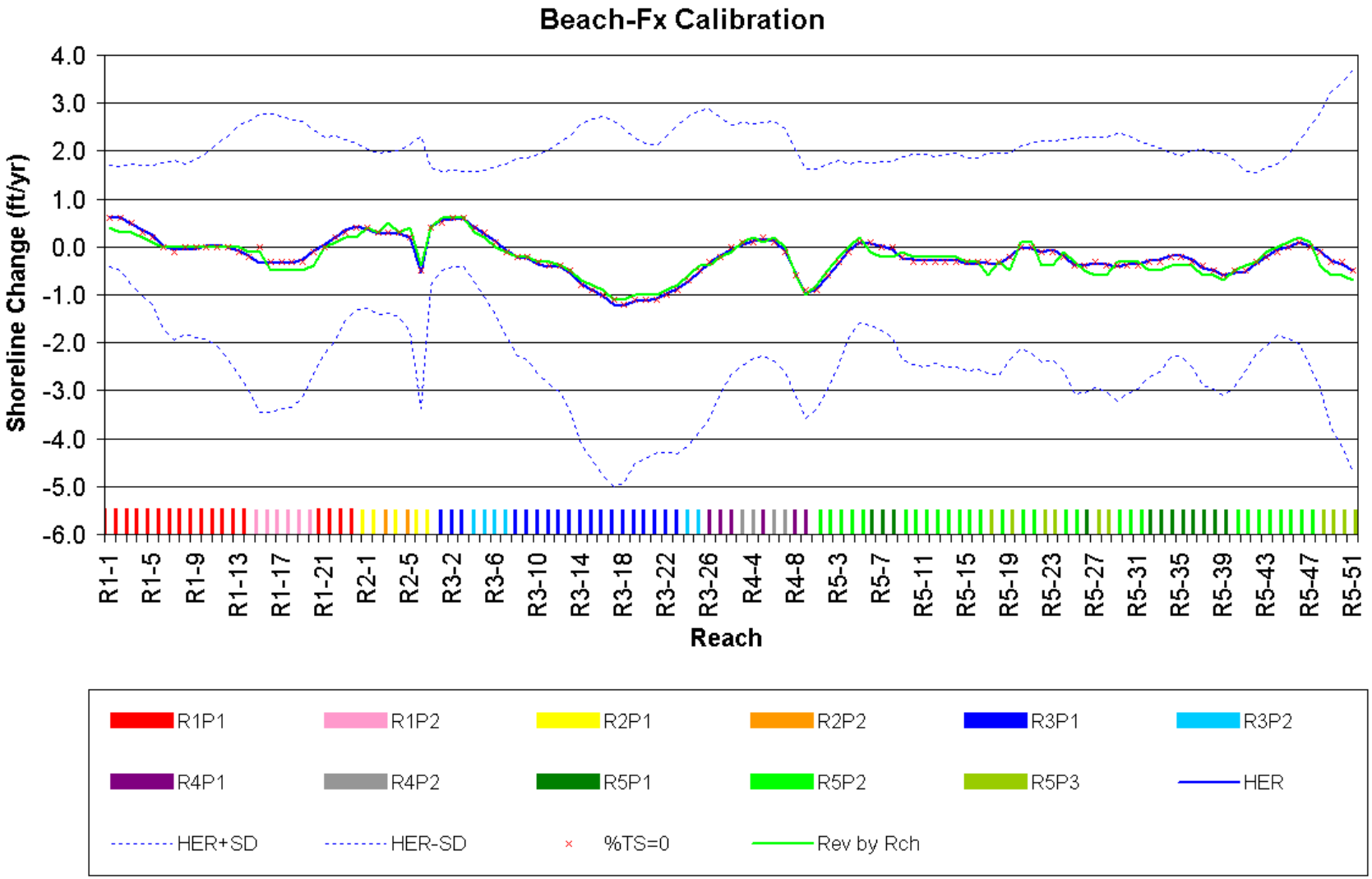

Figure A-1-57. Coastal Processes Calibration, Beach-*Fx* Model

Table A-1-26. Existing Conditions Configuration

Project Reach	Reach Number	Beach-fx Reach Name	Rep Profile	Dune Height	Dune Width	Berm Width
Reach 1	1	R1-1	R1P1	22.2	55.0	23.0
	2	R1-2	R1P1	22.2	55.0	23.0
	3	R1-3	R1P1	22.2	55.0	23.0
	4	R1-4	R1P1	22.2	55.0	23.0
	5	R1-5	R1P1	22.2	55.0	23.0
	6	R1-6	R1P1	22.2	55.0	23.0
	7	R1-7	R1P1	22.2	55.0	23.0
	8	R1-8	R1P1	22.2	55.0	23.0
	9	R1-9	R1P1	22.2	55.0	23.0
	10	R1-10	R1P1	22.2	55.0	23.0
	11	R1-11	R1P1	22.2	55.0	23.0
	12	R1-12	R1P1	22.2	55.0	23.0
	13	R1-13	R1P1	22.2	55.0	23.0
	14	R1-14	R1P1	22.2	55.0	23.0
	15	R1-15	R1P2	13.6	99.0	40.0
	16	R1-16	R1P2	13.6	99.0	40.0
	17	R1-17	R1P2	13.6	99.0	40.0
	18	R1-18	R1P2	13.6	99.0	40.0
	19	R1-19	R1P2	13.6	99.0	40.0
	20	R1-20	R1P2	13.6	99.0	40.0
	21	R1-21	R1P1	22.2	55.0	23.0
	22	R1-22	R1P1	22.2	55.0	23.0
	23	R1-23	R1P1	22.2	55.0	23.0
	24	R1-24	R1P1	22.2	55.0	23.0
Reach 3	32	R3-1	R3P1	23.0	75.5	50.0
	33	R3-2	R3P1	23.0	75.5	50.0
	34	R3-3	R3P1	23.0	75.5	50.0
	35	R3-4	R3P2	12.5	44.0	50.0
	36	R3-5	R3P2	12.5	44.0	50.0
	37	R3-6	R3P2	12.5	44.0	50.0
	38	R3-7	R3P2	12.5	44.0	50.0
	39	R3-8	R3P1	23.0	75.5	50.0
	40	R3-9	R3P1	23.0	75.5	50.0
	41	R3-10	R3P1	23.0	75.5	50.0
	42	R3-11	R3P1	23.0	75.5	50.0
	43	R3-12	R3P1	23.0	75.5	50.0
	44	R3-13	R3P1	23.0	75.5	50.0
	45	R3-14	R3P1	23.0	75.5	50.0
	46	R3-15	R3P1	23.0	75.5	50.0
	47	R3-16	R3P1	23.0	75.5	50.0
	48	R3-17	R3P1	23.0	75.5	50.0
	49	R3-18	R3P1	23.0	75.5	50.0
	50	R3-19	R3P1	23.0	75.5	50.0
	51	R3-20	R3P1	23.0	75.5	50.0

Table A-1-26 (Cont'd). Existing Conditions Configuration

Project Reach	Reach Number	Beach-fx Reach Name	Rep Profile	Dune Height	Dune Width	Berm Width
Reach 3	52	R3-21	R3P1	23.0	75.5	50.0
	53	R3-22	R3P1	23.0	75.5	50.0
	54	R3-23	R3P1	23.0	75.5	50.0
	55	R3-24	R3P2	12.5	44.0	50.0
	56	R3-25	R3P2	12.5	44.0	50.0
	57	R3-26	R4P1	23.0	50.3	35.0
	58	R4-1	R4P1	23.0	50.3	35.0
	59	R4-2	R4P1	23.0	50.3	35.0
	60	R4-3	R4P2	10.0	82.0	110.0
Reach 4	61	R4-4	R4P2	10.0	82.0	110.0
	62	R4-5	R4P1	23.0	50.3	35.0
	63	R4-6	R4P2	10.0	82.0	110.0
	64	R4-7	R4P2	10.0	82.0	110.0
	65	R4-8	R4P1	23.0	50.3	35.0
Reach 5	66	R4-9	R4P1	23.0	50.3	35.0
	67	R5-1	R5P2	24.0	64.0	52.0
	68	R5-2	R5P2	24.0	64.0	52.0
	69	R5-3	R5P2	24.0	64.0	52.0
	70	R5-4	R5P2	24.0	64.0	52.0
	71	R5-5	R5P2	24.0	64.0	52.0
	72	R5-6	R5P1	32.0	183.3	40.0
	73	R5-7	R5P1	32.0	183.3	40.0
	74	R5-8	R5P1	32.0	183.3	40.0
	75	R5-9	R5P1	24.0	64.0	52.0
	76	R5-10	R5P1	24.0	64.0	52.0
	77	R5-11	R5P1	24.0	64.0	52.0
	78	R5-12	R5P2	24.0	64.0	52.0
	79	R5-13	R5P2	24.0	64.0	52.0
	80	R5-14	R5P2	24.0	64.0	52.0
	81	R5-15	R5P2	24.0	64.0	52.0
	82	R5-16	R5P2	24.0	64.0	52.0
	83	R5-17	R5P3	15.5	49.0	65.5
	84	R5-18	R5P2	24.0	64.0	52.0
	85	R5-19	R5P3	15.5	49.0	65.5
	86	R5-20	R5P2	24.0	64.0	52.0
	87	R5-21	R5P2	24.0	64.0	52.0
	88	R5-22	R5P3	15.5	49.0	65.5
	89	R5-23	R5P3	15.5	49.0	65.5
	90	R5-24	R5P2	24.0	64.0	52.0
	91	R5-25	R5P2	24.0	64.0	52.0
	92	R5-26	R5P1	32.0	183.3	40.0
	93	R5-27	R5P3	15.5	49.0	65.5
	94	R5-28	R5P3	15.5	49.0	65.5
	95	R5-29	R5P2	24.0	64.0	52.0
	96	R5-30	R5P2	24.0	64.0	52.0

Table A-1-26 (Cont'd). Existing Conditions Configuration

Project Reach	Reach Number	Beach-fx Reach Name	Rep Profile	Dune Height	Dune Width	Berm Width
Reach 5	97	R5-31	R5P2	24.0	64.0	52.0
	98	R5-32	R5P1	32.0	183.3	40.0
	99	R5-33	R5P1	32.0	183.3	40.0
	100	R5-34	R5P1	32.0	183.3	40.0
	101	R5-35	R5P1	32.0	183.3	40.0
	102	R5-36	R5P1	32.0	183.3	40.0
	103	R5-37	R5P1	32.0	183.3	40.0
	104	R5-38	R5P1	32.0	183.3	40.0
	105	R5-39	R5P1	32.0	183.3	40.0
	106	R5-40	R5P2	24.0	64.0	52.0
	107	R5-41	R5P2	24.0	64.0	52.0
	108	R5-42	R5P2	24.0	64.0	52.0
	109	R5-43	R5P2	24.0	64.0	52.0
	110	R5-44	R5P2	24.0	64.0	52.0
	111	R5-45	R5P2	24.0	64.0	52.0
	112	R5-46	R5P2	24.0	64.0	52.0
	113	R5-47	R5P2	24.0	64.0	52.0
	114	R5-48	R5P3	15.5	49.0	65.5
	115	R5-49	R5P3	15.5	49.0	65.5
	116	R5-50	R5P3	15.5	49.0	65.5
	117	R5-51	R5P3	15.5	49.0	65.5

Table A-1-27. Future Without Project Conditions, 53-Yr Period of Analysis

Reach	Rep Profile	Dune Height (feet)				Dune width (feet)				Berm Width (feet)			
		Exist	53 yr Avg	St Dev (+/-)	Diff	Exist	53 yr Avg	St Dev (+/-)	Diff	Exist	53 yr Avg	St Dev (+/-)	Diff
1	R1P1	22.2	22.2	0.0	0.0	55.0	66.8	3.9	11.8	23.0	4.3	1.6	-18.7
	R1P2	13.6	13.6	0.0	0.0	99.0	118.5	20.1	19.5	40.0	0.0	0.0	-40.0
3	R3P1	23.0	22.9	0.3	-0.1	75.5	67.0	30.5	-8.5	50.0	0.7	2.1	-49.3
	R3P2	20.3	19.8	0.5	-0.5	66.2	61.2	28.9	-5.0	49.3	0.7	1.8	-48.7
4	R4P1	23.0	13.4	4.2	-9.6	50.3	0.0	0.2	-50.3	35.0	2.8	2.3	-32.2
	R4P2	10.0	10.0	0.0	0.0	82.0	82.0	0.0	0.0	110.0	36.0	17.5	-74.0
5	R5P1	32.1	32.0	0.0	0.0	183.3	168.7	29.9	-14.5	40.0	0.4	1.6	-39.6
	R5P2	24.0	24.0	0.1	0.0	64.0	58.3	24.2	-5.7	52.0	0.1	.5	-51.9
	R5P3	15.5	15.5	0.1	0.0	49.0	57.4	19.9	8.4	65.5	0.2	0.9	-65.3

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ATTACHMENT I

WAVE INFORMATION STUDY (WIS) WIND AND WIND STATISTICS

Attachment: Wave Information Study Wind and Wind Statistics

Table 1. Percent Occurrence Tables, WIS Station 179

1980-1990 GOM WIS STATION: 179 LAT: 30.17 N, LON:-86.33 W, DEPTH: 28 M
PERCENT OCCURRENCES OF WAVE HEIGHT BY MONTH

Hmo(m)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CASES	PCT
0.00 - 0.49	1.50	1.32	1.61	1.91	2.61	3.20	3.62	4.34	3.85	2.48	1.77	1.40	28563	29.6
0.50 - 0.99	3.45	2.74	3.12	3.33	4.07	3.82	4.19	3.36	2.87	4.51	3.46	3.42	40826	42.3
1.00 - 1.49	2.20	2.02	1.91	1.90	1.50	0.92	0.65	0.63	1.20	1.19	1.88	2.27	17614	18.3
1.50 - 1.99	0.71	0.85	1.01	0.72	0.27	0.21	0.02	0.09	0.20	0.10	0.57	0.71	5280	5.5
2.00 - 2.49	0.33	0.42	0.46	0.21	0.02	0.04	.	0.03	0.04	0.07	0.29	0.39	2211	2.3
2.50 - 2.99	0.18	0.19	0.26	0.08	0.01	0.01	.	0.02	0.03	0.03	0.13	0.19	1096	1.1
3.00 - 3.49	0.08	0.11	0.07	0.04	0.02	0.01	.	0.00	0.01	0.01	0.08	0.08	492	0.5
3.50 - 3.99	0.02	0.05	0.02	0.01	.	.	.	0.00	0.00	0.01	0.03	0.02	157	0.2
4.00 - 4.49	0.01	0.03	0.02	.	.	.	.	0.00	0.00	0.04	0.00	0.01	101	0.1
4.50 - 4.99	0.00	0.01	0.01	.	.	.	.	0.00	0.00	0.01	.	0.01	42	0.0
5.00 - GREATER	.	.	.	.	.	.	.	0.01	0.01	0.03	.	.	39	0.0
TOTAL CASES	8173	7464	8184	7920	8184	7920	8184	8184	7920	8184	7920	8184	96421	

1980-1990 GOM WIS STATION: 179 LAT: 30.17 N, LON:-86.33 W, DEPTH: 28 M
PERCENT OCCURRENCES OF PEAK PERIOD BY MONTH

Tp(sec)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CASES	PCT
3.0 - 3.9	3.93	2.93	3.12	3.46	4.18	4.70	6.38	6.08	5.38	5.84	4.28	3.89	52224	54.2
4.0 - 4.9	2.38	2.28	2.09	2.21	2.60	1.93	1.64	1.47	1.68	1.57	2.05	2.45	23488	24.4
5.0 - 5.9	0.87	1.01	1.14	1.27	1.22	0.87	0.34	0.47	0.40	0.43	0.64	0.85	9180	9.5
6.0 - 6.9	0.67	0.63	1.17	0.90	0.33	0.51	0.08	0.23	0.25	0.22	0.57	0.69	6037	6.3
7.0 - 7.9	0.34	0.53	0.62	0.27	0.07	0.11	0.04	0.07	0.22	0.20	0.34	0.38	3080	3.2
8.0 - 8.9	0.19	0.22	0.26	0.09	0.08	0.05	.	0.07	0.08	0.06	0.19	0.15	1371	1.4
9.0 - 9.9	0.05	0.10	0.06	0.01	0.00	0.03	.	0.02	0.05	0.04	0.06	0.03	434	0.5
10.0 - 10.9	0.04	0.03	0.03	0.01	.	0.01	.	0.02	0.04	0.02	0.02	0.04	257	0.3
11.0 - 13.9	0.01	0.01	0.00	.	.	.	.	0.06	0.08	0.08	0.06	0.01	303	0.3
14.0 - LONGER	.	.	.	.	.	.	.	0.01	0.02	0.02	.	.	47	0.0
TOTAL CASES	8173	7464	8184	7920	8184	7920	8184	8184	7920	8184	7920	8184	96421	

1980-1990 GOM WIS STATION: 179 LAT: 30.17 N, LON:-86.33 W, DEPTH: 28 M
PERCENT OCCURRENCES OF MEAN DIRECTION BY MONTH

Dp(deg) DIRECTION BAND & CENTER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CASES	PCT
348.75 - 11.24 (0.0)	1.22	1.07	0.84	0.70	0.67	0.54	0.54	0.53	0.69	1.16	1.05	1.19	4055	4.2
11.25 - 33.74 (22.5)	0.90	0.95	0.83	0.69	0.64	0.53	0.54	0.56	0.74	1.02	0.99	1.08	3346	3.5
33.75 - 56.24 (45.0)	0.98	0.80	0.78	0.77	0.66	0.55	0.60	0.58	1.09	1.55	1.01	1.10	4321	4.5
56.25 - 78.74 (67.5)	0.87	0.85	0.83	0.79	0.70	0.63	0.77	0.71	1.38	1.72	1.24	0.96	5264	5.5
78.75 - 101.24 (90.0)	1.08	1.10	0.99	0.99	1.15	1.07	0.87	1.26	1.85	1.70	1.46	1.08	8288	8.6
101.25 - 123.74 (112.5)	1.05	1.08	1.11	1.00	1.41	1.12	1.00	0.99	1.21	1.02	1.33	1.07	7106	7.4
123.75 - 146.24 (135.0)	1.09	1.20	1.55	1.57	1.80	1.62	1.57	1.74	1.64	1.39	1.39	1.55	11665	12.1
146.25 - 168.74 (157.5)	1.41	1.36	1.81	1.50	2.33	1.79	1.95	2.07	1.70	1.48	1.33	1.44	13669	14.2
168.75 - 191.24 (180.0)	1.28	1.19	1.69	1.55	1.57	1.79	1.43	1.44	1.28	0.90	1.08	1.17	10007	10.4
191.25 - 213.74 (202.5)	0.94	1.10	1.04	1.06	1.10	1.30	1.25	0.95	0.83	0.63	0.96	0.90	5849	6.1
213.75 - 236.24 (225.0)	0.76	0.80	0.84	0.95	0.88	1.15	1.25	1.09	0.64	0.56	0.71	0.78	4255	4.4
236.25 - 258.74 (247.5)	0.77	0.83	0.85	1.01	0.88	1.33	1.35	1.30	0.79	0.56	0.66	0.80	4955	5.1
258.75 - 281.24 (270.0)	0.86	0.85	0.83	1.11	0.67	1.05	1.32	1.21	0.63	0.58	0.74	0.75	4440	4.6
281.25 - 303.74 (292.5)	1.06	0.86	0.81	0.88	0.63	0.64	0.89	0.88	0.55	0.65	0.74	0.78	3253	3.4
303.75 - 326.24 (315.0)	1.13	0.86	0.86	0.86	0.67	0.57	0.63	0.62	0.57	0.72	0.75	0.77	2898	3.0
326.25 - 348.74 (337.5)	1.07	0.82	0.82	0.80	0.71	0.54	0.53	0.56	0.62	0.84	0.78	1.07	3050	3.2
TOTAL CASES	8173	7464	8184	7920	8184	7920	8184	8184	7920	8184	7920	8184	96421	

Table 1 (Cont'd). Percent Occurrence Tables, WIS Station 179

1980-1990 GOM WIS STATION: 179 LAT: 30.17 N, LON:-86.33 W, DEPTH: 28 M
PERCENT OCCURRENCES OF WAVE HEIGHT AND PEAK PERIOD FOR ALL DIRECTIONS

Hmo(m)	Tp(sec)										CASES	PERCENT OF TOTAL
	3.0- 3.9	4.0- 4.9	5.0- 5.9	6.0- 6.9	7.0- 7.9	8.0- 8.9	9.0- 9.9	10.0- 10.9	11.0- 13.9	14.0- LONGER		
0.00 - 0.49	21.91	3.65	1.81	1.01	0.52	0.38	0.15	0.14	0.04	0.02	28563	29.62
0.50 - 0.99	30.58	7.38	2.80	1.04	0.33	0.12	0.06	0.02	0.02	.	40826	42.34
1.00 - 1.49	1.67	11.90	3.04	1.19	0.32	0.07	0.02	0.00	0.04	0.01	17614	18.27
1.50 - 1.99	.	1.37	1.64	1.87	0.42	0.05	0.02	0.02	0.07	0.01	5280	5.48
2.00 - 2.49	.	0.05	0.23	0.92	0.88	0.15	0.02	0.01	0.03	.	2211	2.29
2.50 - 2.99	.	.	0.01	0.20	0.51	0.34	0.05	0.01	0.02	.	1096	1.14
3.00 - 3.49	.	.	.	0.02	0.18	0.23	0.05	0.01	0.01	.	492	0.51
3.50 - 3.99	.	.	.	.	0.03	0.06	0.04	0.02	0.02	.	157	0.16
4.00 - 4.49	.	.	.	0.00	.	0.02	0.03	0.02	0.03	.	101	0.10
4.50 - 4.99	.	.	.	.	0.00	.	0.02	0.01	0.01	.	42	0.04
5.00 - GREATER	.	.	.	.	.	0.00	0.00	0.01	0.02	0.01	39	0.04
CASES THIS BAND	52224	23488	9180	6037	3080	1371	434	257	303	47	96421	100.00

1980-1990 GOM WIS STATION: 179 LAT: 30.17 N, LON:-86.33 W, DEPTH: 28 M
PERCENT OCCURRENCES OF WIND SPEED BY MONTH

WS(m/sec)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CASES	PCT
0.00 - 1.99	0.12	0.16	0.24	0.26	0.34	0.37	0.08	0.18	0.37	0.28	0.16	0.20	2666	2.8
2.00 - 3.99	0.97	0.96	1.18	1.37	2.00	2.37	2.54	3.08	2.26	1.30	1.00	0.92	19249	20.0
4.00 - 5.99	2.01	1.55	2.29	2.29	2.86	3.36	4.09	3.54	2.76	2.29	1.94	1.72	29604	30.7
6.00 - 7.99	2.24	1.86	1.99	2.37	2.39	1.59	1.48	1.34	1.51	2.53	2.27	2.29	22993	23.8
8.00 - 9.99	1.52	1.56	1.52	1.19	0.73	0.42	0.25	0.25	0.85	1.43	1.57	1.67	12502	13.0
10.00 - 11.99	0.94	0.89	0.79	0.55	0.10	0.09	0.05	0.04	0.38	0.48	0.86	1.06	6007	6.2
12.00 - 13.99	0.55	0.47	0.34	0.17	0.06	0.01	.	0.02	0.05	0.12	0.34	0.45	2477	2.6
14.00 - 15.99	0.11	0.25	0.12	0.01	0.01	.	.	0.01	0.01	0.04	0.05	0.11	696	0.7
16.00 - 17.99	0.02	0.03	0.03	.	.	.	.	0.02	0.00	0.01	0.00	0.06	178	0.2
18.00 - 19.99	.	0.01	0.00	.	.	.	.	0.00	0.00	0.01	0.00	.	31	0.0
20.00 - GREATER	.	.	.	.	.	.	.	.	0.01	.	0.01	.	18	0.0
NUMBER OF CASES	8173	7464	8184	7920	8184	7920	8184	8184	7920	8184	7920	8184	96421	

1980-1990 GOM WIS STATION: 179 LAT: 30.17 N, LON:-86.33 W, DEPTH: 28 M
PERCENT OCCURRENCES OF WIND DIRECTION BY MONTH

WD(deg) DIRECTION BAND & CENTER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CASES	PCT TOTAL
348.75 - 11.24 (0.0)	1.21	0.92	0.67	0.48	0.42	0.22	0.15	0.25	0.51	0.98	0.79	1.05	7382	7.7
11.25 - 33.74 (22.5)	0.72	0.74	0.67	0.43	0.31	0.21	0.19	0.24	0.52	0.78	0.84	0.91	6322	6.6
33.75 - 56.24 (45.0)	0.80	0.61	0.72	0.58	0.50	0.46	0.48	0.49	1.50	1.87	1.04	0.86	9564	9.9
56.25 - 78.74 (67.5)	0.48	0.55	0.52	0.43	0.54	0.47	0.48	0.72	1.42	1.41	0.89	0.43	8052	8.4
78.75 - 101.24 (90.0)	0.68	0.69	0.65	0.71	1.22	0.86	0.71	1.21	1.51	0.97	1.01	0.74	10545	10.9
101.25 - 123.74 (112.5)	0.41	0.45	0.73	0.49	0.92	0.62	0.58	0.69	0.59	0.47	0.62	0.63	6936	7.2
123.75 - 146.24 (135.0)	0.47	0.57	0.66	0.70	0.87	0.64	0.61	0.63	0.44	0.55	0.68	0.82	7360	7.6
146.25 - 168.74 (157.5)	0.42	0.38	0.66	0.62	0.71	0.41	0.54	0.49	0.23	0.18	0.38	0.52	5359	5.6
168.75 - 191.24 (180.0)	0.45	0.36	0.60	0.49	0.55	0.68	0.66	0.41	0.24	0.15	0.36	0.40	5173	5.4
191.25 - 213.74 (202.5)	0.23	0.28	0.28	0.38	0.41	0.64	0.63	0.24	0.14	0.06	0.16	0.20	3530	3.7
213.75 - 236.24 (225.0)	0.18	0.24	0.26	0.35	0.36	0.60	0.62	0.33	0.10	0.07	0.13	0.22	3331	3.5
236.25 - 258.74 (247.5)	0.21	0.19	0.25	0.34	0.29	0.62	0.61	0.49	0.20	0.08	0.13	0.19	3458	3.6
258.75 - 281.24 (270.0)	0.22	0.30	0.34	0.61	0.35	0.83	0.82	0.78	0.24	0.10	0.17	0.24	4816	5.0
281.25 - 303.74 (292.5)	0.30	0.35	0.32	0.46	0.27	0.40	0.67	0.56	0.10	0.13	0.18	0.25	3844	4.0
303.75 - 326.24 (315.0)	0.93	0.59	0.61	0.68	0.36	0.34	0.49	0.61	0.20	0.33	0.42	0.41	5752	6.0
326.25 - 348.74 (337.5)	0.77	0.53	0.56	0.48	0.41	0.21	0.25	0.33	0.27	0.36	0.41	0.60	4997	5.2
NUMBER OF CASES	8173	7464	8184	7920	8184	7920	8184	8184	7920	8184	7920	8184	96421	

Table 1 (Cont'd). Percent Occurrence Tables, WIS Station 179

STATION: 179 GOM
SUMMARY OF MEAN Hmo(m) BY MONTH AND YEAR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1980	1.11	1.05	1.45	1.03	0.80	0.62	0.64	0.54	0.50	0.72	0.94	0.84	0.85
1981	0.89	1.18	1.15	0.73	0.80	0.58	0.48	0.56	0.48	0.69	0.87	1.19	0.80
1982	1.36	1.05	0.82	1.03	0.57	0.74	0.49	0.57	0.56	0.80	0.92	1.49	0.86
1983	0.90	1.49	1.34	1.19	0.83	0.73	0.55	0.54	0.73	0.72	1.19	1.37	0.96
1984	0.91	0.93	0.91	1.10	0.89	0.53	0.60	0.52	0.69	0.72	1.01	0.70	0.79
1985	1.10	1.15	0.97	0.96	0.64	0.66	0.51	0.77	0.87	1.07	0.94	0.93	0.88
1986	0.83	1.11	1.12	0.59	0.63	0.47	0.59	0.55	0.57	0.76	0.88	0.93	0.75
1987	1.23	1.08	1.17	0.75	0.62	0.75	0.55	0.47	0.49	0.69	0.95	1.07	0.82
1988	1.11	0.89	0.98	1.06	0.67	0.60	0.58	0.69	0.99	0.57	1.14	0.75	0.84
1989	0.80	1.00	0.98	0.69	0.73	0.87	0.71	0.47	0.59	0.69	0.73	1.00	0.77
1990	0.77	1.19	0.86	0.83	0.76	0.51	0.64	0.47	0.44	0.69	0.78	0.99	0.74
MEAN	1.00	1.10	1.07	0.90	0.72	0.64	0.58	0.56	0.63	0.74	0.94	1.02	

STATION: 179 GOM
MAX Hmo(m) WITH ASSOCIATED Tp(sec) AND Dm(deg) BY MONTH AND YEAR

YEAR	JAN	FEB	MAR	APR	MAY	JUN
1980	2.8 8 163	2.4 7 263	3.5 8 168	3.2 9 232	2.0 6 133	2.1 7 261
1981	3.2 8 262	5.0 10 161	4.7 10 245	2.3 7 154	1.9 6 251	1.7 5 95
1982	4.8 10 173	2.9 9 227	2.0 5 300	2.3 7 281	2.0 7 228	2.1 6 128
1983	2.9 6 126	4.5 9 159	4.7 11 157	3.3 9 261	2.0 6 135	1.3 6 167
1984	3.5 8 205	4.0 8 168	4.7 10 269	2.6 7 158	3.3 9 199	1.5 6 267
1985	3.1 8 185	3.8 8 259	3.4 8 142	3.0 8 190	1.5 6 235	2.0 6 153
1986	3.2 8 192	3.0 7 198	3.3 8 162	2.0 6 265	1.4 5 108	1.2 4 112
1987	3.7 8 163	3.4 8 164	3.5 8 148	2.1 7 277	1.4 6 139	2.1 6 202
1988	3.5 8 162	3.3 8 275	2.3 7 209	3.8 8 262	1.6 6 219	1.7 5 117
1989	2.4 7 186	3.5 8 200	2.2 7 162	2.4 7 216	1.8 6 221	3.1 9 196
1990	2.1 6 281	3.5 8 155	3.0 8 154	2.0 7 139	2.2 7 172	1.6 5 252
MAX	4.8 10 173	5.0 10 161	4.7 10 269	3.8 8 262	3.3 9 199	3.1 9 196

YEAR	JUL	AUG	SEP	OCT	NOV	DEC	MAX
1980	1.4 5 281	1.7 10 188	1.6 6 263	3.0 8 172	2.9 7 149	2.3 7 276	3.5 8 17
1981	1.1 5 239	1.5 6 227	1.4 5 195	2.6 7 153	2.6 7 209	3.6 8 184	5.0 10 17
1982	0.9 4 101	1.4 5 103	1.3 5 93	1.4 5 97	2.8 8 162	3.8 8 142	4.8 10 18
1983	1.1 5 113	1.5 5 129	1.7 6 244	1.6 5 271	3.7 10 152	4.8 10 154	4.8 10 16
1984	1.5 6 201	1.8 6 151	1.6 5 105	1.9 6 138	3.7 8 146	2.1 6 143	4.7 10 27
1985	1.4 5 184	5.8 14 166	5.7 11 156	5.8 14 167	4.4 9 200	3.2 8 187	5.8 14 17
1986	1.7 6 274	1.5 6 153	1.4 5 155	2.7 7 153	3.1 8 165	3.5 8 168	3.5 8 17
1987	1.2 5 90	1.1 5 261	1.1 4 342	1.3 5 3	3.0 7 148	3.5 8 164	3.7 8 17
1988	1.6 5 87	3.0 7 158	2.8 10 171	1.2 4 17	3.4 8 165	2.6 7 150	3.8 8 27
1989	1.6 6 223	1.3 5 159	2.0 5 105	1.5 5 309	2.6 7 280	2.6 7 174	3.5 8 21
1990	1.5 6 241	1.3 5 268	1.2 4 4	2.0 5 325	3.8 9 263	2.9 8 179	3.8 9 27
MAX	1.7 6 274	5.8 14 166	5.7 11 156	5.8 14 167	4.4 9 200	4.8 10 154	

MAX Hmo(m): 5.8 MAX Tp(sec): 14. MAX Dp(deg): 166. DATE(gmt): 85083023

MAX WIND SPEED(m/sec): 29. MAX WIND DIRECTION(deg): 74. DATE(gmt): 85090203

MEAN Hmo(m): 0.8 MEAN Tp(sec): 4.

STANDARD DEVIATION Hmo(m): 0.6 STANDARD DEVIATION Tp(sec): 1.4

Table 2. Percent Occurrence Tables, WIS Station 180

1980-1990 GOM WIS STATION: 180 LAT: 30.17 N, LON:-86.25 W, DEPTH: 31 M
PERCENT OCCURRENCES OF WAVE HEIGHT BY MONTH

Hmo(m)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CASES	PCT
0.00 - 0.49	1.64	1.52	1.74	2.01	2.74	3.28	3.67	4.43	3.94	2.71	1.91	1.57	30034	31.1
0.50 - 0.99	3.61	2.86	3.19	3.43	4.07	3.79	4.17	3.33	2.91	4.58	3.66	3.65	41694	43.2
1.00 - 1.49	1.98	1.85	1.77	1.74	1.39	0.92	0.62	0.58	1.11	0.91	1.59	1.98	15859	16.4
1.50 - 1.99	0.64	0.75	0.95	0.70	0.24	0.17	0.02	0.09	0.17	0.10	0.53	0.65	4829	5.0
2.00 - 2.49	0.34	0.38	0.45	0.21	0.02	0.04	.	0.03	0.04	0.07	0.30	0.35	2139	2.2
2.50 - 2.99	0.17	0.21	0.26	0.08	0.01	0.01	.	0.01	0.02	0.03	0.12	0.18	1062	1.1
3.00 - 3.49	0.07	0.10	0.07	0.05	0.02	0.01	.	0.00	0.01	0.01	0.08	0.08	477	0.5
3.50 - 3.99	0.02	0.04	0.02	0.01	.	.	.	0.00	0.00	0.03	0.03	0.02	156	0.2
4.00 - 4.49	0.01	0.03	0.02	.	.	.	.	0.00	0.01	0.03	0.00	0.00	91	0.1
4.50 - 4.99	0.00	0.01	0.01	.	.	.	.	0.00	0.00	0.01	.	0.01	50	0.1
5.00 - GREATER	.	0.00	.	.	.	.	.	0.01	0.00	0.02	.	.	30	0.0
TOTAL CASES	8173	7464	8184	7920	8184	7920	8184	8184	7920	8184	7920	8184	96421	

1980-1990 GOM WIS STATION: 180 LAT: 30.17 N, LON:-86.25 W, DEPTH: 31 M
PERCENT OCCURRENCES OF PEAK PERIOD BY MONTH

Tp(sec)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CASES	PCT
3.0 - 3.9	4.31	3.15	3.31	3.64	4.31	4.71	6.43	6.15	5.50	6.21	4.68	4.30	54685	56.7
4.0 - 4.9	1.96	2.04	1.90	1.98	2.42	1.85	1.57	1.39	1.52	1.17	1.63	2.01	20681	21.4
5.0 - 5.9	0.90	1.00	1.14	1.30	1.24	0.91	0.36	0.48	0.38	0.44	0.65	0.86	9302	9.6
6.0 - 6.9	0.67	0.65	1.18	0.89	0.35	0.53	0.09	0.24	0.28	0.24	0.60	0.69	6177	6.4
7.0 - 7.9	0.34	0.54	0.63	0.29	0.07	0.12	0.04	0.07	0.25	0.20	0.32	0.40	3160	3.3
8.0 - 8.9	0.19	0.22	0.24	0.09	0.09	0.06	.	0.06	0.08	0.06	0.19	0.16	1385	1.4
9.0 - 9.9	0.05	0.11	0.06	0.01	.	0.02	.	0.02	0.05	0.04	0.07	0.02	442	0.5
10.0 - 10.9	0.04	0.03	0.02	0.01	.	0.01	.	0.02	0.04	0.02	0.02	0.04	246	0.3
11.0 - 13.9	0.01	0.01	0.00	.	.	.	.	0.05	0.08	0.08	0.06	0.01	289	0.3
14.0 - LONGER	.	.	.	.	.	.	.	0.01	0.02	0.02	0.01	.	54	0.1
TOTAL CASES	8173	7464	8184	7920	8184	7920	8184	8184	7920	8184	7920	8184	96421	

1980-1990 GOM WIS STATION: 180 LAT: 30.17 N, LON:-86.25 W, DEPTH: 31 M
PERCENT OCCURRENCES OF MEAN DIRECTION BY MONTH

Dp(deg) DIRECTION BAND & CENTER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CASES	PCT
348.75 - 11.24 (0.0)	0.96	0.88	0.68	0.62	0.59	0.51	0.52	0.52	0.62	0.92	0.93	1.02	2662	2.8
11.25 - 33.74 (22.5)	0.87	0.88	0.82	0.67	0.62	0.51	0.54	0.54	0.71	1.04	0.97	1.08	3147	3.3
33.75 - 56.24 (45.0)	0.99	0.83	0.78	0.77	0.67	0.55	0.62	0.59	1.13	1.59	1.06	1.11	4523	4.7
56.25 - 78.74 (67.5)	0.87	0.87	0.83	0.80	0.71	0.64	0.76	0.72	1.41	1.72	1.26	0.96	5351	5.5
78.75 - 101.24 (90.0)	1.03	1.06	0.94	0.94	1.08	1.02	0.82	1.20	1.75	1.61	1.38	1.01	7576	7.9
101.25 - 123.74 (112.5)	1.06	1.08	1.10	0.97	1.41	1.08	1.00	1.00	1.21	1.01	1.32	1.07	7044	7.3
123.75 - 146.24 (135.0)	1.08	1.17	1.54	1.55	1.77	1.58	1.45	1.66	1.60	1.36	1.39	1.54	11287	11.7
146.25 - 168.74 (157.5)	1.40	1.40	1.82	1.50	2.33	1.84	2.01	2.14	1.74	1.50	1.31	1.44	13914	14.4
168.75 - 191.24 (180.0)	1.36	1.27	1.71	1.62	1.66	1.83	1.49	1.43	1.31	0.95	1.11	1.22	10567	11.0
191.25 - 213.74 (202.5)	0.94	1.11	1.10	1.08	1.12	1.31	1.24	0.97	0.87	0.66	0.97	0.91	6049	6.3
213.75 - 236.24 (225.0)	0.78	0.82	0.84	0.96	0.90	1.16	1.27	1.12	0.64	0.56	0.74	0.78	4408	4.6
236.25 - 258.74 (247.5)	0.78	0.85	0.86	1.04	0.90	1.36	1.37	1.34	0.80	0.57	0.66	0.82	5166	5.4
258.75 - 281.24 (270.0)	0.87	0.87	0.85	1.14	0.70	1.06	1.34	1.21	0.63	0.59	0.74	0.75	4563	4.7
281.25 - 303.74 (292.5)	1.09	0.87	0.83	0.89	0.64	0.65	0.88	0.88	0.55	0.66	0.78	0.82	3424	3.6
303.75 - 326.24 (315.0)	1.28	0.90	0.97	0.94	0.73	0.58	0.64	0.62	0.60	0.80	0.79	0.90	3618	3.8
326.25 - 348.74 (337.5)	1.12	0.88	0.81	0.73	0.65	0.53	0.53	0.54	0.64	0.94	0.81	1.06	3122	3.2
TOTAL CASES	8173	7464	8184	7920	8184	7920	8184	8184	7920	8184	7920	8184	96421	

Table 2 (Cont'd). Percent Occurrence Tables, WIS Station 180

1980-1990 GOM WIS STATION: 180 LAT: 30.17 N, LON:-86.25 W, DEPTH: 31 M
PERCENT OCCURANCE OF WAVE HEIGHT AND PEAK PERIOD FOR ALL DIRECTIONS

Hmo(m)	Tp(sec)										CASES	PERCENT OF TOTAL
	3.0- 3.9	4.0- 4.9	5.0- 5.9	6.0- 6.9	7.0- 7.9	8.0- 8.9	9.0- 9.9	10.0- 10.9	11.0- 13.9	14.0- LONGER		
0.00 - 0.49	22.83	3.89	1.97	1.10	0.57	0.41	0.15	0.15	0.04	0.02	30034	31.15
0.50 - 0.99	32.14	6.45	2.86	1.17	0.39	0.13	0.06	0.01	0.03	.	41694	43.24
1.00 - 1.49	1.75	10.05	2.96	1.23	0.33	0.06	0.01	0.00	0.04	0.01	15859	16.45
1.50 - 1.99	.	1.02	1.62	1.74	0.43	0.05	0.04	0.02	0.07	0.01	4829	5.01
2.00 - 2.49	.	0.03	0.21	0.95	0.82	0.16	0.02	0.01	0.03	0.00	2139	2.22
2.50 - 2.99	.	.	0.02	0.21	0.51	0.30	0.04	0.01	0.01	0.00	1062	1.10
3.00 - 3.49	.	.	.	0.01	0.19	0.24	0.04	0.01	0.01	0.00	477	0.49
3.50 - 3.99	.	.	.	.	0.02	0.05	0.04	0.01	0.03	0.00	156	0.16
4.00 - 4.49	.	.	.	0.00	0.00	0.02	0.03	0.02	0.02	.	91	0.09
4.50 - 4.99	.	.	.	.	0.00	0.00	0.02	0.01	0.01	0.00	50	0.05
5.00 - GREATER	.	.	.	.	.	.	0.00	0.01	0.01	0.01	30	0.05
CASES THIS BAND	54685	20681	9302	6177	3160	1385	442	246	289	54	96421	100.00

1980-1990 GOM WIS STATION: 180 LAT: 30.17 N, LON:-86.25 W, DEPTH: 31 M
PERCENT OCCURRENCES OF WIND SPEED BY MONTH

WS(m/sec)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CASES	PCT
0.00 - 1.99	0.12	0.16	0.24	0.27	0.36	0.38	0.08	0.18	0.38	0.29	0.16	0.21	2726	2.8
2.00 - 3.99	0.98	0.97	1.19	1.39	2.00	2.39	2.55	3.10	2.26	1.31	1.00	0.92	19332	20.0
4.00 - 5.99	2.00	1.56	2.28	2.28	2.87	3.35	4.09	3.54	2.75	2.28	1.96	1.73	29610	30.7
6.00 - 7.99	2.25	1.85	1.97	2.38	2.36	1.57	1.47	1.33	1.51	2.53	2.27	2.28	22923	23.8
8.00 - 9.99	1.50	1.56	1.51	1.17	0.73	0.43	0.25	0.25	0.86	1.44	1.57	1.66	12471	12.9
10.00 - 11.99	0.95	0.89	0.79	0.55	0.10	0.09	0.05	0.04	0.37	0.48	0.85	1.06	5982	6.2
12.00 - 13.99	0.54	0.47	0.34	0.17	0.06	0.01	.	0.01	0.05	0.11	0.34	0.45	2455	2.5
14.00 - 15.99	0.11	0.25	0.12	0.01	0.01	.	.	0.01	0.01	0.04	0.05	0.11	694	0.7
16.00 - 17.99	0.03	0.03	0.03	.	.	.	.	0.02	0.01	0.01	0.00	0.06	181	0.2
18.00 - 19.99	.	0.01	0.00	.	.	.	.	0.00	0.00	0.00	0.00	.	27	0.0
20.00 - GREATER	.	.	.	.	.	.	.	.	0.01	.	0.01	.	20	0.0
NUMBER OF CASES	8173	7464	8184	7920	8184	7920	8184	8184	7920	8184	7920	8184	96421	

1980-1990 GOM WIS STATION: 180 LAT: 30.17 N, LON:-86.25 W, DEPTH: 31 M
PERCENT OCCURRENCES OF WIND DIRECTION BY MONTH

WD(deg) DIRECTION BAND & CENTER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CASES	PCT TOTAL
348.75 - 11.24 (0.0)	1.21	0.92	0.67	0.49	0.41	0.22	0.16	0.25	0.50	0.97	0.78	1.06	7376	7.6
11.25 - 33.74 (22.5)	0.71	0.73	0.66	0.43	0.31	0.22	0.18	0.24	0.52	0.78	0.85	0.91	6311	6.5
33.75 - 56.24 (45.0)	0.81	0.60	0.72	0.58	0.50	0.46	0.48	0.50	1.50	1.89	1.05	0.86	9591	9.9
56.25 - 78.74 (67.5)	0.50	0.55	0.53	0.43	0.55	0.48	0.49	0.73	1.43	1.42	0.89	0.43	8111	8.4
78.75 - 101.24 (90.0)	0.67	0.70	0.65	0.71	1.24	0.86	0.71	1.21	1.51	0.95	1.01	0.74	10559	11.0
101.25 - 123.74 (112.5)	0.40	0.45	0.72	0.48	0.89	0.62	0.58	0.70	0.59	0.47	0.63	0.63	6909	7.2
123.75 - 146.24 (135.0)	0.47	0.56	0.66	0.69	0.87	0.63	0.61	0.61	0.43	0.54	0.66	0.82	7278	7.5
146.25 - 168.74 (157.5)	0.41	0.39	0.65	0.62	0.71	0.41	0.54	0.50	0.23	0.19	0.38	0.52	5351	5.5
168.75 - 191.24 (180.0)	0.45	0.36	0.60	0.49	0.55	0.66	0.68	0.41	0.23	0.14	0.36	0.40	5159	5.4
191.25 - 213.74 (202.5)	0.23	0.28	0.29	0.38	0.41	0.65	0.62	0.24	0.14	0.06	0.17	0.21	3548	3.7
213.75 - 236.24 (225.0)	0.18	0.23	0.26	0.35	0.35	0.60	0.63	0.32	0.10	0.06	0.12	0.22	3303	3.4
236.25 - 258.74 (247.5)	0.21	0.19	0.25	0.34	0.29	0.62	0.61	0.49	0.20	0.08	0.13	0.19	3475	3.6
258.75 - 281.24 (270.0)	0.22	0.31	0.34	0.62	0.35	0.84	0.81	0.79	0.24	0.10	0.18	0.23	4851	5.0
281.25 - 303.74 (292.5)	0.30	0.35	0.31	0.46	0.27	0.38	0.66	0.55	0.10	0.14	0.17	0.25	3797	3.9
303.75 - 326.24 (315.0)	0.93	0.59	0.62	0.68	0.37	0.35	0.50	0.61	0.19	0.34	0.42	0.41	5795	6.0
326.25 - 348.74 (337.5)	0.77	0.53	0.56	0.48	0.42	0.20	0.24	0.32	0.28	0.36	0.42	0.60	5007	5.2
NUMBER OF CASES	8173	7464	8184	7920	8184	7920	8184	8184	7920	8184	7920	8184	96421	

Table 2 (Cont'd). Percent Occurrence Tables, WIS Station 180

STATION: 180 GOM
SUMMARY OF MEAN Hmo(m) BY MONTH AND YEAR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1980	1.10	1.00	1.42	1.02	0.79	0.61	0.64	0.53	0.49	0.69	0.90	0.80	0.83
1981	0.84	1.15	1.12	0.71	0.79	0.57	0.48	0.55	0.46	0.66	0.83	1.16	0.77
1982	1.31	1.01	0.80	1.00	0.55	0.73	0.49	0.56	0.54	0.76	0.89	1.45	0.84
1983	0.87	1.44	1.32	1.17	0.81	0.73	0.54	0.53	0.72	0.69	1.17	1.32	0.94
1984	0.87	0.90	0.89	1.09	0.87	0.52	0.60	0.52	0.65	0.70	0.96	0.68	0.77
1985	1.07	1.11	0.94	0.93	0.63	0.65	0.51	0.75	0.85	1.03	0.92	0.88	0.85
1986	0.81	1.08	1.08	0.57	0.61	0.46	0.59	0.54	0.55	0.73	0.85	0.89	0.73
1987	1.20	1.05	1.15	0.74	0.60	0.73	0.54	0.47	0.48	0.64	0.91	1.03	0.79
1988	1.06	0.86	0.96	1.04	0.66	0.59	0.57	0.68	0.96	0.54	1.10	0.70	0.81
1989	0.76	0.96	0.96	0.67	0.71	0.87	0.71	0.46	0.58	0.67	0.71	0.96	0.75
1990	0.75	1.16	0.83	0.79	0.73	0.51	0.63	0.47	0.43	0.66	0.74	0.96	0.72
MEAN	0.97	1.06	1.04	0.88	0.70	0.63	0.57	0.55	0.61	0.71	0.91	0.98	

STATION: 180 GOM
MAX Hmo(m) WITH ASSOCIATED Tp(sec) AND Dm(deg) BY MONTH AND YEAR

YEAR	JAN	FEB	MAR	APR	MAY	JUN
1980	2.9 7 272	2.5 7 262	3.4 8 170	3.3 9 261	2.0 6 134	2.1 6 258
1981	3.3 8 262	5.0 10 163	4.8 10 245	2.3 7 155	1.9 6 251	1.5 5 97
1982	4.8 10 175	2.9 9 229	2.0 5 299	2.2 7 278	2.0 7 227	2.1 6 129
1983	2.7 6 126	4.5 9 161	4.7 11 158	3.3 9 261	2.0 6 137	1.3 6 169
1984	3.5 8 204	3.9 8 177	4.8 10 268	2.6 7 160	3.3 9 200	1.5 6 267
1985	3.2 8 186	3.8 8 257	3.3 7 144	3.0 8 190	1.5 6 235	2.0 6 155
1986	3.3 8 193	3.0 7 198	3.4 7 164	2.0 6 265	1.2 5 181	1.2 4 113
1987	3.7 8 166	3.4 8 169	3.4 7 151	2.1 7 277	1.5 6 141	2.1 6 203
1988	3.5 8 164	3.3 8 275	2.3 7 213	3.8 9 275	1.6 6 219	1.5 5 124
1989	2.4 7 189	3.6 8 201	2.3 6 164	2.4 7 217	1.8 6 221	3.2 8 195
1990	2.1 6 280	3.5 8 157	3.1 8 156	2.0 7 138	2.3 7 173	1.6 5 251
MAX	4.8 10 175	5.0 10 163	4.8 10 268	3.8 9 275	3.3 9 200	3.2 8 195

YEAR	JUL	AUG	SEP	OCT	NOV	DEC	MAX
1980	1.4 5 281	1.7 10 190	1.6 6 261	3.0 8 171	2.9 7 151	2.3 7 273	3.4 8 17
1981	1.1 5 240	1.5 6 226	1.4 5 194	2.6 7 154	2.6 7 208	3.6 8 185	5.0 10 17
1982	0.9 4 210	1.2 5 102	1.2 4 89	1.2 5 155	2.8 8 164	3.9 8 143	4.8 10 18
1983	1.1 4 113	1.5 5 130	1.7 6 242	1.6 6 267	3.7 9 153	4.8 9 156	4.8 9 16
1984	1.5 6 201	1.8 6 152	1.4 5 107	1.9 6 139	3.6 8 147	2.1 6 144	4.8 10 27
1985	1.4 5 184	5.3 14 167	5.4 11 156	5.7 10 165	4.3 9 200	3.2 8 188	5.7 10 17
1986	1.7 6 274	1.5 5 154	1.4 5 156	2.7 7 155	3.1 7 168	3.5 8 175	3.5 8 18
1987	1.1 4 85	1.1 5 257	1.0 4 335	1.2 4 31	3.0 7 150	3.3 7 168	3.7 8 17
1988	1.4 5 85	2.8 7 161	2.8 7 158	1.1 4 27	3.3 8 214	2.4 6 152	3.8 9 28
1989	1.6 6 222	1.2 5 158	1.9 5 105	1.5 5 308	2.6 7 280	2.6 7 176	3.6 8 21
1990	1.5 6 239	1.3 5 268	1.1 4 28	2.0 5 322	3.9 9 264	2.9 8 179	3.9 9 27
MAX	1.7 6 274	5.3 14 167	5.4 11 156	5.7 10 165	4.3 9 200	4.8 9 156	

MAX Hmo(m): 5.7 MAX Tp(sec): 10. MAX Dp(deg): 165. DATE(gmt): 85103119

MAX WIND SPEED(m/sec): 29. MAX WIND DIRECTION(deg): 79. DATE(gmt): 85090203

MEAN Hmo(m): 0.8 MEAN Tp(sec): 4.

STANDARD DEVIATION Hmo(m): 0.6 STANDARD DEVIATION Tp(sec): 1.4

Table 3. Percent Occurrence Tables, WIS Station 181

1980-1990 GOM WIS STATION: 181 LAT: 30.17 N, LON:-86.17 W, DEPTH: 31 M
PERCENT OCCURRENCES OF WAVE HEIGHT BY MONTH

Hmo(m)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CASES	PCT
0.00 - 0.49	1.72	1.57	1.79	2.06	2.82	3.34	3.71	4.47	4.04	2.81	1.98	1.61	30772	31.9
0.50 - 0.99	3.67	2.92	3.26	3.53	4.17	3.84	4.20	3.41	3.05	4.64	3.78	3.82	42707	44.3
1.00 - 1.49	1.85	1.81	1.73	1.63	1.23	0.81	0.56	0.47	0.90	0.76	1.45	1.84	14501	15.0
1.50 - 1.99	0.65	0.69	0.92	0.65	0.22	0.16	0.02	0.08	0.15	0.09	0.51	0.62	4598	4.8
2.00 - 2.49	0.35	0.39	0.45	0.21	0.02	0.04	.	0.03	0.04	0.08	0.28	0.32	2118	2.2
2.50 - 2.99	0.15	0.20	0.23	0.08	0.01	0.01	.	0.01	0.02	0.03	0.11	0.18	991	1.0
3.00 - 3.49	0.08	0.09	0.06	0.04	0.02	0.01	.	0.00	0.01	0.01	0.07	0.08	442	0.5
3.50 - 3.99	0.01	0.04	0.02	0.01	.	.	.	0.00	0.01	0.04	0.02	0.01	152	0.2
4.00 - 4.49	0.00	0.03	0.02	.	.	.	.	0.01	0.00	0.02	0.00	0.00	82	0.1
4.50 - 4.99	0.00	0.01	0.01	.	.	.	.	.	0.00	0.01	.	0.01	45	0.0
5.00 - GREATER	.	.	.	.	.	.	.	.	0.00	0.01	.	.	13	0.0
TOTAL CASES	8173	7464	8184	7920	8184	7920	8184	8184	7920	8184	7920	8184	96421	

1980-1990 GOM WIS STATION: 181 LAT: 30.17 N, LON:-86.17 W, DEPTH: 31 M
PERCENT OCCURRENCES OF PEAK PERIOD BY MONTH

Tp(sec)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CASES	PCT
3.0 - 3.9	4.44	3.28	3.41	3.74	4.44	4.81	6.51	6.23	5.74	6.40	4.87	4.53	56306	58.4
4.0 - 4.9	1.85	1.94	1.82	1.87	2.31	1.73	1.48	1.30	1.30	0.98	1.46	1.81	19131	19.8
5.0 - 5.9	0.89	0.96	1.13	1.32	1.21	0.93	0.38	0.49	0.36	0.43	0.65	0.87	9274	9.6
6.0 - 6.9	0.67	0.66	1.19	0.89	0.36	0.54	0.08	0.23	0.31	0.25	0.61	0.66	6229	6.5
7.0 - 7.9	0.34	0.55	0.64	0.30	0.09	0.12	0.04	0.07	0.23	0.21	0.30	0.39	3162	3.3
8.0 - 8.9	0.18	0.20	0.23	0.08	0.08	0.06	.	0.06	0.08	0.06	0.18	0.15	1314	1.4
9.0 - 9.9	0.06	0.10	0.05	0.01	.	0.02	.	0.02	0.05	0.04	0.07	0.02	428	0.4
10.0 - 10.9	0.03	0.03	0.02	0.01	.	0.01	.	0.02	0.04	0.03	0.02	0.04	240	0.2
11.0 - 13.9	0.01	0.01	0.00	.	.	.	.	0.06	0.08	0.08	0.05	0.01	283	0.3
14.0 - LONGER	.	.	.	.	.	.	.	0.00	0.02	0.03	0.01	.	54	0.1
TOTAL CASES	8173	7464	8184	7920	8184	7920	8184	8184	7920	8184	7920	8184	96421	

1980-1990 GOM WIS STATION: 181 LAT: 30.17 N, LON:-86.17 W, DEPTH: 31 M
PERCENT OCCURRENCES OF MEAN DIRECTION BY MONTH

Dp(deg) DIRECTION BAND & CENTER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CASES	PCT
348.75 - 11.24 (0.0)	1.04	0.91	0.72	0.61	0.59	0.51	0.53	0.52	0.63	1.00	0.94	1.06	2949	3.1
11.25 - 33.74 (22.5)	0.93	0.91	0.85	0.70	0.64	0.51	0.54	0.55	0.75	1.15	1.04	1.16	3613	3.7
33.75 - 56.24 (45.0)	0.99	0.82	0.79	0.79	0.68	0.57	0.64	0.59	1.16	1.65	1.08	1.10	4674	4.8
56.25 - 78.74 (67.5)	0.87	0.87	0.83	0.78	0.72	0.65	0.78	0.72	1.45	1.66	1.31	0.94	5384	5.6
78.75 - 101.24 (90.0)	0.98	1.02	0.87	0.88	1.01	0.95	0.77	1.17	1.61	1.51	1.22	0.93	6677	6.9
101.25 - 123.74 (112.5)	1.05	1.08	1.07	0.96	1.38	1.06	0.99	0.98	1.20	0.99	1.29	1.09	6884	7.1
123.75 - 146.24 (135.0)	1.08	1.14	1.55	1.52	1.76	1.55	1.36	1.56	1.56	1.33	1.41	1.51	10929	11.3
146.25 - 168.74 (157.5)	1.36	1.43	1.79	1.52	2.33	1.87	2.02	2.22	1.76	1.51	1.32	1.45	14058	14.6
168.75 - 191.24 (180.0)	1.40	1.27	1.73	1.64	1.72	1.87	1.56	1.41	1.36	0.99	1.13	1.24	10889	11.3
191.25 - 213.74 (202.5)	0.93	1.12	1.13	1.07	1.12	1.31	1.24	0.99	0.90	0.67	0.95	0.93	6114	6.3
213.75 - 236.24 (225.0)	0.81	0.83	0.87	0.97	0.92	1.17	1.29	1.15	0.65	0.57	0.77	0.78	4599	4.8
236.25 - 258.74 (247.5)	0.80	0.86	0.88	1.08	0.91	1.38	1.40	1.38	0.79	0.58	0.67	0.84	5374	5.6
258.75 - 281.24 (270.0)	0.88	0.89	0.87	1.18	0.72	1.07	1.35	1.23	0.64	0.60	0.76	0.78	4794	5.0
281.25 - 303.74 (292.5)	1.14	0.89	0.87	0.93	0.67	0.65	0.88	0.86	0.56	0.68	0.82	0.82	3631	3.8
303.75 - 326.24 (315.0)	1.21	0.88	0.92	0.86	0.68	0.57	0.64	0.62	0.59	0.78	0.75	0.88	3271	3.4
326.25 - 348.74 (337.5)	1.00	0.82	0.76	0.72	0.65	0.52	0.51	0.53	0.60	0.82	0.76	0.99	2581	2.7
TOTAL CASES	8173	7464	8184	7920	8184	7920	8184	8184	7920	8184	7920	8184	96421	

Table 3 (Cont'd). Percent Occurrence Tables, WIS Station 181

1980-1990 GOM WIS STATION: 181 LAT: 30.17 N, LON:-86.17 W, DEPTH: 31 M
PERCENT OCCURRENCES OF WAVE HEIGHT AND PEAK PERIOD FOR ALL DIRECTIONS

Hmo(m)	Tp(sec)										CASES	PERCENT OF TOTAL
	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	7.0-7.9	8.0-8.9	9.0-9.9	10.0-10.9	11.0-13.9	14.0-LONGER		
0.00 - 0.49	23.13	4.15	2.04	1.17	0.59	0.44	0.18	0.15	0.04	0.03	30772	31.91
0.50 - 0.99	33.34	6.24	2.89	1.21	0.40	0.12	0.06	0.01	0.03	.	42707	44.29
1.00 - 1.49	1.93	8.51	2.83	1.26	0.35	0.06	0.02	0.01	0.07	0.01	14501	15.04
1.50 - 1.99	.	0.90	1.62	1.65	0.43	0.05	0.03	0.01	0.05	0.02	4598	4.77
2.00 - 2.49	.	0.04	0.22	0.93	0.84	0.13	0.02	0.01	0.02	0.00	2118	2.20
2.50 - 2.99	.	.	0.02	0.20	0.49	0.26	0.03	0.01	0.01	0.00	991	1.03
3.00 - 3.49	.	.	0.00	0.03	0.15	0.23	0.02	0.01	0.01	0.00	442	0.46
3.50 - 3.99	.	.	.	0.00	0.03	0.05	0.03	0.01	0.03	.	152	0.16
4.00 - 4.49	.	.	.	.	0.00	0.02	0.03	0.02	0.01	0.00	82	0.09
4.50 - 4.99	.	.	.	.	0.00	0.00	0.02	0.01	0.01	.	45	0.05
5.00 - GREATER	.	.	.	.	.	.	0.00	0.01	0.00	.	13	0.05
CASES THIS BAND	56306	19131	9274	6229	3162	1314	428	240	283	54	96421	100.00

1980-1990 GOM WIS STATION: 181 LAT: 30.17 N, LON:-86.17 W, DEPTH: 31 M
PERCENT OCCURRENCES OF WIND SPEED BY MONTH

WS(m/sec)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CASES	PCT
0.00 - 1.99	0.12	0.16	0.25	0.27	0.37	0.39	0.07	0.18	0.38	0.29	0.16	0.22	2755	2.9
2.00 - 3.99	1.01	0.97	1.22	1.42	2.02	2.40	2.56	3.10	2.29	1.31	1.00	0.93	19501	20.2
4.00 - 5.99	1.99	1.58	2.25	2.30	2.89	3.35	4.08	3.53	2.74	2.29	1.97	1.73	29602	30.7
6.00 - 7.99	2.25	1.84	2.02	2.34	2.35	1.56	1.48	1.34	1.50	2.51	2.26	2.30	22905	23.8
8.00 - 9.99	1.50	1.54	1.48	1.16	0.71	0.42	0.25	0.25	0.87	1.44	1.57	1.64	12365	12.8
10.00 - 11.99	0.95	0.89	0.79	0.56	0.10	0.09	0.05	0.04	0.36	0.48	0.85	1.05	5975	6.2
12.00 - 13.99	0.53	0.47	0.33	0.16	0.05	0.01	.	0.01	0.05	0.11	0.33	0.44	2409	2.5
14.00 - 15.99	0.11	0.24	0.11	0.01	0.01	.	.	0.01	0.01	0.05	0.05	0.11	684	0.7
16.00 - 17.99	0.03	0.03	0.03	.	.	.	.	0.02	0.01	0.01	0.00	0.06	182	0.2
18.00 - 19.99	.	0.01	.	.	.	.	.	0.00	0.00	0.00	0.00	.	22	0.0
20.00 - GREATER	.	.	.	.	.	.	.	.	0.01	.	0.01	.	21	0.0
NUMBER OF CASES	8173	7464	8184	7920	8184	7920	8184	8184	7920	8184	7920	8184	96421	

1980-1990 GOM WIS STATION: 181 LAT: 30.17 N, LON:-86.17 W, DEPTH: 31 M
PERCENT OCCURRENCES OF WIND DIRECTION BY MONTH

WD(deg) DIRECTION BAND & CENTER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CASES	PCT TOTAL
348.75 - 11.24 (0.0)	1.22	0.94	0.66	0.49	0.40	0.22	0.16	0.25	0.50	0.98	0.77	1.05	7361	7.6
11.25 - 33.74 (22.5)	0.72	0.71	0.66	0.43	0.32	0.22	0.18	0.23	0.53	0.78	0.85	0.91	6304	6.5
33.75 - 56.24 (45.0)	0.79	0.60	0.71	0.57	0.50	0.46	0.48	0.51	1.50	1.90	1.06	0.86	9593	9.9
56.25 - 78.74 (67.5)	0.50	0.54	0.53	0.44	0.55	0.48	0.48	0.73	1.44	1.41	0.88	0.44	8128	8.4
78.75 - 101.24 (90.0)	0.67	0.71	0.65	0.70	1.25	0.86	0.71	1.20	1.50	0.95	1.01	0.73	10547	10.9
101.25 - 123.74 (112.5)	0.38	0.45	0.73	0.49	0.87	0.62	0.58	0.71	0.59	0.47	0.63	0.65	6915	7.2
123.75 - 146.24 (135.0)	0.48	0.57	0.66	0.69	0.88	0.63	0.62	0.62	0.43	0.53	0.66	0.81	7309	7.6
146.25 - 168.74 (157.5)	0.41	0.38	0.65	0.61	0.70	0.41	0.53	0.49	0.22	0.19	0.37	0.52	5284	5.5
168.75 - 191.24 (180.0)	0.45	0.37	0.59	0.48	0.55	0.67	0.68	0.42	0.24	0.14	0.36	0.40	5145	5.3
191.25 - 213.74 (202.5)	0.22	0.28	0.29	0.37	0.41	0.65	0.61	0.25	0.14	0.06	0.17	0.21	3533	3.7
213.75 - 236.24 (225.0)	0.18	0.23	0.26	0.35	0.36	0.60	0.63	0.32	0.10	0.06	0.11	0.22	3291	3.4
236.25 - 258.74 (247.5)	0.21	0.18	0.25	0.36	0.29	0.62	0.63	0.51	0.20	0.08	0.13	0.19	3513	3.6
258.75 - 281.24 (270.0)	0.22	0.31	0.35	0.63	0.35	0.86	0.81	0.79	0.24	0.10	0.17	0.23	4895	5.1
281.25 - 303.74 (292.5)	0.30	0.34	0.30	0.45	0.28	0.37	0.65	0.55	0.10	0.14	0.17	0.24	3776	3.9
303.75 - 326.24 (315.0)	0.94	0.61	0.62	0.67	0.36	0.35	0.50	0.61	0.19	0.33	0.43	0.42	5819	6.0
326.25 - 348.74 (337.5)	0.77	0.52	0.58	0.48	0.43	0.21	0.24	0.31	0.28	0.36	0.42	0.60	5008	5.2
NUMBER OF CASES	8173	7464	8184	7920	8184	7920	8184	8184	7920	8184	7920	8184	96421	

Table 3 (Cont'd). Percent Occurrence Tables, WIS Station 181

STATION: 181 GOM
SUMMARY OF MEAN Hmo(m) BY MONTH AND YEAR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1980	1.08	0.99	1.39	1.00	0.77	0.61	0.63	0.51	0.47	0.67	0.87	0.78	0.82
1981	0.84	1.12	1.11	0.68	0.77	0.55	0.48	0.54	0.45	0.65	0.82	1.14	0.76
1982	1.29	0.99	0.78	0.98	0.54	0.73	0.49	0.55	0.52	0.73	0.86	1.42	0.82
1983	0.85	1.41	1.30	1.15	0.79	0.71	0.54	0.52	0.72	0.66	1.15	1.29	0.92
1984	0.86	0.88	0.88	1.07	0.85	0.51	0.59	0.51	0.63	0.68	0.94	0.65	0.75
1985	1.06	1.08	0.92	0.90	0.62	0.65	0.50	0.71	0.83	0.96	0.90	0.87	0.83
1986	0.79	1.07	1.05	0.56	0.59	0.45	0.59	0.54	0.53	0.71	0.83	0.88	0.71
1987	1.19	1.03	1.12	0.73	0.57	0.72	0.53	0.47	0.48	0.64	0.88	0.99	0.78
1988	1.02	0.84	0.94	1.03	0.65	0.57	0.56	0.66	0.91	0.53	1.06	0.68	0.79
1989	0.74	0.94	0.94	0.66	0.69	0.86	0.70	0.45	0.56	0.65	0.69	0.95	0.74
1990	0.73	1.13	0.80	0.77	0.72	0.50	0.63	0.46	0.42	0.64	0.73	0.94	0.70
MEAN	0.95	1.04	1.02	0.87	0.69	0.62	0.57	0.54	0.59	0.68	0.88	0.96	

STATION: 181 GOM
MAX Hmo(m) WITH ASSOCIATED Tp(sec) AND Dm(deg) BY MONTH AND YEAR

YEAR	JAN	FEB	MAR	APR	MAY	JUN
1980	3.0 7 270	2.5 7 264	3.4 8 168	3.5 9 262	2.0 6 135	2.1 6 257
1981	3.3 8 262	4.9 10 166	4.8 10 248	2.3 7 156	1.9 6 250	1.3 5 98
1982	4.8 10 176	2.8 9 233	2.0 5 298	2.2 7 278	2.0 7 228	2.2 6 130
1983	2.6 10 128	4.5 9 163	4.5 11 158	3.3 9 262	1.9 6 138	1.2 6 171
1984	3.5 8 205	3.9 8 178	4.8 9 272	2.6 7 161	3.3 9 202	1.5 6 267
1985	3.2 8 187	3.7 8 257	3.1 7 146	3.0 8 191	1.5 6 235	2.0 6 153
1986	3.2 8 195	3.0 7 206	3.3 7 167	2.0 6 265	1.2 5 182	1.1 4 119
1987	3.5 8 170	3.2 7 170	3.2 7 154	2.1 7 277	1.4 5 141	2.1 6 203
1988	3.3 8 173	3.3 8 275	2.3 7 216	3.8 9 276	1.6 6 219	1.4 6 128
1989	2.3 7 190	3.5 8 202	2.1 6 165	2.4 7 218	1.8 6 221	3.1 8 196
1990	2.1 6 279	3.4 8 158	3.1 8 158	2.0 7 138	2.3 7 173	1.6 5 251
MAX	4.8 10 176	4.9 10 166	4.8 9 272	3.8 9 276	3.3 9 202	3.1 8 196

YEAR	JUL	AUG	SEP	OCT	NOV	DEC	MAX
1980	1.4 6 280	1.5 13 196	1.6 6 260	3.0 8 172	2.8 7 151	2.2 7 272	3.5 9 27
1981	1.1 5 241	1.5 6 225	1.4 5 194	2.6 7 155	2.6 7 209	3.6 8 191	4.9 10 17
1982	0.9 4 199	1.2 4 99	1.1 4 57	1.2 5 160	2.8 8 165	3.8 8 145	4.8 10 18
1983	1.1 4 76	1.4 5 133	1.7 6 241	1.6 6 239	3.7 9 154	4.7 9 157	4.7 9 16
1984	1.5 6 204	1.8 6 152	1.3 4 107	1.9 6 139	3.5 8 148	2.0 6 145	4.8 9 28
1985	1.3 5 185	4.3 14 165	5.2 11 158	5.5 10 174	4.2 9 201	3.1 8 189	5.5 10 18
1986	1.7 6 274	1.5 5 154	1.4 5 157	2.5 6 155	3.0 7 170	3.3 8 176	3.3 8 18
1987	1.1 4 82	1.1 5 256	1.0 4 337	1.2 4 28	2.8 7 151	3.1 8 170	3.5 8 18
1988	1.2 5 82	2.6 6 165	2.7 10 168	1.1 4 324	3.3 8 215	2.2 6 153	3.8 9 28
1989	1.6 6 222	1.2 5 159	1.6 6 113	1.5 5 305	2.7 7 280	2.6 7 176	3.5 8 21
1990	1.5 6 239	1.3 5 268	1.1 4 27	2.0 5 322	3.9 9 265	2.9 8 183	3.9 9 27
MAX	1.7 6 274	4.3 14 165	5.2 11 158	5.5 10 174	4.2 9 201	4.7 9 157	

MAX Hmo(m): 5.5 MAX Tp(sec): 10. MAX Dp(deg): 174. DATE(gmt): 85103120

MAX WIND SPEED(m/sec): 28. MAX WIND DIRECTION(deg): 84. DATE(gmt): 85090203

MEAN Hmo(m): 0.8 MEAN Tp(sec): 4.

STANDARD DEVIATION Hmo(m): 0.5 STANDARD DEVIATION Tp(sec): 1.4

ATTACHMENT I-A

WALTON COUNTY
PAUSIBLE STORM SUITE

ATTACHMENT I-A: Walton County Plausible Storm Suite

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed MPH	Approximate Landfall Pressure MB	Storm Identifier	Beach-fx Parameters Surge Peak ft (MSL)	TWL Peak ft (MSL)	Hmo Peak ft	Tp Peak sec
Not Named	1886	Franklin County, Florida	H2	85	973	18860630_H1	1.2	2.5	10.2	6.8
						18860630_H2	1.2	2.1	10.2	6.8
						18860630_H3	1.2	2.1	10.2	6.8
						18860630_H4	1.2	2.1	10.2	6.8
						18860630_M1	1.2	2.3	10.2	6.8
						18860630_M2	1.2	1.8	10.2	6.8
						18860630_M3	1.2	1.9	10.2	6.8
						18860630_M4	1.2	1.8	10.2	6.8
						18860630_L1	1.2	2.0	10.2	6.8
						18860630_L2	1.2	1.6	10.2	6.8
						18860630_L3	1.2	1.7	10.2	6.8
						18860630_L4	1.2	1.6	10.2	6.8
Not Named	1887	Okaloosa County, Florida	H1	75	981	18870727_H1	3.5	5.1	15.0	8.2
						18870727_H2	3.5	4.2	15.0	8.2
						18870727_H3	3.5	3.2	15.0	8.2
						18870727_H4	3.5	4.2	15.0	8.2
						18870727_M1	3.5	4.8	15.0	8.2
						18870727_M2	3.5	4.2	15.0	8.2
						18870727_M3	3.5	3.5	15.0	8.2
						18870727_M4	3.5	4.2	15.0	8.2
						18870727_L1	3.5	4.6	15.0	8.2
						18870727_L2	3.5	4.2	15.0	8.2
						18870727_L3	3.5	3.7	15.0	8.2
						18870727_L4	3.5	4.2	15.0	8.2
Not Named	1889	Baldwin County, Alabama	TS	60	985	18890923_H1	2.1	3.6	11.1	7.1
						18890923_H2	2.1	2.7	11.1	7.1
						18890923_H3	2.1	1.8	11.1	7.1

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed MPH	Approximate Landfall Pressure MB	Storm Identifier	Beach-fx Parameters Surge Peak ft (MSL)	TWL Peak ft (MSL)	Hmo Peak ft	Tp Peak sec
						18890923_H4	2.1	2.7	11.1	7.1
						18890923_M1	2.1	3.3	11.1	7.1
						18890923_M2	2.1	2.7	11.1	7.1
						18890923_M3	2.1	2.0	11.1	7.1
						18890923_M4	2.1	2.7	11.1	7.1
						18890923_L1	2.1	3.1	11.1	7.1
						18890923_L2	2.1	2.7	11.1	7.1
						18890923_L3	2.1	2.2	11.1	7.1
						18890923_L4	2.1	2.7	11.1	7.1
Not Named	1893	Taylor County, Florida	TS	60	N/A	18930615_H1	1	2.3	9.7	6.6
						18930615_H2	1	2.0	9.7	6.6
						18930615_H3	1	2.0	9.7	6.6
						18930615_H4	1	1.9	9.7	6.6
						18930615_M1	1	2.0	9.7	6.6
						18930615_M2	1	1.7	9.7	6.6
						18930615_M3	1	1.7	9.7	6.6
						18930615_M4	1	1.6	9.7	6.6
						18930615_L1	1	1.8	9.7	6.6
						18930615_L2	1	1.5	9.7	6.6
						18930615_L3	1	1.5	9.7	6.6
						18930615_L4	1	1.4	9.7	6.6
Not Named	1893	Jackson County, Mississippi*	H2	95	N/A	18931002_H1	2.4	3.9	35.9	12.8
						18931002_H2	2.4	3.6	35.9	12.8
						18931002_H3	2.4	3.1	35.9	12.8
						18931002_H4	2.4	3.3	35.9	12.8
						18931002_M1	2.4	3.6	35.9	12.8
						18931002_M2	2.4	3.4	35.9	12.8
						18931002_M3	2.4	2.9	35.9	12.8
						18931002_M4	2.4	3.1	35.9	12.8

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed	Approximate Landfall Pressure	Storm Identifier	Beach-fx Parameters Surge Peak	TWL Peak	Hmo Peak	Tp Peak
				MPH	MB		ft (MSL)	ft (MSL)	ft	sec
						18931002_L1	2.4	3.4	35.9	12.8
						18931002_L2	2.4	3.2	35.9	12.8
						18931002_L3	2.4	2.7	35.9	12.8
						18931002_L4	2.4	3.0	35.9	12.8
Not Named	1894	Bay County, Florida	H3	105	955	18941008_H1	1.7	3.0	8.5	6.2
						18941008_H2	1.7	2.9	8.5	6.2
						18941008_H3	1.7	2.8	8.5	6.2
						18941008_H4	1.7	2.7	8.5	6.2
						18941008_M1	1.7	2.7	8.5	6.2
						18941008_M2	1.7	2.6	8.5	6.2
						18941008_M3	1.7	2.5	8.5	6.2
						18941008_M4	1.7	2.5	8.5	6.2
						18941008_L1	1.7	2.5	8.5	6.2
						18941008_L2	1.7	2.4	8.5	6.2
						18941008_L3	1.7	2.3	8.5	6.2
						18941008_L4	1.7	2.3	8.5	6.2
Not Named	1896	Okaloosa County, Florida	H2	85	973	18960707_H1	2.8	3.9	15.8	8.5
						18960707_H2	2.8	3.2	15.8	8.5
						18960707_H3	2.8	2.8	15.8	8.5
						18960707_H4	2.8	3.0	15.8	8.5
						18960707_M1	2.8	3.6	15.8	8.5
						18960707_M2	2.8	3.0	15.8	8.5
						18960707_M3	2.8	2.6	15.8	8.5
						18960707_M4	2.8	3.0	15.8	8.5
						18960707_L1	2.8	3.4	15.8	8.5
						18960707_L2	2.8	2.9	15.8	8.5
						18960707_L3	2.8	2.6	15.8	8.5
						18960707_L4	2.8	2.9	15.8	8.5

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed MPH	Approximate Landfall Pressure MB	Storm Identifier	Beach-fx Parameters: Surge Peak ft (MSL)	TWL Peak ft (MSL)	Hmo Peak ft	Tp Peak sec
Not Named	1901	Jackson County, Mississippi*	H1	80	973	19010815_H1	1.5	2.9	23.2	10.3
						19010815_H2	1.5	2.7	23.2	10.3
						19010815_H3	1.5	2.3	23.2	10.3
						19010815_H4	1.5	2.7	23.2	10.3
						19010815_M1	1.5	2.6	23.2	10.3
						19010815_M2	1.5	2.4	23.2	10.3
						19010815_M3	1.5	2.1	23.2	10.3
						19010815_M4	1.5	2.5	23.2	10.3
						19010815_L1	1.5	2.4	23.2	10.3
						19010815_L2	1.5	2.2	23.2	10.3
						19010815_L3	1.5	1.9	23.2	10.3
						19010815_L4	1.5	2.3	23.2	10.3
Not Named	1906	Jackson County, Mississippi	H2	95	N/A	19060926_H1	2.5	3.9	8.2	6.1
						19060926_H2	2.5	3.4	8.2	6.1
						19060926_H3	2.5	3.1	8.2	6.1
						19060926_H4	2.5	3.8	8.2	6.1
						19060926_M1	2.5	3.6	8.2	6.1
						19060926_M2	2.5	3.2	8.2	6.1
						19060926_M3	2.5	2.9	8.2	6.1
						19060926_M4	2.5	3.5	8.2	6.1
						19060926_L1	2.5	3.4	8.2	6.1
						19060926_L2	2.5	3.1	8.2	6.1
						19060926_L3	2.5	2.8	8.2	6.1
						19060926_L4	2.5	3.3	8.2	6.1
Not Named	1912	Mobile County, Alabama	H1	65	988	19120913_H1	1	2.4	19.8	9.5
						19120913_H2	1	2.3	19.8	9.5
						19120913_H3	1	2.1	19.8	9.5
						19120913_H4	1	2.2	19.8	9.5

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed MPH	Approximate Landfall Pressure MB	Storm Identifier	Beach-fx Parameters Surge Peak ft (MSL)	TWL Peak ft (MSL)	Hmo Peak ft	Tp Peak sec
						19120913_M1	1	2.1	19.8	9.5
						19120913_M2	1	2.0	19.8	9.5
						19120913_M3	1	1.9	19.8	9.5
						19120913_M4	1	1.9	19.8	9.5
						19120913_L1	1	1.9	19.8	9.5
						19120913_L2	1	1.8	19.8	9.5
						19120913_L3	1	1.6	19.8	9.5
						19120913_L4	1	1.7	19.8	9.5
Not Named	1915	Lafourche Parish, Lousiana	H3	110	944	19150929_H1	2.1	3.5	29.7	11.6
						19150929_H2	2.1	3.3	29.7	11.6
						19150929_H3	2.1	3.1	29.7	11.6
						19150929_H4	2.1	3.1	29.7	11.6
						19150929_M1	2.1	3.2	29.7	11.6
						19150929_M2	2.1	3.1	29.7	11.6
						19150929_M3	2.1	2.8	29.7	11.6
						19150929_M4	2.1	2.9	29.7	11.6
						19150929_L1	2.1	3.0	29.7	11.6
						19150929_L2	2.1	2.9	29.7	11.6
						19150929_L3	2.1	2.6	29.7	11.6
						19150929_L4	2.1	2.7	29.7	11.6
Not Named	1916	Mobile County, Alabama	H3	105	950	19160705_H1	1.2	2.6	16.4	8.6
						19160705_H2	1.2	2.3	16.4	8.6
						19160705_H3	1.2	2.4	16.4	8.6
						19160705_H4	1.2	2.4	16.4	8.6
						19160705_M1	1.2	3.9	16.4	8.6
						19160705_M2	1.2	3.3	16.4	8.6
						19160705_M3	1.2	2.6	16.4	8.6
						19160705_M4	1.2	3.3	16.4	8.6
						19160705_L1	1.2	3.7	16.4	8.6

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed MPH	Approximate Landfall Pressure MB	Storm Identifier	Beach-fx Parameters: Surge Peak ft (MSL)	TWL Peak ft (MSL)	Hmo Peak ft	Tp Peak sec
						19160705_L2	1.2	3.3	16.4	8.6
						19160705_L3	1.2	2.9	16.4	8.6
						19160705_L4	1.2	3.3	16.4	8.6
Not Named	1916	Santa Rosa County, Florida	H2	95	970	19161018_H1	2.7	4.2	18.2	9.1
						19161018_H2	2.7	3.3	18.2	9.1
						19161018_H3	2.7	2.4	18.2	9.1
						19161018_H4	2.7	3.3	18.2	9.1
						19161018_M1	2.7	3.9	18.2	9.1
						19161018_M2	2.7	3.3	18.2	9.1
						19161018_M3	2.7	2.6	18.2	9.1
						19161018_M4	2.7	3.3	18.2	9.1
						19161018_L1	2.7	3.7	18.2	9.1
						19161018_L2	2.7	3.3	18.2	9.1
						19161018_L3	2.7	2.9	18.2	9.1
						19161018_L4	2.7	3.3	18.2	9.1
Not Named	1917	Okaloosa County, Florida	H3	100	949	19170929_H1	4	5.6	29.9	11.7
						19170929_H2	4	4.7	29.9	11.7
						19170929_H3	4	3.7	29.9	11.7
						19170929_H4	4	4.7	29.9	11.7
						19170929_M1	4	5.3	29.9	11.7
						19170929_M2	4	4.7	29.9	11.7
						19170929_M3	4	4.0	29.9	11.7
						19170929_M4	4	4.7	29.9	11.7
						19170929_L1	4	5.1	29.9	11.7
						19170929_L2	4	4.7	29.9	11.7
						19170929_L3	4	4.2	29.9	11.7
						19170929_L4	4	4.7	29.9	11.7
Not Named	1919	Kleberg County, Texas	H3	100	950	19190912_H1	1.2	2.5	6.6	5.5

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed MPH	Approximate Landfall Pressure MB	Storm Identifier	Beach-fx Parameters Surge Peak ft (MSL)	TWL Peak ft (MSL)	Hmo Peak ft	Tp Peak sec
						19190912_H2	1.2	2.4	6.6	5.5
						19190912_H3	1.2	2.2	6.6	5.5
						19190912_H4	1.2	4.8	6.6	5.5
						19190912_M1	1.2	2.3	6.6	5.5
						19190912_M2	1.2	2.1	6.6	5.5
						19190912_M3	1.2	1.9	6.6	5.5
						19190912_M4	1.2	2.2	6.6	5.5
						19190912_L1	1.2	2.0	6.6	5.5
						19190912_L2	1.2	1.9	6.6	5.5
						19190912_L3	1.2	1.7	6.6	5.5
						19190912_L4	1.2	1.9	6.6	5.5
Not Named	1924	Gulf County, Florida	H2	75	980	19240915_H1	1.6	2.9	12.7	7.6
						19240915_H2	1.6	2.6	12.7	7.6
						19240915_H3	1.6	2.5	12.7	7.6
						19240915_H4	1.6	2.4	12.7	7.6
						19240915_M1	1.6	2.6	12.7	7.6
						19240915_M2	1.6	2.3	12.7	7.6
						19240915_M3	1.6	2.2	12.7	7.6
						19240915_M4	1.6	2.2	12.7	7.6
						19240915_L1	1.6	2.4	12.7	7.6
						19240915_L2	1.6	2.1	12.7	7.6
						19240915_L3	1.6	2.0	12.7	7.6
						19240915_L4	1.6	2.1	12.7	7.6
Not Named	1926	Baldwin County, Alabama	H2	95	955	19260920_H1	3	4.5	19.8	9.5
						19260920_H2	3	3.9	19.8	9.5
						19260920_H3	3	2.9	19.8	9.5
						19260920_H4	3	3.8	19.8	9.5
						19260920_M1	3	4.2	19.8	9.5
						19260920_M2	3	3.7	19.8	9.5

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed MPH	Approximate Landfall Pressure MB	Storm Identifier	Beach-fx Parameters Surge Peak ft (MSL)	TWL Peak ft (MSL)	Hmo Peak ft	Tp Peak sec
						19260920_M3	3	2.9	19.8	9.5
						19260920_M4	3	3.7	19.8	9.5
						19260920_L1	3	4.0	19.8	9.5
						19260920_L2	3	3.6	19.8	9.5
						19260920_L3	3	3.1	19.8	9.5
						19260920_L4	3	3.6	19.8	9.5
Not Named	1930	Pinellas County, Florida	TS	35	N/A	19300908_H1	1.6	2.9	16.3	8.6
						19300908_H2	1.6	2.7	16.3	8.6
						19300908_H3	1.6	2.4	16.3	8.6
						19300908_H4	1.6	2.7	16.3	8.6
						19300908_M1	1.6	2.6	16.3	8.6
						19300908_M2	1.6	2.5	16.3	8.6
						19300908_M3	1.6	2.1	16.3	8.6
						19300908_M4	1.6	2.4	16.3	8.6
						19300908_L1	1.6	2.4	16.3	8.6
						19300908_L2	1.6	2.2	16.3	8.6
						19300908_L3	1.6	1.9	16.3	8.6
						19300908_L4	1.6	2.2	16.3	8.6
Not Named	1932	Alabama - Baldwin County	H1	70	N/A	19320831_H1	1.3	2.7	9.9	6.7
						19320831_H2	1.3	2.1	9.9	6.7
						19320831_H3	1.3	1.9	9.9	6.7
						19320831_H4	1.3	2.3	9.9	6.7
						19320831_M1	1.3	2.4	9.9	6.7
						19320831_M2	1.3	2.0	9.9	6.7
						19320831_M3	1.3	1.7	9.9	6.7
						19320831_M4	1.3	2.0	9.9	6.7
						19320831_L1	1.3	2.2	9.9	6.7
						19320831_L2	1.3	1.9	9.9	6.7
						19320831_L3	1.3	1.4	9.9	6.7

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed	Approximate Landfall Pressure	Storm Identifier	Beach-fx Parameters Surge Peak	TWL Peak	Hmo Peak	Tp Peak
				MPH	MB		ft (MSL)	ft (MSL)	ft	sec
						19320831_L4	1.3	1.9	9.9	6.7
Not Named	1933	Tamaulipas, Mexico	TS	60	981	19330802_H1	1	2.4	20.5	9.7
						19330802_H2	1	2.2	20.5	9.7
						19330802_H3	1	2.0	20.5	9.7
						19330802_H4	1	2.3	20.5	9.7
						19330802_M1	1	2.1	20.5	9.7
						19330802_M2	1	2.0	20.5	9.7
						19330802_M3	1	1.7	20.5	9.7
						19330802_M4	1	2.0	20.5	9.7
						19330802_L1	1	1.9	20.5	9.7
						19330802_L2	1	1.7	20.5	9.7
						19330802_L3	1	1.5	20.5	9.7
						19330802_L4	1	1.8	20.5	9.7
Not Named	1936	Okaloosa County, Florida	H1	80	973	19360731_H1	2.7	4.1	22.4	10.1
						19360731_H2	2.7	3.3	22.4	10.1
						19360731_H3	2.7	2.3	22.4	10.1
						19360731_H4	2.7	3.4	22.4	10.1
						19360731_M1	2.7	3.8	22.4	10.1
						19360731_M2	2.7	3.3	22.4	10.1
						19360731_M3	2.7	2.5	22.4	10.1
						19360731_M4	2.7	3.3	22.4	10.1
						19360731_L1	2.7	3.6	22.4	10.1
						19360731_L2	2.7	3.2	22.4	10.1
						19360731_L3	2.7	2.8	22.4	10.1
						19360731_L4	2.7	3.2	22.4	10.1
Not Named	1940	Cameron Parish, Lousiana*	H1	70	N/A	19400804_H1	1	2.4	19.7	9.5
						19400804_H2	1	2.3	19.7	9.5
						19400804_H3	1	2.1	19.7	9.5

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed MPH	Approximate Landfall Pressure MB	Storm Identifier	Beach-fx Parameters: Surge Peak ft (MSL)	TWL Peak ft (MSL)	Hmo Peak ft	Tp Peak sec
						19400804_H4	1	2.3	19.7	9.5
						19400804_M1	1	2.1	19.7	9.5
						19400804_M2	1	2.0	19.7	9.5
						19400804_M3	1	1.8	19.7	9.5
						19400804_M4	1	2.0	19.7	9.5
						19400804_L1	1	1.9	19.7	9.5
						19400804_L2	1	1.8	19.7	9.5
						19400804_L3	1	1.6	19.7	9.5
						19400804_L4	1	1.8	19.7	9.5
Not Named	1947	St. Benard Parish, Lousiana*	H1	80	N/A	19470919_H1	1.5	2.9	11.2	7.1
						19470919_H2	1.5	2.1	11.2	7.1
						19470919_H3	1.5	2.2	11.2	7.1
						19470919_H4	1.5	2.4	11.2	7.1
						19470919_M1	1.5	2.6	11.2	7.1
						19470919_M2	1.5	2.0	11.2	7.1
						19470919_M3	1.5	1.9	11.2	7.1
						19470919_M4	1.5	2.2	11.2	7.1
						19470919_L1	1.5	2.4	11.2	7.1
						19470919_L2	1.5	2.0	11.2	7.1
						19470919_L3	1.5	1.7	11.2	7.1
						19470919_L4	1.5	2.0	11.2	7.1
Florence	1953	Walton County, Florida	H1	80	N/A	19530926_H1	3.2	4.5	21.0	9.8
						19530926_H2	3.2	3.7	21.0	9.8
						19530926_H3	3.2	2.7	21.0	9.8
						19530926_H4	3.2	3.6	21.0	9.8
						19530926_M1	3.2	4.2	21.0	9.8
						19530926_M2	3.2	3.6	21.0	9.8
						19530926_M3	3.2	3.0	21.0	9.8

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed	Approximate Landfall Pressure	Storm Identifier	Beach-fx Parameters Surge Peak	TWL Peak	Hmo Peak	Tp Peak
				MPH	MB		ft (MSL)	ft (MSL)	ft	sec
						19530926_M4	3.2	3.6	21.0	9.8
						19530926_L1	3.2	4.0	21.0	9.8
						19530926_L2	3.2	3.6	21.0	9.8
						19530926_L3	3.2	3.2	21.0	9.8
						19530926_L4	3.2	3.6	21.0	9.8
Flossy	1956	Okaloosa County, Florida*	H1	80	N/A	19560924_H1	2.8	4.2	29.8	11.6
						19560924_H2	2.8	3.3	29.8	11.6
						19560924_H3	2.8	2.3	29.8	11.6
						19560924_H4	2.8	3.4	29.8	11.6
						19560924_M1	2.8	3.9	29.8	11.6
						19560924_M2	2.8	3.3	29.8	11.6
						19560924_M3	2.8	2.6	29.8	11.6
						19560924_M4	2.8	3.3	29.8	11.6
						19560924_L1	2.8	3.7	29.8	11.6
						19560924_L2	2.8	3.2	29.8	11.6
						19560924_L3	2.8	2.8	29.8	11.6
						19560924_L4	2.8	3.3	29.8	11.6
Ethel	1960	Harrison County, Mississippi	TS	60	N/A	19600915_H1	1	2.4	18.9	9.3
						19600915_H2	1	2.2	18.9	9.3
						19600915_H3	1	2.2	18.9	9.3
						19600915_H4	1	2.3	18.9	9.3
						19600915_M1	1	2.1	18.9	9.3
						19600915_M2	1	2.0	18.9	9.3
						19600915_M3	1	1.9	18.9	9.3
						19600915_M4	1	2.0	18.9	9.3
						19600915_L1	1	1.9	18.9	9.3
						19600915_L2	1	1.8	18.9	9.3
						19600915_L3	1	1.7	18.9	9.3
						19600915_L4	1	1.8	18.9	9.3

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed MPH	Approximate Landfall Pressure MB	Storm Identifier	Beach-fx Parameters Surge Peak ft (MSL)	TWL Peak ft (MSL)	Hmo Peak ft	Tp Peak sec
Hilda	1964	St. Mary Parish, Lousiana	H2	95	959	19641004_H1	2.3	3.7	30.8	11.8
						19641004_H2	2.3	2.8	30.8	11.8
						19641004_H3	2.3	2.2	30.8	11.8
						19641004_H4	2.3	2.9	30.8	11.8
						19641004_M1	2.3	3.4	30.8	11.8
						19641004_M2	2.3	2.8	30.8	11.8
						19641004_M3	2.3	2.1	30.8	11.8
						19641004_M4	2.3	2.8	30.8	11.8
						19641004_L1	2.3	3.2	30.8	11.8
						19641004_L2	2.3	2.8	30.8	11.8
						19641004_L3	2.3	2.4	30.8	11.8
						19641004_L4	2.3	2.8	30.8	11.8
Betsy	1965	Lafourche Parish, Lousiana*	H4	135	941	19650910_H1	1.3	2.7	19.9	9.5
						19650910_H2	1.3	2.1	19.9	9.5
						19650910_H3	1.3	2.3	19.9	9.5
						19650910_H4	1.3	2.6	19.9	9.5
						19650910_M1	1.3	2.4	19.9	9.5
						19650910_M2	1.3	2.0	19.9	9.5
						19650910_M3	1.3	2.1	19.9	9.5
						19650910_M4	1.3	2.3	19.9	9.5
						19650910_L1	1.3	2.2	19.9	9.5
						19650910_L2	1.3	1.9	19.9	9.5
						19650910_L3	1.3	1.9	19.9	9.5
						19650910_L4	1.3	2.1	19.9	9.5
Camille	1969	Hancock County, Mississippi *	H5	165	909	19690817_H1	3.1	4.5	51.6	15.3
						19690817_H2	3.1	4.1	51.6	15.3

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed MPH	Approximate Landfall Pressure MB	Storm Identifier	Beach-fx Parameters Surge Peak ft (MSL)	TWL Peak ft (MSL)	Hmo Peak ft	Tp Peak sec
						19690817_H3	3.1	3.3	51.6	15.3
						19690817_H4	3.1	4.0	51.6	15.3
						19690817_M1	3.1	4.2	51.6	15.3
						19690817_M2	3.1	3.9	51.6	15.3
						19690817_M3	3.1	3.1	51.6	15.3
						19690817_M4	3.1	3.8	51.6	15.3
						19690817_L1	3.1	4.0	51.6	15.3
						19690817_L2	3.1	3.8	51.6	15.3
						19690817_L3	3.1	3.2	51.6	15.3
						19690817_L4	3.1	3.7	51.6	15.3
Sub Tropical 1	1969	Okaloosa County, Florida	SD	30	996	19691002_H1	3.1	2.2	28.1	11.3
						19691002_H2	3.1	1.9	28.1	11.3
						19691002_H3	3.1	1.7	28.1	11.3
						19691002_H4	3.1	1.8	28.1	11.3
						19691002_M1	3.1	1.9	28.1	11.3
						19691002_M2	3.1	1.7	28.1	11.3
						19691002_M3	3.1	1.4	28.1	11.3
						19691002_M4	3.1	1.6	28.1	11.3
						19691002_L1	3.1	1.7	28.1	11.3
						19691002_L2	3.1	1.5	28.1	11.3
						19691002_L3	3.1	1.3	28.1	11.3
						19691002_L4	3.1	1.5	28.1	11.3
Agnes	1972	Bay County, Florida	H1	65	983	19720619_H1	1.4	2.7	23.2	10.3
						19720619_H2	1.4	2.2	23.2	10.3
						19720619_H3	1.4	2.1	23.2	10.3
						19720619_H4	1.4	2.5	23.2	10.3
						19720619_M1	1.4	2.2	23.2	10.3
						19720619_M2	1.4	2.0	23.2	10.3
						19720619_M3	1.4	1.8	23.2	10.3

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed MPH	Approximate Landfall Pressure MB	Storm Identifier	Beach-fx Parameters: Surge Peak ft (MSL)	TWL Peak ft (MSL)	Hmo Peak ft	Tp Peak sec
						19720619_M4	1.4	2.2	23.2	10.3
						19720619_L1	1.4	2.2	23.2	10.3
						19720619_L2	1.4	1.8	23.2	10.3
						19720619_L3	1.4	1.6	23.2	10.3
						19720619_L4	1.4	2.0	23.2	10.3
Sub Tropical 1	1974	Pinellas County, Florida	SS	45	N/A	19740907_H1	1	2.4	17.3	8.9
						19740907_H2	1	2.2	17.3	8.9
						19740907_H3	1	2.2	17.3	8.9
						19740907_H4	1	2.3	17.3	8.9
						19740907_M1	1	2.1	17.3	8.9
						19740907_M2	1	2.0	17.3	8.9
						19740907_M3	1	2.0	17.3	8.9
						19740907_M4	1	2.0	17.3	8.9
						19740907_L1	1	1.9	17.3	8.9
						19740907_L2	1	1.7	17.3	8.9
						19740907_L3	1	1.7	17.3	8.9
						19740907_L4	1	1.8	17.3	8.9
Eloise	1975	Walton County, Florida	H3	110	955	19750923_H1	5.6	6.6	28.5	11.4
						19750923_H2	5.6	5.7	28.5	11.4
						19750923_H3	5.6	4.8	28.5	11.4
						19750923_H4	5.6	5.7	28.5	11.4
						19750923_M1	5.6	6.4	28.5	11.4
						19750923_M2	5.6	5.7	28.5	11.4
						19750923_M3	5.6	5.1	28.5	11.4
						19750923_M4	5.6	5.7	28.5	11.4
						19750923_L1	5.6	6.1	28.5	11.4
						19750923_L2	5.6	5.7	28.5	11.4
						19750923_L3	5.6	5.3	28.5	11.4
						19750923_L4	5.6	5.7	28.5	11.4

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed MPH	Approximate Landfall Pressure MB	Storm Identifier	Beach-fx Parameters: Surge Peak ft (MSL)	TWL Peak ft (MSL)	Hmo Peak ft	Tp Peak sec
						19851031_M1	1.9	3.1	17.6	14.6
						19851031_M2	1.9	2.7	17.6	14.6
						19851031_M3	1.9	1.8	17.6	14.6
						19851031_M4	1.9	2.4	17.6	14.6
						19851031_L1	1.9	2.8	17.6	14.6
						19851031_L2	1.9	2.6	17.6	14.6
						19851031_L3	1.9	2.0	17.6	14.6
						19851031_L4	1.9	2.4	17.6	14.6
Kate	1985	Gulf County, Florida	H2	85	967	19851121_H1	1.8	3.1	13.5	15.0
						19851121_H2	1.8	2.8	13.5	15.0
						19851121_H3	1.8	2.5	13.5	15.0
						19851121_H4	1.8	2.8	13.5	15.0
						19851121_M1	1.8	2.8	13.5	15.0
						19851121_M2	1.8	2.5	13.5	15.0
						19851121_M3	1.8	2.2	13.5	15.0
						19851121_M4	1.8	2.5	13.5	15.0
						19851121_L1	1.8	2.6	13.5	15.0
						19851121_L2	1.8	2.4	13.5	15.0
						19851121_L3	1.8	2.0	13.5	15.0
						19851121_L4	1.8	2.3	13.5	15.0
Florence	1988	Plaquemines Parish, Louisana	H1	70	984	19880909_H1	1	2.3	8.7	13.4
						19880909_H2	1	2.2	8.7	13.4
						19880909_H3	1	2.0	8.7	13.4
						19880909_H4	1	2.1	8.7	13.4
						19880909_M1	1	2.0	8.7	13.4
						19880909_M2	1	1.9	8.7	13.4
						19880909_M3	1	1.7	8.7	13.4
						19880909_M4	1	1.8	8.7	13.4
						19880909_L1	1	1.8	8.7	13.4

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed	Approximate Landfall Pressure	Storm Identifier	Beach-fx Parameters: Surge Peak	TWL Peak	Hmo Peak	Tp Peak
				MPH	MB		ft (MSL)	ft (MSL)	ft	sec
						19880909_L2	1	1.7	8.7	13.4
						19880909_L3	1	1.5	8.7	13.4
						19880909_L4	1	1.6	8.7	13.4
Andrew	1992	St. Mary Parish, Louisana*	H4	120	955	19920825_H1	1.2	2.6	7.0	11.9
						19920825_H2	1.2	2.3	7.0	11.9
						19920825_H3	1.2	2.0	7.0	11.9
						19920825_H4	1.2	2.3	7.0	11.9
						19920825_M1	1.2	2.3	7.0	11.9
						19920825_M2	1.2	2.0	7.0	11.9
						19920825_M3	1.2	1.8	7.0	11.9
						19920825_M4	1.2	2.1	7.0	11.9
						19920825_L1	1.2	2.1	7.0	11.9
						19920825_L2	1.2	1.8	7.0	11.9
						19920825_L3	1.2	1.5	7.0	11.9
						19920825_L4	1.2	1.9	7.0	11.9
Alberto	1994	Okaloosa County, Florida	TS	55	993	19940703_H1	2.4	3.8	19.0	10.0
						19940703_H2	2.4	2.9	19.0	10.0
						19940703_H3	2.4	2.2	19.0	10.0
						19940703_H4	2.4	3.0	19.0	10.0
						19940703_M1	2.4	3.5	19.0	10.0
						19940703_M2	2.4	2.9	19.0	10.0
						19940703_M3	2.4	2.2	19.0	10.0
						19940703_M4	2.4	2.9	19.0	10.0
						19940703_L1	2.4	3.3	19.0	10.0
						19940703_L2	2.4	2.9	19.0	10.0
						19940703_L3	2.4	2.4	19.0	10.0
						19940703_L4	2.4	2.9	19.0	10.0
Erin	1995	Santa Rosa County, Florida*	H2	80	974	19950803_H1	2.1	3.6	15.7	9.2

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed MPH	Approximate Landfall Pressure MB	Storm Identifier	Beach-fx Parameters Surge Peak ft (MSL)	TWL Peak ft (MSL)	Hmo Peak ft	Tp Peak sec
						19950803_H2	2.1	2.8	15.7	9.2
						19950803_H3	2.1	1.9	15.7	9.2
						19950803_H4	2.1	2.7	15.7	9.2
						19950803_M1	2.1	3.3	15.7	9.2
						19950803_M2	2.1	2.7	15.7	9.2
						19950803_M3	2.1	2.0	15.7	9.2
						19950803_M4	2.1	2.7	15.7	9.2
						19950803_L1	2.1	3.1	15.7	9.2
						19950803_L2	2.1	2.7	15.7	9.2
						19950803_L3	2.1	2.3	15.7	9.2
						19950803_L4	2.1	2.7	15.7	9.2
Opal	1995	Santa Rosa County, Florida*	H3	110	938	19951004_H1	7	8.8	27.3	13.6
						19951004_H2	7	7.8	27.3	13.6
						19951004_H3	7	6.9	27.3	13.6
						19951004_H4	7	7.8	27.3	13.6
						19951004_M1	7	8.5	27.3	13.6
						19951004_M2	7	7.8	27.3	13.6
						19951004_M3	7	7.2	27.3	13.6
						19951004_M4	7	7.8	27.3	13.6
						19951004_L1	7	8.3	27.3	13.6
						19951004_L2	7	7.8	27.3	13.6
						19951004_L3	7	7.4	27.3	13.6
						19951004_L4	7	7.8	27.3	13.6
Earl	1998	Bay County, Florida	H1	70	987	19980902_H1	1.7	2.9	18.9	12.4
						19980902_H2	1.7	2.1	18.9	12.4
						19980902_H3	1.7	1.6	18.9	12.4
						19980902_H4	1.7	2.1	18.9	12.4
						19980902_M1	1.7	2.6	18.9	12.4
						19980902_M2	1.7	2.0	18.9	12.4

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed	Approximate Landfall Pressure	Storm Identifier	Beach-fx Parameters Surge Peak	TWL Peak	Hmo Peak	Tp Peak
				MPH	MB		ft (MSL)	ft (MSL)	ft	sec
						19980902_M3	1.7	1.4	18.9	12.4
						19980902_M4	1.7	2.0	18.9	12.4
						19980902_L1	1.7	2.4	18.9	12.4
						19980902_L2	1.7	2.0	18.9	12.4
						19980902_L3	1.7	1.6	18.9	12.4
						19980902_L4	1.7	2.0	18.9	12.4
Georges	1998	Harrison County, Mississippi	H2	90	964	19980927_H1	1.7	3.1	21.9	13.4
						19980927_H2	1.7	2.9	21.9	13.4
						19980927_H3	1.7	2.6	21.9	13.4
						19980927_H4	1.7	2.9	21.9	13.4
						19980927_M1	1.7	2.8	21.9	13.4
						19980927_M2	1.7	2.6	21.9	13.4
						19980927_M3	1.7	2.4	21.9	13.4
						19980927_M4	1.7	2.6	21.9	13.4
						19980927_L1	1.7	2.6	21.9	13.4
						19980927_L2	1.7	2.4	21.9	13.4
						19980927_L3	1.7	2.2	21.9	13.4
						19980927_L4	1.7	2.4	21.9	13.4
Barry	2001	Walton County, Florida	TS	60	992	20010805_H1	2.5	3.8	20.7	9.7
						20010805_H2	2.5	2.9	20.7	9.7
						20010805_H3	2.5	2.2	20.7	9.7
						20010805_H4	2.5	3.0	20.7	9.7
						20010805_M1	2.5	3.5	20.7	9.7
						20010805_M2	2.5	2.9	20.7	9.7
						20010805_M3	2.5	2.2	20.7	9.7
						20010805_M4	2.5	2.9	20.7	9.7
						20010805_L1	2.5	3.3	20.7	9.7
						20010805_L2	2.5	2.9	20.7	9.7
						20010805_L3	2.5	2.4	20.7	9.7

Table I-A - Walton County Plausible Storm Suite

Storm Name	Year	Landfall	Estimated Category at Landfall	Approximate Landfall Wind Speed MPH	Approximate Landfall Pressure MB	Storm Identifier	Beach-fx Parameters Surge Peak ft (MSL)	TWL Peak ft (MSL)	Hmo Peak ft	Tp Peak sec
						20010805_L4	2.5	2.9	20.7	9.7
Ivan	2004	Baldwin County, Alabama	H3	105	943	20040915_H1	5.1	6.5	25.2	14.3
						20040915_H2	5.1	6.5	25.2	14.3
						20040915_H3	5.1	5.7	25.2	14.3
						20040915_H4	5.1	6.2	25.2	14.3
						20040915_M1	5.1	6.2	25.2	14.3
						20040915_M2	5.1	6.2	25.2	14.3
						20040915_M3	5.1	5.6	25.2	14.3
						20040915_M4	5.1	6.0	25.2	14.3
						20040915_L1	5.1	6.0	25.2	14.3
						20040915_L2	5.1	6.0	25.2	14.3
						20040915_L3	5.1	5.6	25.2	14.3
						20040915_L4	5.1	5.8	25.2	14.3

ATTACHMENT II

SEDIMENT BUDGET VOLUME CHANGE TABLE AND PLOTS

ATTACHMENT II: Sediment Budget Volume Change Table and Plots: 1995 to May 2004, May 2004 to November 2004, and 1995 to November 2004 Periods

Table 1. Volume Change by Reach: Analysis A

		May 95 (pre-Opal)	May 04 (pre-Ivan)	May 95 (pre-Opal)
		May 04 (pre-Ivan)	Nov 04 (post-Ivan)	Nov 04 (post-Ivan)
	Interval (yr)	9.0	-	9.5
		Volume Change		
	Reach	cy/ft/yr	cy/ft	cy/ft/yr
Dune to MHW	R1 – R19	-1.9	-15.9	-2.9
	R19 – R23	-1.4	-21.2	-3.2
	R23 – R41	-1.8	-22.7	-3.5
	R41 – R48	-1.1	-20.2	-2.8
	R48 – R55	-2.1	-12.7	-3.2
	R55 – R64	-2.8	-8.6	-3.4
	R64 – R80	-2.6	-13.7	-3.0
	R80 – R98	-2.1	-11.1	-3.2
	R–98 – R109	-2.9	-7.4	-3.0
	R–109 – R127	-2.0	-12.2	-3.0
MHW to MLW	R1 – R19	-0.2	0.2	-0.2
	R19 – R23	-0.2	-0.9	-0.2
	R23 – R41	-0.1	-0.9	-0.2
	R41 – R48	-0.2	-0.9	-0.2
	R48 – R55	-0.3	0.4	-0.2
	R55 – R64	-0.3	0.6	-0.2
	R64 – R80	-0.3	-0.2	-0.3
	R80 – R98	-0.2	-0.2	-0.3
	R–98 – R109	-0.3	-0.5	-0.2
	R–109 – R127	-0.3	-0.7	-0.3
MLW to -35 ft	R1 – R19	-5.3	-11.1	-5.9
	R19 – R23	-5.2	-21.5	-7.0
	R23 – R41	-4.1	-13.8	-5.3
	R41 – R48	-4.9	-8.0	-5.5
	R48 – R55	-5.5	-10.4	-6.3
	R55 – R64	-6.4	-12.5	-7.4
	R64 – R80	-5.9	-14.3	-7.9
	R80 – R98	-6.5	-19.9	-8.3
	R–98 – R109	-5.8	-38.4	-9.3
	R–109 – R127	-4.9	-38.8	-8.8
Dune to -35 ft	R1 – R19	-7.4	-25.6	-8.9
	R19 – R23	-6.7	-43.0	-9.7
	R23 – R41	-6.0	-37.3	-9.1
	R41 – R48	-6.2	-29.1	-8.6
	R48 – R55	-7.8	-22.7	-9.7
	R55 – R64	-9.6	-20.4	-11.1
	R64 – R80	-8.3	-28.2	-11.1
	R80 – R98	-8.8	-31.2	-11.8
	R–98 – R109	-8.4	-45.8	-11.4
	R–109 – R127	-7.2	-51.8	-12.1

Table 2. Volume Change by Reach: Analysis B

		May 95 (pre-Opal)	May 04 (pre-Ivan)	May 95 (pre-Opal)
		May 04 (pre-Ivan)	Nov 04 (post-Ivan)	Nov 04 (post-Ivan)
	Interval (yr)	9.0	-	9.5
		Volume Change		
	Reach	cy/ft/yr	cy/ft	cy/ft/yr
Dune to MHW	R1 – R23	-1.8	-16.7	-3.0
	R23 – R41	-1.8	-22.7	-3.5
	R41 – R66	-2.1	-13.0	-3.2
	R66 – R77	-2.4	-14.1	-2.7
	R77 – R127	-2.3	-11.0	-3.2
MHW to MLW	R1 – R23	-0.2	0.1	-0.2
	R23 – R41	-0.1	-0.9	-0.2
	R41 – R66	-0.3	0.1	-0.2
	R66 – R77	-0.3	-0.1	-0.2
	R77 – R127	-0.3	-0.4	-0.3
MLW to -35 ft	R1 – R23	-5.2	-14.2	-6.1
	R23 – R41	-4.1	-13.8	-5.3
	R41 – R66	-5.6	-11.7	-6.6
	R66 – R77	-5.4	-13.3	-7.7
	R77 – R127	-5.7	-30.9	-8.6
Dune to -35 ft	R1 – R23	-7.2	-29.6	-9.1
	R23 – R41	-6.0	-37.3	-9.1
	R41 – R66	-8.0	-24.6	-10.0
	R66 – R77	-7.5	-27.5	-10.7
	R77 – R127	-8.1	-42.1	-11.7

Table 3. Cumulative Volume Change (R1 – R127)

	May 1995 (pre-Opal) – May 2004 (pre-Ivan)	May 2004 (pre-Ivan) – November 2004 (post-Ivan)	May 1995 (pre-Opal) – November 2004 (post-Ivan)
	Volume Change (cy)		
Dune to MHW	-2,519,000	-1,930,000	-3,931,000
MHW to MLW	-278,000	-37,000	-297,000
MLW to -35 ft	-6,414,000	-2,637,000	-9,137,000
Dune to -35 ft	-9,211,000	-4,604,000	-13,365,000

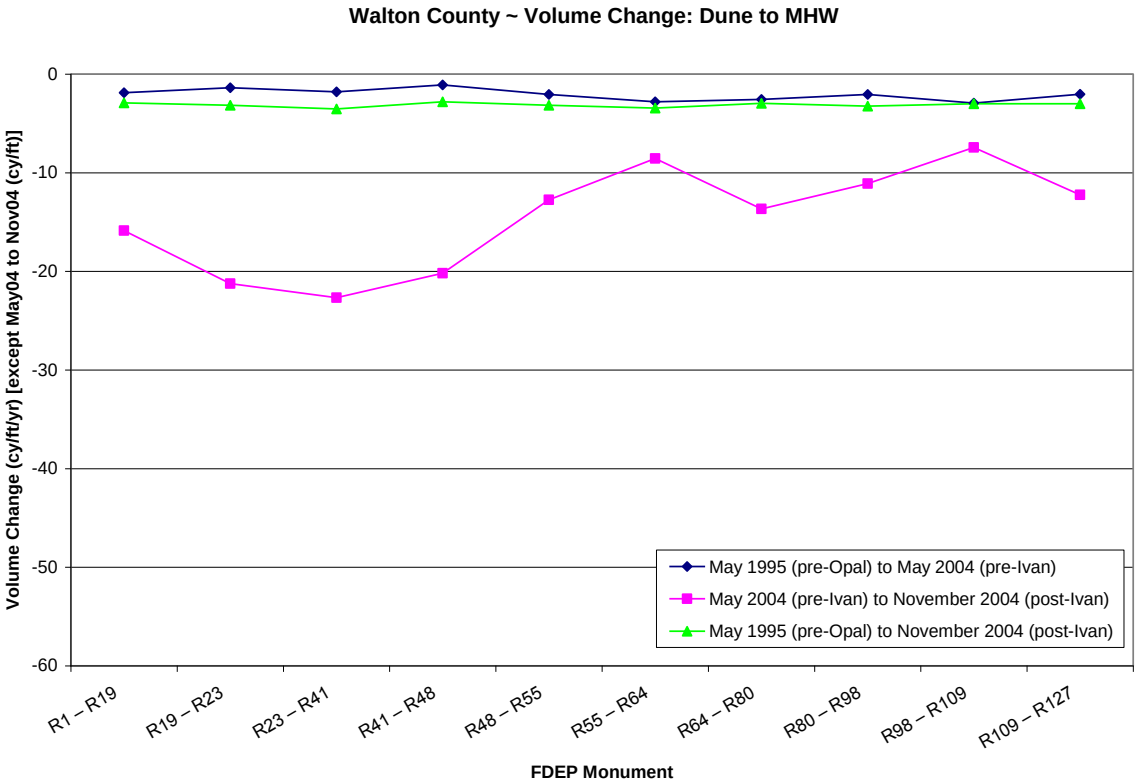

Figure 1. Dune to MHW Volume Change by Reach: Analysis A

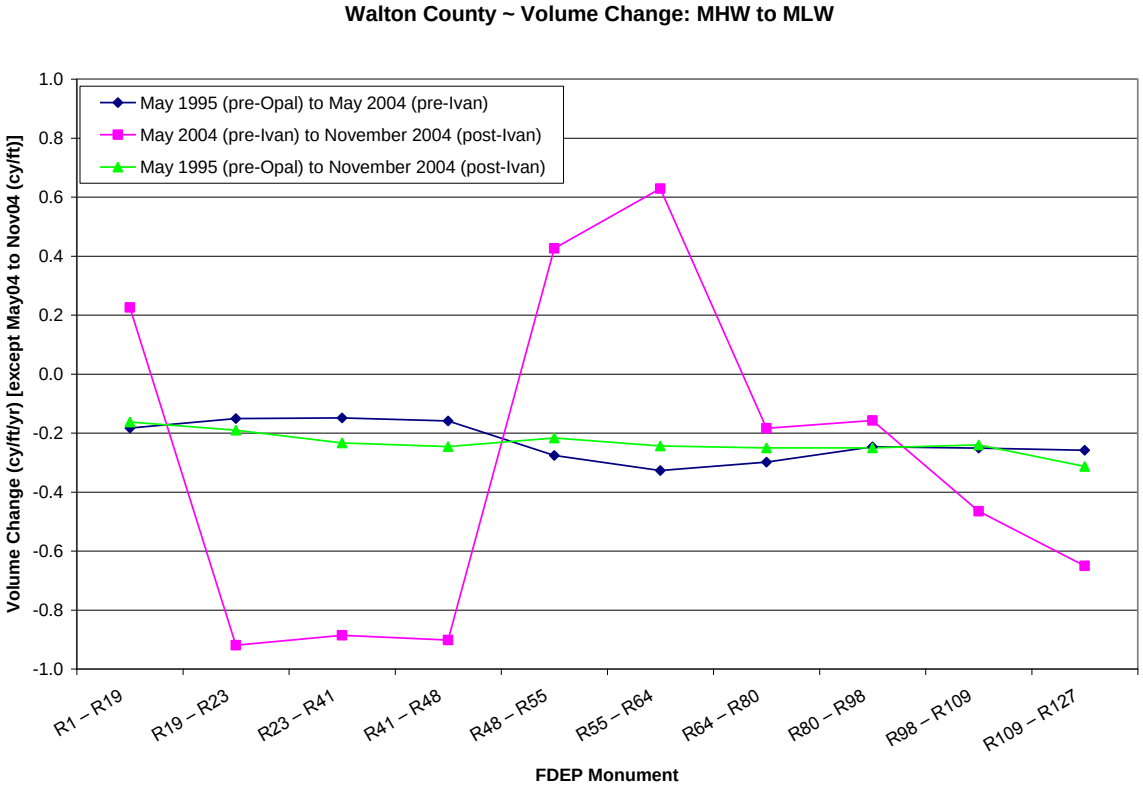

Figure 2. MHW to MLW Volume Change by Reach: Analysis A

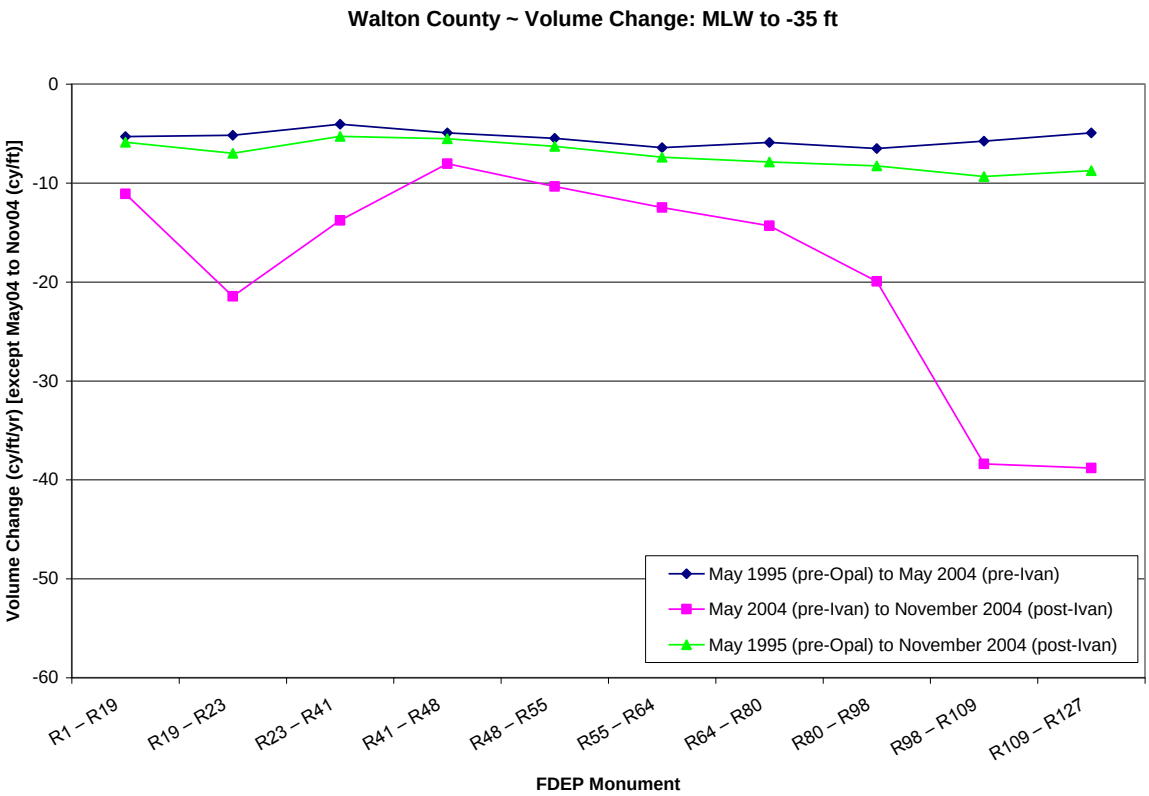

Figure 3. MLW to -35 ft Volume Change by Reach: Analysis A

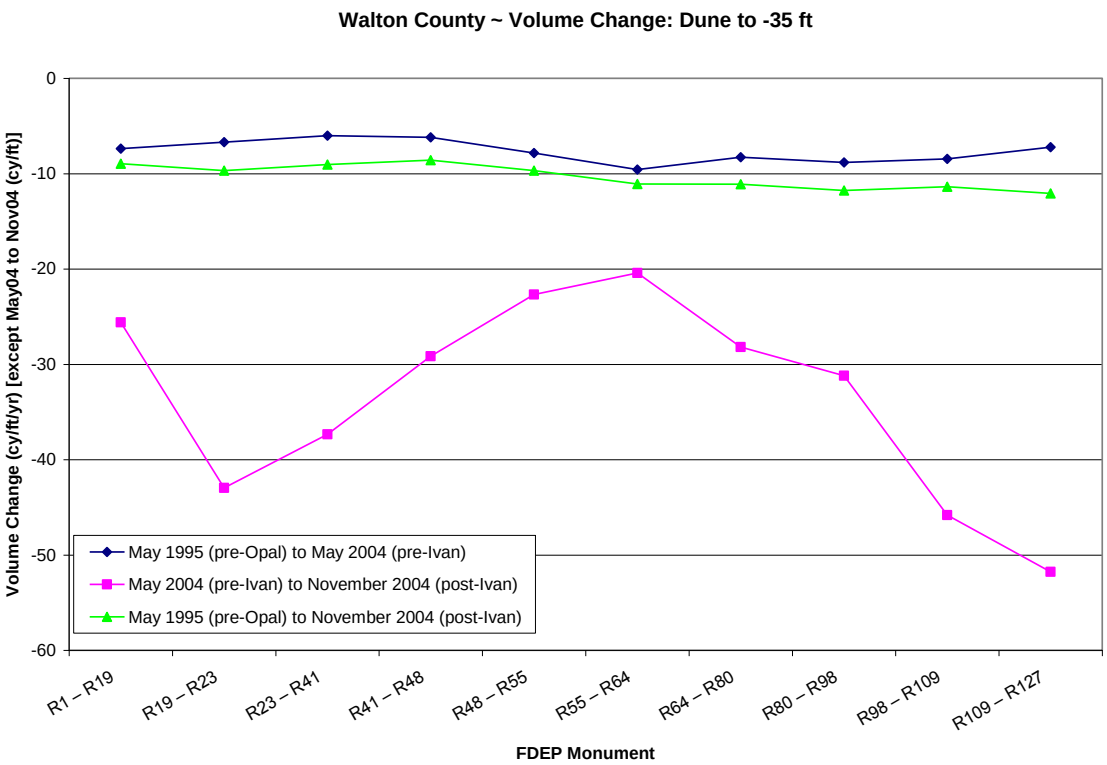

Figure 4. Dune to -35 ft Volume Change by Reach: Analysis A

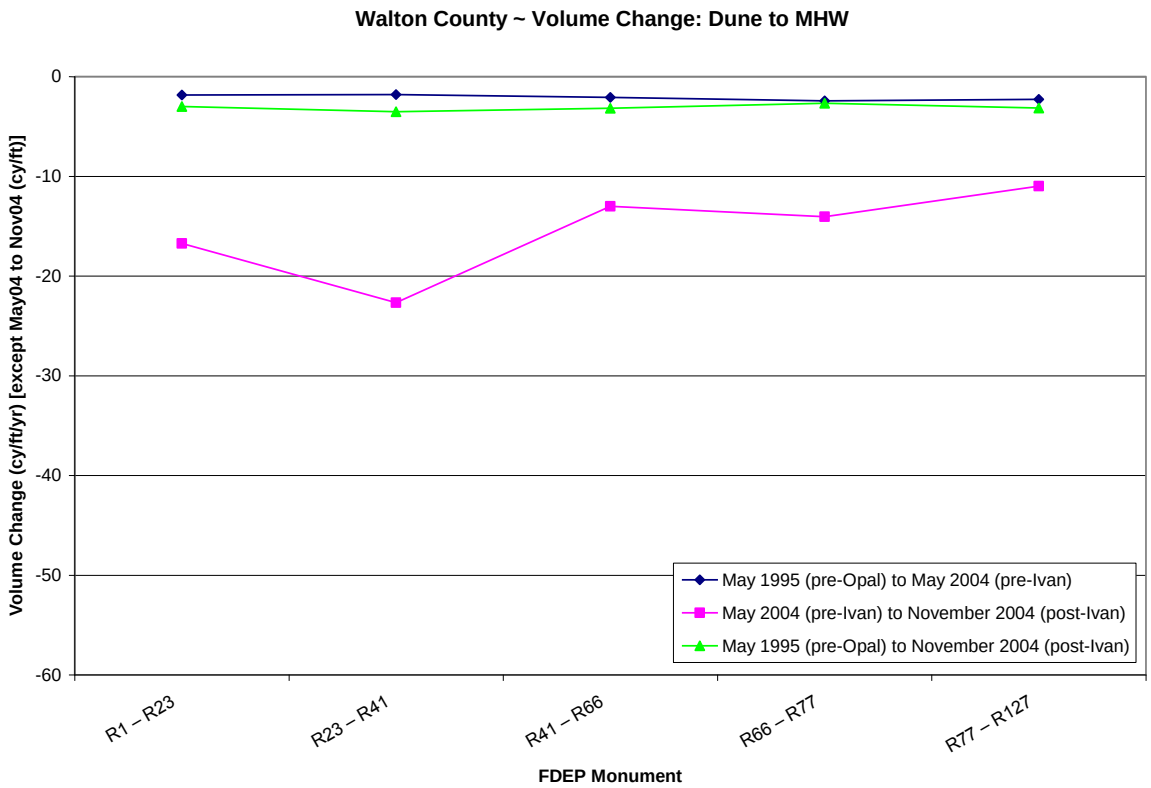

Figure 5. Dune to MHW Volume Change by Reach: Analysis B

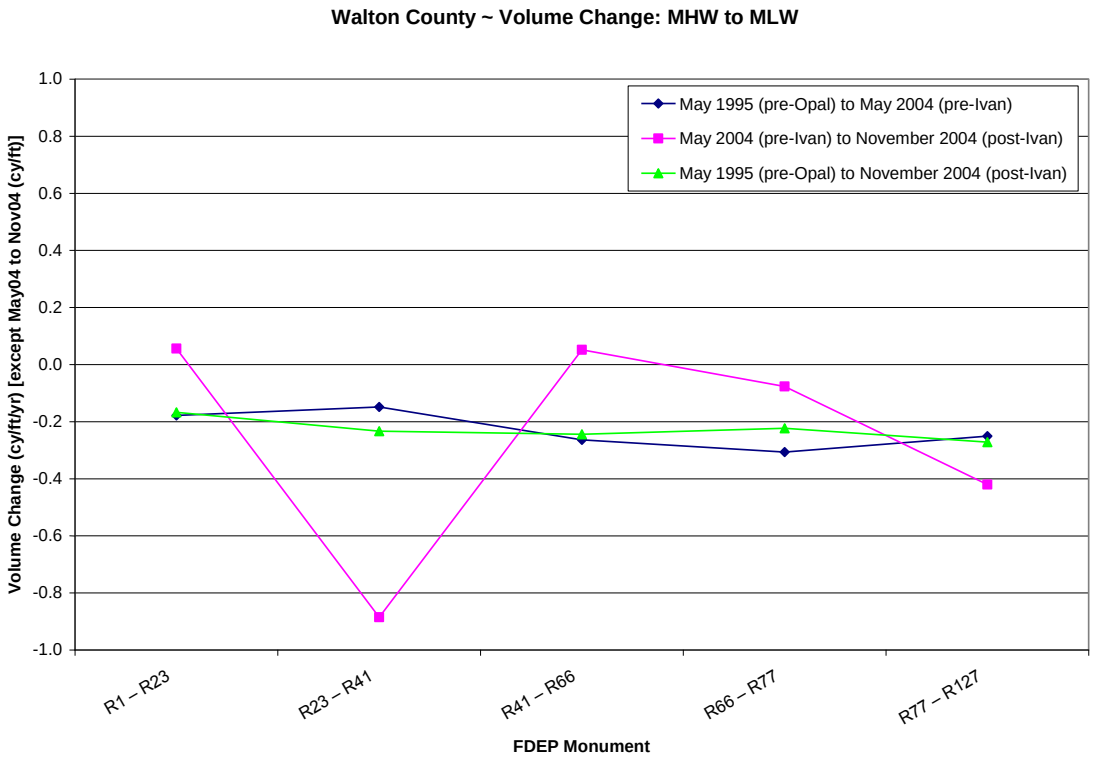

Figure 6. MHW to MLW Volume Change by Reach: Analysis B

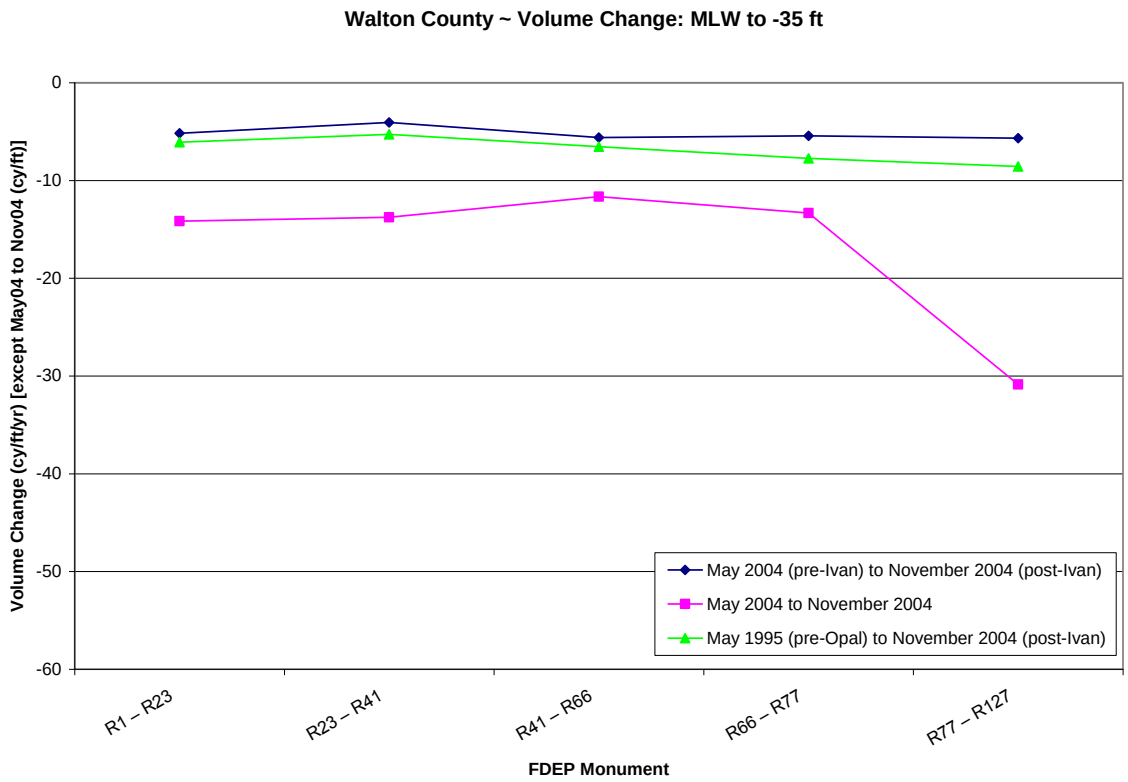

Figure 7. MLW to -35 ft Volume Change by Reach: Analysis B

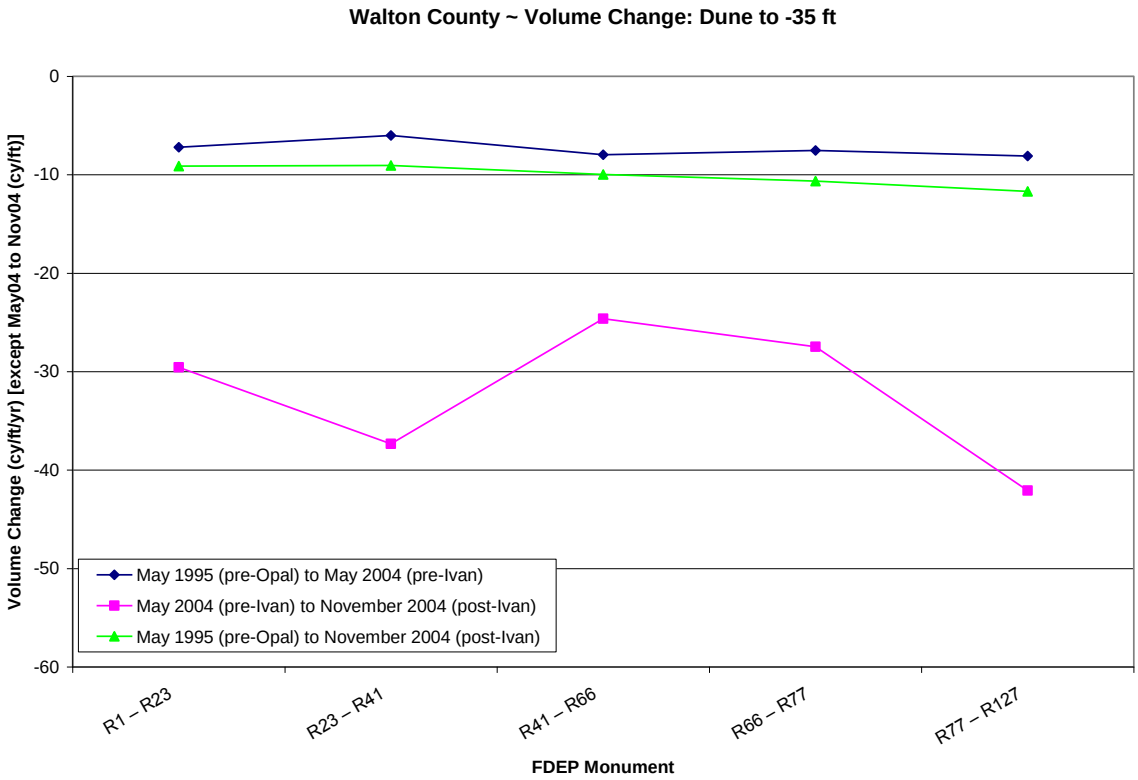

Figure 8. Dune to -35 ft Volume Change by Reach: Analysis B

ATTACHMENT III

REGRESSION ANALYSIS FOR SHORELINE CHANGE RATES

ATTACHMENT III: Regression Analysis for Shoreline Change Rates

Table 1. Shoreline Change Rates Following Linear Regression Analysis

	1973 – 2004 Nov	1973 – 2004 May	1973 – 1995 May	1995 May – 2004 May	1995 May – 2004 Nov	2004 May – 2004 Nov
Monument	Slope	Slope	Slope	Slope	Slope	Slope
	(ft/yr)	(ft/yr)	(ft/yr)	(ft/yr)	(ft/yr)	(ft/yr)
Average	-0.22	-0.02	2.13	-2.59	-2.45	-12.41
St. Dev.	0.70	0.74	1.00	2.87	2.31	36.09
R-1	-0.64	-0.13	2.16	-1.85	-3.52	-38.10
R-2	0.58	0.69	1.15	6.12	3.36	-69.84
R-3	-0.22	0.30	2.61	-3.95	-4.91	-32.41
R-3a	-0.14	0.07	1.62	-2.11	-2.20	-13.27
R-4	0.87	0.93	1.27	4.90	2.86	-56.75
R-5	-0.56	-0.29	2.35	-7.13	-5.79	16.86
R-6	0.25	0.12	2.58	-3.33	-0.05	78.31
R-6a	-0.93	-0.86	0.58	0.37	-0.53	-41.08
R-7	-0.33	-0.18	1.76	-3.19	-2.70	8.80
R-8	0.44	0.08	1.50	1.05	2.58	27.77
R-9	0.04	0.44	3.35	-3.21	-4.02	-30.32
R-10	-0.03	-0.04	1.49	-2.84	-1.10	35.29
R-11	0.36	0.56	2.75	-1.55	-1.75	-16.41
R-12	0.23	-0.13	2.51	-2.45	1.44	81.64
R-13	-0.38	-0.06	3.52	-6.16	-5.30	7.24
R-14	0.00	0.50	2.20	-3.92	-4.10	-3.28
R-15	-0.11	-0.09	2.05	-2.95	-1.81	13.82
R-16	0.53	0.54	1.37	-3.12	-1.65	33.74
R-17	0.53	0.76	4.39	-5.51	-3.89	21.52
R-18	0.54	0.37	2.72	-1.33	1.12	40.65
R-19	-0.76	-0.60	0.10	-2.21	-2.40	-12.36
R-20	-0.15	-0.15	2.05	-4.73	-4.73	0.00
R-21	0.24	0.51	2.63	0.80	-0.09	-26.36
R-22	1.68	1.74	3.76	0.39	0.65	4.96
R-23	0.45	0.89	2.63	0.73	-1.64	-71.93
R-24	-0.68	-0.40	1.42	-4.14	-3.38	12.99
R-25	-0.93	-1.32	0.14	-2.72	-0.11	53.38
R-26	1.06	1.45	2.26	-1.12	-1.95	-19.42
R-27	0.82	0.60	1.61	0.71	2.28	14.27
R-28	0.76	0.93	3.19	-1.74	-1.37	-6.80
R-29	0.74	0.88	3.94	-2.07	-1.42	-8.80
R-30	-0.30	-0.13	1.67	-1.41	-1.58	-32.53
R-31	-2.42	-2.23	-0.95	-1.68	-2.74	-35.00
R-32	0.57	0.98	1.83	-2.62	-3.37	-28.62
R-33	1.23	1.55	4.28	-7.84	-0.47	-

Table 1 (Cont'd): Shoreline Change Rates Following Linear Regression Analysis

R-34	-0.38	0.13	1.65	-2.12	-3.97	-53.02
R-35	-1.57	-1.13	2.35	-11.00	-8.34	48.23
R-36	0.34	0.66	2.06	-7.93	-6.55	17.63
R-37	0.51	0.64	2.20	-0.53	-0.78	-21.61
R-38	0.25	0.60	2.68	-1.01	-2.24	-52.85
R-39	-0.76	-0.28	1.69	0.94	-1.74	-91.63
R-40	-0.42	-0.04	1.57	-2.48	-3.61	-37.57
R-41	0.34	0.60	0.88	-0.63	-1.54	-16.33
R-42	0.09	0.37	2.57	0.54	-0.46	-47.71
R-43	0.28	0.42	1.73	4.99	2.39	-76.62
R-44	-0.53	0.11	1.83	-0.72	-3.32	-64.35
R-45	-1.03	-0.66	1.06	-3.42	-4.10	-29.48
R-46	-0.15	0.03	1.93	-0.23	-1.01	-31.98
R-47	0.24	0.23	1.90	-2.20	-1.09	13.66
R-48	0.19	0.17	2.69	-3.03	-1.59	28.84
R-49	-0.85	-0.77	1.72	0.54	0.73	3.23
R-50	-0.47	-0.42	1.22	-6.02	-3.97	29.64
R-51	-1.36	-1.33	1.69	-2.59	-1.31	11.40
R-52	0.33	0.47	2.94	-2.20	-1.90	-4.36
R-53	-0.40	-0.29	2.18	-0.46	-0.95	-23.82
R-54	-0.04	0.37	2.59	-5.92	-5.27	-1.00
R-55	0.04	0.14	1.55	-5.66	-3.87	24.60
R-56	0.55	0.62	2.57	-5.01	-3.22	27.24
R-57	-0.84	-0.49	2.28	-7.65	-6.22	18.58
R-58	-0.63	-0.41	2.23	-7.16	-5.56	1.55
R-59	-0.57	-0.85	2.32	-1.18	0.60	33.52
R-60	-0.37	-0.15	1.48	-5.07	-3.98	10.08
R-61	-1.40	-1.38	0.45	-3.80	-2.93	21.10
R-62	0.00	-0.02	1.93	-4.98	-2.80	49.21
R-63	-0.52	-0.19	2.47	-5.16	-4.45	-8.78
R-64	-0.25	0.25	2.84	-3.99	-4.58	-21.82
R-65	0.65	0.90	2.48	-4.78	-3.63	25.60
R-66	0.00	0.54	3.65	-6.41	-6.07	-17.02
R-67	0.27	0.14	2.54	-2.62	-0.72	29.00
R-68	-1.60	-1.78	2.49	2.64	1.93	-9.75
R-69	0.34	0.91	3.11	-3.76	-4.34	-47.70
R-70	-0.61	-0.72	1.43	-3.62	-1.94	14.72
R-71	-0.41	-0.39	2.50	-2.62	-1.87	-0.67
R-72	0.33	0.89	3.50	-2.11	-3.14	-19.35
R-73	-0.87	-1.08	5.37	3.20	3.54	9.15
R-74	-1.03	-1.01	2.40	-4.04	-2.94	-12.73
R-75	-1.67	-1.43	1.30	-4.68	-3.93	3.95
R-76	-1.28	-1.14	0.54	-3.76	-3.57	-18.55
R-77	-2.40	-2.61	-0.38	-5.58	-3.12	38.25
R-78	0.32	0.52	3.14	-1.96	-1.33	-12.81
R-79	-1.27	-1.04	2.11	-4.27	-4.34	-38.73
R-80	0.40	1.07	3.20	-3.10	-5.05	-49.94

Table 1 (Cont'd): Shoreline Change Rates Following Linear Regression Analysis

R-81	-1.58	-1.52	0.30	-1.07	-1.34	-29.63
R-82	0.55	0.63	1.70	1.69	0.79	-20.86
R-83	0.35	0.34	3.08	-2.17	-1.03	14.55
R-84	0.32	0.32	0.68	-2.38	-2.38	0.00
R-85	0.24	0.77	2.11	0.44	-2.30	-72.05
R-86	-0.68	-0.62	1.46	-6.29	-4.21	40.50
R-87	-0.17	-0.18	1.82	-0.75	0.02	4.28
R-88	0.30	0.58	3.16	-4.27	-3.71	5.88
R-89	-0.49	-0.33	0.24	-0.37	-1.30	-24.26
R-90	-0.41	-0.03	1.98	-4.71	-4.67	-23.82
R-91	0.27	0.70	2.93	-1.30	-2.77	-46.24
R-92	0.41	0.57	0.94	-2.16	-1.98	13.30
R-93	-0.64	-0.63	2.39	-2.25	-0.73	4.63
R-94	-0.75	-1.08	1.77	-2.42	-0.27	30.88
R-95	-0.90	-0.53	1.93	-7.70	-5.97	23.60
R-96	-0.72	-0.81	0.52	1.08	0.76	-12.55
R-97	0.78	0.90	3.83	0.06	0.01	-28.39
R-98	-0.20	0.05	3.11	-3.01	-2.91	-13.96
R-99	-0.52	-0.23	1.18	-4.35	-3.91	-7.20
R-100	0.62	0.93	2.12	-0.33	-1.49	-32.05
R-101	-0.10	0.00	2.14	1.12	0.12	-41.69
R-102	0.26	0.56	1.99	-8.88	-6.80	33.11
R-103	-0.75	-0.32	2.91	-5.57	-5.76	-21.30
R-103a	-1.66	-1.02	-	1.46	-2.75	-99.53
R-104	0.26	-0.11	1.59	-0.95	1.06	30.00
R-105	-0.54	-0.09	3.00	-5.82	-5.46	-33.28
R-106	-0.21	0.30	2.78	-2.31	-4.34	-61.85
R-107	-0.63	-0.63	2.03	-5.87	-5.87	0.00
R-108	-0.23	0.31	1.88	-0.15	-2.42	-72.07
R-109	-0.38	-0.38	2.28	-4.50	-4.50	-
R-110	-0.55	-0.04	2.44	-2.35	-3.92	-52.01
R-111	-0.87	-0.50	1.28	1.95	-0.57	-56.67
R-112	-0.99	-0.68	2.60	-1.21	-2.81	-71.21
R-113	-0.63	-0.57	2.20	-4.85	-3.32	5.51
R-114	-0.61	-0.04	2.18	-2.21	-4.38	-62.24
R-115	-0.03	0.35	2.46	-7.57	-6.58	9.09
R-116	-0.02	0.40	1.91	-2.24	-3.67	-70.05
R-117	-1.14	-1.01	0.30	-1.53	-1.76	-24.57
R-118	-1.10	-0.47	1.53	-0.70	-4.32	-89.32
R-119	-0.33	0.01	2.36	-1.90	-3.19	-63.41
R-120	-0.79	-0.24	1.48	-1.80	-4.14	-83.53
R-121	-0.69	-0.38	1.74	-2.69	-3.62	-37.81
R-122	0.53	0.77	3.00	0.18	-0.99	-41.07
R-123	-0.03	-0.08	2.73	-3.13	-0.78	21.89
R-124	-0.11	0.41	2.15	0.59	-2.16	-60.97
R-125	-0.19	0.05	2.51	-6.05	-4.98	-11.56
R-126	0.07	0.43	3.28	-4.27	-3.54	-13.28
R-127	0.57	0.84	5.19	-8.23	-5.82	-3.97

APPENDIX A
SECTION 2

GEOTECHNICAL CONSIDERATIONS

WALTON COUNTY, FLORIDA
HURRICANE AND STORM DAMAGE REDUCTION
GENERAL INVESTIGATIONS STUDY

APPENDIX A - ENGINEERING DESIGN
SECTION 2 - GEOTECHNICAL CONSIDERATIONS

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6. Native Beach Materials	A-2-9
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8. Conditions at Other Investigated Areas	A-2-22

LIST OF ATTACHMENTS

ATTACHMENT I CONSTRUCTION DRAWINGS
(Note: Digital version of these drawings is included on CD attached at end of report)

ATTACHMENT II WALTON COUNTY SAND SOURCE INVESTIGATION GEOPHYSICAL AND GEOTECHNICAL DATA ANALYSIS
(Digital data only – CD attached at end of report)

GEOTECHNICAL CONSIDERATIONS

1. General

The purpose of this study is to assess the needs for hurricane and storm damage reduction and opportunities for environmental restoration and protection along the Gulf Coast of Walton County, Florida. The most immediate and critical needs of the local communities are to address gulf front beach and dune erosion and include environmental protection opportunities. The study area is located in Walton County, Florida. The Walton County shoreline extends along the northern Gulf of Mexico and comprises 26 miles of shoreline including six miles of state parks. A coastal peninsula extending west from the mainland characterizes the western two-thirds of the coastline, and a mainland beach characterizes the eastern third. The Choctawhatchee Bay lies north of the peninsula. Walton County begins from the City of Destin in Okaloosa County, Florida; eastward to the beginning of Bay County, Florida. Walton County is situated approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida.

Walton County's shoreline is receding and its protective dunes and high bluffs are being adversely impacted by hurricane and coastal storm forces. The impacts of these storms to property and infrastructure are considerable and can possibly be reduced through a beach restoration and stabilization project. Behind the dune system, upland drainage feeds several freshwater lakes that intermittently breach the dune system and discharge directly into the Gulf. Primary dune elevations range from 13 to 45 feet National Geodetic Vertical Datum (NGVD) and average 26 feet NGVD. During the late 1990s, the area endured several strong hurricanes resulting in extensive shoreline erosion (Taylor Engineering, 2003). In 2004 the area was affected severely by Hurricane Ivan (Sep 04) and early into the 2005 hurricane season it was impacted by Hurricanes Arlene (June 05) and Dennis (July 05).

Walton County's 26-miles of coastline initially was subdivided into reaches that very nearly coincided with the neighborhood divisions that already existed in the county's coastal community. That division resulted in 10 major reaches initially formulated for economic reach delineation. Surveys were taken every 1,000 feet and were used to develop the beach profile. There are 117 model reaches in the Walton County study which are about 1,000 feet in length.

Due to the effects of Hurricane Ivan on the beach the PDT decided that the project existing conditions had changed significantly. As a result new surveys of the beach were ordered and obtained. A new existing condition was established and named post-Ivan. That existing condition then became the initial point of beach condition (base condition) for the 54-year period of analysis accommodating a 50-year project life.

Further the PDT sought out, briefed and obtained from all the affected stakeholders approval of an expedited study plan which resulted in a revised PMP. That plan included reducing the number of study reaches to five (Table A-2-1). This was made possible because the hurricane had removed the physiographic differences in the shoreline, thus reducing the number of representative profiles needed to account for variation between and among reaches.

The hurricane season of 2005 started early and the project was significantly affected by Hurricanes Arlene and Dennis. It was decided that the without project condition should remain as post Ivan and continue the study with that existing condition even though that condition had changed significantly.

2. Study Reaches and Representative Profiles

The Walton County upland cross section is defined by dune elevations ranging from +9.5 to + 33 feet NAVD88 and a natural berm elevation of +5.5 feet NAVD88. The study region was divided into five study reaches based on structural development and state park areas, Figure A-2-1. The historical and 2004 beach surveys were used to develop 11 representative profiles which characterize the existing condition for the five study reaches. The representative profiles were identified based on similarity in shape of the upper beach profile (dune height and width, berm width, foreshore beach slope, and profile volume) and shape of the offshore profile. Because significant erosion occurred due to Hurricane Ivan in September 2004, the representative profiles were revised using the post-Ivan data to characterize the upper portion of the beach and to include the post-Ivan data in the submerged portion of the beach.

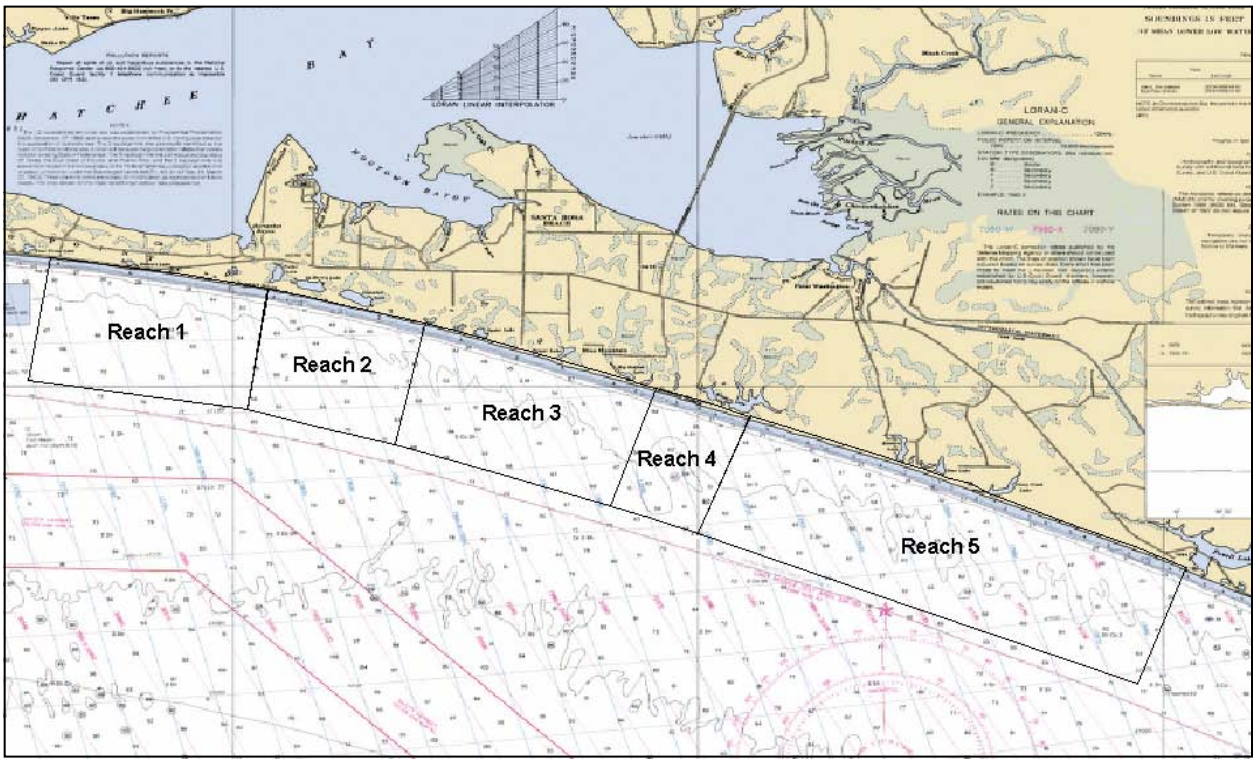

FIGURE A-2-1. WALTON COUNTY STUDY REACHES

TABLE A-2-1

Reach	FDEP Range Monuments	Distance (miles)	Local Communities	State Parks
1	R-1 to R-22	5.2	Miramar Beach Sandestin and 4 Mile Village	
2	R-23 to R-40	3.4		Topsail Hill State Recreation Area
3	R-41 to R-66	5.2	Beach Highlands, Dune Allen Beach, Santa Rosa Beach, Blue Mountain Beach	
4	R-67 to R-77	2.6	Grayton Beach	Grayton Beach State Recreation Area
5	R-78 to R-127	9.2	Seaside, Seagrove Beach, Rosemary Beach, Inlet Beach	Deer Lake State Recreation Area

The Generalized Model for Simulating Shoreline Change (GENESIS) (Hanson and Kraus 1989) was applied to estimate the existing and future without project shoreline positions in the Walton County area. The shoreline data from the May 2004 CHARTS survey encompassing all of Walton County and parts of Bay and Okaloosa Counties was used for the initial condition. The results indicate significant scatter in the shoreline positions. The average shoreline change within the project area measures 0.51 ft/yr indicating slight accretion. However; this average value masks the prevalence of the shoreline fluctuations that generally fall within +/- 6.56 ft/yr. The Storm-Induced BEAch CHange Model (SBEACH) (Larson and Kraus 1989a; Larson, Kraus, and Byrnes 1990) for predicting beach, berm, and dune erosion due to storm waves and water levels was used to develop an existing condition and future without project storm response database of storm-induced beach profile change within the Walton County study area. The modeled responses were subsequently processed using the USACE Beach-*fx* model. A total of 46 historical hurricane events were identified and used to characterize the storm climatology within the Walton County study area. With the exception of Hurricane Ivan, the ADCIRC model (Luettich et al., 1994; Westerink et al., 1992) was used to estimate the storm surge associated with the individual historical storm event. Wave information was obtained from the WIS wave hindcast and NDBC Station 40239 for Hurricane Ivan conditions.

For purposes of Beach-*fx* modeling, a simplified beach profiles were developed representing a single trapezoidal dune, with a horizontal berm. The submerged profile is represented by a series of points or an approximate functional representation. The beach variables which change with storms are dune width, dune height, berm width, and upland elevation. Constant values are upland elevation, dune slope, berm height, foreslope, and shape of the submerged profile. Thus, in response to a given storm, the berm can be eroded or accreted; the dune height and/or width can change and translate landward or seaward. The 11 representative beach profiles simplified to meet the requirements of the Beach-*fx* model and comparisons of the representative and simplified beach profiles for Reaches 1 through 5 are located in Appendix A.

SBEACH simulations were conducted to develop a database of pre-generated beach profile responses to storms, for a range of storms and profiles, for the Walton County. The 11 simplified beach profiles were modified for various berm and dune configurations as listed in Appendix A. Maximum dune and berm widths were determined based on volumes provided by the Federal Emergency Management Agency (FEMA) post-Hurricane Ivan emergency beach nourishment. FEMA funded the placement of an average of six to eight cubic yards per linear foot of shoreline at specific locations on the western end. This study assumes the FEMA emergency nourishment volumes are placed over the entire domain, and emergency placement will be implemented once the existing post-Hurricane Ivan shoreline conditions are reached. The SBEACH simulations were conducted to predict the response of each dune and berm configuration to

the 552 storms developed for this study. Approximately 240,000 SBEACH simulations were conducted to develop the shoreline responses for the Beach-*fx* storm response database.

3. Alternatives

A process was followed for initial screening of alternatives and resulted in the recommendation of a set of preliminary alternatives to further evaluate in feasibility. The design looked at both historical and current dune heights and dune widths and berm heights and berm widths over the study area as defined in each representative profile. In Reaches 1, 3, and 5 the dune height is preserved as a result of the emergency nourishment action. Because emergency nourishment is only applied to the dune, the erosion is most significant to the berm. The PDT determined project alternatives for evaluation generally would vary the berm width in 50-, 75-, 100-, and 125-foot increments. The optimized section was found to be a 50 foot berm with a set dune height and width against the existing dune. The engineering effort tailored the required berm and dune quantity to the existing condition at a given location. The typical sections for these efforts are illustrated in Figure A-2-2.

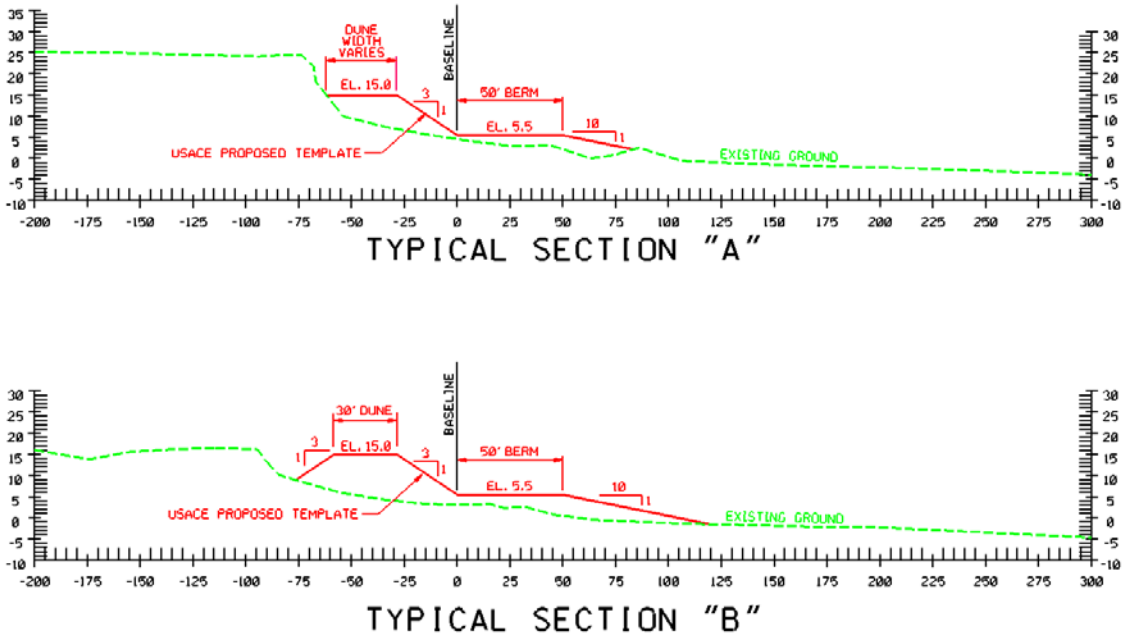

FIGURE A-2-2. TYPICAL PROJECT SECTIONS

Estimated fill requirements for the NED plan and a Locally Preferred (LP) plan are indicated in the table below. The two plans maintain the same placement template but the LP plan extends the coverage area to the westernmost limits of the county where the NED plan could not justify the coverage. The typical sections indicated, except that the width of dune crest was

varied to match the existing el 15 contour at most locations if this contour occurred within 150 feet of the project baseline rather than using the indicated 1V:3H landward slope, were applied to conditions indicated by the survey over the previously determined reaches and using the previously determined baseline and reaches. The width of the dune crest was varied as described to avoid creating a trough landward of the dune that would cause poor drainage resulting in ponding during dredging and after storms. The latest (as of Nov 2011) available survey was used for the estimates, which is a Lidar survey made Apr 2010. The indicated depletion rates are based on Beach-fx model results. The indicated estimates are based in part on the midpoint of fill placement for initial nourishment occurring approximately Apr 2014. A construction start of Jan 2014 was assumed to estimate the midpoint date.

TABLE A-2-2

Estimates of Required Beach Fill and Borrow

Description	NED Plan	LPP
Depletion rate (cy/yr, mean)	158,500	178,900
Depletion rate (cy/yr, mean + standard deviation)	245,800	280,100
Depletion period for initial nourishment (yr)	4.00	4.00
Renourishment period (yr)	10.00	10.00
No. of renourishments	4	4
Initial nourishment, surveyed component (cy)	2,639,000	3,152,000
Initial nourishment, est. depletion component (cy, mean)	634,000	716,000
Initial nourishment (cy, mean)	3,273,000	3,868,000
Renourishment (cy/10yr, mean)	1,585,000	1,789,000
Renourishment (cy/10yr, mean + st. dev. renourishment)	2,458,000	2,801,000
Fill, project life (cy, mean)	9,613,000	11,024,000
Fill, project life (cy, mean + st. dev renourishment)	13,105,000	15,072,000
Borrow / fill ratio	1.25	1.25
Borrow, project life (cy, mean)	12,016,000	13,780,000
Borrow, project life (cy, mean + st. dev renourishment)	16,381,000	18,840,000

The fill volumes in Table A-2-2 are estimates of fill template volumes. Estimates of depletion and renourishments are based on depletion from Beach-x model studies. The borrow volumes are effective volumes, excluding volumes of soil expected to remain within the borrow area limits after effective depletion. The borrow capacity needs to be larger than these values to take into account the possibility of fill placement above the beach fill template, survey inaccuracies, and some unsatisfactory material being encountered in the borrow areas. For this assessment, it was assumed that an effective borrow capacity of 125% of the required fill template volumes will be needed for borrow.

4. Geology

The general geology of the Walton County beaches is somewhat unique due to the lack of a true barrier island immediately offshore. The shoreline is characterized by a coastal peninsula fronting Choctawhatchee Bay in the

western two-thirds of the county and by Pleistocene bluffs that range in elevation from 10 to 45 feet in the eastern portion. The present day beach is of the Holocene age and consists of over 95 percent quartz and the wave action has broken down and polished the granules to the current consistency. Sediment at the ebb tide delta is typically medium sand, generally well sorted. Offshore on the linear shoal, quality material is almost exclusively moderately well sorted medium sand.

5. Investigations

Investigations and studies to identify native beach material properties and suitable offshore borrow areas for the project were performed by Taylor Engineering, Inc. The borrow source investigation included an area offshore of Walton County and the eastern part of Okaloosa County, as shown in Figure A-2-3 and on drawing F-100. The borrow investigations were conducted in two phases, each with different levels of detail. The reconnaissance phase covered a relatively large area with information obtained at large spacing. The detailed phase focused on smaller areas with samples collected at closer spacing. The investigated area for borrow comprises approximately 53.1 square miles, with this area based on limits extending to 1000 feet outside of the perimeter of boring locations.

The reconnaissance phase borrow investigation was conducted 2001 to 2006 and was a geophysical, lithological and granulometric investigation (See Appendix A). Sub-bottom profiles were used initially to locate prospective core locations to identify high quality sand sources for beach nourishment. An investigation was undertaken as described in detail herein. Vibracore borings and selected seismic records were interpreted in an attempt to confirm the presence and quality of sand off Walton County. The reconnaissance phase borings were identified as borings WN-1 to WN-25 and W-26 to W-80. The locations of the cores are shown on Figure A-2-3 and on drawings F-100. Coordinates are listed in Table I and seismic lines are presented in Figure A-2-2 in the main Taylor Report in Appendix A. The reconnaissance phase borings were made in an irregular pattern with variable spacing. Based on the 80 borings within a 40.5 square mile area defined at the perimeter of the boring locations, average boring spacing for the reconnaissance phase borings was approximately equal to that of borings on a 3750 feet square grid.

Acoustic data was obtained during the reconnaissance phase from seismic lines run parallel and near perpendicular to the coast. These were interpreted and reflectors calibrated using lithological interpretation.

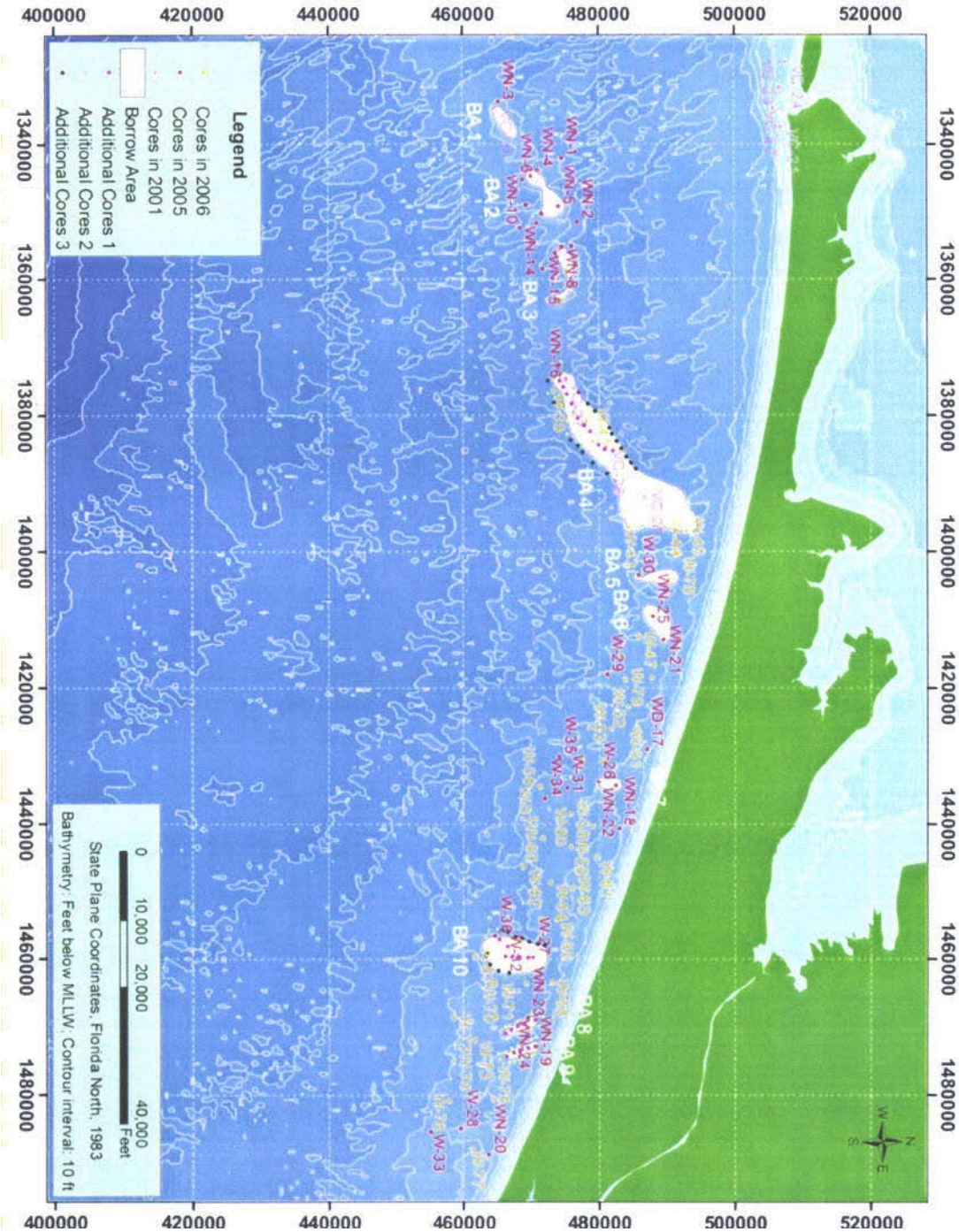

FIGURE A-2-3 BORROW AREA INVESTIGATION LOCATIONS

Vibracores and sub-bottom (seismic) profiles were obtained by Alpine. The cores were split longitudinally, prepared for analysis, photographed and

lithologically logged. Sediment samples were extracted at the surface of each core and at approximately 1.5 ft. intervals. Sediment samples were washed and prepared for granulometric description. Where they occurred, carbonates (shell) were determined as a percentage of the sample (see section on carbonate determination). Dry sieving was accomplished at ¼ phi intervals using an ultrasonic siever. The high resolution seismic reflection profiles were collected with an ORE (Geopulse boomer-type" profiling system. The seismic data are generally of high quality and they allowed predictions of sand thickness when calibrated to the vibracores.

Ten potential borrow areas, BA-1 to BA-10, were identified for detailed investigation after evaluation of the reconnaissance phase information. The limits of these ten areas are shown on Figure A-2-3 and on drawing F-100.

Detailed phase offshore borrow investigations were conducted by Taylor Engineering Inc. within or near five of the potential borrow areas to supplement the reconnaissance phase information. The detailed phase investigations included 99 additional vibracore borings which were comprised of 51 WA- series borings at an area near BA-4; 2 WB- series borings at an area within BA-10; 2 WC- series borings at an area within BA-8; 2 WD- series borings at an area near BA-9; and 42 WE- series borings near BA-7. As may be deduced by the numbers of borings at the areas, the area near BA-4 and the area near BA-7 were investigated in much more detail than the other areas. From this point forward unless otherwise stated, BA-4 and BA-7 refer to the areas that were investigated in detail rather than the areas identified in reconnaissance phase with these names.

Most but not all procedures for obtaining and recording data from the detailed phase vibracore borings were very similar to those used during the reconnaissance phase. Notable exceptions were that drilling logs on USACE ENG Form 1836 were prepared. The cores were split longitudinally, prepared for analysis, photographed and lithologically logged. Sediment samples were extracted at the surface of each core and at approximately 1.5 ft. intervals. Sediment samples were washed and prepared for granulometric description. Dry sieving was accomplished at ¼ phi intervals using an ultrasonic siever.

6. Native Beach Materials

Taylor Engineering in 2003 collected total of 314 samples from the dune vegetation, dune toe, mid-berm, mean high water (MHW), and mean low water (MLW) at approximately one-mile intervals throughout Walton County. Ellis & Associates, Inc. tested the native beach material samples in the laboratory to determine the carbonate content and grain size distribution for each sample. The grain size distribution tests originally conducted on the native beach sand samples were made using 0.5 phi intervals. Ellis & Associates retested the samples using 0.25 phi intervals. The summaries in this study are obtained from the Ellis & Associates grain size test data.

Ellis & Associates conducted acid digestion tests on the native beach sand samples to determine carbonate percentage. The results indicate that the native beach sand contains predominantly quartzitic sand with minimal carbonates. The maximum percentage of calcium carbonate is 1.24% (MLW at R-115), the minimum is 0%, and the average is 0.23%.

The native beach material consists of well- to moderately well-sorted medium sand (grain size between 1 and 2 phi). The largest and smallest mean grain sizes both occur at R-115: MLW has mean grain size 1.045 phi (0.485mm), and the dune vegetation has mean grain size 2.091 phi (0.235 mm). The largest sorting — 0.737 phi (0.24 mm) — occurred at MLW at R-125, and the smallest — 0.284 phi (0.05 mm) — occurred at the mid-berm at R-85. The subaerial beach has a smaller mean grain size and better sorting than the intertidal zone. Based on all the data, the subaerial beach in Walton County has a mean grain size of 0.28 mm and the intertidal zone has a mean grain size of 0.34 mm. Overall the native beach sand of Walton County has a mean grain size of 0.30 mm (1.72 phi) and a sorting of 0.48 phi.

The fines content of the native beach material, defined as the percentage by weight that passes through US Standard Sieve size 230, ranges from 0.0% to 0.3%.

Taylor Engineering identified the color of 313 of 314 native beach samples in moist condition to be Munsell color 5Y 8/1 (white). The one exception, R-115 from the dune vegetation, had Munsell color 2.5Y 7/2, or light gray. These samples are representative of the majority of beach and dune sand, but are not representative of some darker bluff sands or peat and clay deposits exposed by hurricanes.

7. Proposed Borrow Areas

Requirements for beach nourishment fill material in the state of Florida are given in Chapter 62B-41 “Rules and Procedures for Coastal Construction

Permits" of the Florida Administrative Code. The most relevant requirements are stated verbatim in the following paragraph from paragraph 62B-41.007.

To protect the environmental functions of Florida's beaches, only beach compatible fill shall be placed on the beach or in any associated dune system. Beach compatible fill is material that maintains the general character and functionality of the material occurring on the beach and in the adjacent dune and coastal system. Such material shall be predominately of carbonate, quartz or similar material with a particle size distribution ranging between 0.062mm (4.0φ) and 4.76mm (-2.25φ) (classified as sand by either the Unified Soils or the Wentworth classification), shall be similar in color and grain size distribution (sand grain frequency, mean and median grain size and sorting coefficient) to the material in the existing coastal system at the disposal site and shall not contain:
1. Greater than 5 percent, by weight, silt, clay or colloids passing the #230 sieve (4.0φ);
2. Greater than 5 percent, by weight, fine gravel retained on the #4 sieve (-2.25φ);
3. Coarse gravel, cobbles or material retained on the 3/4 inch sieve in a percentage or size greater than found on the native beach;
4. Construction debris, toxic material or other foreign matter; and
5. Not result in cementation of the beach.

Other criteria for satisfactory material for beach material for this project were developed and provided in the "Revised Sand Quality Control and Quality Assurance Plan" dated Oct 2008 by Taylor Eng. Paraphrasing, this document stated that acceptable limits for the material will be 0 to 2.5% for silt content, 0 to 5.0% for shell content, 0.24 to 0.49 mm for mean grain size, 5Y 7/2 or lighter for Munsell color of moist material; where silt content is defined as the portion of material by weight passing the #230 sieve and shell content is synonymous with carbonate content.

Based on interpretation of similar requirements in QA/QC plans at other projects, it is assumed that some deviation from the above criteria is acceptable, but only if the spatial extent of the deviations does not exceed 10,000 continuous square feet at the beach fill placement site. Furthermore these criteria refer to the characteristics of the soil as it will exist when placed on the beach, which may differ from characteristics observed in samples from the borrow areas. Some lightening of the soil, often of one-half to one Munsell value unit, typically occurs due to washing of the soil during dredging. Further lightening typically occurs after drying, exposure to sun, and weathering. Where grain size varies spatially within the zone of dredging, typically there is some mixing of grain sizes during the dredging and fill placement processes.

Taylor Eng. evaluated the investigation data and developed a plan for a 1.58 square mile borrow area encompassing approximately the southwestern two-thirds of the area near BA-4 that was investigated in detail to be used for an initial

nourishment. This planned borrow area was comprised of 3 contiguous areas with bottom elevations of -79.0, -78.3, and -76.3 feet NAVD88. Taylor Eng. estimated the limit volume of the planned borrow area to be 9,023,000 cy. Assuming that 1 foot will remain on average after depletion of the area, the effective capacity of the borrow area is estimated to be 7,388,000 cy.

An evaluation to further assess the suitability and quantity of available borrow material relative to the capacity needed for the full project life was conducted by USACE Mobile District Jan-Feb 2012. This evaluation was based on boring and sample data provided by Taylor Eng. Except where comparison is made to the Taylor Eng. evaluation and borrow area plan, the remainder of this paragraph (Proposed Borrow Areas) describes the USACE Mobile District evaluation. For this evaluation, the thickness of satisfactory material extending downward from ground surface and its bottom elevation was estimated at each boring. For the purpose of this estimate, samples or intervals of vibracore were considered to be satisfactory material if it was predominately sand with the following properties, as observed in borrow area vibracore samples or vibracore photographs:

(1) mean grain size between 0.24 and 0.48 mm inclusive;
(2) moist Munsell color value of 6 or more, provided that soil with Munsell color value 6 is present only in small quantity; and
(3) fines content greater than or equal to 2.5%, with fines content defined as the percent passing the #230 sieve.

Isolated samples of unsatisfactory material not meeting the above criteria were included in the estimated thickness of satisfactory material, but only if each such sample or interval were immediately underlain by at least 2 samples or at least 3 feet of vibracore possessing all of the above properties. This requirement was used in the evaluation to avoid excluding sometimes large thicknesses of satisfactory material that underlies one unsatisfactory sample near the surface.

It was considered in developing these borrow area selection criteria that the relatively small quantity of unsatisfactory material represented by the isolated samples of unsatisfactory material will be sufficiently blended with satisfactory material in the processes of dredging and fill placement that the resulting partially blended soil will be satisfactory. No blending other than that obtained by usual dredging and fill placement procedures is proposed. In choosing Munsell color value of 6 for the criteria it was considered, based on testing and past experience with similar soil, that moist sand with Munsell color value 6 will typically lighten by either 1 or 2 Munsell color values unit after washing during dredging and by waves and rainfall, drying and bleaching from exposure sun, and other weathering; and thus will become similar to the native beach material if it comprises only a small fraction of the borrow material.

The bottom depths of satisfactory moist Munsell color at 189 borings from the reconnaissance and detailed phase investigations were estimated from vibracore photographs. Sieve analyses results were available for at least upper parts of

179 of these borings but were unavailable at 10 borings (W-47, WB-5, WC-2, WC-5, WD-2, WD-5, WE-44, WE-45, WE-46, and WE-47). The depth of tested samples in the 179 vibracore borings that were tested varied from zero to 19.5 feet and averaged 10.4 feet. Sieve testing of samples was likely typically terminated at depths where it became visually apparent that the material was unsatisfactory. Therefore the deeper untested materials were assumed to be unsatisfactory and were likely at least predominately so. The thickness and bottom elevation at the 10 borings without sieve analyses were estimated exclusively from moist color of soil, so estimates of thickness and bottom elevation of surficial satisfactory materials at those locations are not completely reliable with regard to grain size suitability. The thickness and bottom elevation of the surficial satisfactory material generally varies greatly. The thickness of the surficial satisfactory material encountered at boring locations in the overall investigated area varies from zero to 18.0 feet, averages 6.1 feet with standard deviation of 4.8 feet, and varies as shown in Figure A-2-4, Figure A-2-5, and Figure A-2-6. The bottom of the surficial satisfactory material as encountered in the borings varies from elevation -85.0 to -53.9 feet, averages elevation -71.6 feet with standard deviation of 8.1 feet, and varies spatially as shown Figure A-2-7, Figure A-2-8, and Figure A-2-9. The total volume of satisfactory material meeting the above-given criteria, including the volume represented by a few isolated unsatisfactory samples, is estimated based on Theissen polygon method of analysis to be on order of 135,000,000 cy. However this estimate is based on reconnaissance level of investigation over most of the area and includes much material unusable for borrow because of intermingling with unsatisfactory material. Volumes of satisfactory material indicated by reconnaissance level of detail are frequently greatly reduced when investigated in detail.

The preceding and other following estimates of borrow volumes where described as being made by the “Theissen polygon” method were made by computing the volume represented by each boring as the area of its associated Theissen polygon multiplied by the thickness of material at that boring. A Theissen polygon is associated with each considered boring location in this case and is the region which is closer to that boring than to any other point in a set of borings being considered. The 53.1 sq. mile overall investigated area and the Theissen polygons along the perimeter of this area include a 1000-feet horizontal offset from the perimeter of the borings. Similar analyses made for the areas with detailed investigations instead included a 500-feet horizontal offset from the perimeter of the more closely spaced borings. A horizontal offset not exceeding half of the average boring spacing was considered to be appropriate in each case. Hydrographic surveys were not used in the estimates unless otherwise stated; e.g. the average ground surface elevation over the Thiessen polygon area was typically assumed to be the same as the ground surface elevation measured at the boring location.

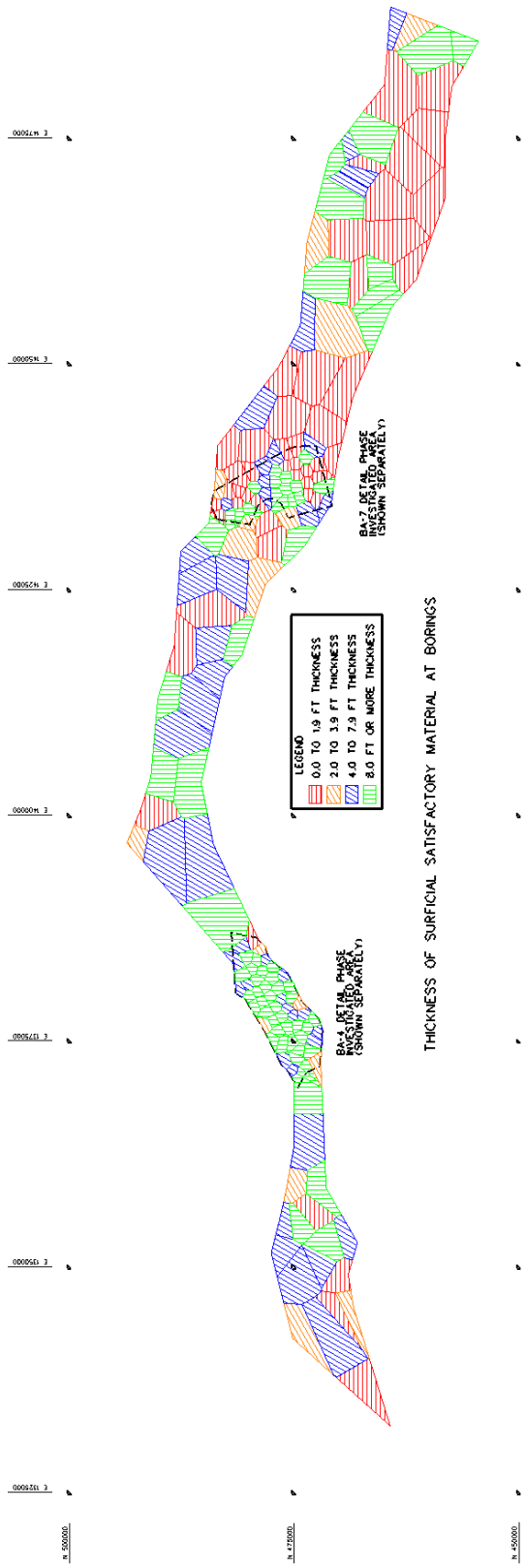

FIGURE A-2-4 THICKNESS OF SURFICIAL SATISFACTORY MATERIAL AT INVESTIGATION AREA

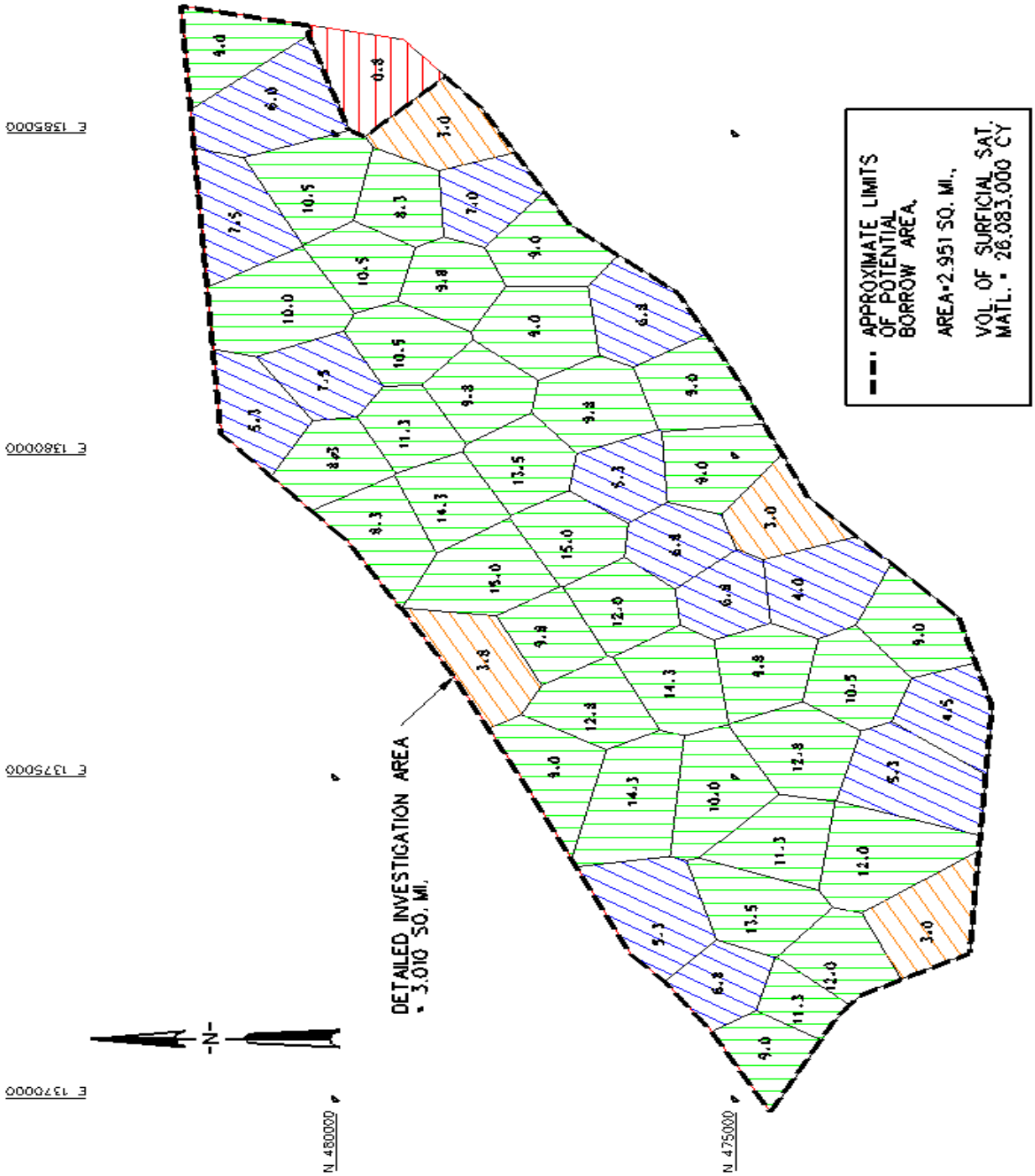

FIGURE A-2-5 THICKNESS OF SURFICIAL SATISFACTORY MATERIAL AT BA-4

Figure A-2-5 notes: See Figure A-2-4 for legend. Spot thicknesses of surficial satisfactory material and Theissen polygons associated with boring locations are shown.

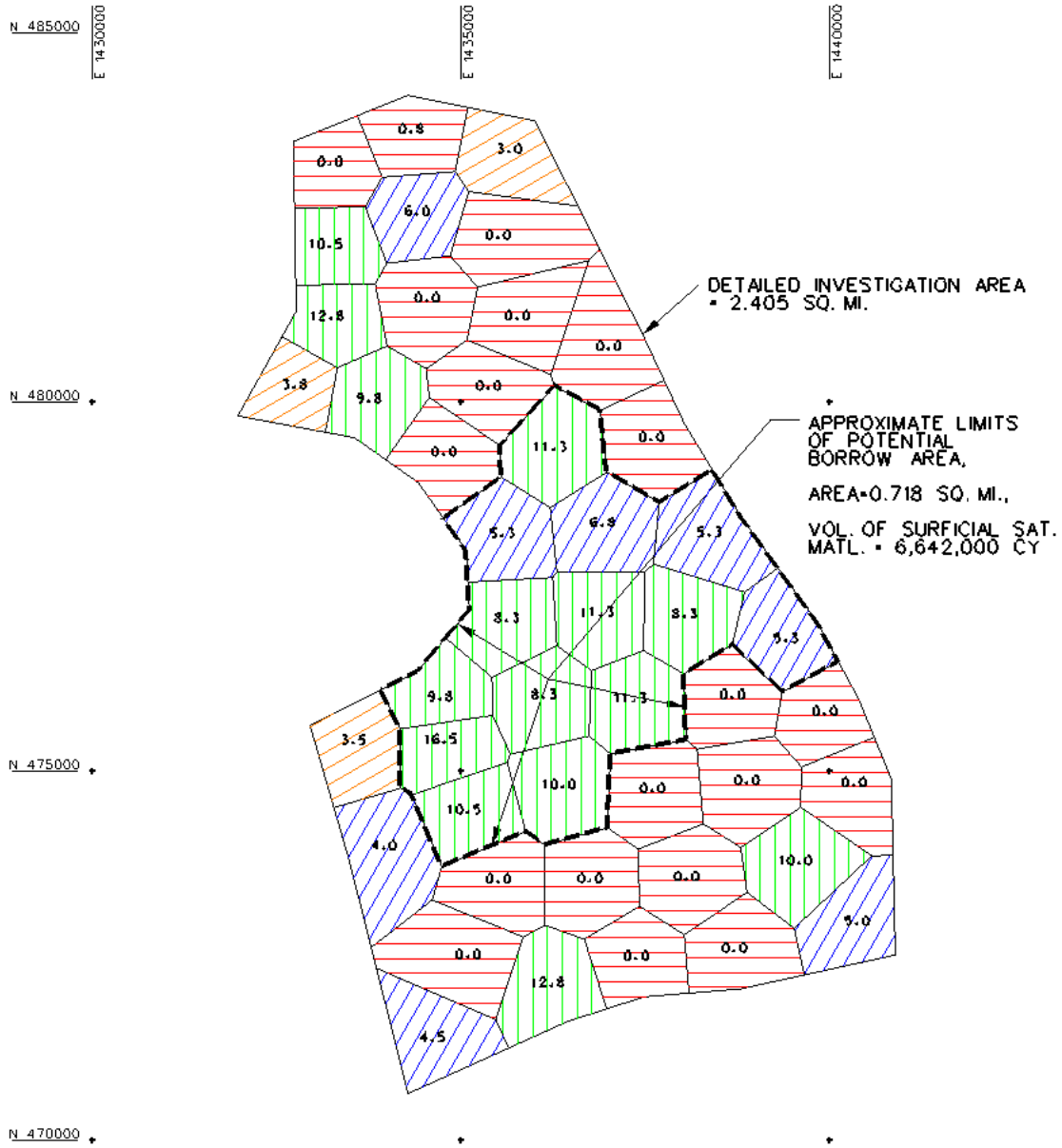

FIGURE A-2-6 THICKNESS OF SURFICIAL SATISFACTORY MATERIAL AT BA-7

Figure A-2-6 notes: See Figure A-2-4 for legend. Spot thicknesses of surficial satisfactory material and Theissen polygons associated with boring locations are shown.

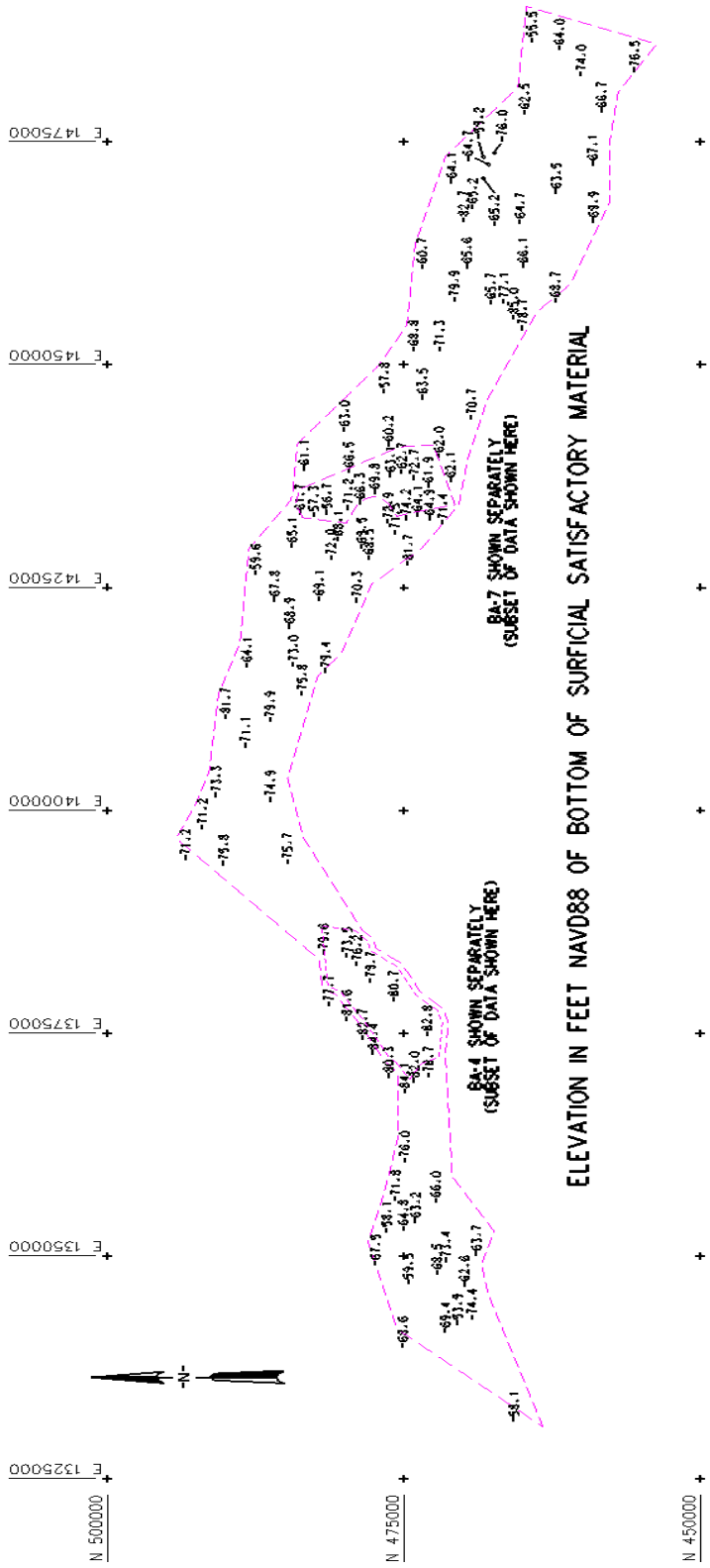

FIGURE A-2-7 BOTTOM ELEVATION OF SATISFACTORY SURFICIAL MATERIAL AT INVESTIGATION AREA

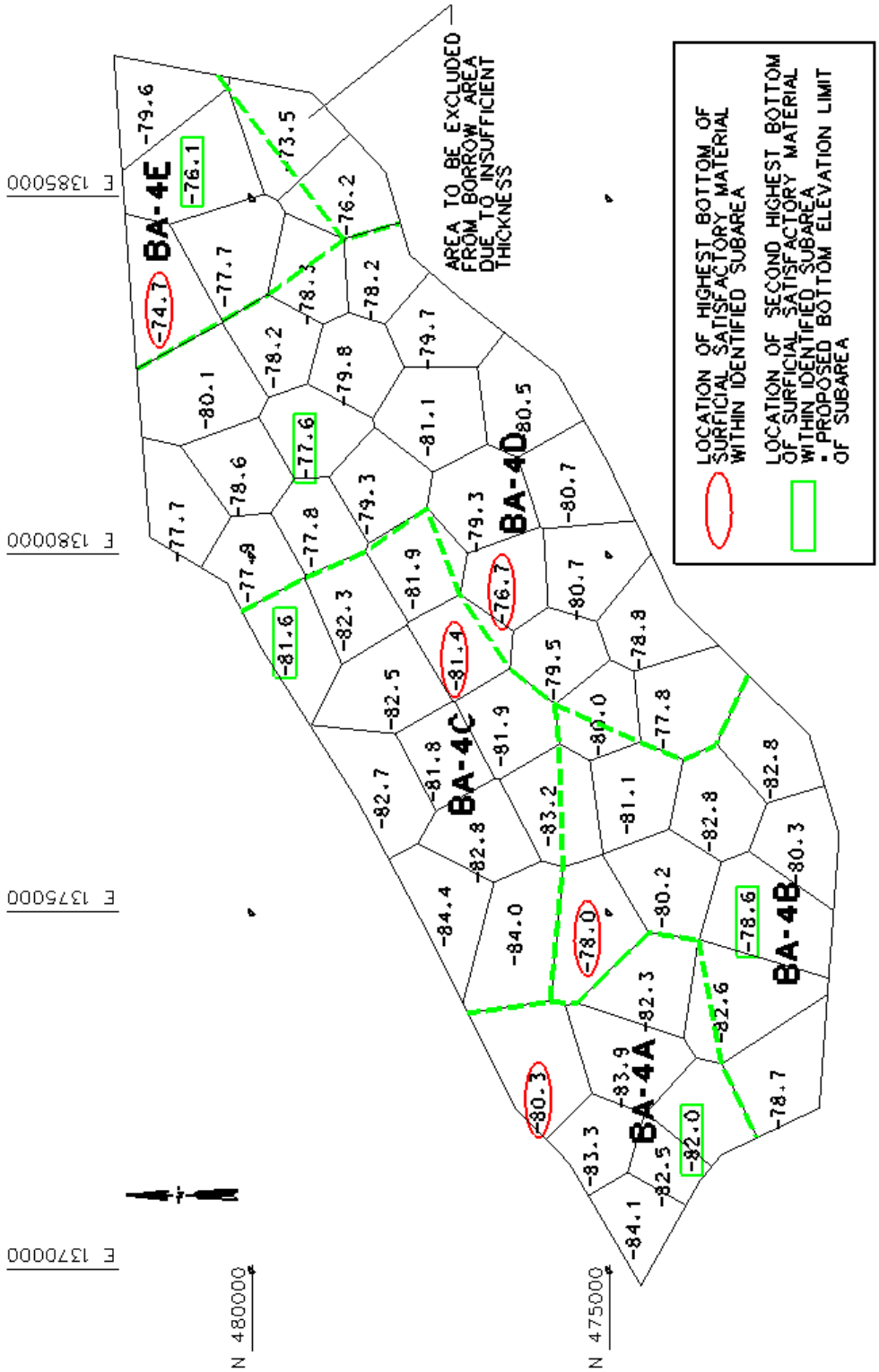

FIGURE A-2-8 BOTTOM ELEVATION OF SATISFACTORY SURFICIAL MATERIAL AT BA-4

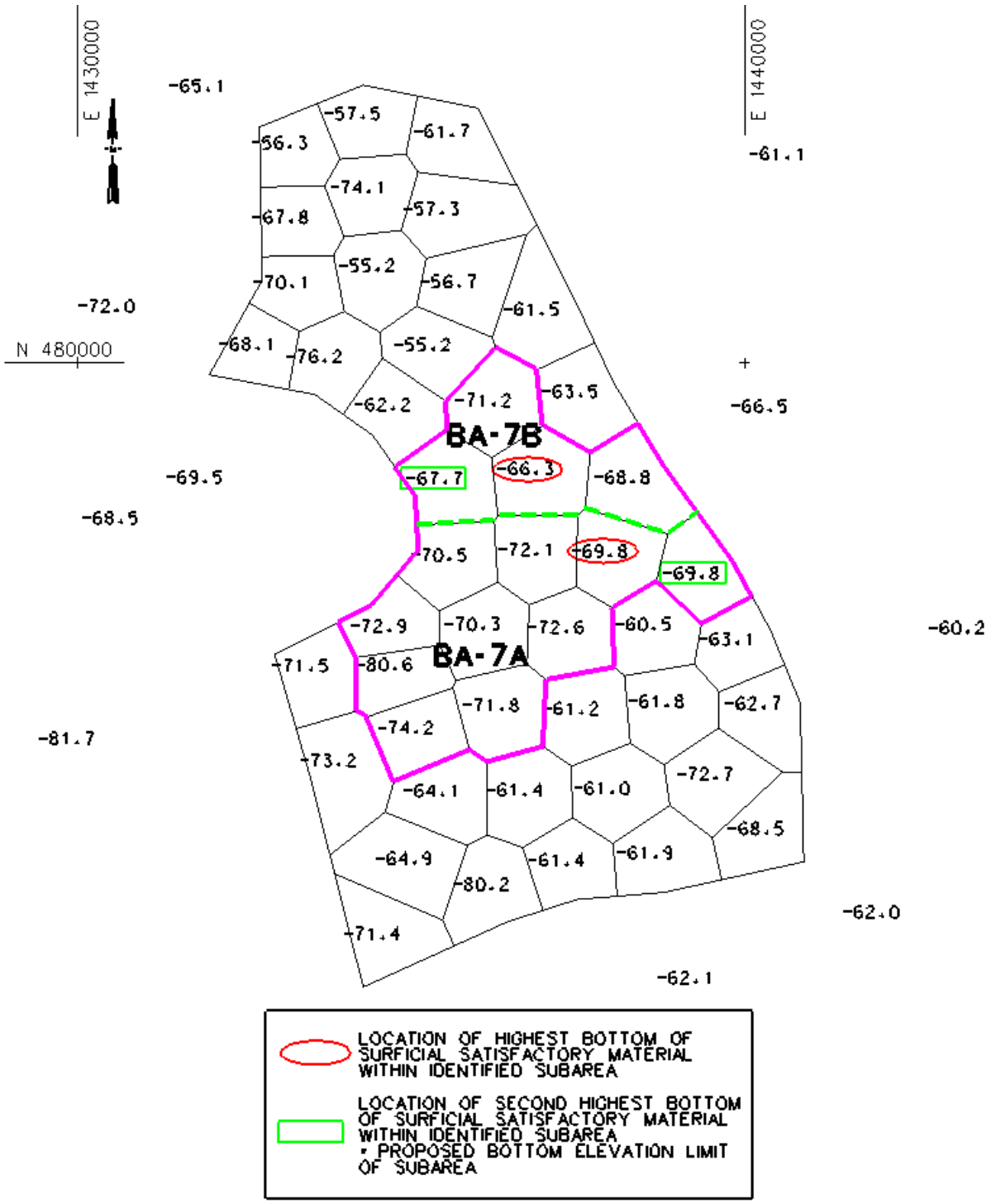

FIGURE A-2-9 BOTTOM ELEVATION OF SATISFACTORY SURFICIAL MATERIAL AT BA-7

In additional to establishing criteria for and determining the existence of a quantity of satisfactory material larger than the fill requirement, consideration several other factors is necessary for selection and design of a borrow area and determination of its capacity. These factors include:

(1) A sufficient volume of contiguously located satisfactory material is required within the borrow area limits. A minimum limit volume of approximately 3,000,000 cy is desirable at a borrow area, so as to keep the number of mobilizations to different borrow areas and associated costs reasonably small. The volume within the selected borrow area limits should include only material that has been investigated in sufficient detail to be reliably known to be predominately satisfactory material.
(2) An average thickness of at least 4 feet of material within the borrow area limit volume is desirable for dredging efficiency.
(3) The borrow area should have a constant bottom elevation, or at most just a few different bottom elevations, for dredging efficiency.
(4) Borrow areas close to the beach fill placement are better than borrow areas far away so as to minimize hauling cost if other considerations are equal.

Much of the satisfactory material for beach nourishment fill occurs in zones that are too small or is intermingled with unsatisfactory material to a degree that it is unsuitable for borrow. The areas investigated at only reconnaissance level are insufficiently investigated to rely on for design of borrow areas, but may be used to identify potential borrow areas for detailed investigations of other areas.

Approximate horizontal limits of two potential borrow areas, corresponding approximately with contiguous Theissen polygons at boring locations with at least 3 to 4 feet of surficial satisfactory material within the areas investigated in detail, are shown on the preceding Figure A-2-5 and Figure A-2-6. Estimated volumes of the surficial satisfactory material within these approximate limits are 26,083,000 cy at the 2.951 sq. mile area near BA-4 shown on Figure A-2-5 and 6,642,000 cy at the 0.718 sq. mile area near BA-7 shown on Figure A-2-6. These volumes include satisfactory material that can’t be effectively used in borrow areas because of geometric criteria and intermingling with unsatisfactory material. Both of these areas possibly could be enlarged if further detailed investigation is conducted, as sufficient thickness of satisfactory material was found at several borings along the perimeter of both of these areas.

The part of the BA-4 investigation area that was considered suitable for borrow was subdivided into 5 contiguous areas identified as BA-4A to BA-4E. A small area on the east end of BA-4 had insufficient thickness of satisfactory material to be included. Proposed limits of the BA-4 borrow area are shown in Figure A-2-8. The limits were based primarily on generally similar bottom of satisfactory material elevations within each area. Limiting bottom elevations of -82.0, -78.6, -81.6, -77.6, and -76.1 feet NAVD88 were chosen for BA-4A, BA-4B,

BA-4C, BA-4D, and BA-4E respectively. The bottom elevations of each area were chosen to coincide with the second highest elevation bottom of surficial sastisfactroy material of the borings within that area. This will typically include one sample indicating unsatisfactory material near the bottom limit at one boring in each subarea, but is expected to be adequate to obtain predominately satisfactory material at each subarea. The chosen horizontal limit points generally are points on Theissen polygons, but some of the polygon points were omitted as to reduce the number of sharp bends at the borrow area limits. The estimated limit volume of BA-4 is 18,643,000 cy based on computation with Inroads considering an Apr 2007 hydrographic survey and 1V:5H excavation slopes located just inside the shown borrow area limits. The area within the top of excavation slope lines is 80,686,000 sq. ft. and the average thickness of material above the bottom limits is 6.238 feet. Assuming an average thickness of 1 foot will remain in the area after its effective depletion, the effective capacity of the borrow area is estimated to be approximately 15,654,000 cy. The soil within the proposed BA-4 limits is typically moderately well sorted medium sand. The composite mean grain size is approximately 0.311 mm or 1.69 phi. The composite fines content is approximately 0.21 percent. 5 of the 325 samples within the borrow area limits when considered individually were indicated to be unsatisfactory by the QA/QC grain-size criteria but were considered to be isolated samples. One of these had larger mean grain size than 0.48 mm and 4 had mean grain size smaller than 0.24 mm. All but one sample within the borrow area limits had less than 2.5 fines content, the lone exception being 3.2%.

The proposed horizontal and vertical limits of BA-7 were selected similarly to those of BA-7. An area with sufficient thickness of surficial satisfactory material was identified and defined using Thiessen polygons at boring locations, Two subareas, identified as BA-7A and BA-7B, with somewhat similar elevations of bottom of surficial satisfactory material were selected. Limiting bottom elevations of -69.8 and -67.7 feet NAVD88 were chosen for BA-7A and BA-7B respectively. The bottom elevations of each area were chosen to coincide with the second highest elevation bottom of surficial satisfactory material of the borings within that area. A hydrographic survey of the area was unavailable. A limit volume of 5,260,000 cy was estimated using the Thiessen polygon method from the boring elevations. The area within the shown limits is 20,105,000 sq. ft.. and the average thickness of material above the bottom limits is 7.064 feet. Assuming an average thickness of 1 foot will remain in the area after its effective depletion, the effective capacity of the borrow area is estimated to be approximately 4,515,000 cy. The soil within the proposed BA-7 limits is predominately moderately well sorted medium sand. The composite mean grain size is 0.361 mm or 1.47 phi. The composite fines content is 0.13 percent. 8 of the 80 samples within the borrow area limits when considered individually were indicated to be unsatisfactory by the QA/QC grain-size criteria but were considered to be isolated samples. 5 of these had larger mean grain size than 0.48 mm and 3 had

mean grain size smaller than 0.24 mm. All samples within the BA-7 limits had less than 2.5 fines content.

The B-4 borrow area is the largest and best source of borrow. All materials used for beach nourishment will be excavated by hopper dredge, transported to the placement area offshore and pumped into the beach template. Small bulldozers will be used on land to shape the material to the prescribed template. Estimates indicate that most likely BA-4 will have sufficient borrow capacity for the project life, but that there is a significant possibility that it will not. In the event that BA-4 is depleted, use of an area at BA-7 with limits approximately as shown on Figures A-2-6 is proposed. Considering approximate estimated effective capacities of 15,654,000 cy for BA-4 and 4,515,000 cy for BA-7, the combined effective capacity of these two area is estimated to be approximately 20,199,000 cy. Monitoring of the borrow discharges will be a constant requirement for compliance with color and grain size criteria. Borrow area approval permits are only valid for 10 years and additional testing and analysis at that time will be necessary.

8. Conditions at Other Investigated Areas

The initial data indicated pockets of viable sand bodies along the study site. The west flank of the study area in Okaloosa County has high quality sand associated with the eastern part of the Destin East Pass ebb-tide delta. Alternate sites that deserved additional reconnaissance were located offshore in approximately 65 to 70 feet of water. This sand body is associated with the Holocene transgression and an abandoned barrier island that migrated across the mid-inner shelf to its present location. A cursory evaluation indicated that it varies in elevation above the sea bed from 13 feet to 26 feet due south of Destin. The remainder of the material is generally poor in quality to the Walton County line and is characterized by highly chaotic reflectors in the seismic data, when calibrated with the cores. This analysis indicated the presence of organic-rich sediments and shell. While high quality sand does exist off Walton County, it is intermittent and restricted to pockets. A poor quality, organic-rich suite of sandy silt and clay material occurs intermittently in the shallow sub-bottom along numerous locations. The high quality material, however, does occur over large enough areas to warrant further and more detailed investigation in this area.

Vibracores were taken through sediments on the inner shelf and nearshore Walton County. Figure 2, Attachment II, shows the location of these cores and core photos, interpretive logs and grain size distribution are provided in the Attachment II. Inspection of the core photos, interpretive logs, and grain size data suggest that the geology of the shore is complex. Several cores penetrated through what we interpret as old, lagoonal sediments containing organic material, silts and clay. The recent impacts of numerous storms/hurricanes have significantly impacted the shelf off Walton County and exposed considerably more of these sediments than were ordinarily expected.

Correlation of these vibracores to subsurface stratigraphic architecture is difficult because the first multiple obscures much of the seismic records representative of coring sites. As an example, the profile of the ebb-tide delta in the area is clearly evident and parts of the record seaward of delta-front suggest that an irregular reflection marked in Figure 3 of the Attachment II is probably representative of the shelf over which the delta appears to be prograding. Many vibracores from this area confirm a thick sequence of high quality sand that appears to be compatible in color arid size with requirements for local beach nourishment projects.

Several cores are located at the northeastern end of the inner shelf ridge that trends northeast-southwest across the inner shelf (Figure A-2-2). The northeast end of this ridge is characterized by less relief and more complex morphology than other parts of this feature where vibracores were acquired. The core photographs and interpretive logs of several cores indicated that quartz-rich sand overlies finer grained and organic rich deposits interpreted as being below the shell ravinement created by the rise of sea level during the Holocene (Figure A-2-4). The sandy tops of some of these vibracores are shell-rich, discolored, and probably not viable candidates for a beach nourishment project.

At the site of Vibracore 27 (seismic Line 105), Figure 5**,** Attachment II, the ridge varies in thickness from 5-8 m (16-26 ft.) Although the seismic data show an irregular profile to the ridge, the vibracoring site is comparatively uniform in thickness and the ridge sediments rest on a well-defined and relatively flat surface. This surface is interpreted as the ravinement formed as sea level rose across the shelf following the latest Pleistocene glacial maximum. The vibracore photograph and interpretive log illustrates that about 5 m (16 ft.) of high quality sand is present at this location. Vibracoring results correlate well with the seismic data acquired near the coring site. Vibracores 28 and 29 are associated with a broad buildup in the northeast-southwest trending submarine ridge (Figure 6 appendix A). The base of the buildup, as interpreted from high-resolution seismic data, is 6-7 m (20-23 ft.) below the seafloor. Both Vibracores 28 and 29 display high quality quartz sand approximately 5 m (16 IL) thick. Although the seismic line shown in Figure 6 is probably a good representation of the bottom conditions at the Vibracore 29 site. Vibracore 28 is located at a considerable distance from seismic Line 97 and therefore the correlation of sand thickness to ridge morphology is a tenuous one. However, both coring sites support sufficient sand to be considered as a viable borrow site. Seismic line **93** (Figure 7 Attachment II) shows that Vibracore 30 was acquired on the edge of a continuous part of the submarine ridge under investigation. Seismic data suggest that the sediments comprising this ridge are approximately 5 m (16 ft.) thick. The photograph and interpretive log indicate high quality white quartz sand that is over 4 m (13 ft.) thick at a site slightly to the southwest of seismic Line **93.** Organically stained, highly burrowed, and shell-rich sediments are observed stratigraphically below the sands that could he considered for beach restoration purposes.

ATTACHMENT I

CONSTRUCTION DRAWINGS

(Note: Digital version of these drawings is included on CD attached at end of report)

MARCH 2012

US Army Corps
of Engineers
Mobile District

CONSTRUCTION PLANS FOR

SOLICITATION NO.
-

WALTON COUNTY BEACHES RESTORATION

WALTON COUNTY, FLORIDA

WALTON COUNTY
FLORIDA

THIS FOLIO HAS BEEN REDUCED
TO ONE HALF THE ORIGINAL SCALE

SHEET REF.	TITLE OF DRAWINGS
X-001	INDEX OF DRAWINGS
F-100	OVERALL SITE PLAN
F-101	SITE PLAN
F-102	SITE PLAN
F-103	SITE PLAN
F-104	SITE PLAN
F-105	SITE PLAN
F-106	SITE PLAN
F-107	SITE PLAN
F-108	SITE PLAN
F-109	SITE PLAN
F-110	SITE PLAN
F-111	SITE PLAN
F-112	SITE PLAN
F-113	SITE PLAN
F-114	SITE PLAN
F-115	SITE PLAN
F-116	SITE PLAN
F-117	PROPOSED BORROW AREA BA-4
F-118	PROPOSED BORROW AREA BA-7
F-300	CROSS SECTIONS
F-301	CROSS SECTIONS
F-302	CROSS SECTIONS
F-303	CROSS SECTIONS
F-304	CROSS SECTIONS
F-305	CROSS SECTIONS
F-306	CROSS SECTIONS
F-307	CROSS SECTIONS
F-308	CROSS SECTIONS
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F-326	CROSS SECTIONS
F-327	CROSS SECTIONS

US Army Corps of Engineers
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Number	Date	Description

Recommended by: Chief, Design Branch — Date
Approved by: Chief, Engineering Division — Date

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

Designed By: M. MCKOWN
Drawn By: S. TURNER
Checked By: M. MCKOWN
Reviewed By: E. HERMAN
Date: MARCH 2012
File No. X
LSG Sheet File Name: X001.DGN
Solicitation Number: -

WALTON COUNTY, FLORIDA

INDEX OF DRAWINGS

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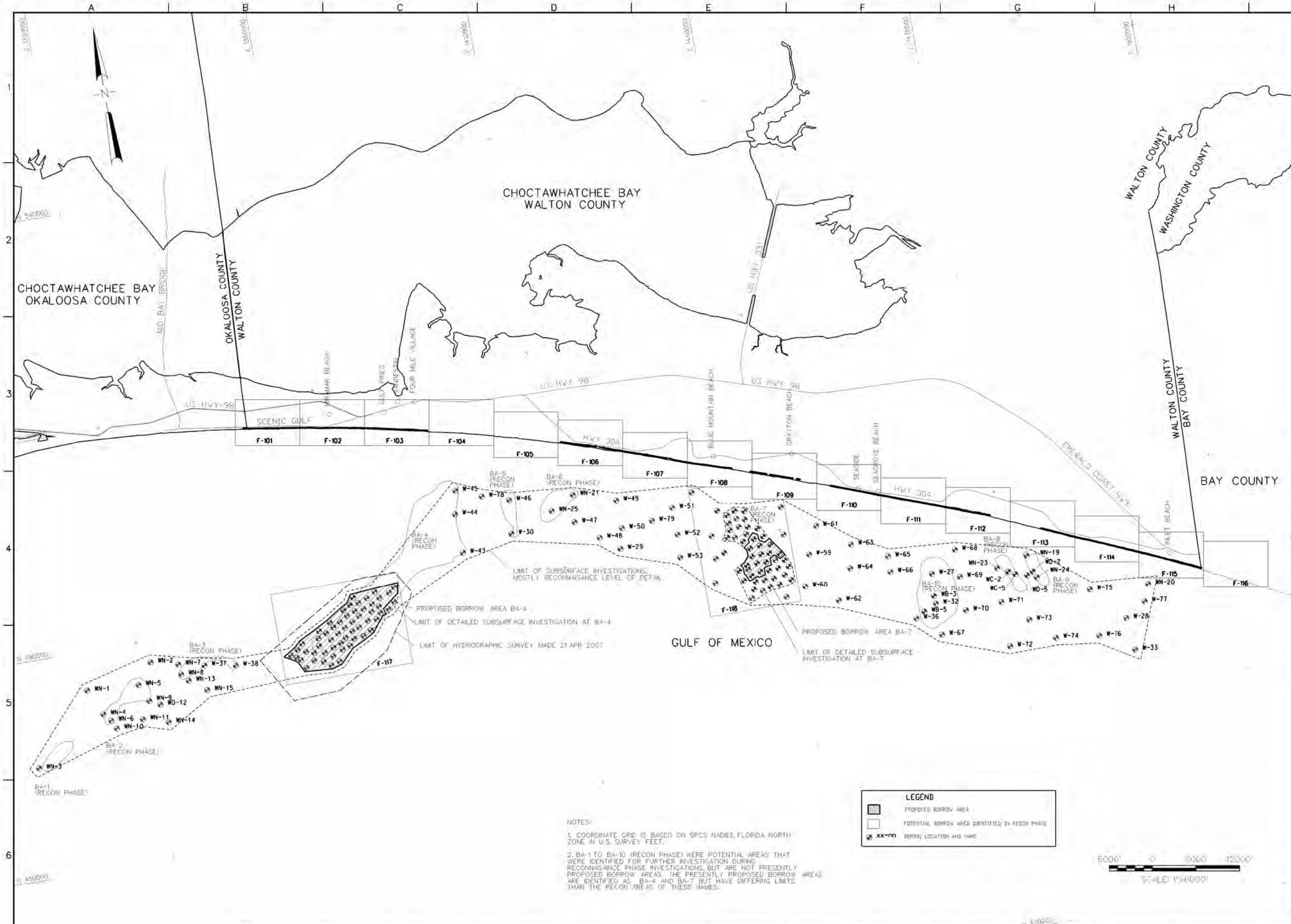
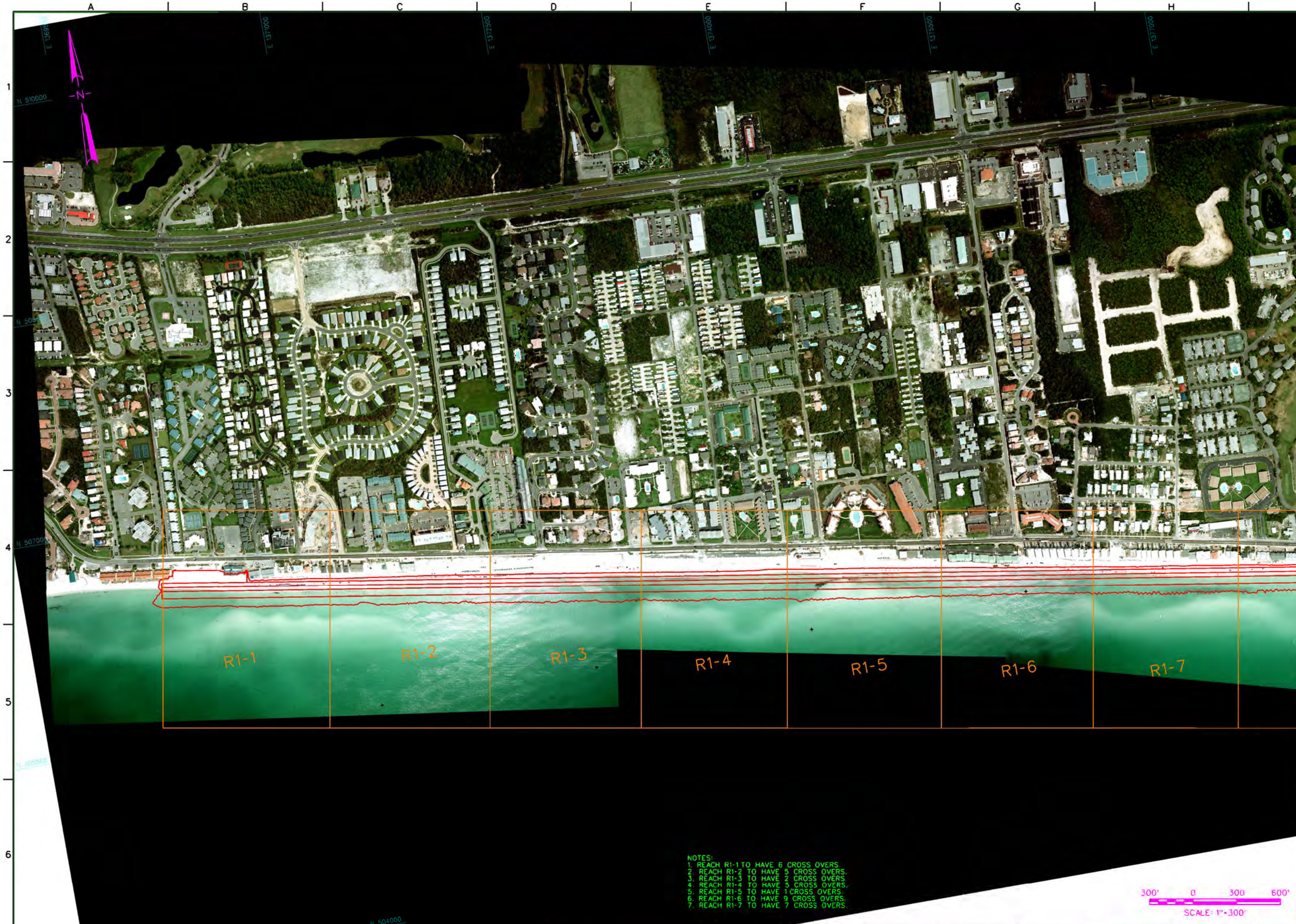


NOTES:

1. COORDINATE GRID IS BASED ON SPCS NAD83, FLORIDA NORTH ZONE IN U.S. SURVEY FEET.

2. BA-1 TO BA-10 (RECON PHASE) WERE POTENTIAL AREAS THAT WERE IDENTIFIED FOR FURTHER INVESTIGATION DURING RECONNAISANCE PHASE INVESTIGATIONS, BUT ARE NOT PRESENTLY PROPOSED BORROW AREAS. THE PRESENTLY PROPOSED BORROW AREAS ARE IDENTIFIED AS BA-4 AND BA-7 BUT HAVE DIFFERING LIMITS THAN THE RECON AREAS OF THESE NAMES.



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6. REACH R1-6 TO HAVE 9 CROSS OVERS.
7. REACH R1-7 TO HAVE 7 CROSS OVERS.

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WALTON COUNTY, FLORIDA

SITE PLAN

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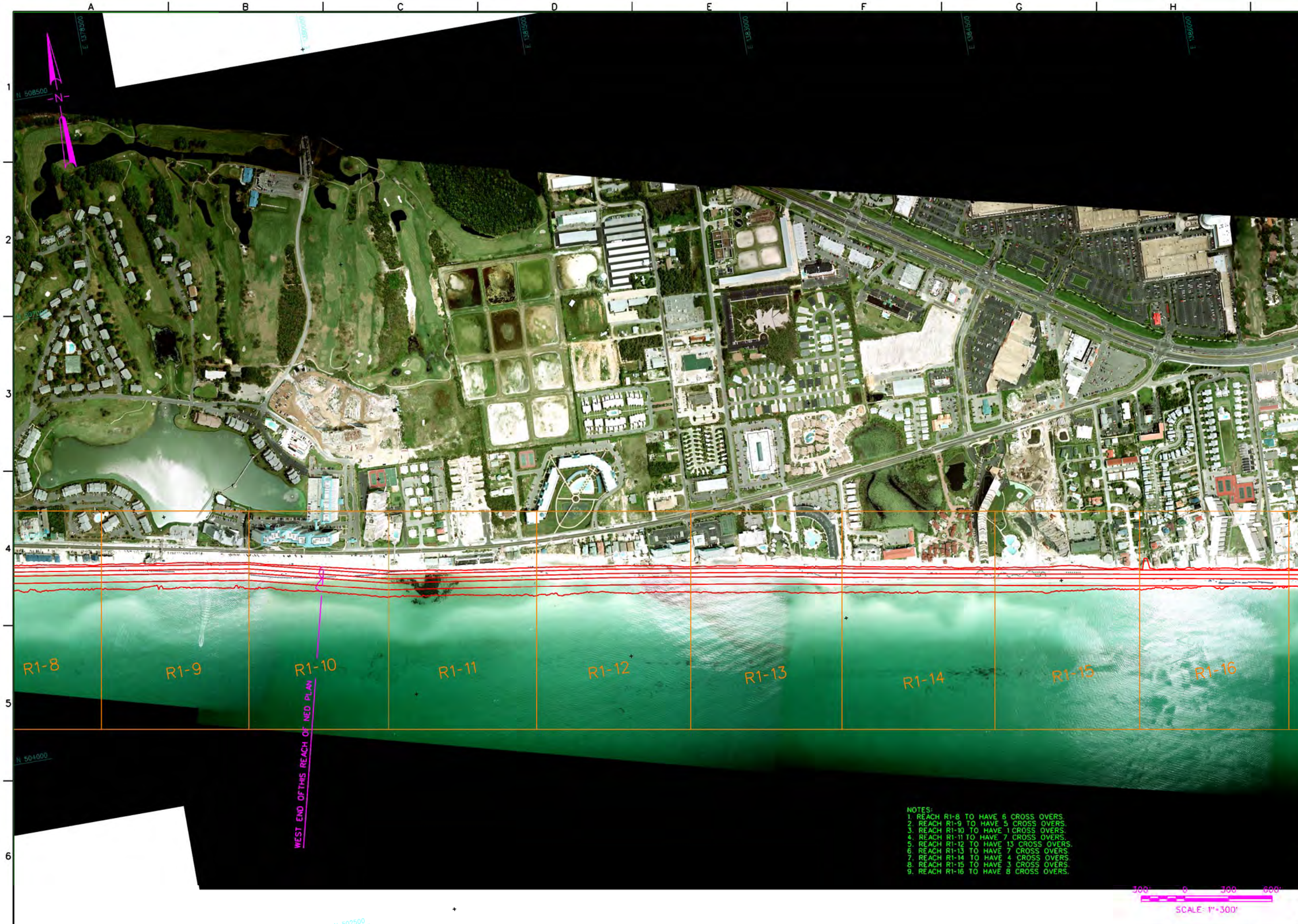

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8. REACH R1-15 TO HAVE 3 CROSS OVERS.
9. REACH R1-16 TO HAVE 8 CROSS OVERS.

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WALTON COUNTY, FLORIDA

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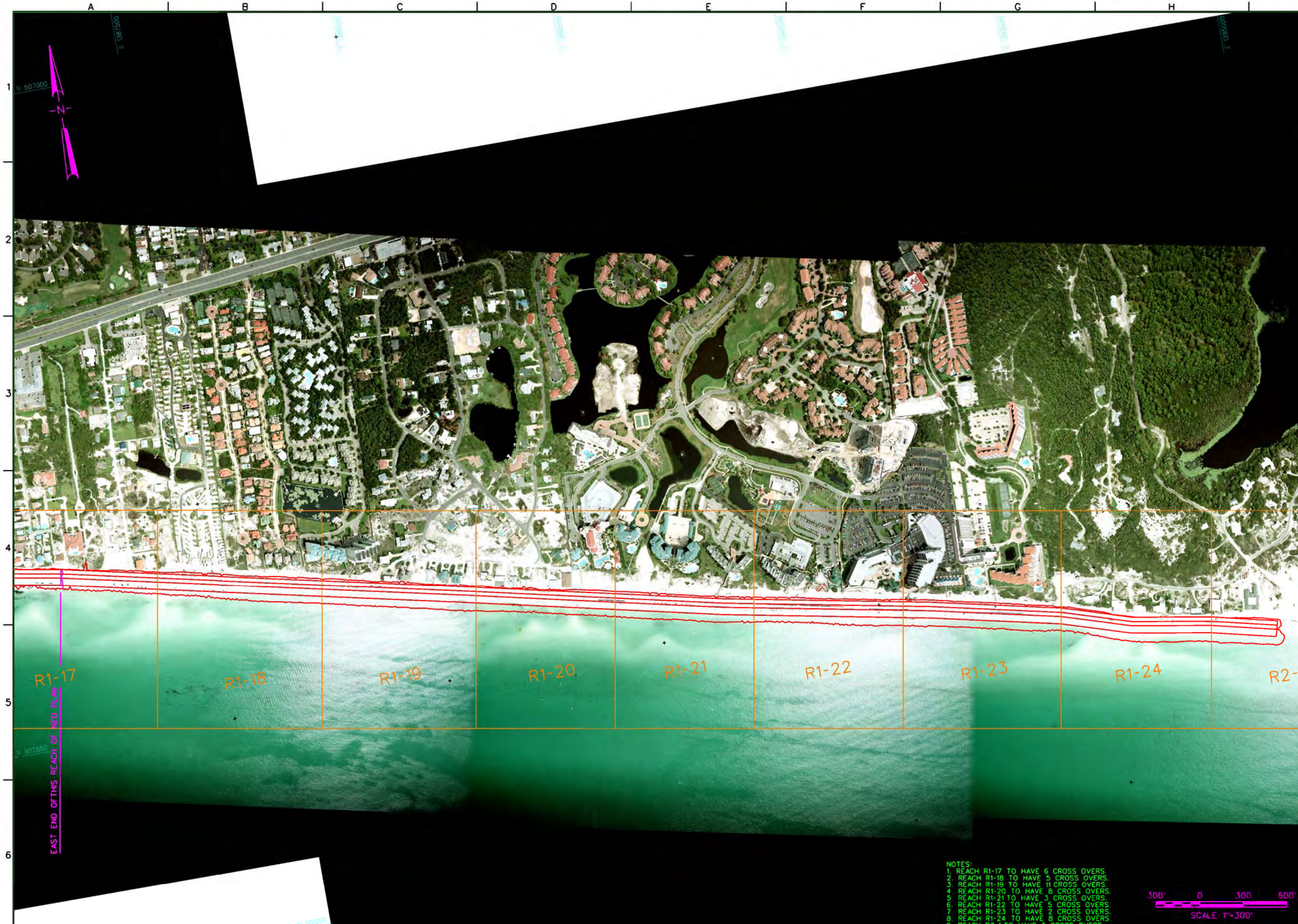

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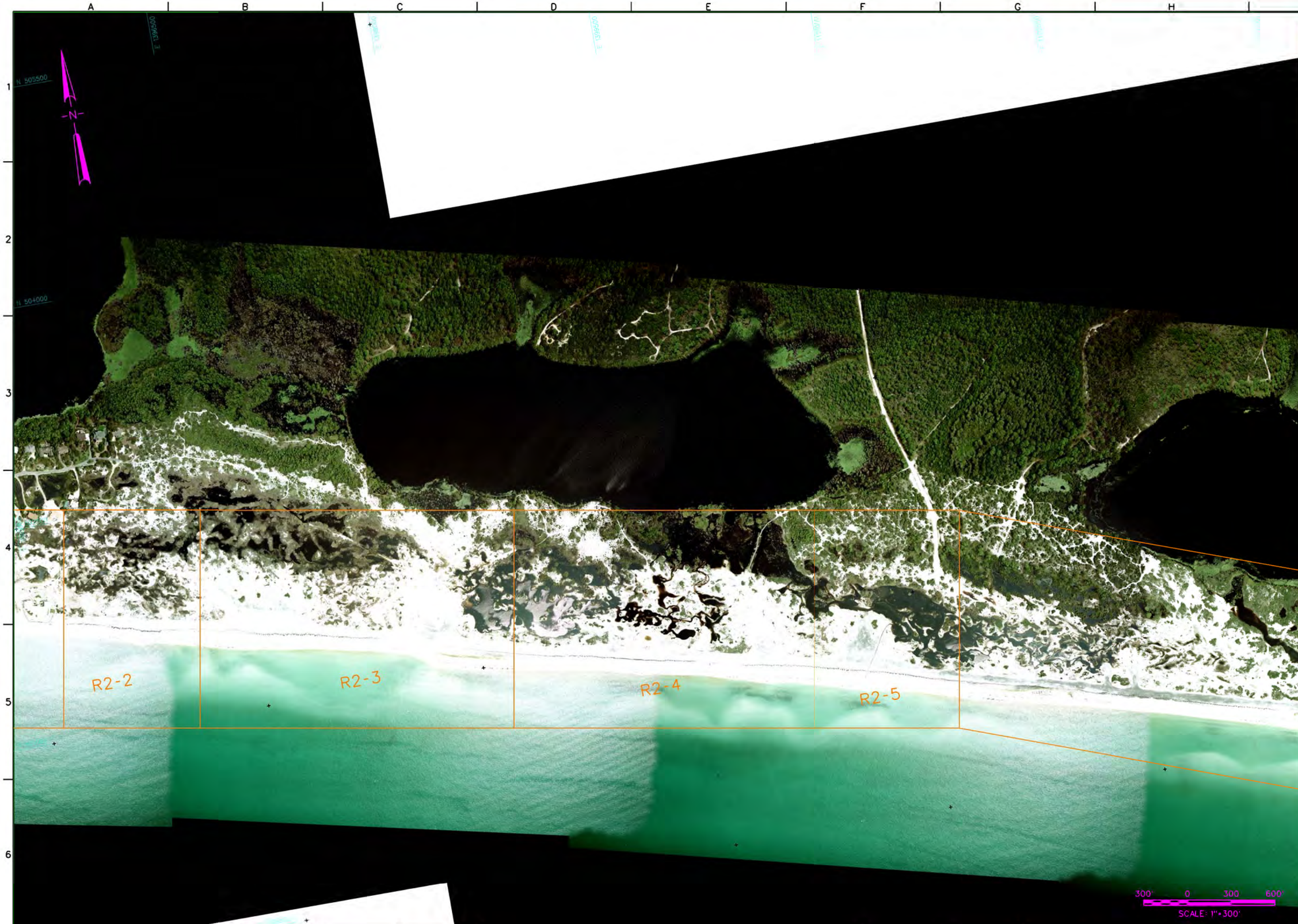

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F-105

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SCALE: 1"=300'

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SCALE 1"=300'

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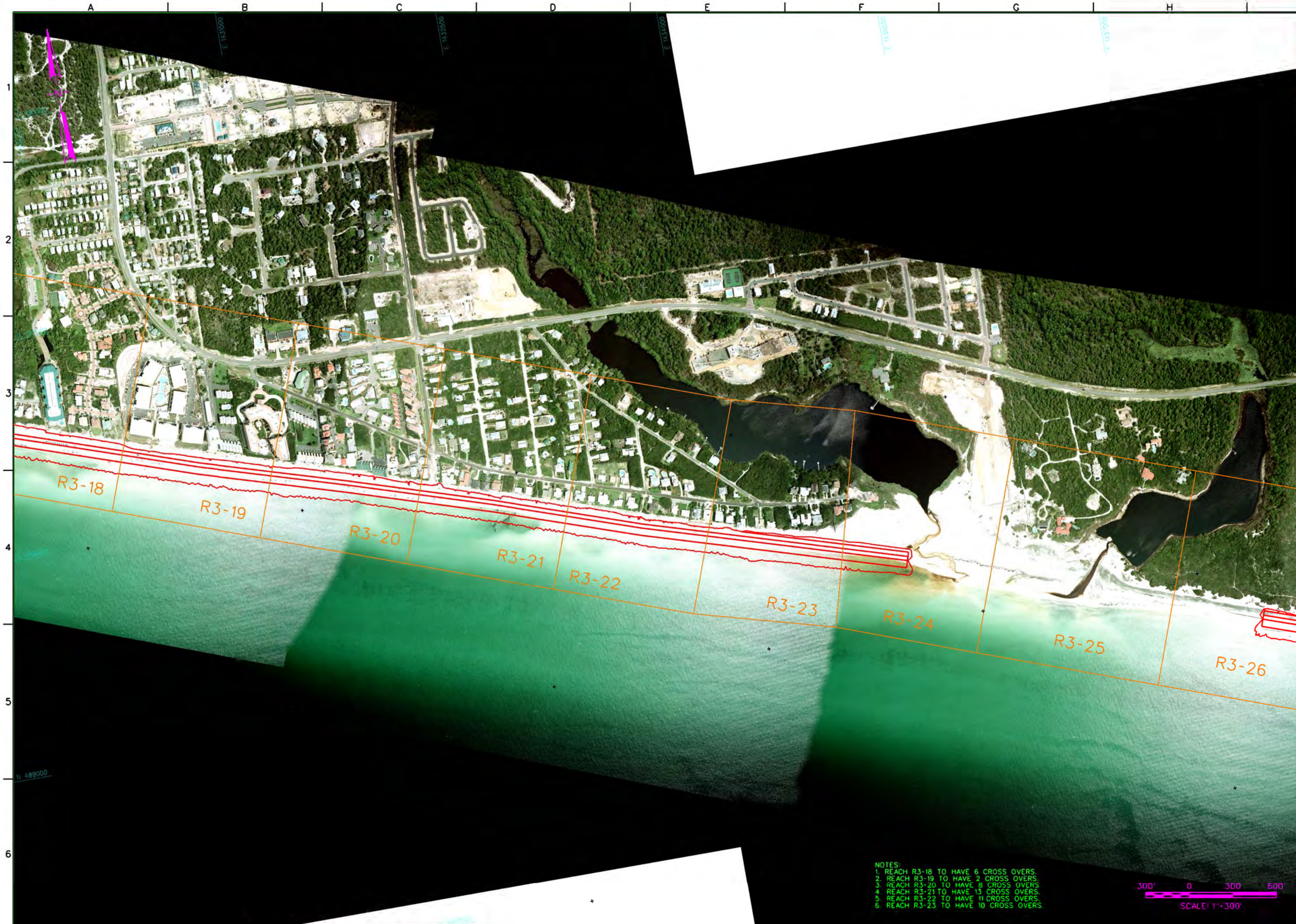

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WALTON COUNTY, FLORIDA

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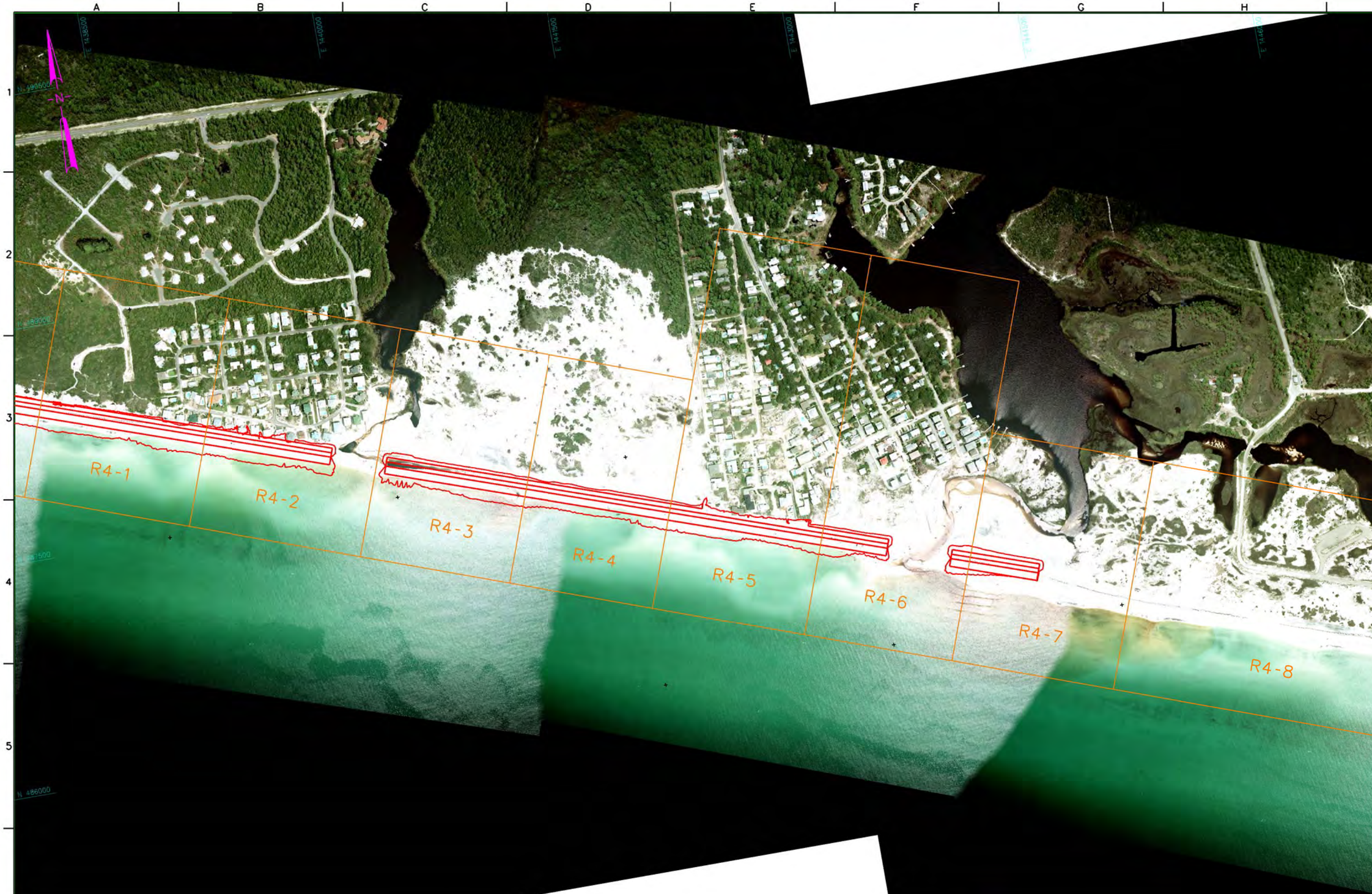

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6. REACH R4-6 TO HAVE 1 CROSS OVERS.

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SCALE: 1"=300'

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F-109

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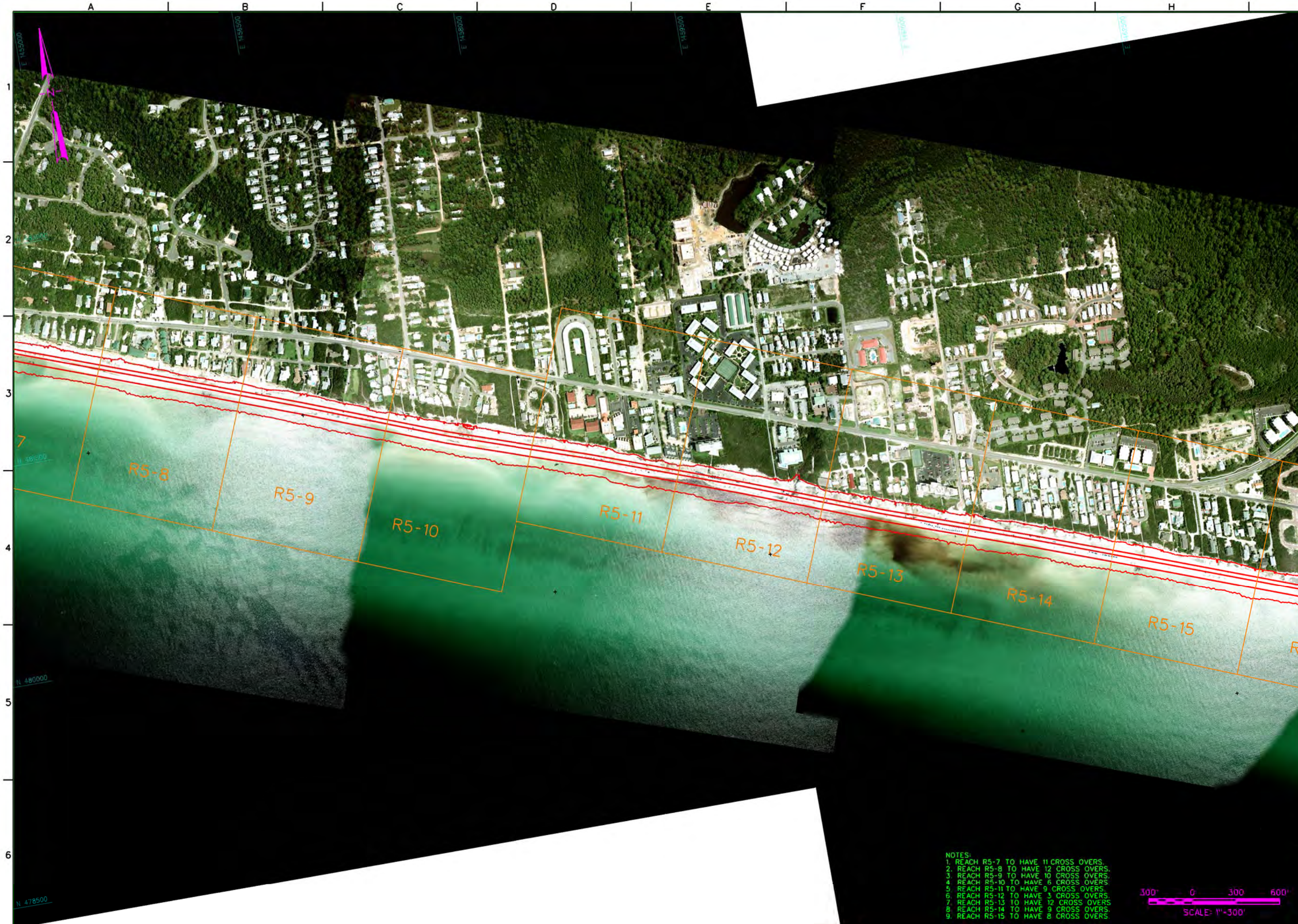

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WALTON COUNTY, FLORIDA
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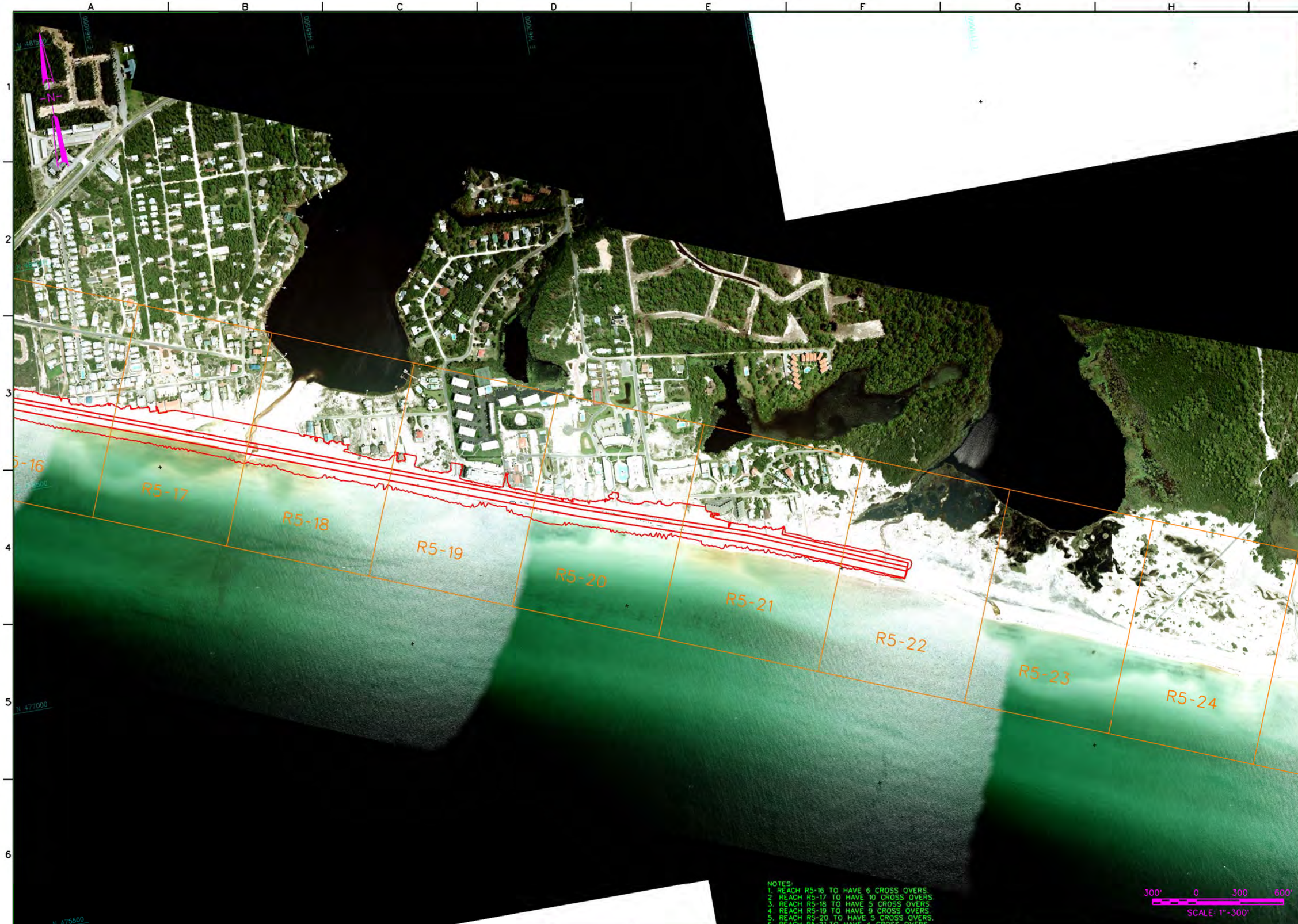

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U.S. ARMY ENGINEER DISTRICT
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MOBILE, ALABAMA

WALTON COUNTY, FLORIDA

SITE PLAN

Sheet Reference Number:
F-112

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SCALE: 1"=300'

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WALTON COUNTY, FLORIDA

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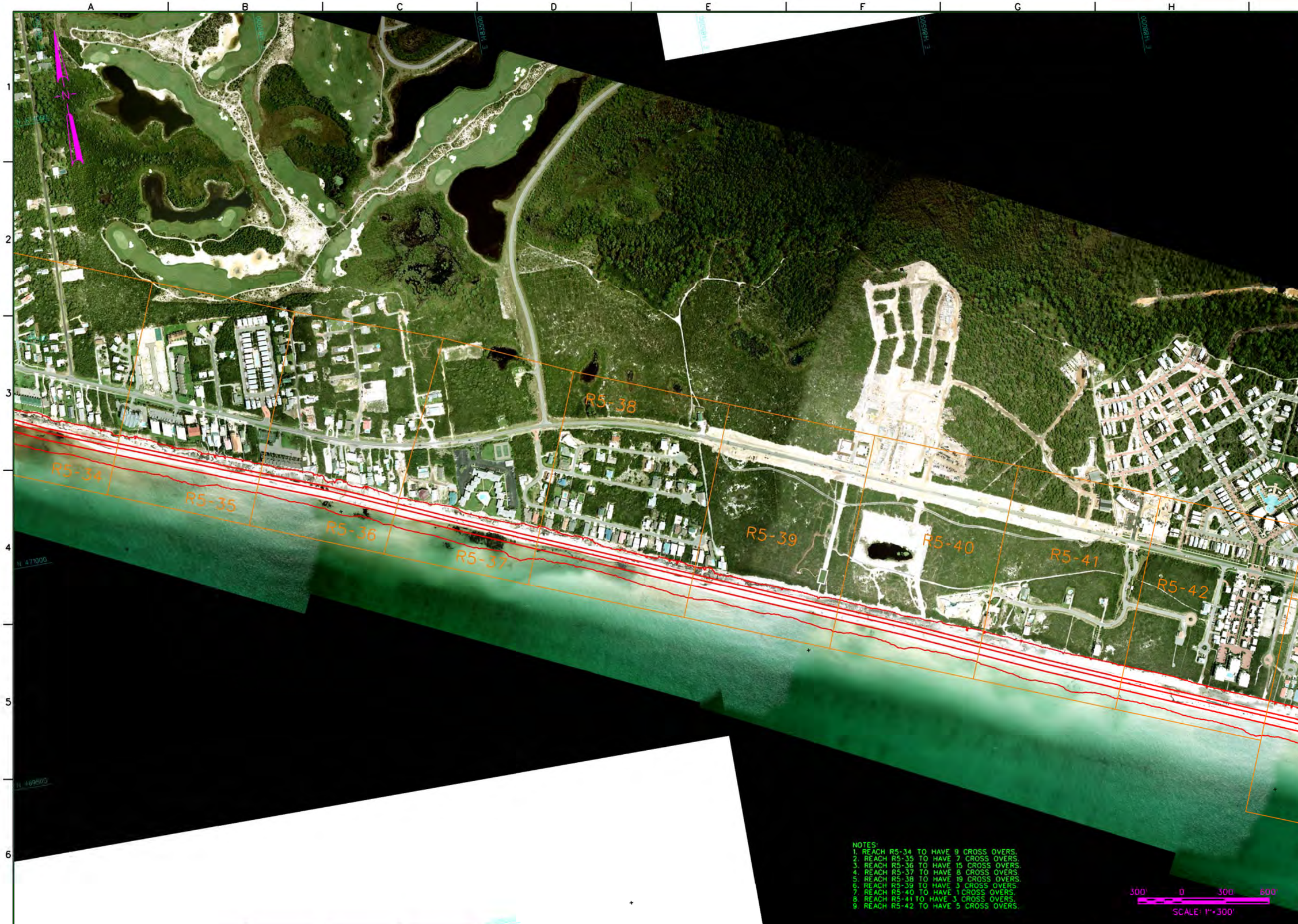

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File No. -
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U.S. ARMY ENGINEER DISTRICT
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MOBILE, ALABAMA

WALTON COUNTY, FLORIDA

SITE PLAN

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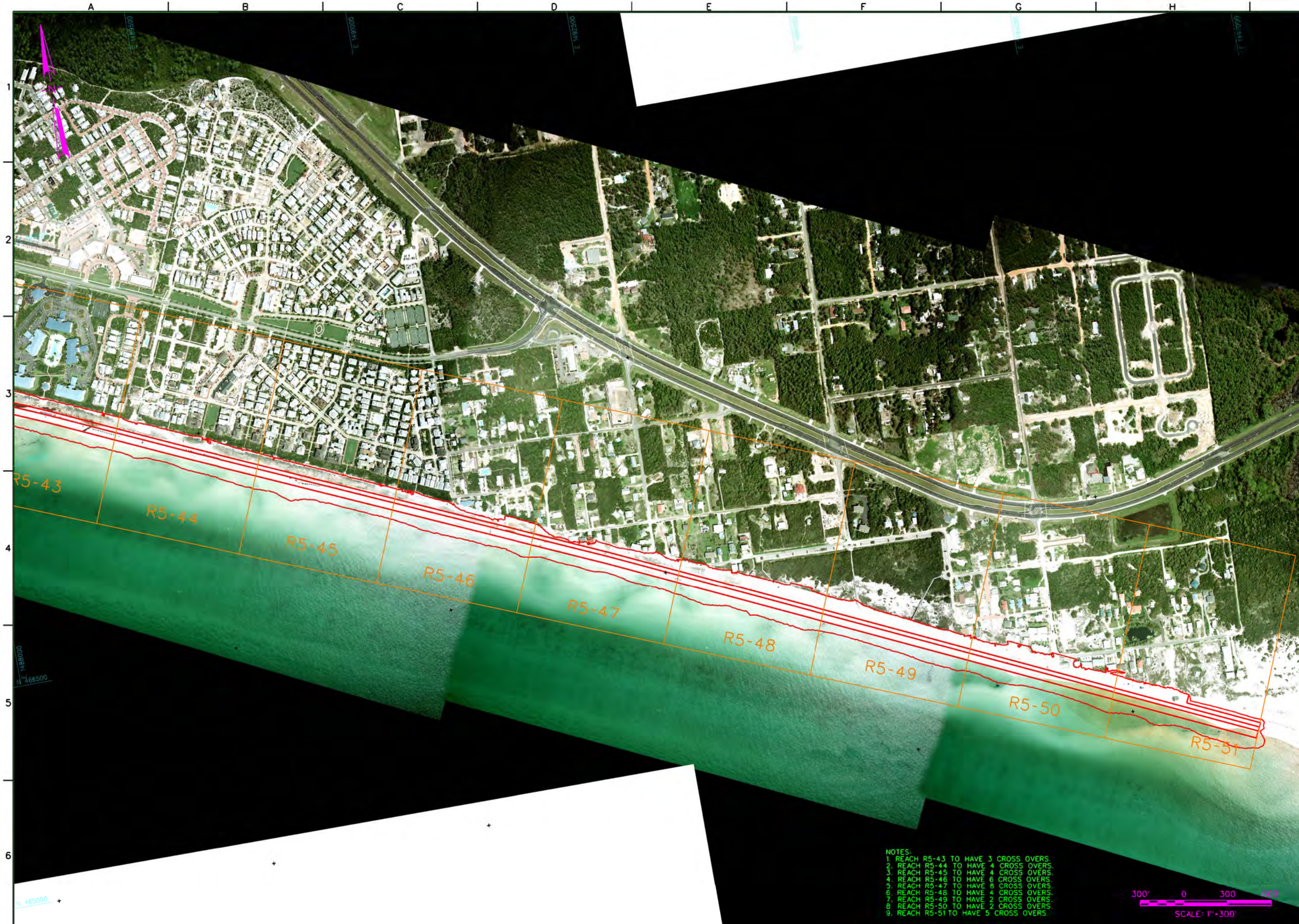

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F-115

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SCALE: 1"=300'

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Drawn By: S. TURNER
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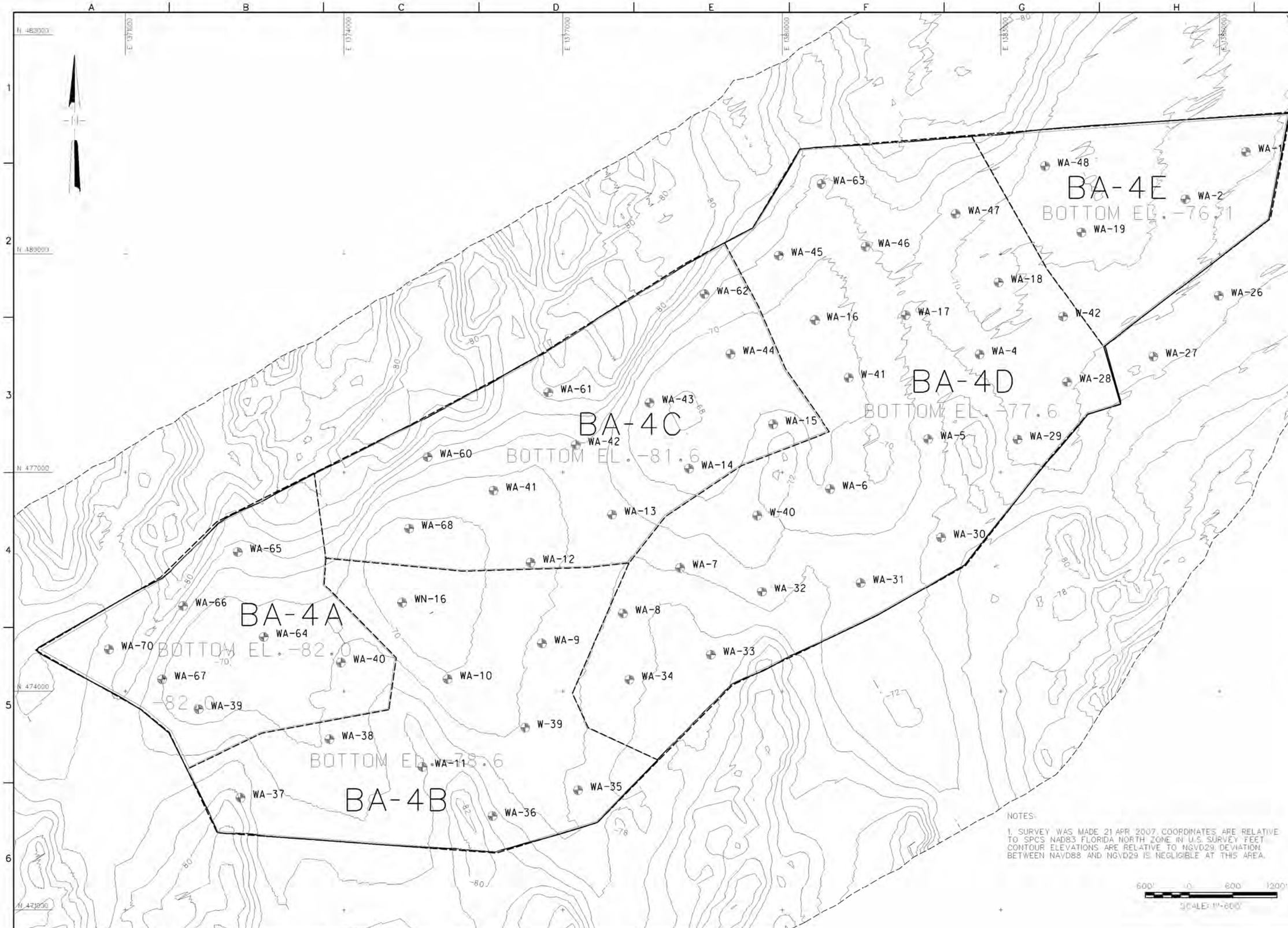
Checked By: M. MCKOWN
I.S.O. Sheet File Name: F-116.DGN
Reviewed By: E. HERMAN
Solicitation Number:

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA

SITE PLAN

Sheet Reference Number:
F-116



NOTES:

1. SURVEY WAS MADE 21 APR 2007. COORDINATES ARE RELATIVE TO SPCS NAD83 FLORIDA NORTH ZONE IN U.S. SURVEY FEET. CONTOUR ELEVATIONS ARE RELATIVE TO NGVD29. DEVIATION BETWEEN NAVD88 AND NGVD29 IS NEGLIGIBLE AT THIS AREA.

600' 0 600 1200'
SCALE: 1"=600'

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

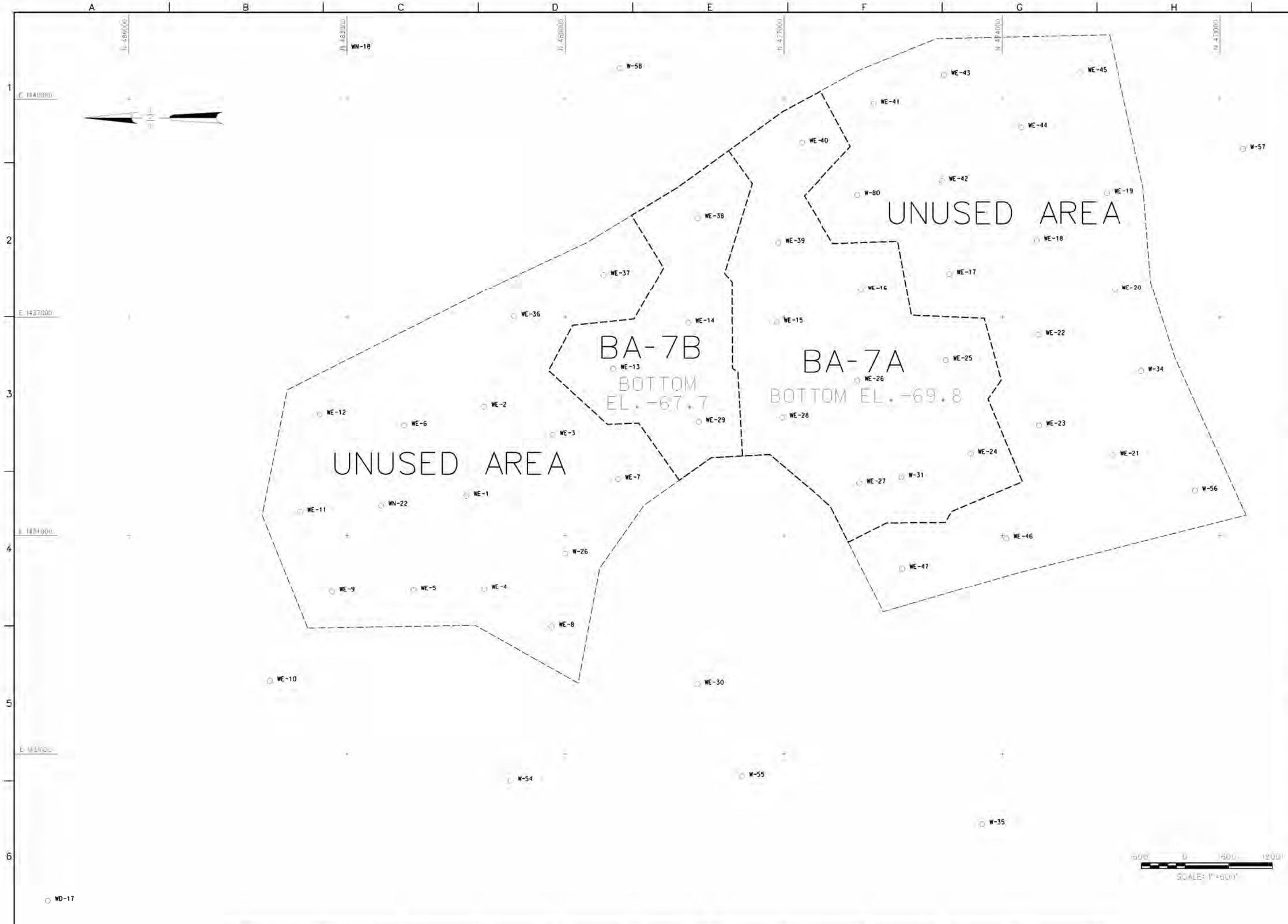
Designed By: -
Drawn By: R. NETTLES
Checked By: -
Reviewed By: -
Date: FEB 2012
File No.: -
I.S.O. Sheet File Name: F-117.DGN
Solicitation Number: -

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA

PROPOSED BORROW AREA BA-4

Sheet Reference Number:
F-117



US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

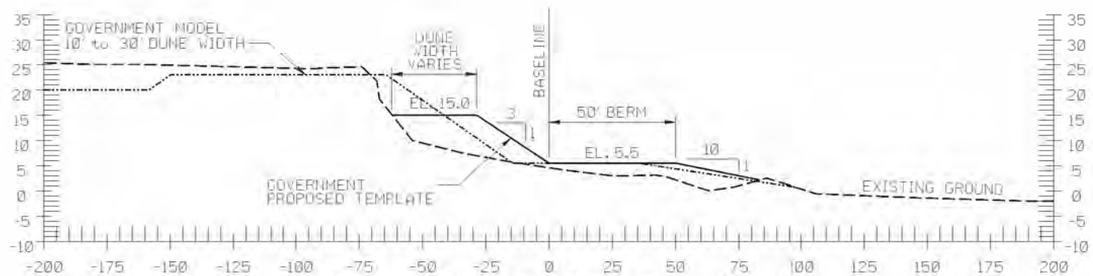
Designed By: -
Date: FEB -2012
Drawn By: R. NETTLES
File No: -
Checked By: -
I.S.O. Sheet File Name: F-118.DGN
Reviewed By: -
Solicitation Number: -

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

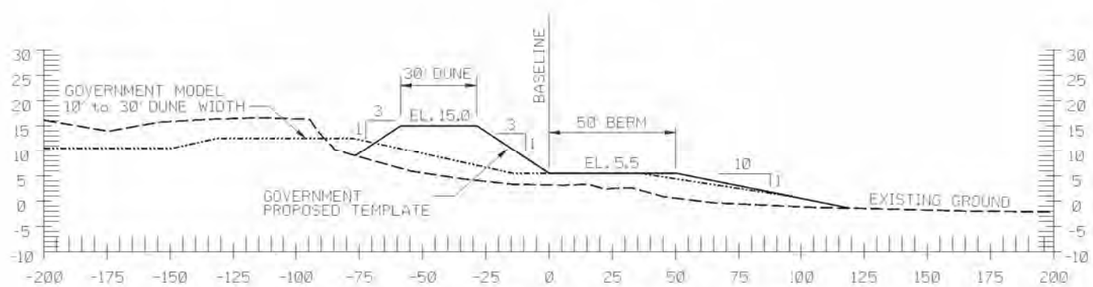
WALTON COUNTY, FLORIDA

PROPOSED BORROW AREA BA-7

Sheet Reference Number:
F-118



TYPICAL SECTION "A"



TYPICAL SECTION "B"

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

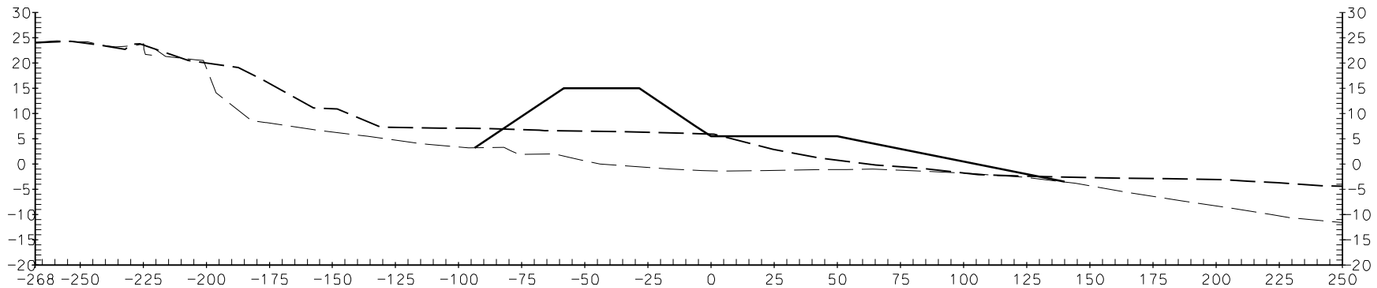
Designed By: M. MCKOWN
Drawn By: S. TURNER
Checked By: M. MCKOWN
Reviewed By: E. HERMAN
Date: -
File No. -
(S.O. Sheet File Name F-300.DGN)
Solicitation Number: -

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

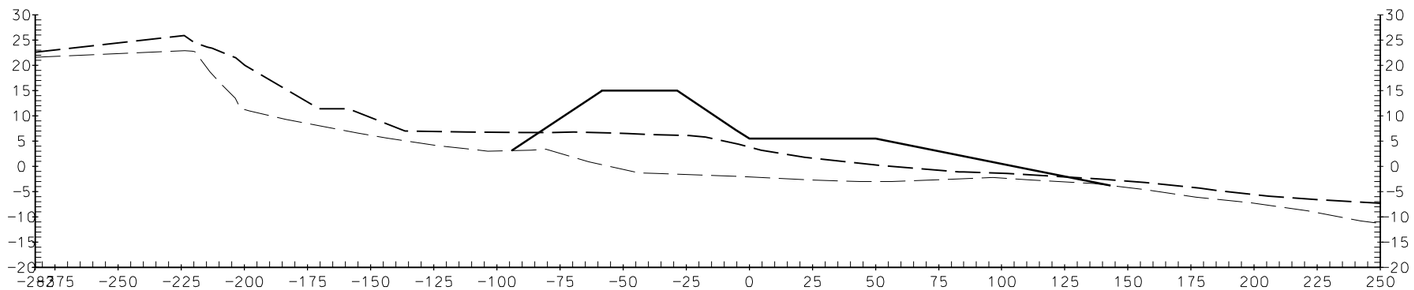
WALTON COUNTY, FLORIDA

TYPICAL SECTIONS

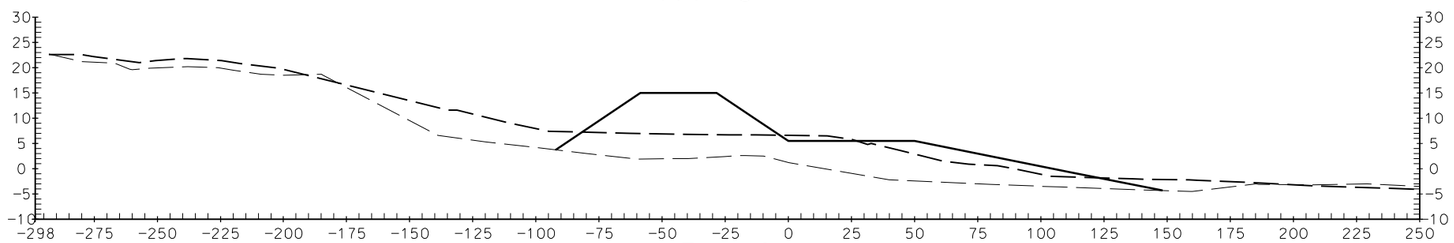
Sheet Reference Number:
F-300



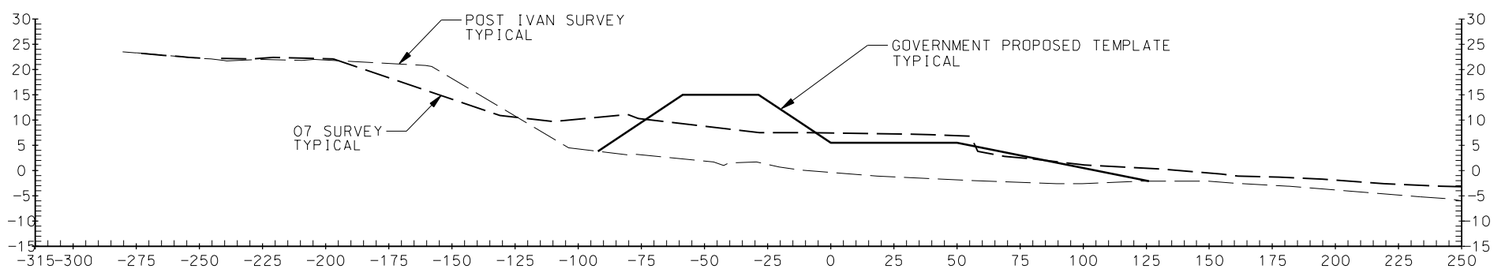
R1-4



R1-3



R1-2



R1-1

US Army Corps of Engineers
Mobile District

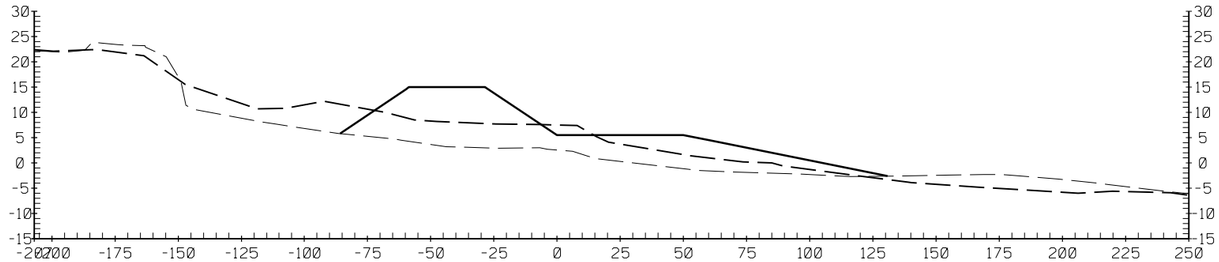
Symbol	Description	Date	Approved

Designed By: M. MCKOWN
Drawn By: S. TURNER
Checked By: M. MCKOWN
Reviewed By: E. HERMAN
Date: -
File No. -
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Solicitation Number: -

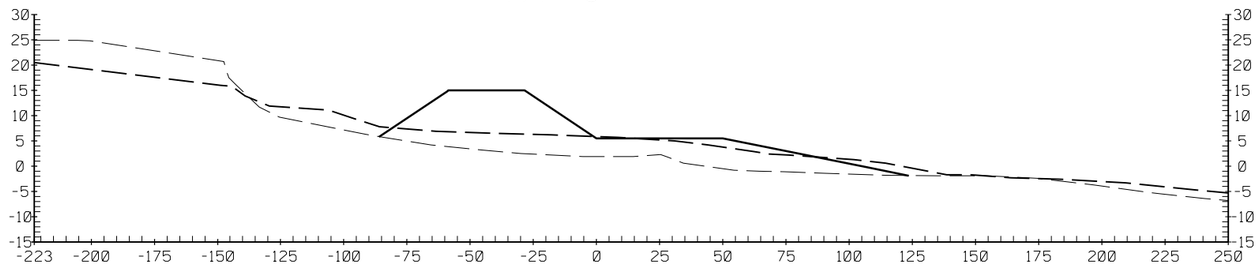
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
-
CROSS SECTIONS
-

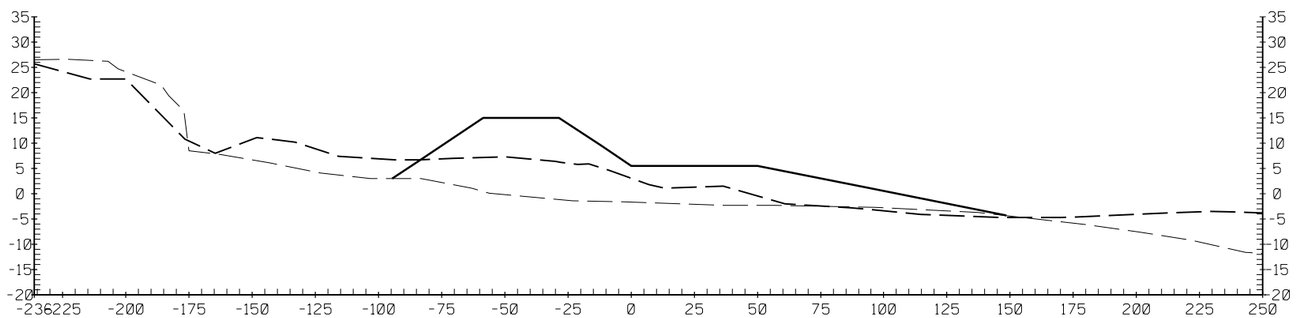
Sheet Reference Number:
F-301



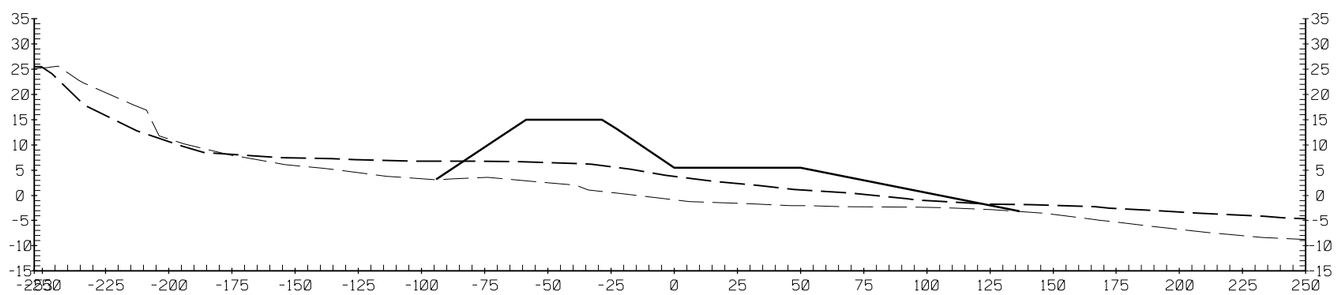
R1-8



R1-7



R1-6



R1-5

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved
	Description		

Designed By: M. MCKOWN
Drawn By: S. TURNER
Checked By: M. MCKOWN
Reviewed By: E. HERMAN
Date: -
File No.: -
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Solicitation Number: -

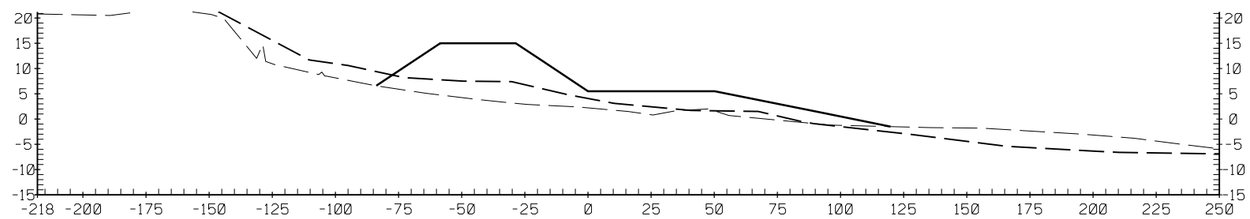
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
-
-

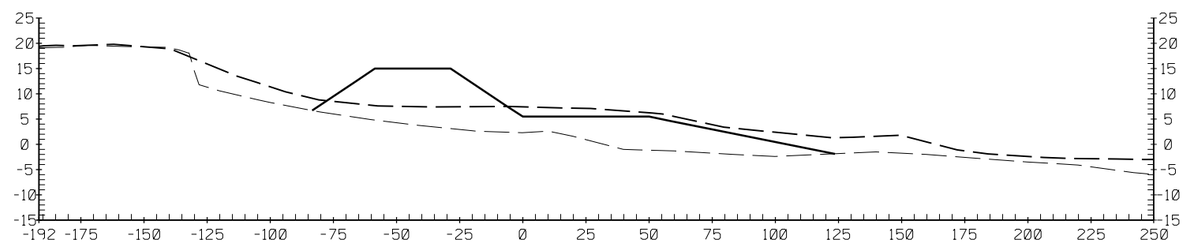
CROSS SECTIONS

-

Sheet Reference Number:
F-302



R1-10



R1-9

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

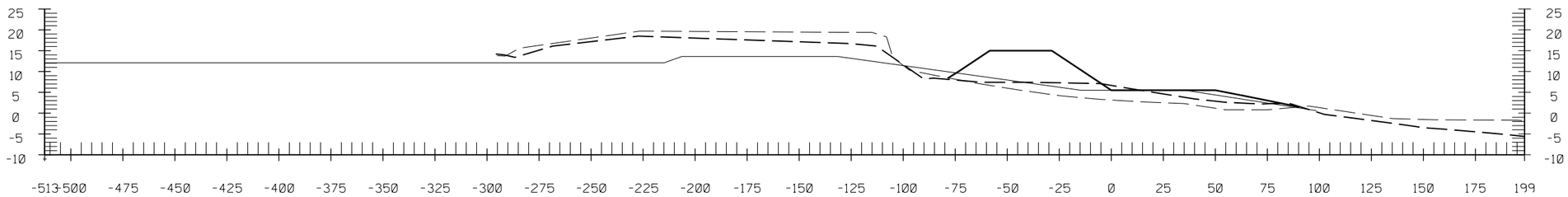
Description

Designed By: M. MCKOWN
Date: -
Drawn By: S. TURNER
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

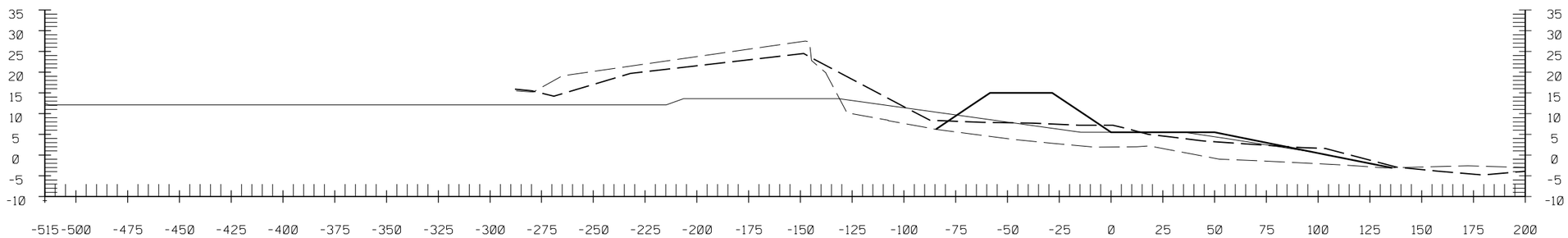
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -
CROSS SECTIONS
-

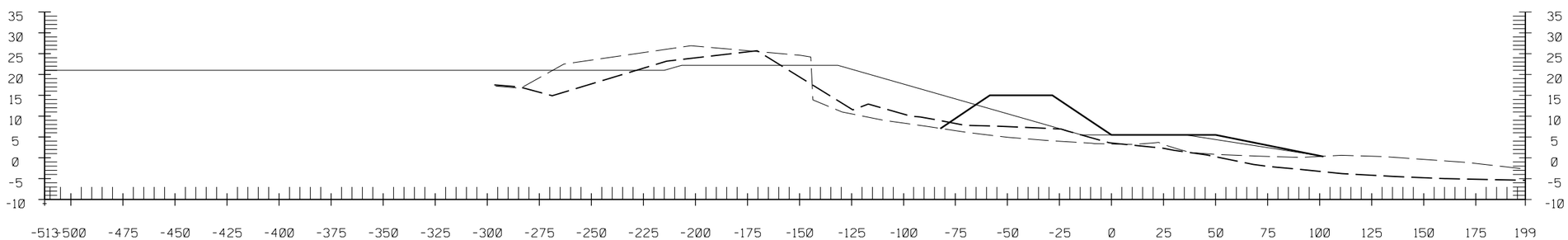
Sheet Reference Number:
F-303



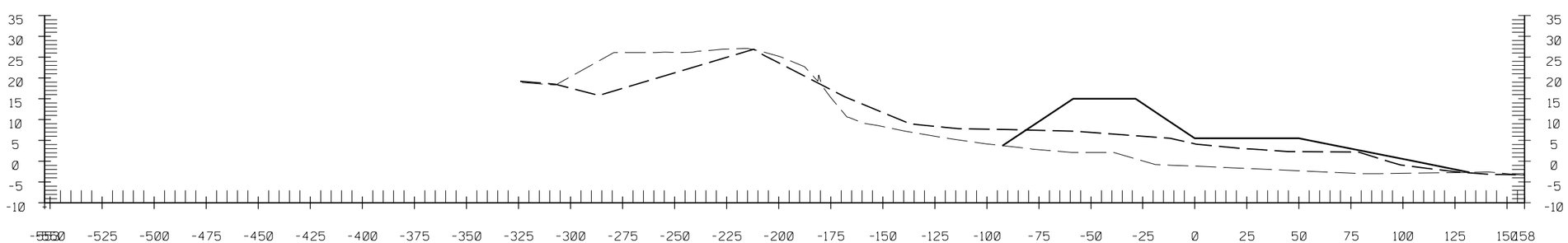
RI-14



R1-13



R1-12



R1-11

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

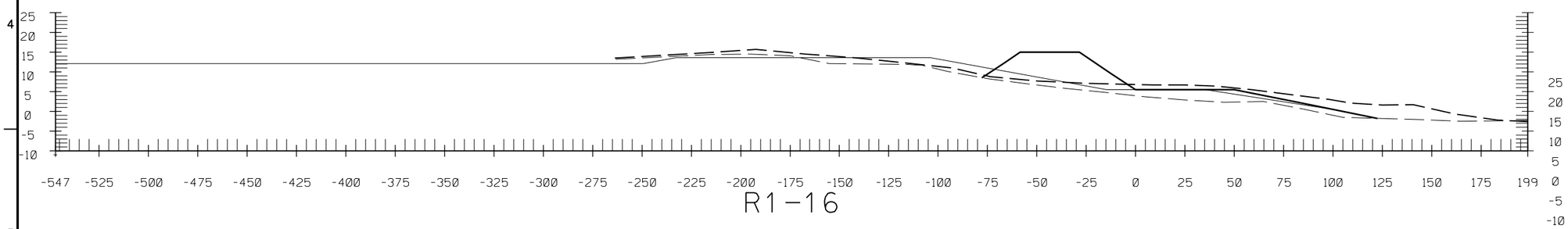
Description

Designed By: M. MCKOWN
Date: -
Drawn By: S. TURNER
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

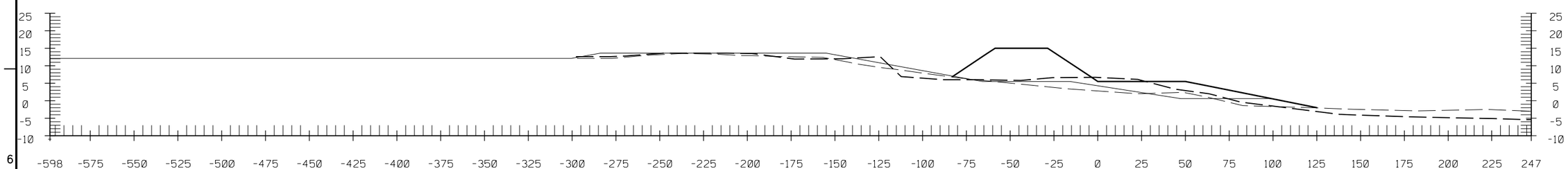
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -
CROSS SECTIONS
-

Sheet Reference Number:
F-304



R1-16



R1-15

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

Description

Designed By: M. MCKOWN
Date: -
Drawn By: S. TURNER
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

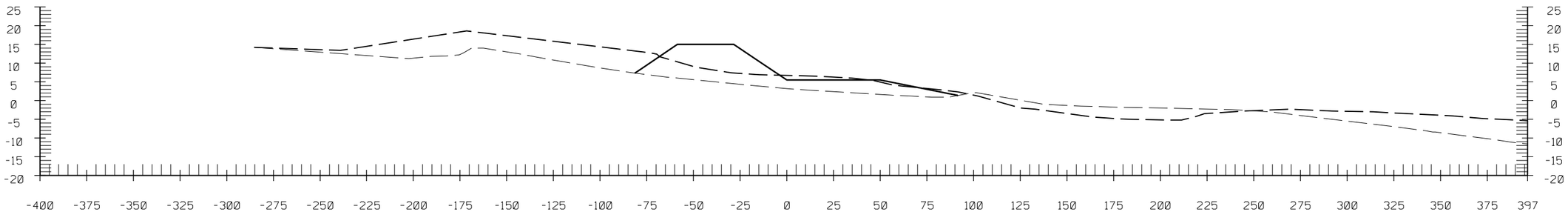
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -

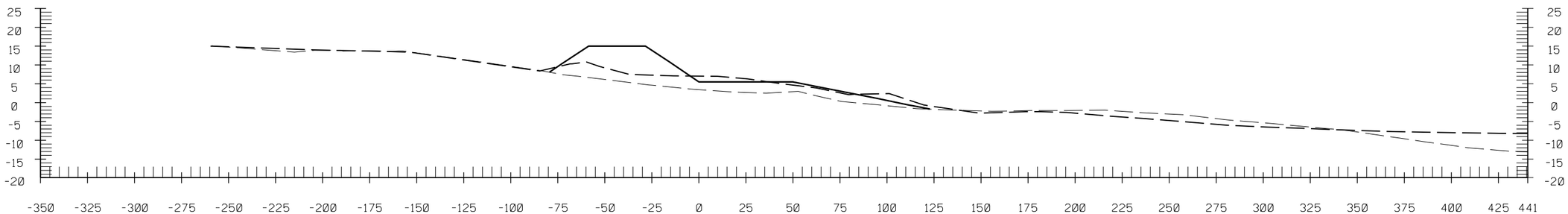
CROSS SECTIONS

-

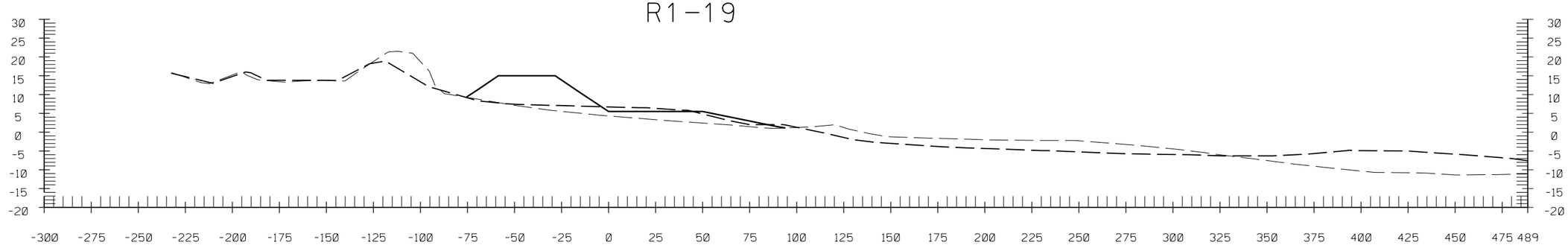
Sheet Reference Number:
F-305



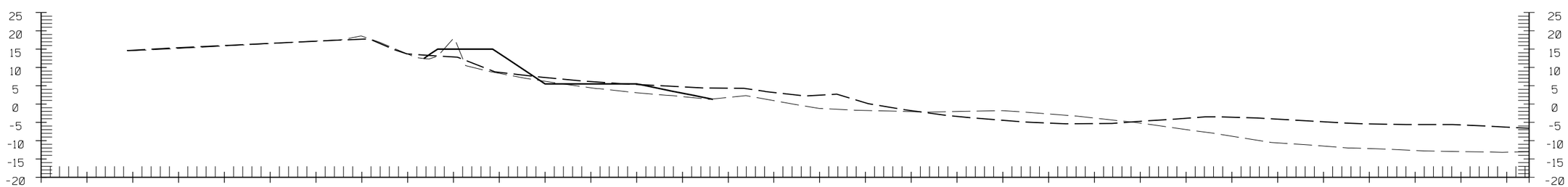
R1-20



R1-19



R1-18



R1-17

US Army Corps of Engineers
Mobile District

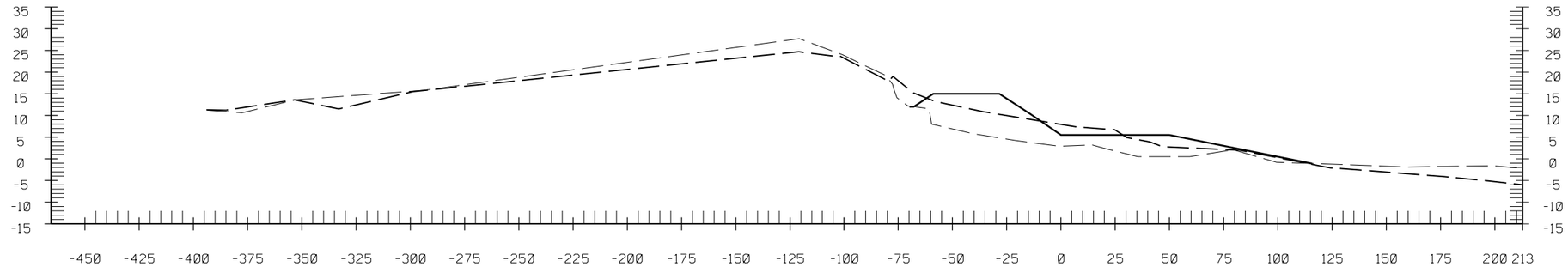
Symbol	Description	Date	Approved
	Description		

Designed By: M. MCKOWN
Date: -
Drawn By: S. TURNER
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x340_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

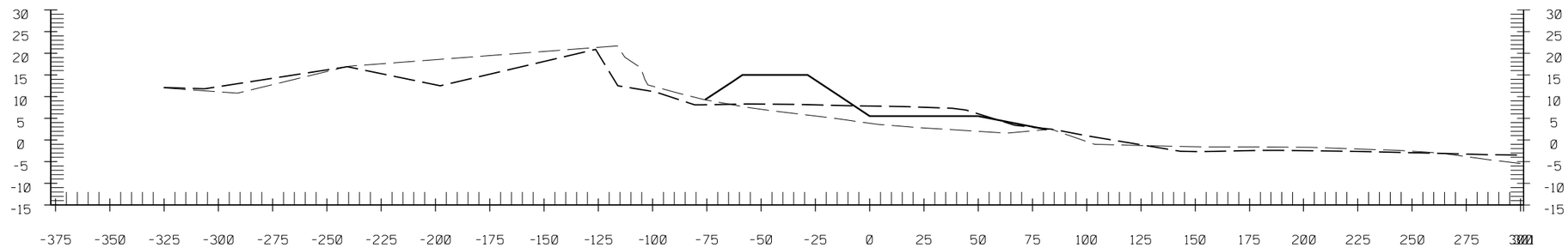
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -
CROSS SECTIONS
-

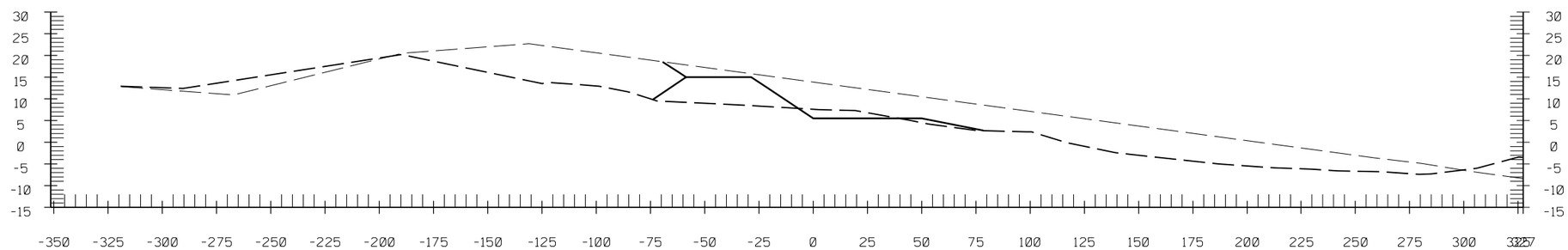
Sheet Reference Number:
F-306



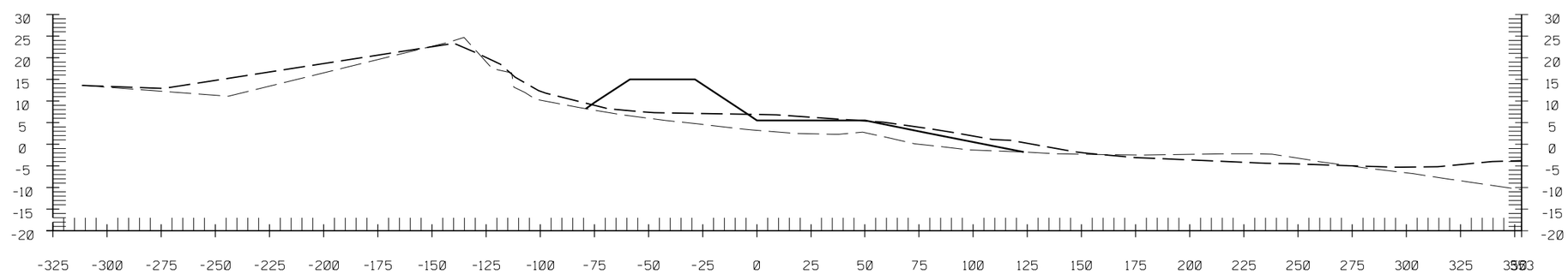
R1-24



R1-23



R1-22



R1-21

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

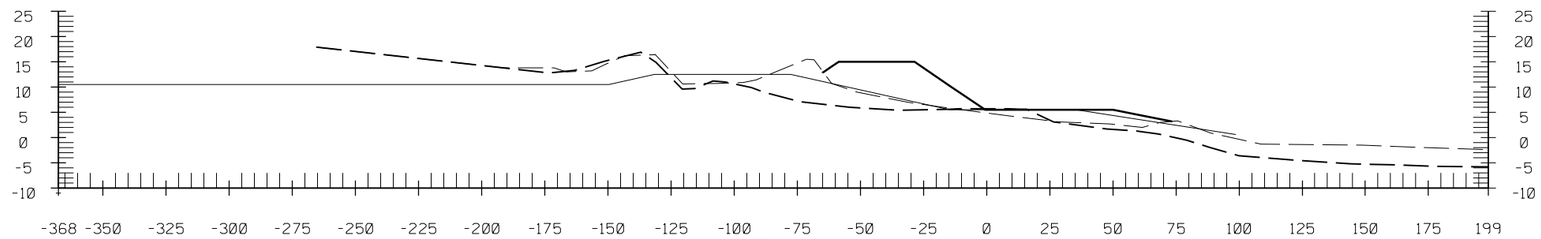
Description

Designed By: M. MCKOWN
Date: -
Drawn By: S. TURNER
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

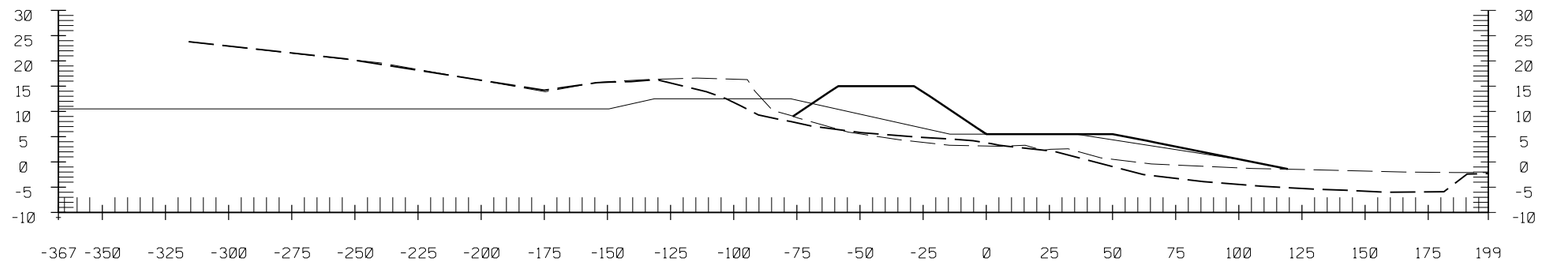
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -
CROSS SECTIONS
-

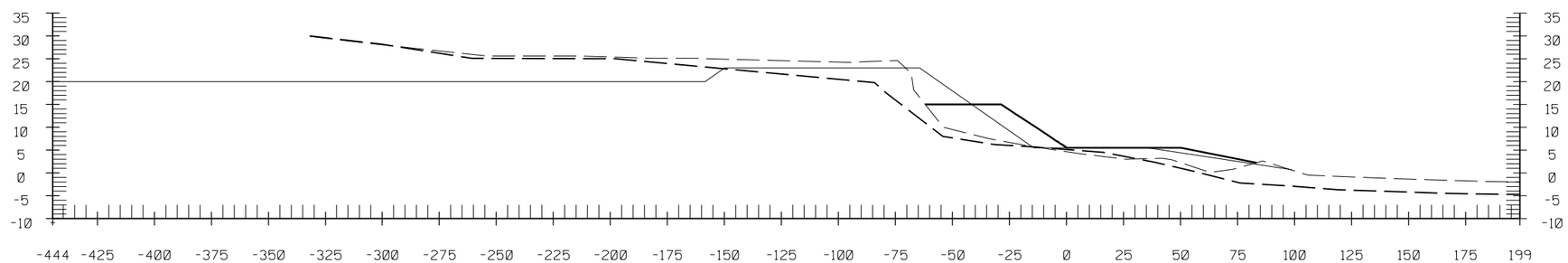
Sheet Reference Number:
F-307



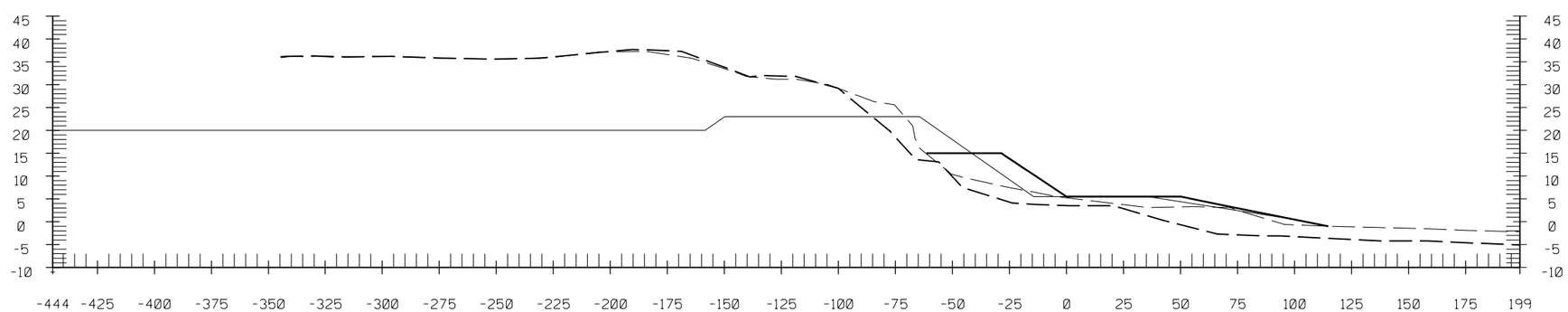
R3-5



R3-4



R3-3



R3-2

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

Description

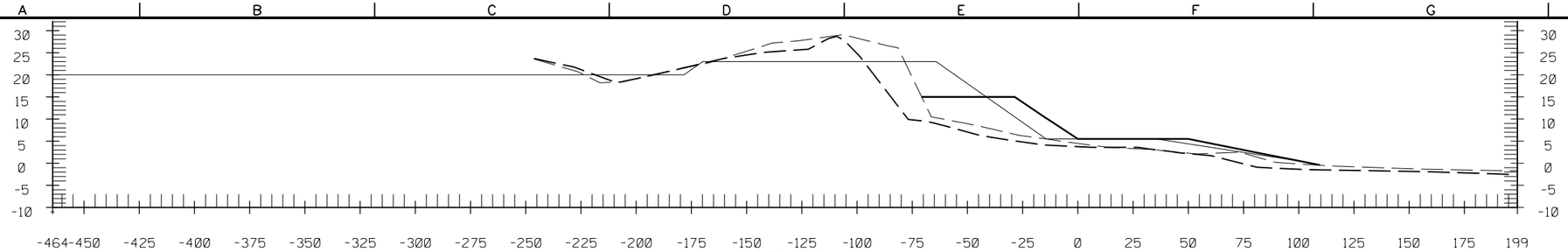
Designed By: M. MCKOWN
Date: -
Drawn By: S. TURNER
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

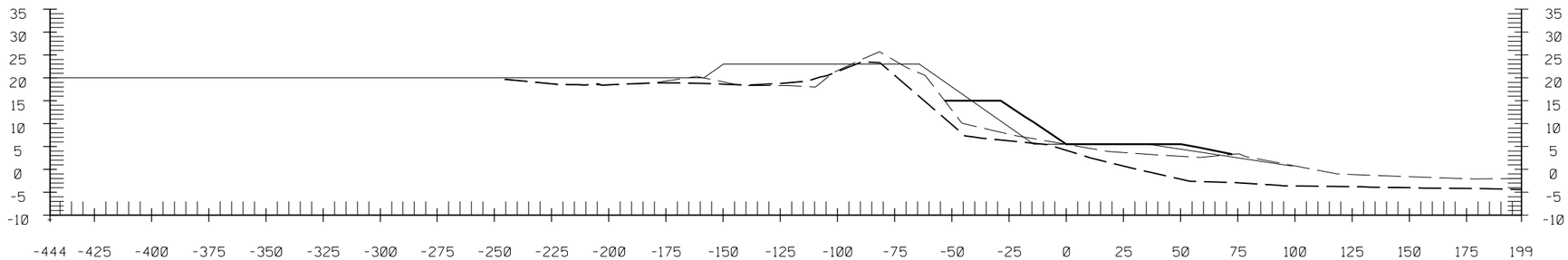
WALTON COUNTY, FLORIDA
-
-

CROSS SECTIONS
AREA 2
-

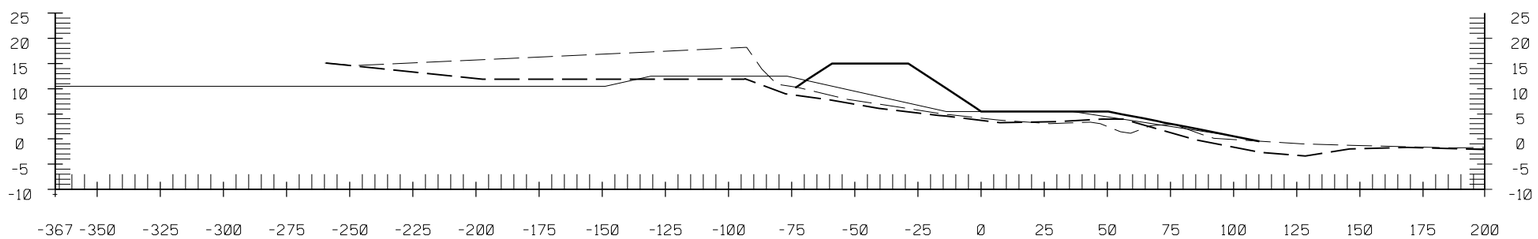
Sheet Reference Number:
F-308



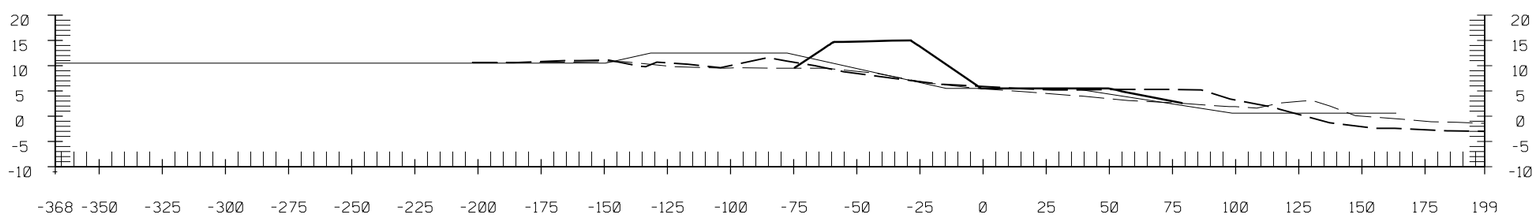
R3-9



R3-8



R3-7



R3-6

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

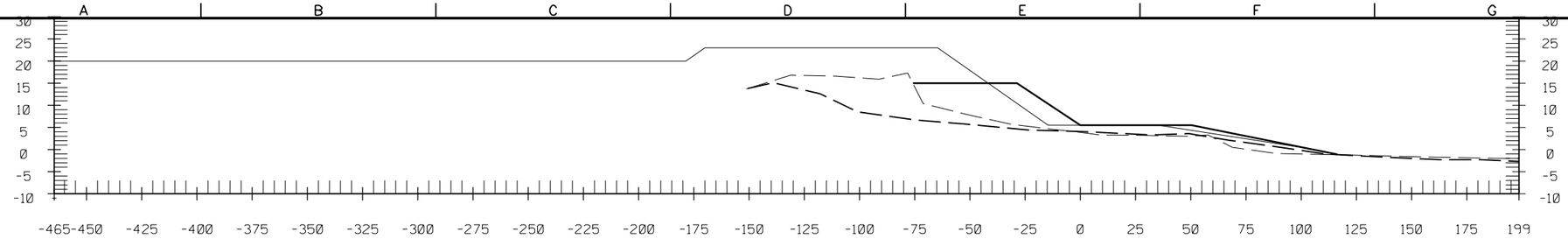
Description

Designed By: M. MCKOWN
Date: -
Drawn By: S. TURNER
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

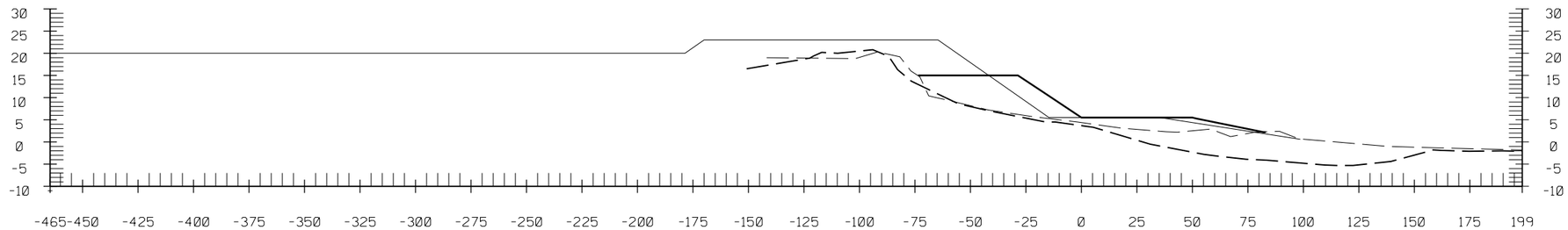
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -
CROSS SECTIONS
-

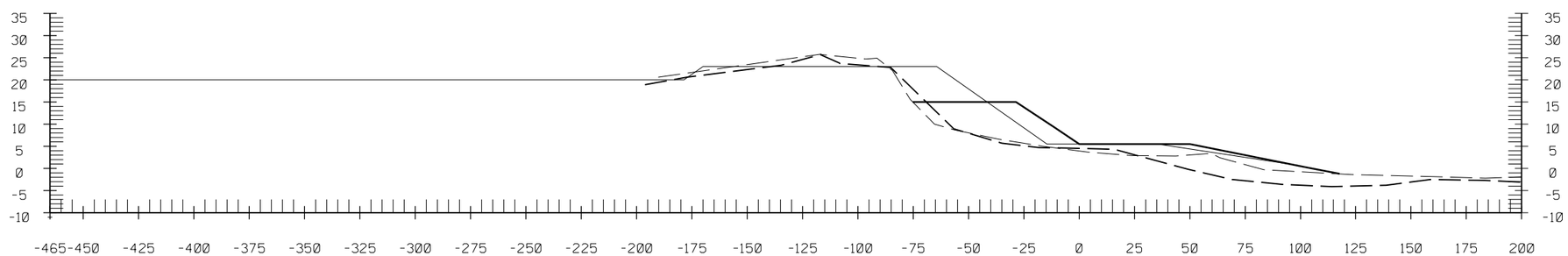
Sheet Reference Number:
F-309



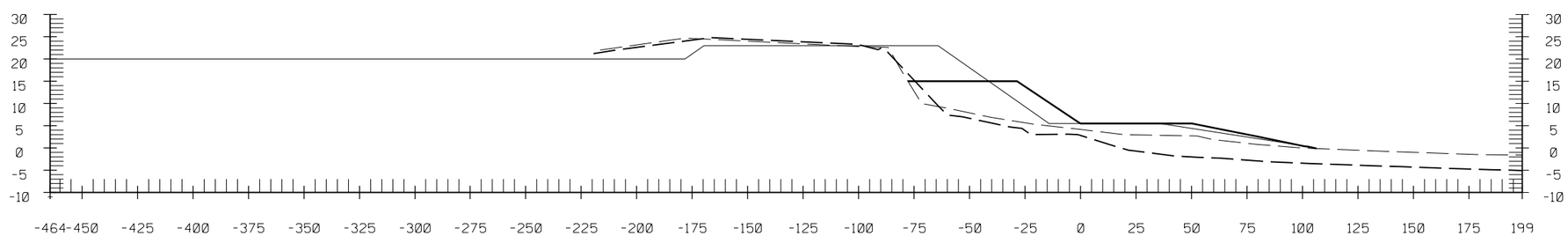
R3-13



R3-12



R3-11



R3-10

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

Description

Designed By: M. MCKOWN
Date: -
Drawn By: S. TURNER
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

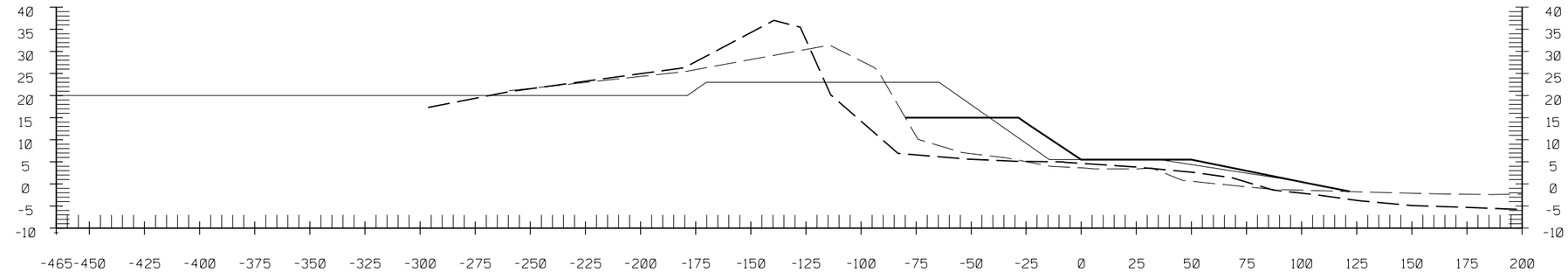
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
-
-

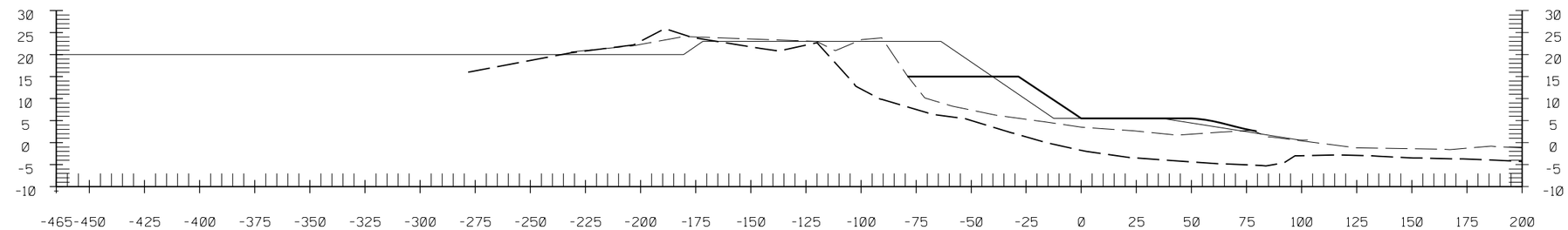
CROSS SECTIONS

-

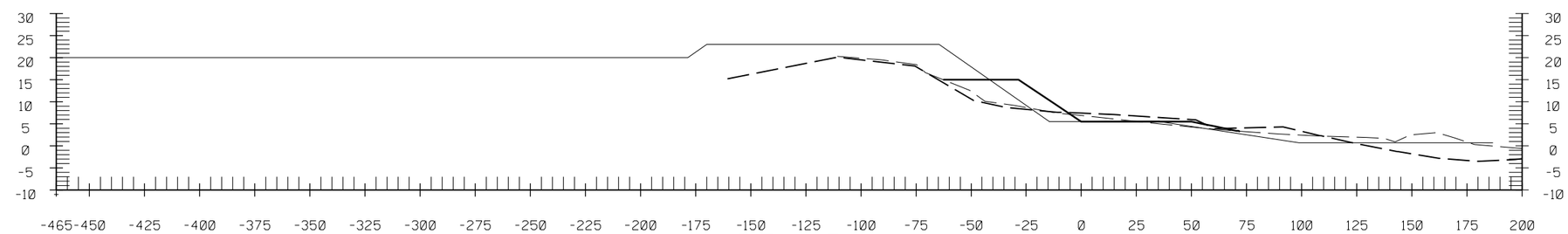
Sheet Reference Number:
F-310



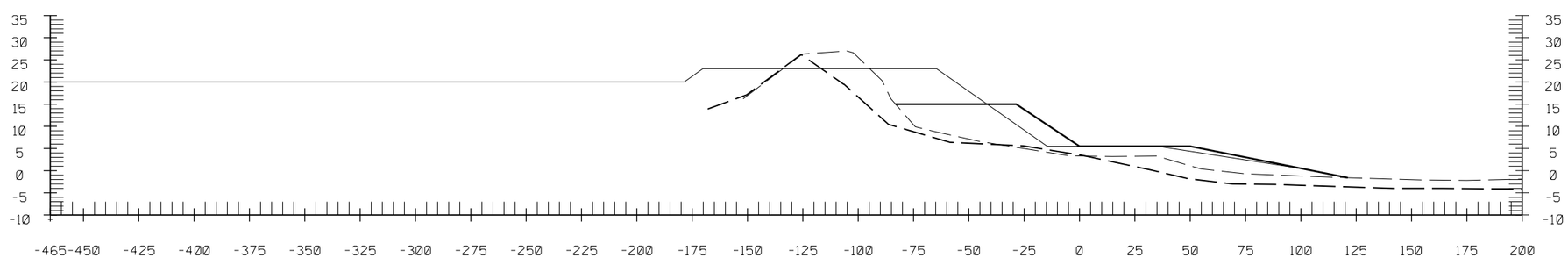
R3-17



R3-16



R3-15



R3-14

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

Description

Designed By: M. MCKOWN
Date: -
Drawn By: S. TURNER
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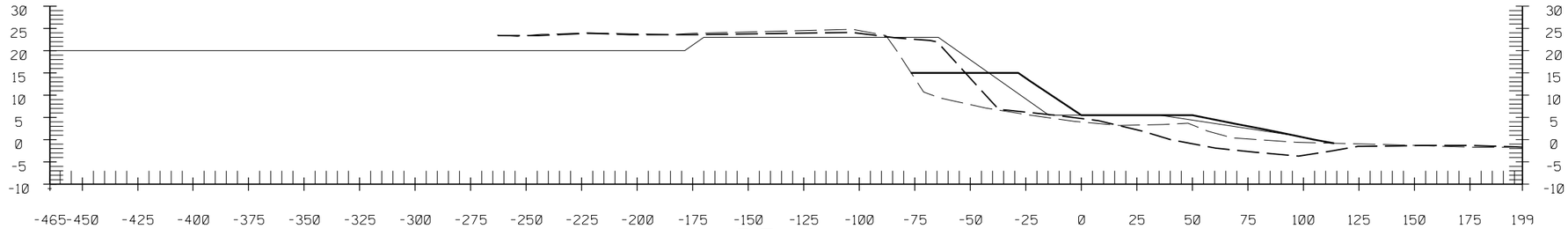
I.S.O. Sheet File Name: 22x340_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

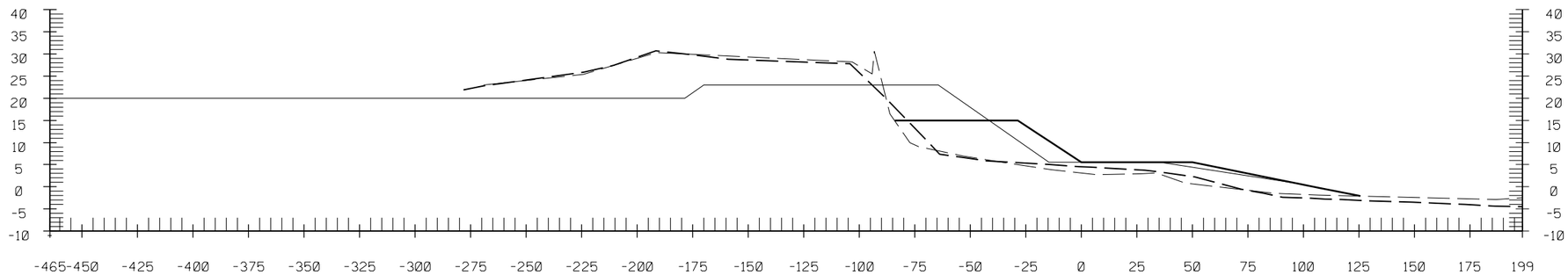
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -
CROSS SECTIONS
- -

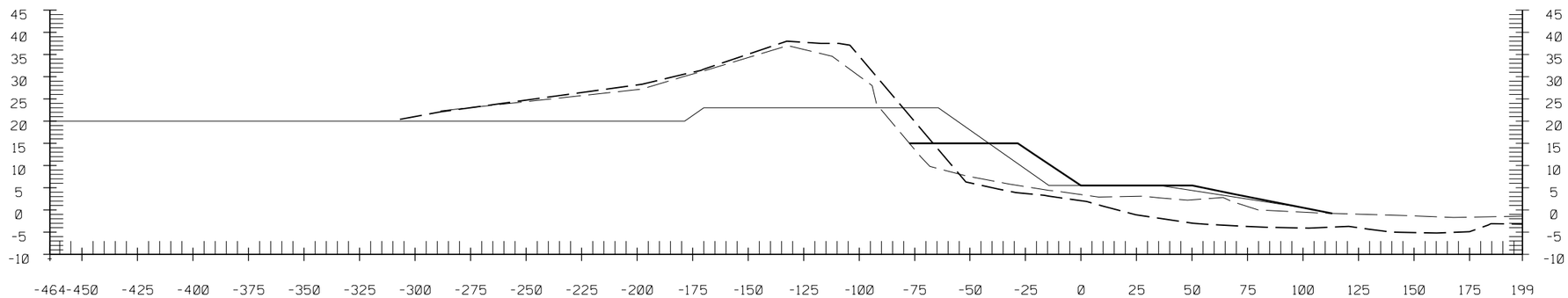
Sheet Reference Number:
F-311



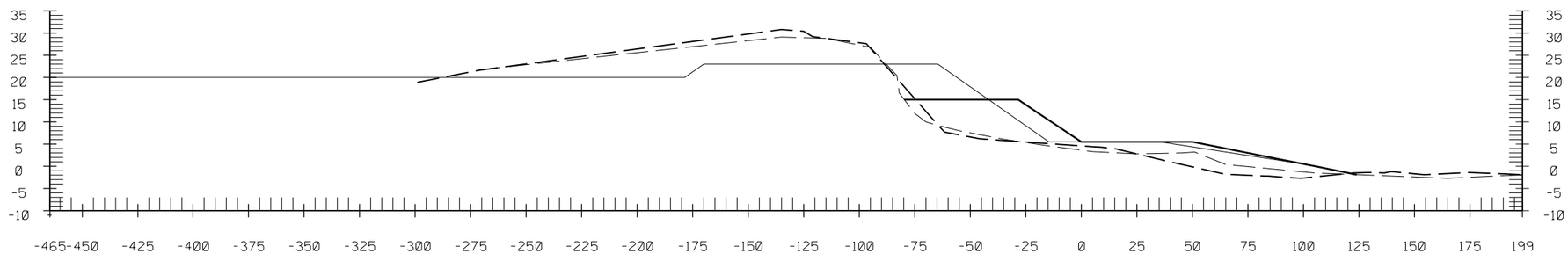
R3-21



R3-20



R3-19



R3-18

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved
	Description		

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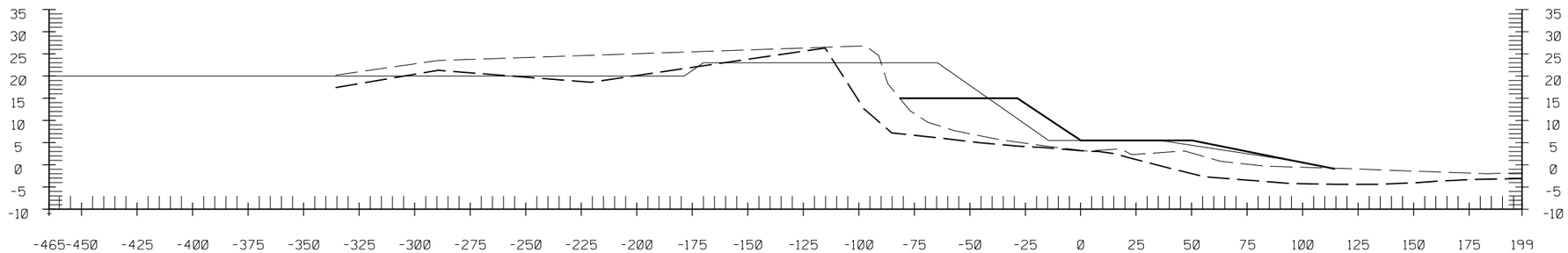
Date: -
Drawn By: S. TURNER
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x346_fp_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

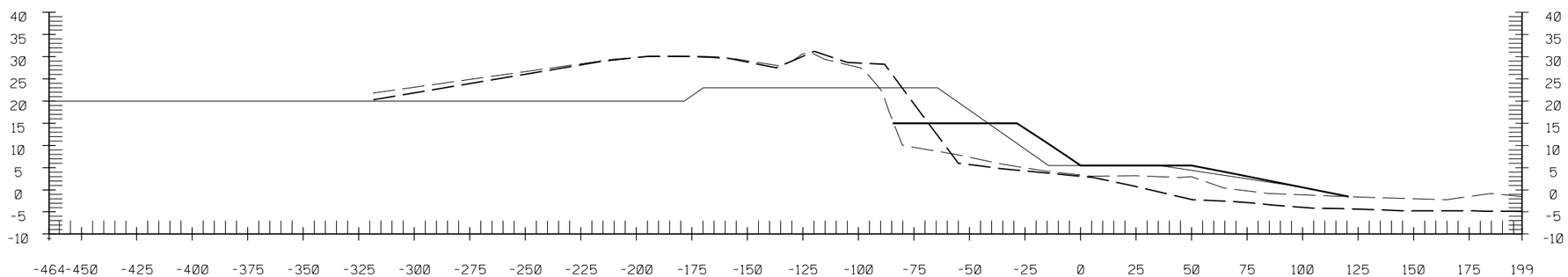
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -
CROSS SECTION
- -

Sheet Reference Number:
F-312



R3-23



R3-22

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved
	Description		

Designed By: M. MCKOWN
Date: -
Drawn By: S. TURNER
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

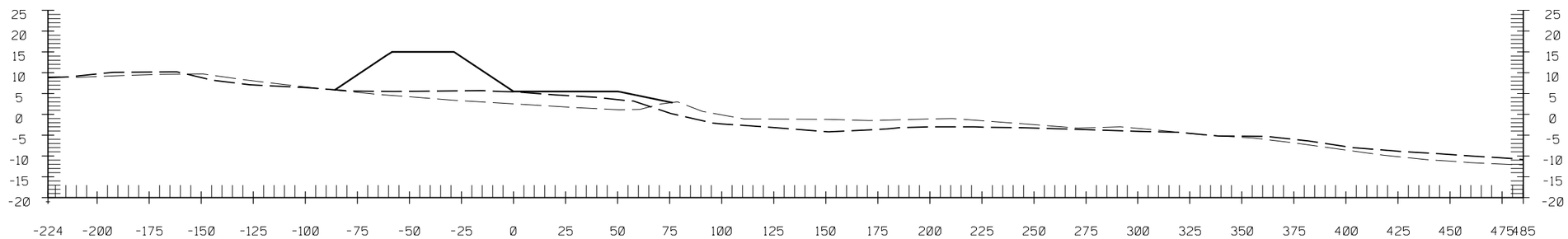
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -

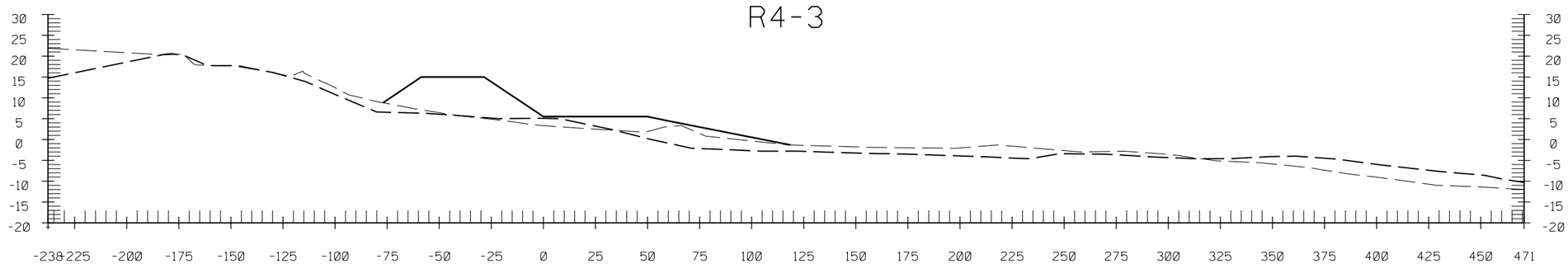
CROSS SECTIONS

- -

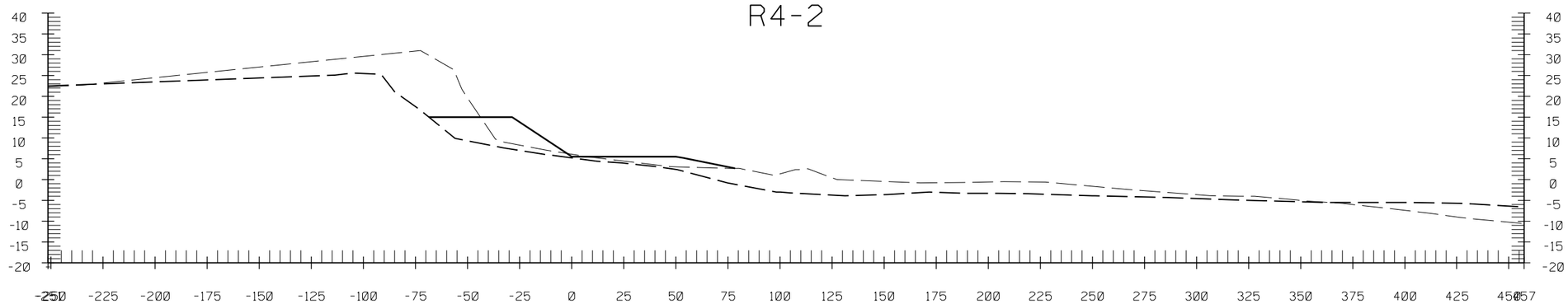
Sheet Reference Number:
F-313



R4-3



R4-2



R4-1

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

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Date: -
Drawn By: S. TURNER
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_tp_out.dgn
Reviewed By: E. HERMAN
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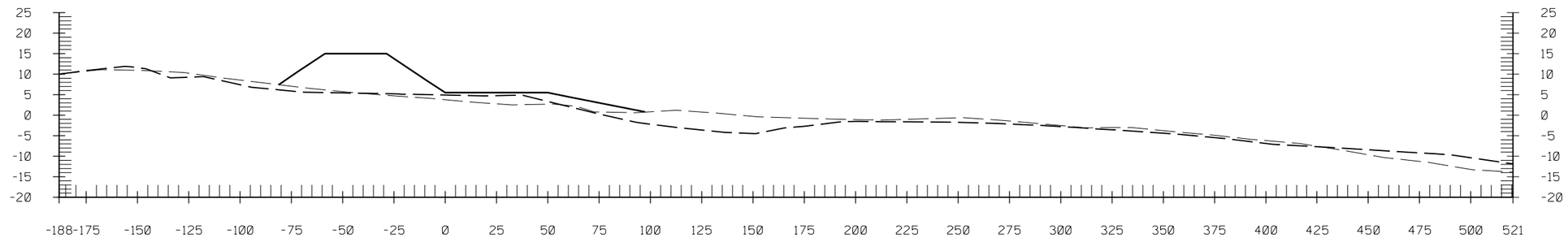
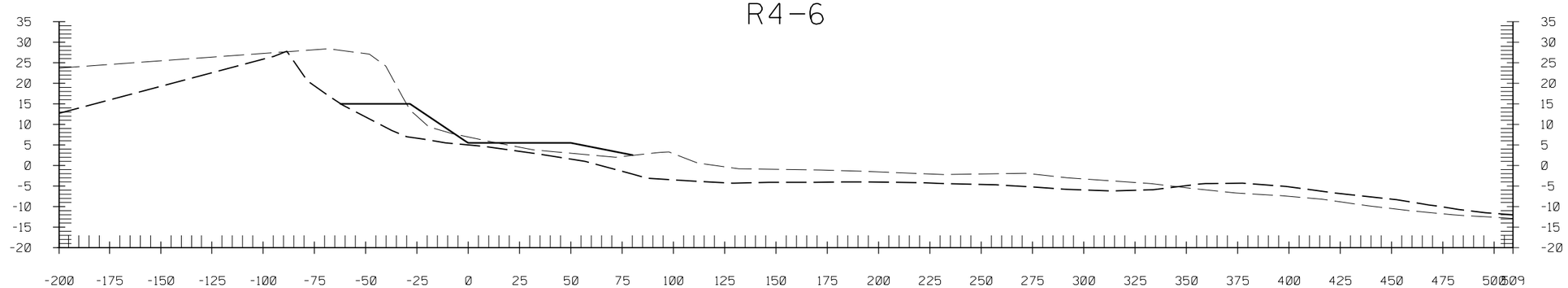
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -
CROSS SECTIONS
-

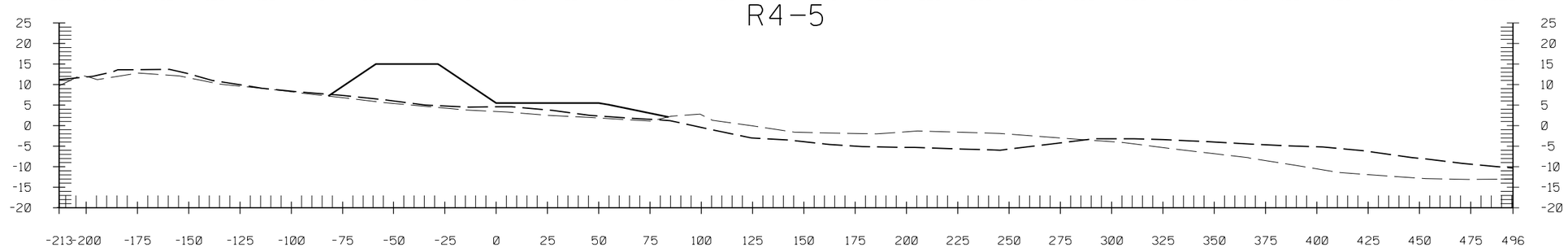
Sheet Reference Number:
F-314



R4-6



R4-5



R4-4

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

Description

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

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Drawn By: S. TURNER		File No. -	
Checked By: M. MCKOWN		I.S.O. Sheet File Name: 22x346_ip_out.dgn	
Reviewed By: E. HERMAN		Solicitation Number: -	

WALTON COUNTY, FLORIDA
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CROSS SECTIONS
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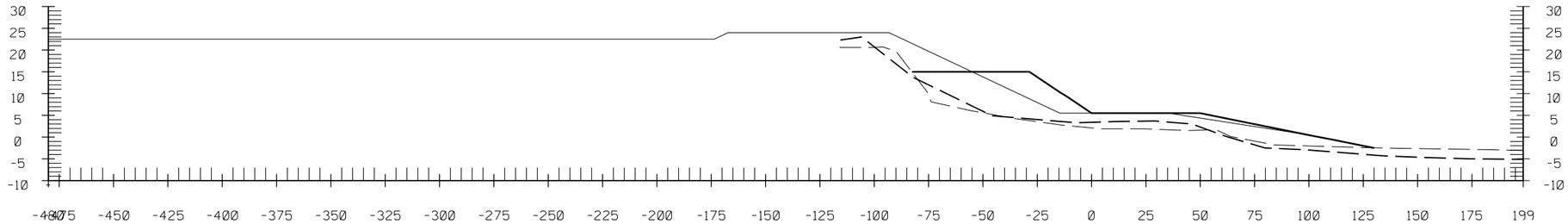
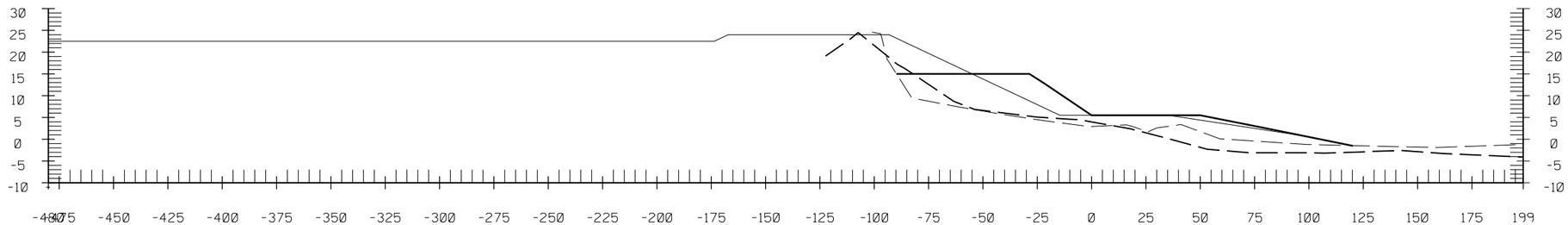
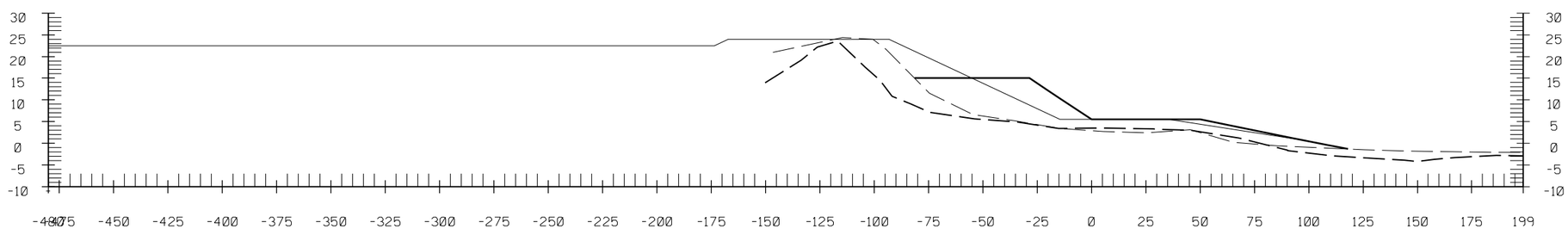
Sheet Reference Number:
F-315



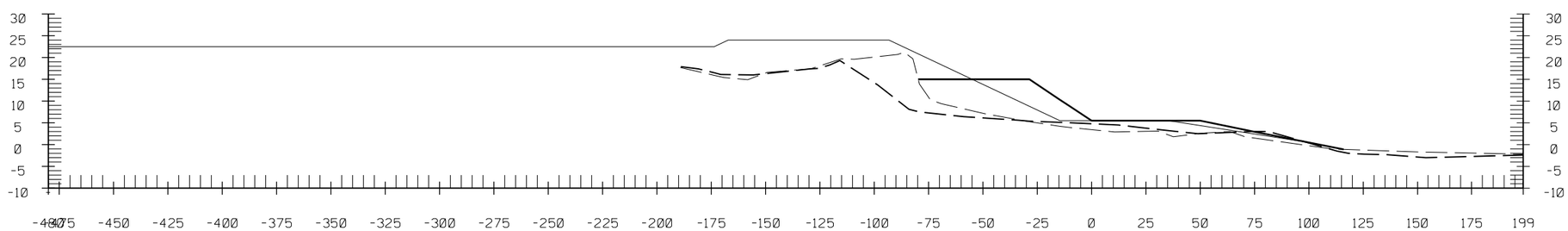
R5-4



R5-3



R5-2



R5-1

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

Description

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Date: -
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Checked By: M. MCKOWN
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Reviewed By: E. HERMAN
Solicitation Number: -

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -

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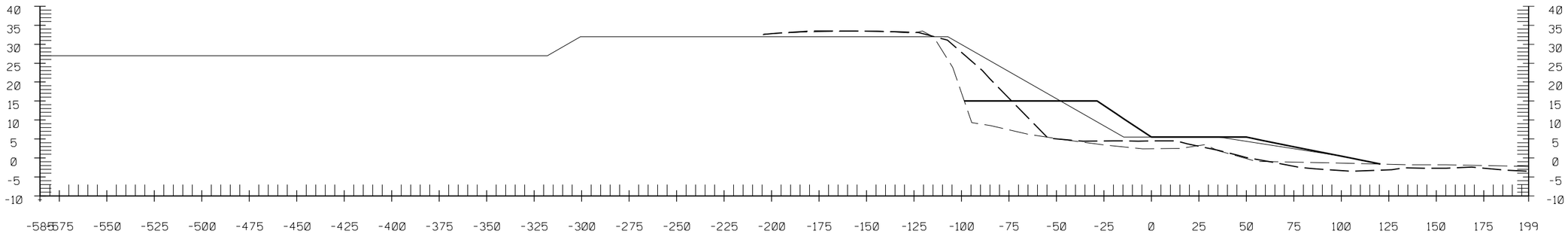
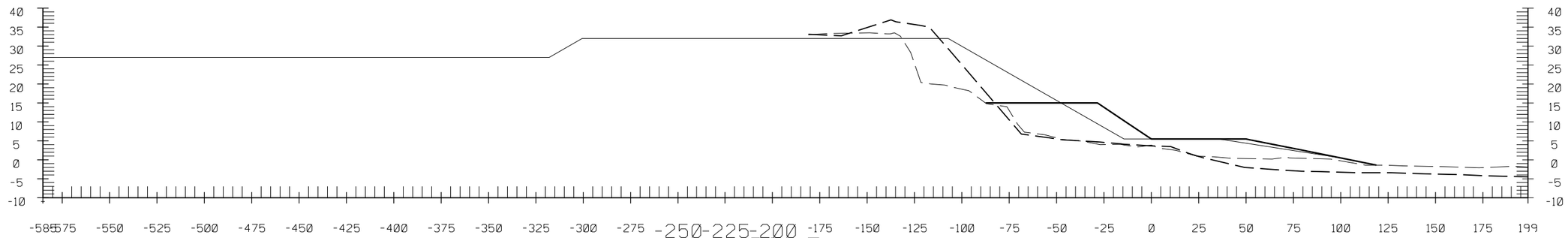
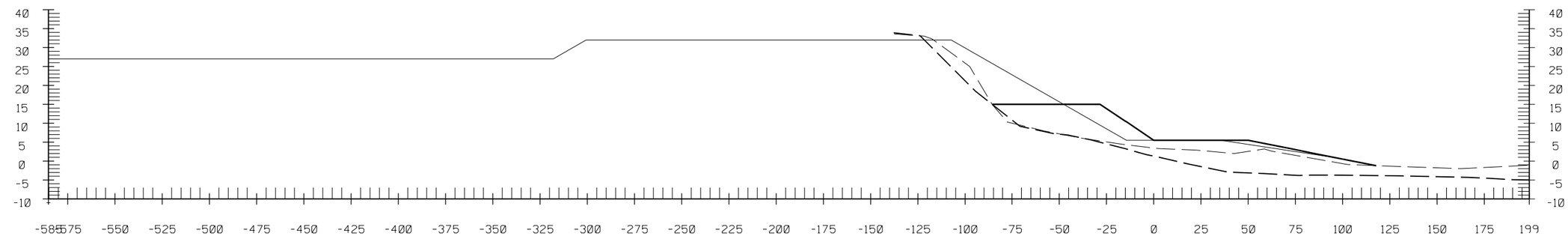
Sheet Reference Number:
F-316



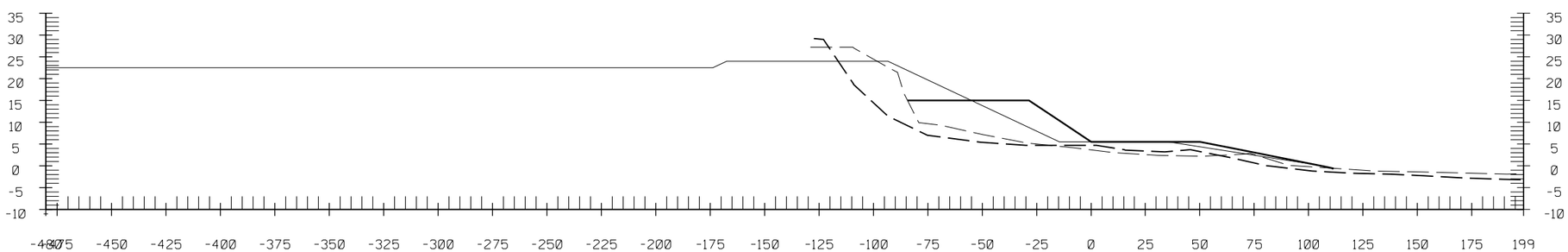
R5-8



R5-7



R5-6



R5-5

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

Description

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Date: -
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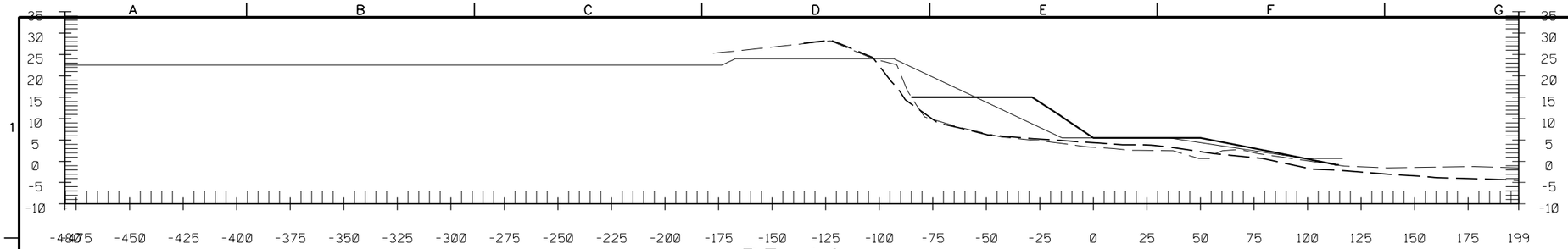
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

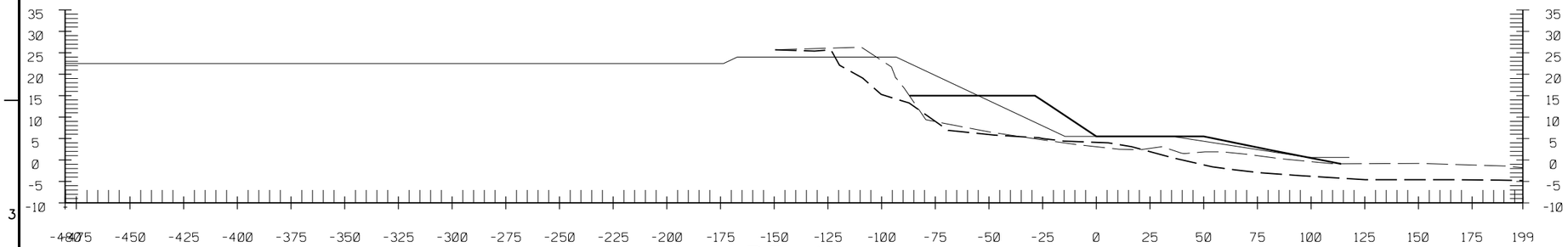
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
-
-
CROSS SECTIONS
-

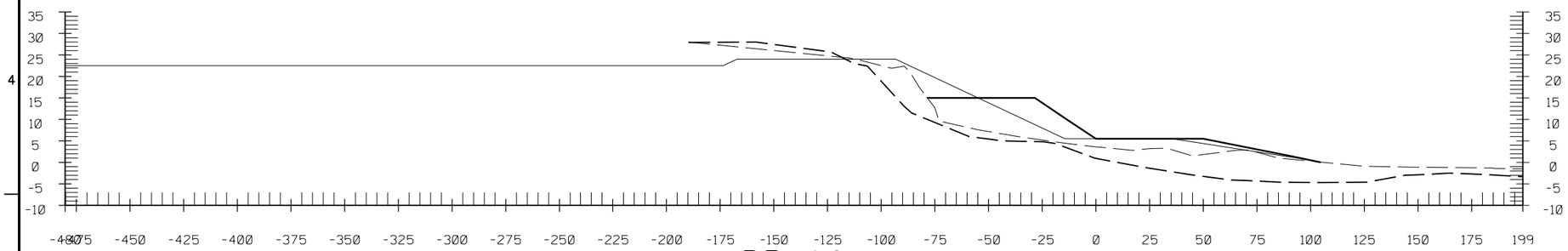
Sheet Reference Number:
F-317



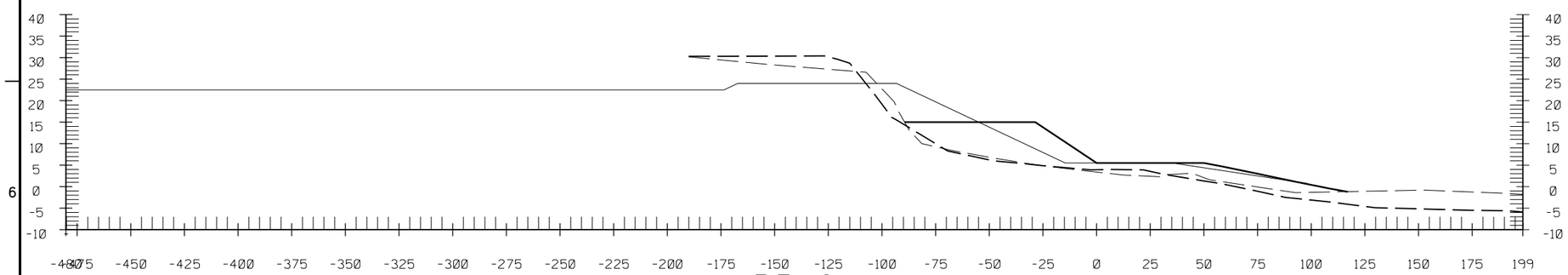
R5-12



R5-11



R5-10



R5-9

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

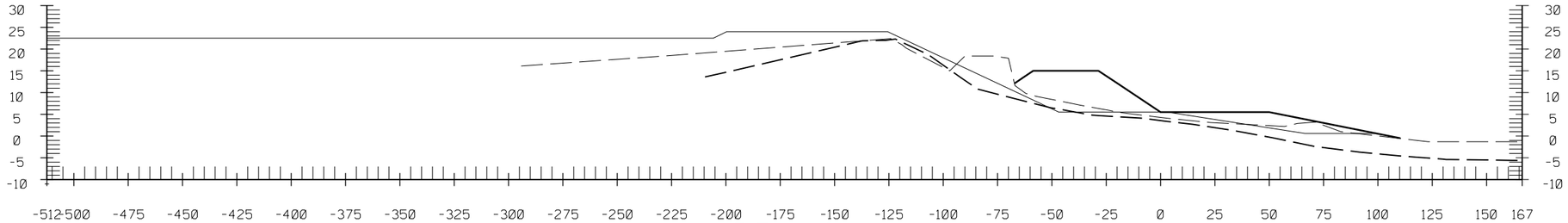
Description

Designed By: M. MCKOWN
Date: -
Drawn By: S. TURNER
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

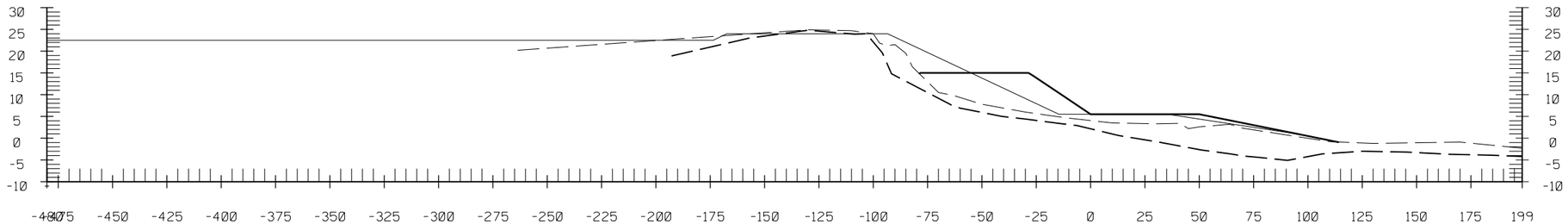
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -
CROSS SECTIONS
-

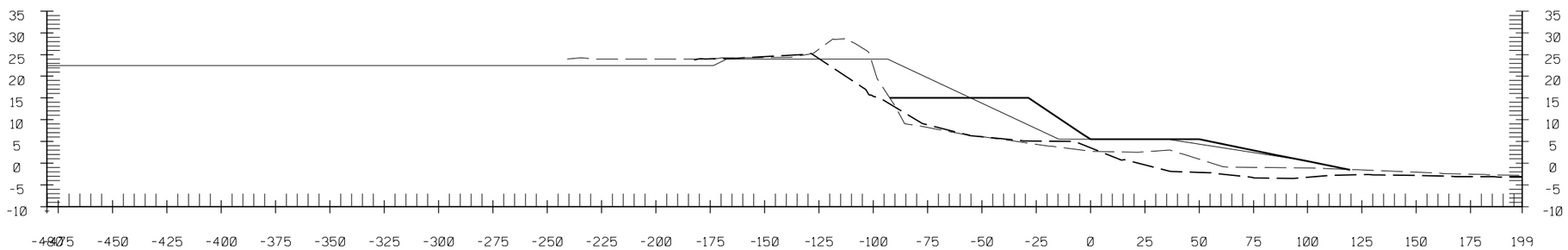
Sheet Reference Number:
F-318



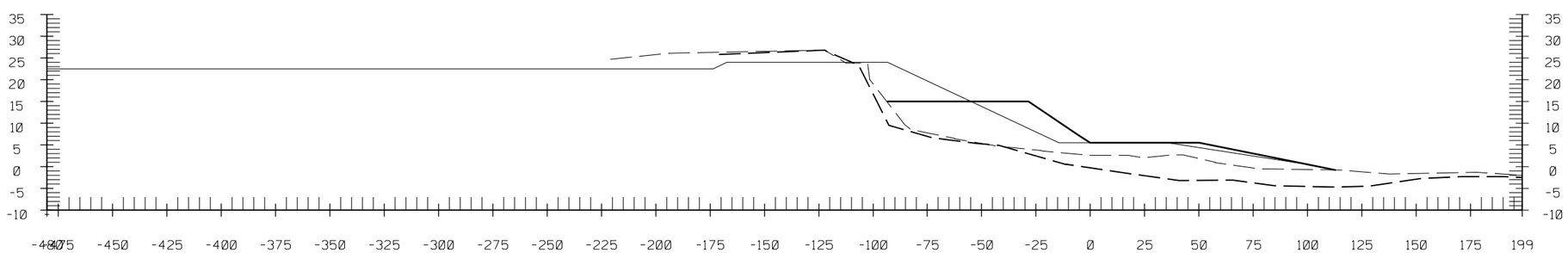
R5-16



R5-15



R5-14



R5-13

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

Description

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Date: -
Drawn By: S. TURNER
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
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U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -

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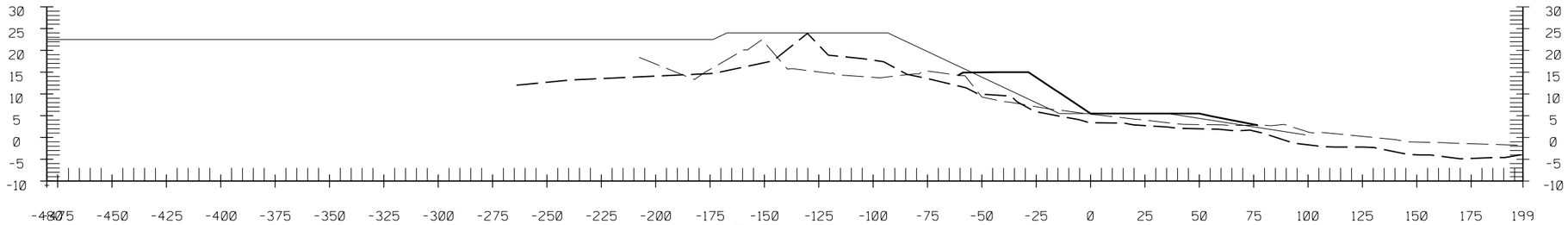
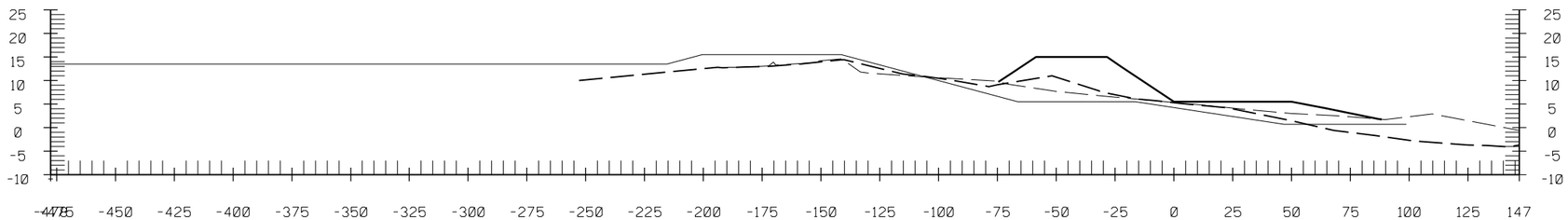
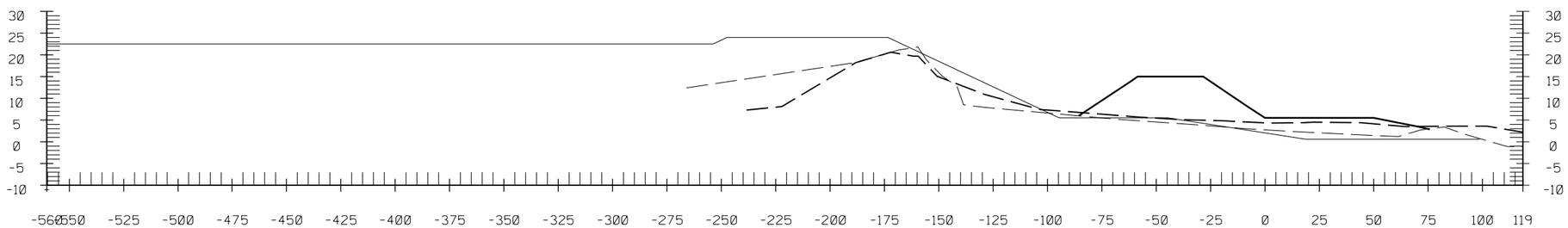
Sheet Reference Number:
F-319



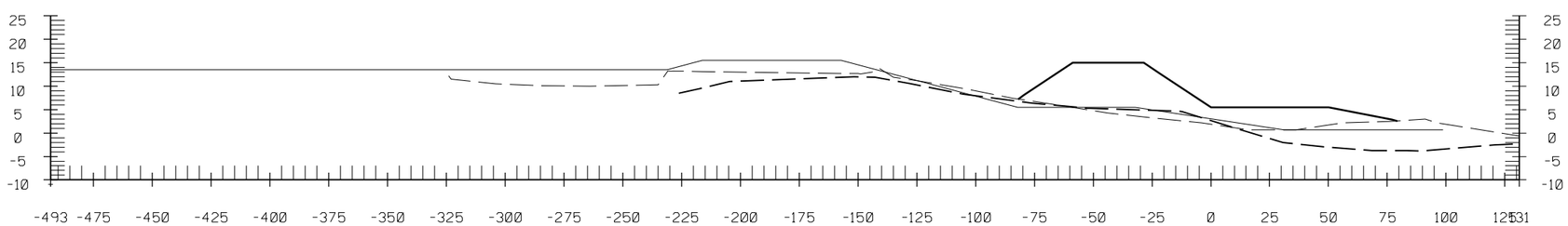
R5-20



R5-19



R5-18



R5-17

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved
	Description		

Designed By: M. MCKOWN
Date: -
Drawn By: S. TURNER
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Reviewed By: E. HERMAN
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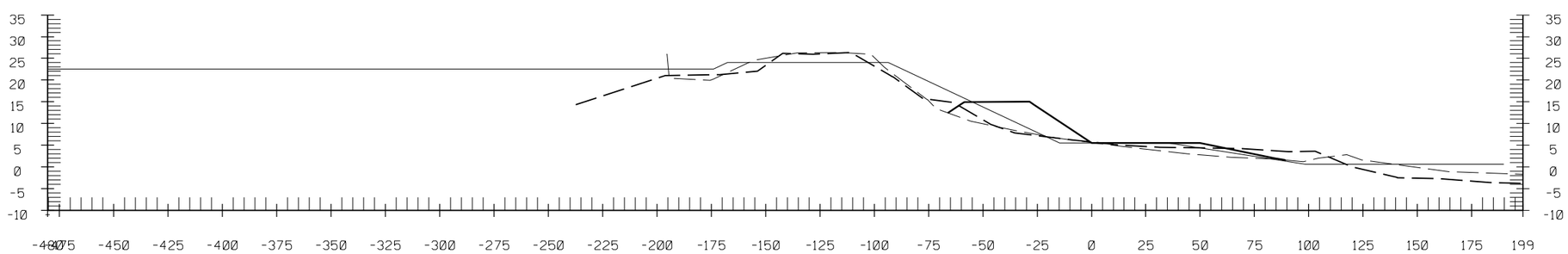
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -

CROSS SECTIONS

-

Sheet Reference Number:
F-320



R5-21

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved
	Description		

Designed By: M. MCKOWN
Date: -
Drawn By: S. TURNER
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_lp_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
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CROSS SECTIONS

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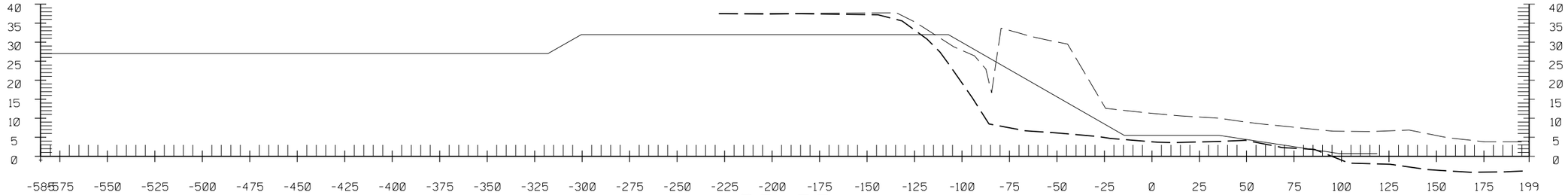
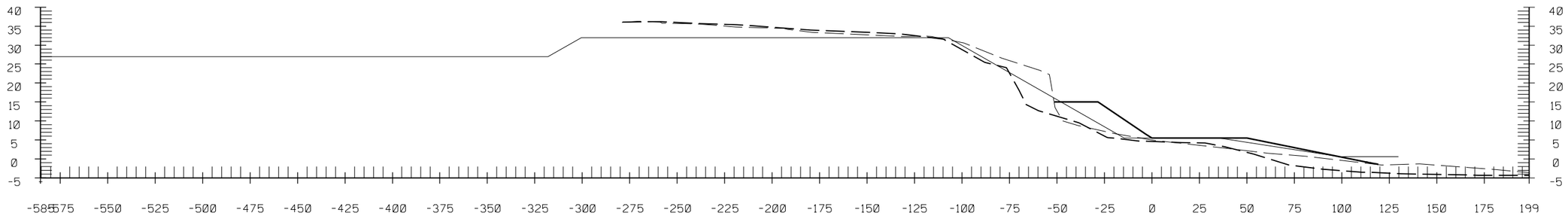
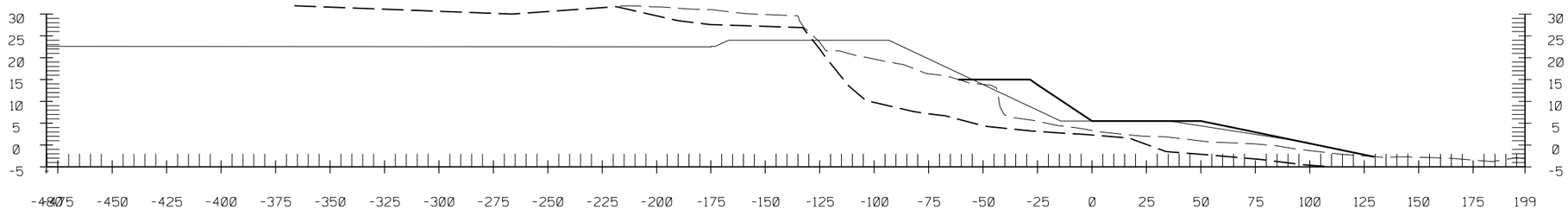
Sheet Reference Number:
F-321



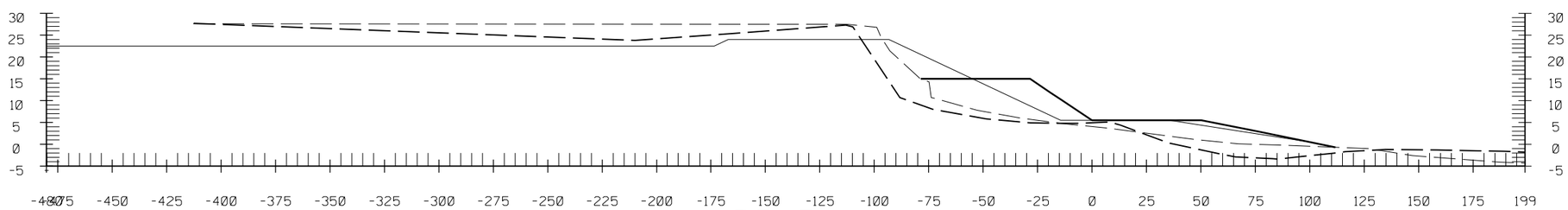
R5-33



R5-32



R5-31



R5-30

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

Description

Designed By: M. MCKOWN
Date: -
Drawn By: S. TURNER
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Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
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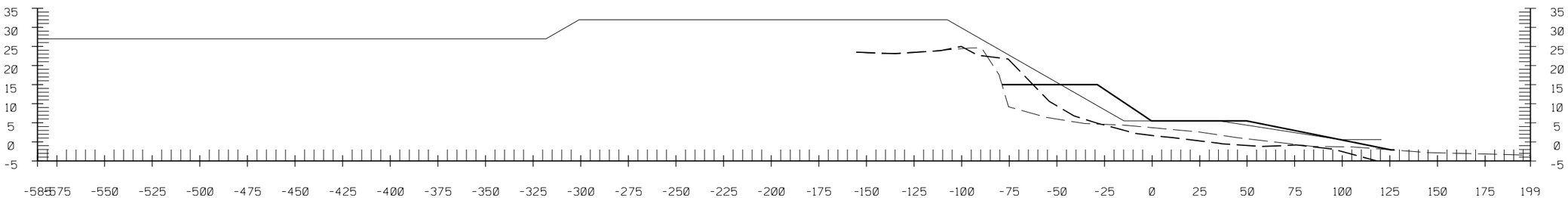
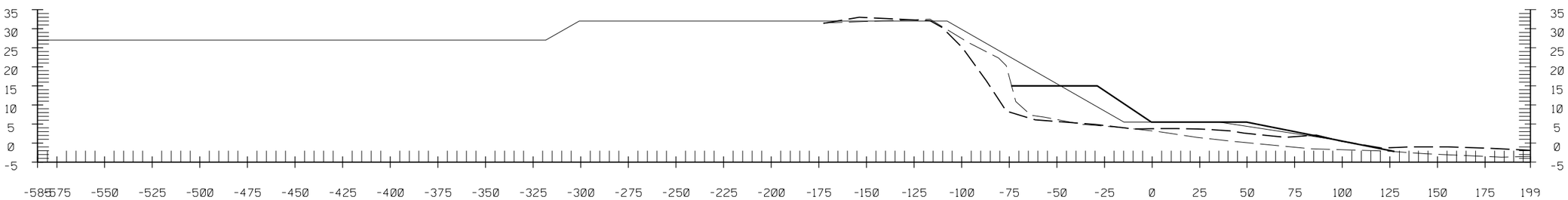
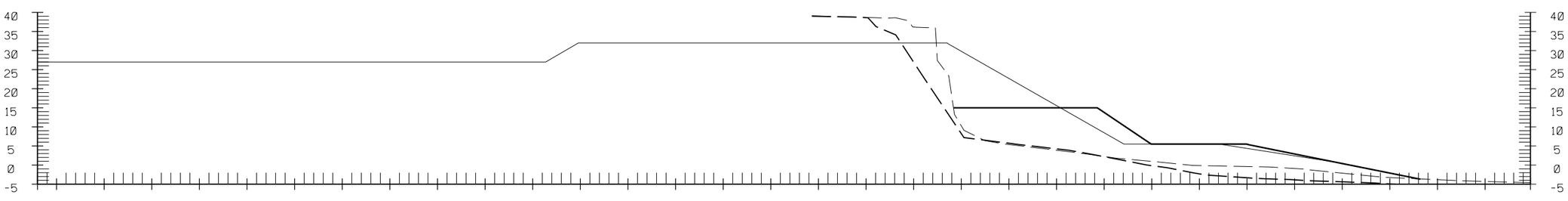
Sheet Reference Number:
F-322



R5-36



R5-35



R5-34

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved

Description

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Date: -
Drawn By: S. TURNER
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Checked By: M. MCKOWN
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U.S. ARMY ENGINEER DISTRICT
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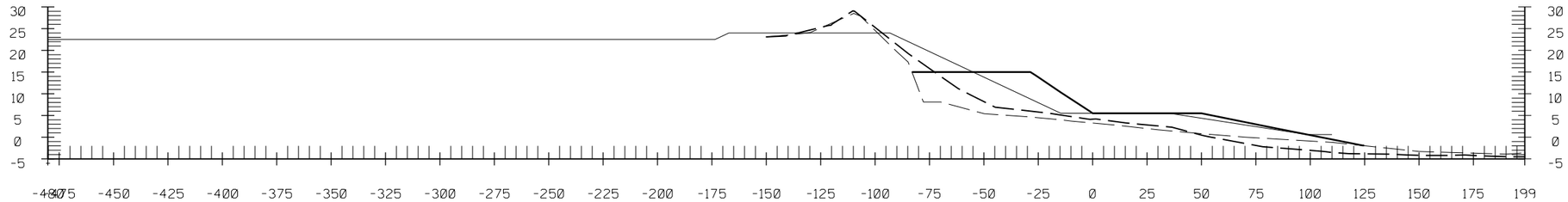
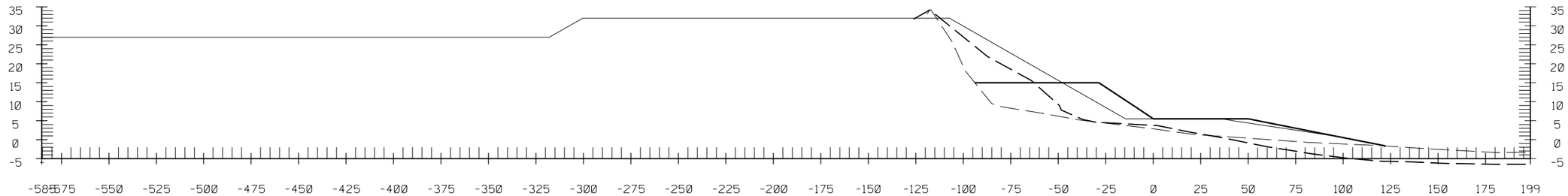
Sheet Reference Number:
F-323



R5-40



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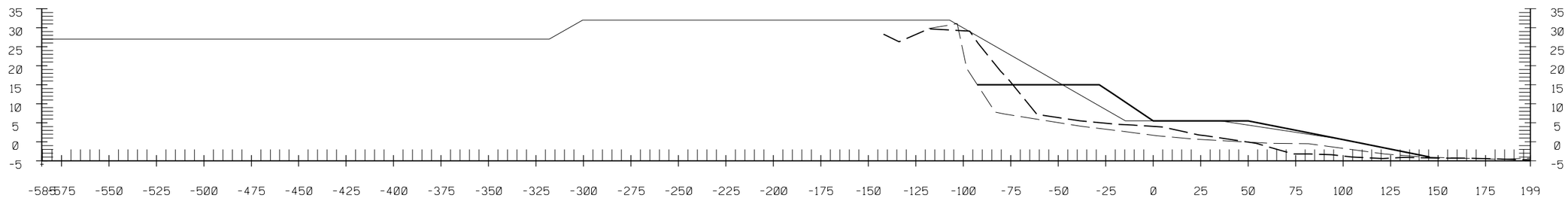

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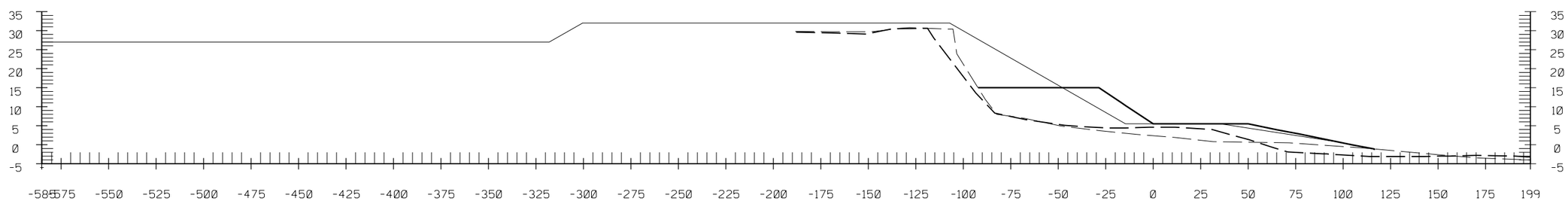

R5-37

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved
	Description		

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Date: -
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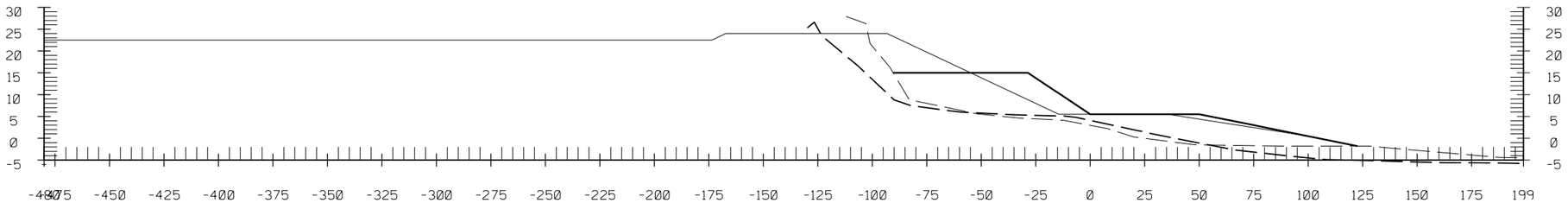
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -
CROSS SECTIONS
-

Sheet Reference Number:
F-324



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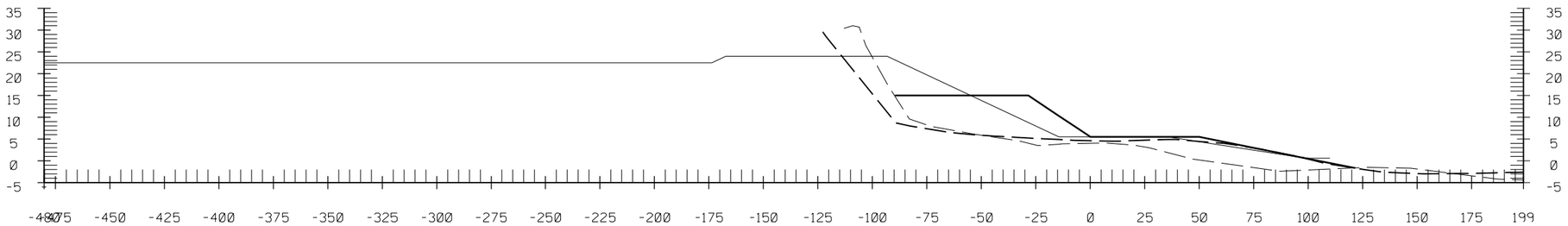

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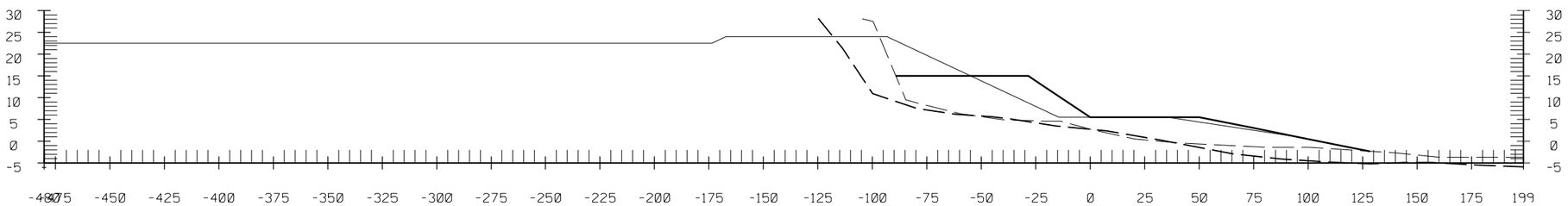

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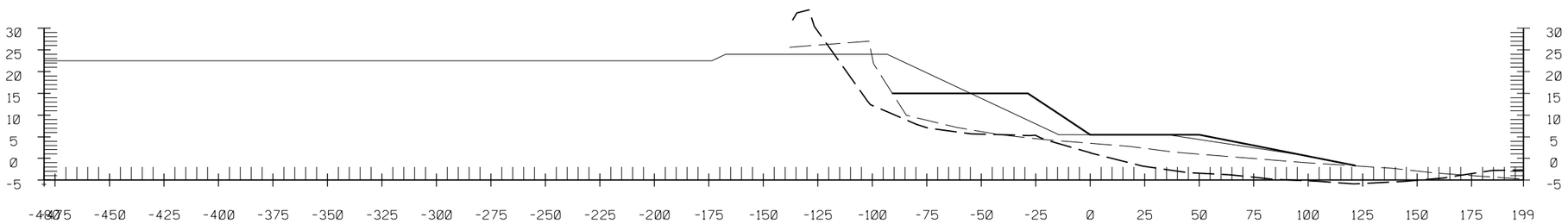

R5-41

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved
	Description		

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Date: -
Drawn By: S. TURNER
File No. -
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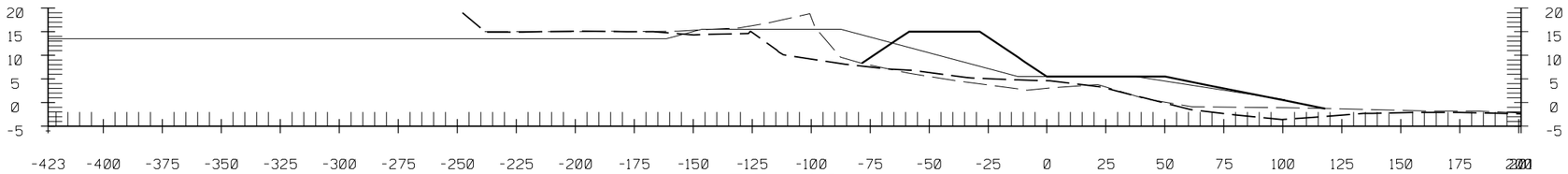
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -
CROSS SECTIONS
-

Sheet Reference Number:
F-325



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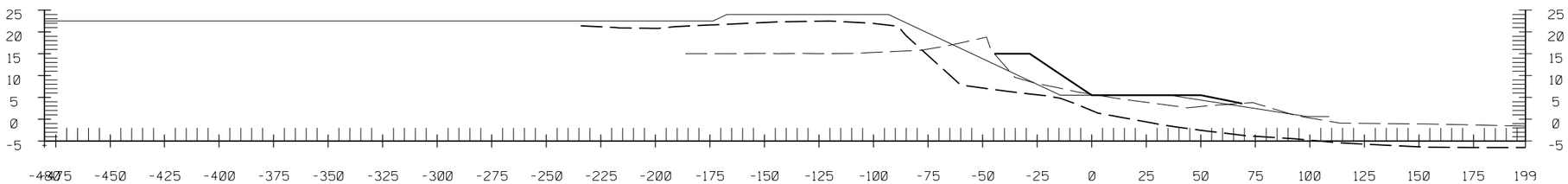

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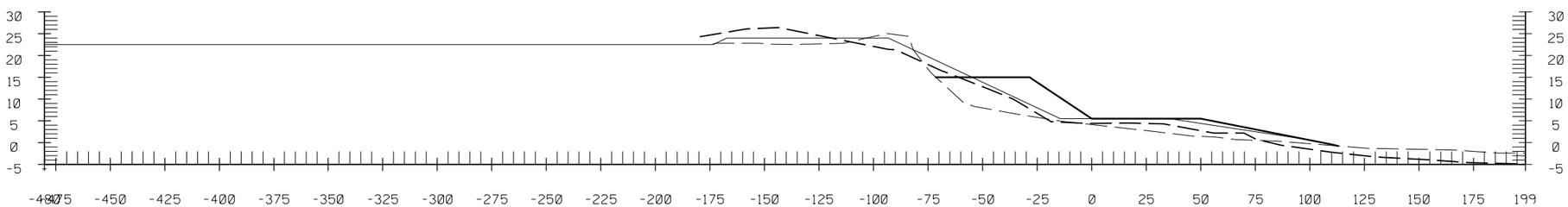

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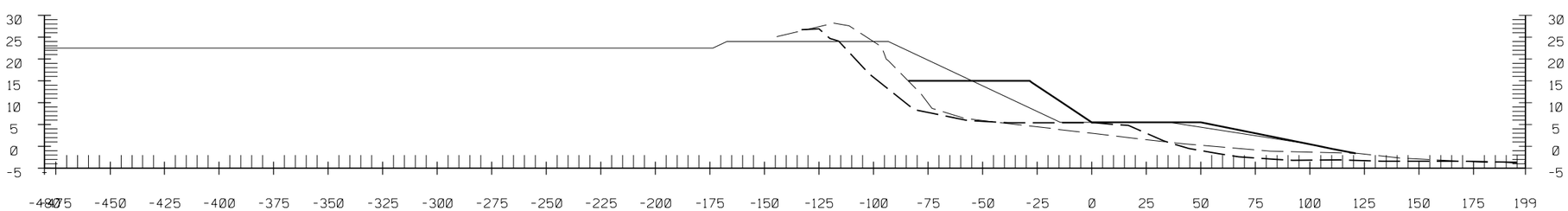

R5-45

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved
	Description		

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Date: -
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I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

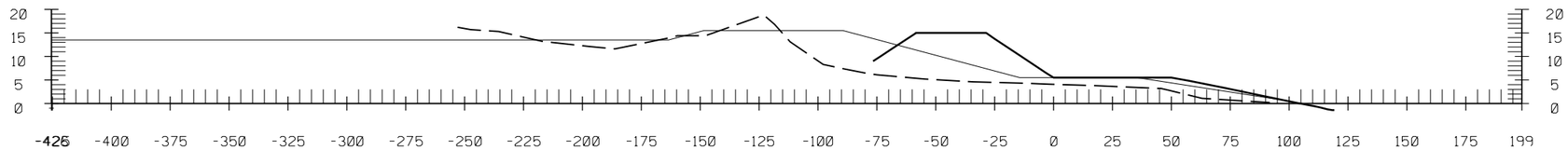
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -

CROSS SECTIONS

-

Sheet Reference Number:
F-326



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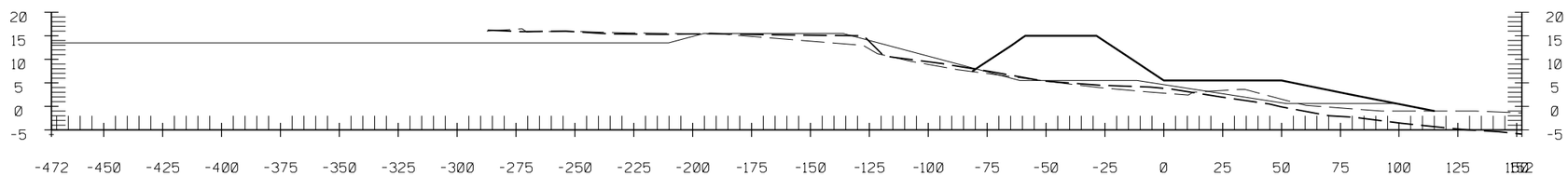

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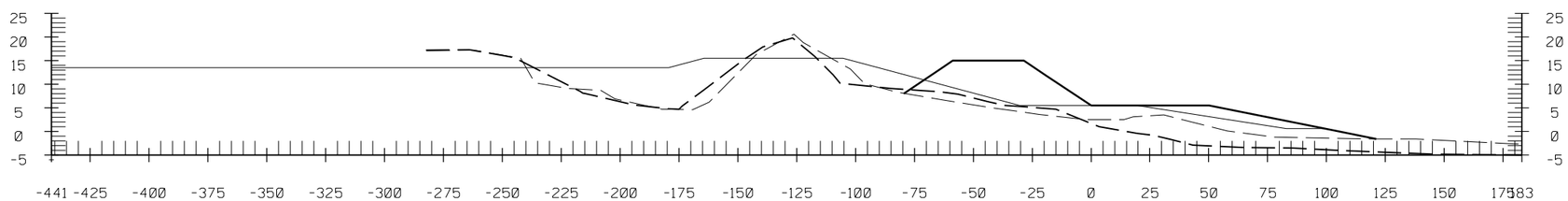

R5-49

US Army Corps of Engineers
Mobile District

Symbol	Description	Date	Approved
	Description		

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Date: -
Drawn By: S. TURNER
File No. -
Checked By: M. MCKOWN
I.S.O. Sheet File Name: 22x34b_ip_out.dgn
Reviewed By: E. HERMAN
Solicitation Number: -

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
MOBILE, ALABAMA

WALTON COUNTY, FLORIDA
- -
CROSS SECTIONS
-

Sheet Reference Number:
F-327

ATTACHMENT II

WALTON COUNTY SAND SOURCE INVESTIGATIONGEOPHYSICAL AND GEOTECHNICAL DATA ANALYSIS

(Digital data only – CD attached at end of report)

Appendix A
Section 3

COST ENGINEERING

WALTON COUNTY, FLORIDA
HURRICANE AND STORM DAMAGE REDUCTION

GENERAL INVESTIGATIONS STUDY
DRAFT REPORT

APPENDIX A - ENGINEERING DESIGN
SECTION 3 – COST ENGINEERING

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ATTACHMENT V PROJECT SCHEDULE

ATTACHMENT I

TOTAL PROJECT COST SUMMARY

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " NED " DISTRICT: MOBILE

LOCATION: Walton County, Fl P.O.C.: Joseph H. Ellsworth / Rita B. Perkins

	CURRENT MCACES (MII & CEDEP) ESTIMATE PREPARED: Jan 2012 EFFECTIVE PRICING LEVEL: Sep 2011				AUTHORIZ./BUDGET YEAR: FY - 12 EFFECTIVE PRICING LEVEL: Sep 2011			.....FULLY FUNDED ESTIMATE.....		
ACCOUNT No.	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	COST ($K)	CNTG ($K)	TOTAL ($K)	COST ($K)	CNTG ($K)	FULL ($K)
01---	LANDS and DAMAGES	543	136	25%	678	551	137	688	557	138	695
17---	Initial Beach Nourishment (2014)	41,632	9,576	23%	51,208	42,289	9,726	52,015	43,689	10,048	53,737
	Total Construction	41,632	9,576		51,208	42,289	9,726	52,015	43,689	10,048	53,737
22---	Initial Environmental (2014)	150	35	23%	185	152	36	188	157	37	194
30---	Initial Planning, Engineering & Design	1,270	292	23%	1,562	1,271	292	1,563	1,310	301	1,611
31---	Initial Construction Management	846	195	23%	1,041	847	195	1,042	884	203	1,087
	TOTAL PROJECT COST =======>	**44,441**	**10,234**		**54,674**	**45,110**	**10,386**	**55,496**	**46,597**	**10,727**	**57,324**
								rounded **$ 55,000**			rounded **$ 57,000**

DISTRICT APPROVED:

_____ CHIEF, COST ENGINEERING

_____ CHIEF, REAL ESTATE

_____ CHIEF, PLANNING

_____ CHIEF, ENGINEERING

_____ CHIEF, OPERATIONS

_____ CHIEF, CONSTRUCTION

_____ CHIEF, PROGRAMS MANAGEMENT

_____ PROJECT MANAGER

_____ DDE (PM)

" NED PLAN "

$ 16,000	*	**29.3%**	***TOTAL Federal Cost ===>*** **$ 17,000**
$ 39,000	*	**70.7%**	***TOTAL Non - Federal Cost ==>*** **$ 40,000**
$ 55,000			***TOTAL Initial PROJECT Cost =*** **$ 57,000**

* Subject to Cost Share Apportionment based on Economic Analysis

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " NED " DISTRICT: MOBILE

LOCATION: Walton County, Fl P.O.C.: Joseph H. Ellsworth / Rita B. Perkins

	CURRENT MCACES (MII & CEDEP) ESTIMATE PREPARED: Jan 2012 EFFECTIVE PRICING LEVEL: Sep 2011				AUTHORIZ./BUDGET YEAR: FY - 12 EFFECTIVE PRICING LEVEL: Sep 2011			.....FULLY FUNDED ESTIMATE.....		
ACCOUNT No.	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	COST ($K)	CNTG ($K)	TOTAL ($K)	COST ($K)	CNTG ($K)	FULL ($K)
01---	LANDS and DAMAGES	543	136	25%	678	551	137	688	557	138	695
17---	Initial Beach Nourishment (2014)	41,632	9,576	23%	51,208	42,289	9,726	52,015	43,689	10,048	53,737
17---	Beach Renourishment- 1st Contract (2024)	17,102	3,933	23%	21,035	17,371	3,995	21,366	21,417	4,926	26,343
17---	Beach Renourishment- 2nd Contract (2034)	17,102	3,933	23%	21,035	17,371	3,995	21,366	27,007	6,211	33,218
17---	Beach Renourishment- 3rd Contract (2044)	17,102	3,933	23%	21,035	17,371	3,995	21,366	32,282	7,424	39,706
17---	Beach Renourishment- 4th Contract (2054)	17,102	3,933	23%	21,035	17,371	3,995	21,366	36,576	8,412	44,988
	Total Construction	110,040	25,308		135,348	111,773	25,706	137,479	160,971	37,021	197,992
22---	Initial Environmental (2014)	150	35	23%	185	152	36	188	157	37	194
22---	1st - Environmental (2024)	75	17	23%	92	76	17	93	94	21	115
22---	2nd - Environmental (2034)	75	17	23%	92	76	17	93	118	26	144
22---	3rd - Environmental (2044)	75	17	23%	92	76	17	93	141	32	173
22---	4th - Environmental (2054)	75	17	23%	92	76	17	93	160	36	196
30---	Initial Planning, Engineering & Design	1,270	292	23%	1,562	1,271	292	1,563	1,310	301	1,611
30---	1st - Planning, Engineering & Design	515	119	23%	634	516	119	635	634	146	780
30---	2nd - Planning, Engineering & Design	515	119	23%	634	516	119	635	758	175	933
30---	3rd - Planning, Engineering & Design	515	119	23%	634	516	119	635	910	210	1,120
30---	4th - Planning, Engineering & Design	515	119	23%	634	516	119	635	1,093	252	1,345
31---	Initial Construction Management	846	195	23%	1,041	847	195	1,042	884	203	1,087
31---	1st - Construction Management	344	79	23%	423	344	79	423	428	98	526
31---	2nd - Construction Management	344	79	23%	423	344	79	423	512	118	630
31---	3 rd - Construction Management	344	79	23%	423	344	79	423	613	141	754
31---	4th - Construction Management	344	79	23%	423	344	79	423	734	169	903
	TOTAL PROJECT COST =======>	**116,584**	**26,826**		**143,410**	**118,338**	**27,226**	**145,564**	**170,074**	**39,124**	**209,198**
								rounded **$ 146,000**			rounded **$ 209,000**

DISTRICT APPROVED:

_____ CHIEF, COST ENGINEERING

_____ CHIEF, REAL ESTATE

_____ CHIEF, PLANNING

_____ CHIEF, ENGINEERING

_____ CHIEF, OPERATIONS

_____ CHIEF, CONSTRUCTION

_____ CHIEF, PROGRAMS MANAGEMENT

_____ PROJECT MANAGER

_____ DDE (PM)

" NED PLAN "

$ 43,000	*	**29.3%**	***TOTAL Federal Cost ===>*** **$ 61,000**
$ 103,000	*	**70.7%**	***TOTAL Non - Federal Cost ==>*** **$ 148,000**
$ 146,000			***TOTAL PROJECT Cost ====== $ 209,000***

* Subject to Cost Share Apportionment based on Economic Analysis

**** TOTAL CONTRACT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " NED " DISTRICT: MOBILE

LOCATION: Walton County, Fl P.O.C.: Joseph H. Ellsworth / Rita B. Perkins

		CURRENT MCACES (MII & CEDEP) ESTIMATE PREPARED: Jan 2012 EFFECTIVE PRICING LEVEL: Sep 2011				AUTHORIZ./BUDGET YEAR: FY - 12 EFFECTIVE PRICING LEVEL: Sep 2011				.....FULLY FUNDED ESTIMATE.....				
ACCOUNT No.	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
01---	LANDS and DAMAGES (PCA)													
	PCA	25	6	25%	31	1.6%	25	6	31	Apr 2013	1.1%	25	6	31
	EASEMENTS ACQUISITION	518	129	25%	647	1.6%	526	131	657	Apr 2013	1.1%	532	132	664
		543	136		678		551	137	688			557	138	695
17---	BEACH NOURISHMENT (**Initial** Contract) FY-14													
	DREDGING	34,073	7,837	23%	41,910	1.6%	34,610	7,960	42,570	Jul 2014	3.3%	35,756	8,224	43,980
	DREDGING (Mob & Demob) $995.5k (reference CEDEP for Cost Derivation)													
	DREDGING (Hopper) $33,077.5k (reference CEDEP for Cost Derivation)													
	BEACH WORK	5,559	1,279	23%	6,838	1.6%	5,647	1,299	6,946	Jul 2014	3.3%	5,834	1,342	7,176
	PLANTING	2,000	460	23%	2,460	1.6%	2,032	467	2,499	Jul 2014	3.3%	2,099	482	2,581
		41,632	9,576		51,208		42,289	9,726	52,015			43,689	10,048	53,737
22---	ENVIRONMENTAL	150	35	23%	185	1.6%	152	36	188	Jul 2014	3.3%	157	37	194
	Total (Features 01, 17 & 22)	42,325	9,747		52,071		42,992	9,899	52,891			44,403	10,223	54,626
30---	PLANNING, ENGINEERING & DESIGN, **3%+-**	1,270	292	23%	1,562	0.1%	1,271	292	1,563	Oct 2013	3.1%	1,310	301	1,611
31---	CONSTRUCTION MANAGEMENT, **2% +-**	846	195	23%	1,041	0.1%	847	195	1,042	Jul 2014	4.3%	884	203	1,087
	FEDERAL & Non-FEDERAL SUBTOTAL	44,441	10,234		54,674		45,110	10,386	55,496			46,597	10,727	57,324

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " NED " DISTRICT: MOBILE

LOCATION: Walton County, Fl P.O.C.: Joseph H. Ellsworth / Rita B. Perkins

ACCOUNT No.	FEATURE DESCRIPTION	CURRENT MCACES (MII & CEDEP) ESTIMATE PREPARED: Jan 2012 EFFECTIVE PRICING LEVEL: Sep 2011 COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	AUTHORIZ./BUDGET YEAR: FY - 12 EFFECTIVE PRICING LEVEL: Sep 2011 OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	.....FULLY FUNDED ESTIMATE..... FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
17---	Beach Renourishment- 1st Contract (2024)													
	DREDGING	17,102	3,933	23%	21,035	1.6%	17,371	3,995	21,366	Jul 23	23.3%	21,417	4,926	26,343
	DREDGING (Mob & Demob) $995.5k (reference CEDEP for Cost Derivation)													
	DREDGING (Hopper) $16,106.5k (reference CEDEP for Cost Derivation)													
		17,102	3,933		21,035		17,371	3,995	21,366			21,417	4,926	26,343
22---	ENVIRONMENTAL	75	17	23%	92	1.6%	76	17	93	Jul 23	23.3%	94	21	115
	Total (Feature 17 & 22)	17,177	3,950		21,127		17,447	4,012	21,459			21,511	4,947	26,458
30---	PLANNING, ENGINEERING & DESIGN, **3%+-**	515	119	23%	634	0.1%	516	119	635	Oct 22	22.9%	634	146	780
31---	CONSTRUCTION MANAGEMENT, **2% +-**	344	79	23%	423	0.1%	344	79	423	Jul 23	24.5%	428	98	526
	FEDERAL & Non-FEDERAL SUBTOTAL	18,036	4,148		22,184		18,307	4,210	22,517			22,573	5,191	27,764

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " NED " DISTRICT: MOBILE

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		CURRENT MCACES (MII & CEDEP) ESTIMATE PREPARED: Jan 2012 EFFECTIVE PRICING LEVEL: Sep 2011				AUTHORIZ./BUDGET YEAR: FY - 12 EFFECTIVE PRICING LEVEL: Sep 2011				.....FULLY FUNDED ESTIMATE.....				
ACCOUNT No.	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
17---	Beach Renourishment- 2nd Contract (2034)													
	DREDGING	17,102	3,933	23%	21,035	1.6%	17,371	3,995	21,366	Jul 33	55.5%	27,007	6,211	33,218
	DREDGING (Mob & Demob) $995.5k (reference CEDEP for Cost Derivation)													
	DREDGING (Hopper) $16,106.5k (reference CEDEP for Cost Derivation)													
		17,102	3,933		21,035		17,371	3,995	21,366			27,007	6,211	33,218
22---	ENVIRONMENTAL	75	17	23%	92	1.6%	76	17	93	Jul 33	55.5%	118	26	144
	Total (Feature 17 & 22)	17,177	3,950		21,127		17,447	4,012	21,459			27,125	6,237	33,362
30---	PLANNING, ENGINEERING & DESIGN, **3%+-**	515	119	23%	634	0.1%	516	119	635	Oct 32	47.0%	758	175	933
31---	CONSTRUCTION MANAGEMENT, **2% +-**	344	79	23%	423	0.1%	344	79	423	Jul 33	48.9%	512	118	630
	FEDERAL & Non-FEDERAL SUBTOTAL	18,036	4,148		22,184		18,307	4,210	22,517			28,395	6,530	34,925

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " NED " DISTRICT: MOBILE

LOCATION: Walton County, Fl P.O.C.: Joseph H. Ellsworth / Rita B. Perkins

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ACCOUNT No.	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
17---	Beach Renourishment- 3rd Contract (2044)													
	DREDGING	17,102	3,933	23%	21,035	1.6%	17,371	3,995	21,366	Jul 43	85.8%	32,282	7,424	39,706
	DREDGING (Mob & Demob) $995.5k (reference CEDEP for Cost Derivation)													
	DREDGING (Hopper) $16,106.5k (reference CEDEP for Cost Derivation)													
		17,102	3,933		21,035		17,371	3,995	21,366			32,282	7,424	39,706
22---	ENVIRONMENTAL	75	17	23%	92	1.6%	76	17	93	Jul 43	85.8%	141	32	173
	Total (Feature 17 & 22)	17,177	3,950		21,127		17,447	4,012	21,459			32,423	7,456	39,879
30---	PLANNING, ENGINEERING & DESIGN, **3%+-**	515	119	23%	634	0.1%	516	119	635	Oct 42	76.4%	910	210	1,120
31---	CONSTRUCTION MANAGEMENT, **2% +-**	344	79	23%	423	0.1%	344	79	423	Jul 43	78.2%	613	141	754
	FEDERAL & Non-FEDERAL SUBTOTAL	18,036	4,148		22,184		18,307	4,210	22,517			33,946	7,807	41,753

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " NED " DISTRICT: MOBILE

LOCATION: Walton County, Fl P.O.C.: Joseph H. Ellsworth / Rita B. Perkins

	CURRENT MCACES (MII & CEDEP) ESTIMATE PREPARED: Jan 2012 EFFECTIVE PRICING LEVEL: Sep 2011					AUTHORIZ./BUDGET YEAR: FY - 12 EFFECTIVE PRICING LEVEL: Sep 2011				.....FULLY FUNDED ESTIMATE.....				
ACCOUNT No.	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
17---	Beach Renourishment- 4th Contract (2054)													
	DREDGING	17,102	3,933	23%	21,035	1.6%	17,371	3,995	21,366	Jul 53	110.6%	36,576	8,412	44,988
	DREDGING (Mob & Demob) $995.5k (reference CEDEP for Cost Derivation)													
	DREDGING (Hopper) $16,106.5k (reference CEDEP for Cost Derivation)													
		17,102	3,933		21,035		17,371	3,995	21,366			36,576	8,412	44,988
22---	ENVIRONMENTAL	75	17	23%	92	1.6%	76	17	93	Jul 53	110.6%	160	36	196
	Total (Feature 17 & 22)	17,177	3,950		21,127		17,447	4,012	21,459			36,736	8,448	45,184
30---	PLANNING, ENGINEERING & DESIGN, **3%+-**	515	119	23%	634	0.1%	516	119	635	Oct 52	111.8%	1,093	252	1,345
31---	CONSTRUCTION MANAGEMENT, **2% +-**	344	79	23%	423	0.1%	344	79	423	Jul 53	113.4%	734	169	903
	FEDERAL & Non-FEDERAL SUBTOTAL	18,036	4,148		22,184		18,307	4,210	22,517			38,563	8,869	47,432

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " LPP " DISTRICT: MOBILE

LOCATION: Walton County, Fl P.O.C.: Joseph H. Ellsworth/ Rita B.Perkins

	CURRENT MCACES (MII & CEDEP) ESTIMATE PREPARED: Jan 2012 EFFECTIVE PRICING LEVEL: Sep 2011				AUTHORIZ./BUDGET YEAR: FY - 12 EFFECTIVE PRICING LEVEL: Sep 2011			.....FULLY FUNDED ESTIMATE.....		
ACCOUNT No.	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	COST ($K)	CNTG ($K)	TOTAL ($K)	COST ($K)	CNTG ($K)	FULL ($K)
01---	LANDS and DAMAGES	543	136	25%	678	551	137	688	557	138	695
17---	Initial Beach Nourishment (2014)	47,589	10,946	23%	58,535	48,340	11,118	59,458	49,941	11,486	61,427
	Total Construction	47,589	10,946		58,535	48,340	11,118	59,458	49,941	11,486	61,427
22---	Initial Environmental (2014)	150	35	23%	185	152	36	188	157	37	194
30---	Initial Planning, Engineering & Design	1,448	333	23%	1,781	1,450	333	1,783	1,494	343	1,837
31---	Initial Construction Management	966	222	23%	1,188	967	222	1,189	1,009	232	1,241
	TOTAL PROJECT COST =======>	**50,696**	**11,672**		**62,367**	**51,460**	**11,846**	**63,306**	**53,158**	**12,236**	**65,394**
								rounded **$ 63,000**			rounded **$ 65,000**

DISTRICT APPROVED:

_____ CHIEF, COST ENGINEERING

_____ CHIEF, REAL ESTATE

_____ CHIEF, PLANNING

_____ CHIEF, ENGINEERING

_____ CHIEF, OPERATIONS

_____ CHIEF, CONSTRUCTION

_____ CHIEF, PROGRAMS MANAGEMENT

_____ PROJECT MANAGER

_____ DDE (PM)

" LP PLAN "

$ 18,000	*	**29.3%**	***TOTAL Federal Cost ===>*** **$ 19,000**
$ 45,000	*	**70.7%**	***TOTAL Non - Federal Cost ==>*** **$ 46,000**
$ 63,000			***TOTAL Initial PROJECT Cost =*** **$ 65,000**

* Subject to Cost Share Apportionment based on Economic Analysis

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " LPP " DISTRICT: MOBILE

LOCATION: Walton County, Fl P.O.C.: Joseph H. Ellsworth/ Rita B.Perkins

	CURRENT MCACES (MII & CEDEP) ESTIMATE PREPARED: Jan 2012 EFFECTIVE PRICING LEVEL: Sep 2011				AUTHORIZ./BUDGET YEAR: FY - 12 EFFECTIVE PRICING LEVEL: Sep 2011			.....FULLY FUNDED ESTIMATE.....		
ACCOUNT No.	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	COST ($K)	CNTG ($K)	TOTAL ($K)	COST ($K)	CNTG ($K)	FULL ($K)
01---	LANDS and DAMAGES	543	136	25%	678	551	137	688	557	138	695
17---	Initial Beach Nourishment (2014)	47,589	10,946	23%	58,535	48,340	11,118	59,458	49,941	11,486	61,427
17---	Beach Renourishment- 1st Contract (2024)	19,224	4,422	23%	23,646	19,527	4,492	24,019	24,075	5,538	29,613
17---	Beach Renourishment- 2nd Contract (2034)	19,224	4,422	23%	23,646	19,527	4,492	24,019	30,359	6,984	37,343
17---	Beach Renourishment- 3rd Contract (2044)	19,224	4,422	23%	23,646	19,527	4,492	24,019	36,289	8,348	44,637
17---	Beach Renourishment- 4th Contract (2054)	19,224	4,422	23%	23,646	19,527	4,492	24,019	41,115	9,458	50,573
	Total Construction	124,485	28,634		153,119	126,448	29,086	155,534	181,779	41,814	223,593
22---	Initial Environmental (2014)	150	35	23%	185	152	36	188	157	37	194
22---	1st - Environmental (2024)	75	17	23%	92	76	17	93	94	21	115
22---	2nd - Environmental (2034)	75	17	23%	92	76	17	93	118	26	144
22---	3rd - Environmental (2044)	75	17	23%	92	76	17	93	141	32	173
22---	4th - Environmental (2054)	75	17	23%	92	76	17	93	160	36	196
30---	Initial Planning, Engineering & Design	1,448	333	23%	1,781	1,450	333	1,783	1,494	343	1,837
30---	1st - Planning, Engineering & Design	579	133	23%	712	580	133	713	713	163	876
30---	2nd - Planning, Engineering & Design	579	133	23%	712	580	133	713	853	195	1,048
30---	3rd - Planning, Engineering & Design	579	133	23%	712	580	133	713	1,023	235	1,258
30---	4th - Planning, Engineering & Design	579	133	23%	712	580	133	713	1,228	282	1,510
31---	Initial Construction Management	966	222	23%	1,188	967	222	1,189	1,009	232	1,241
31---	1st - Construction Management	386	89	23%	475	386	89	475	480	111	591
31---	2nd - Construction Management	386	89	23%	475	386	89	475	575	132	707
31---	3 rd - Construction Management	386	89	23%	475	386	89	475	688	159	847
31---	4th - Construction Management	386	89	23%	475	386	89	475	824	190	1,014
	TOTAL PROJECT COST =======>	**131,751**	**30,316**		**162,067**	**133,736**	**30,770**	**164,506**	**191,893**	**44,146**	**236,039**
								rounded **$ 165,000**			rounded **$ 236,000**

DISTRICT APPROVED:

_____ CHIEF, COST ENGINEERING

_____ CHIEF, REAL ESTATE

_____ CHIEF, PLANNING

_____ CHIEF, ENGINEERING

_____ CHIEF, OPERATIONS

_____ CHIEF, CONSTRUCTION

_____ CHIEF, PROGRAMS MANAGEMENT

_____ PROJECT MANAGER

_____ DDE (PM)

" LP PLAN "

$ 48,000	*	**29.3%**	***TOTAL Federal Cost ===>*** **$ 69,000**
$ 117,000	*	**70.7%**	***TOTAL Non - Federal Cost ==>*** **$ 167,000**
$ 165,000			***TOTAL PROJECT Cost ====== $ 236,000***

* Subject to Cost Share Apportionment based on Economic Analysis

**** TOTAL CONTRACT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " LPP "
DISTRICT: MOBILE
LOCATION: Walton County, Fl
P.O.C.: Joseph H. Ellsworth/ Rita B.Perkins

		CURRENT MCACES (MII & CEDEP) ESTIMATE PREPARED: Jan 2012 EFFECTIVE PRICING LEVEL: Sep 2011				AUTHORIZ./BUDGET YEAR: FY - 12 EFFECTIVE PRICING LEVEL: Sep 2011				.....FULLY FUNDED ESTIMATE.....				
ACCOUNT No.	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
01---	LANDS and DAMAGES (PCA)													
	PCA	25	6	25%	31	1.6%	25	6	31	Apr 2013	1.1%	25	6	31
	EASEMENTS ACQUISITION	518	129	25%	647	1.6%	526	131	657	Apr 2013	1.1%	532	132	664
		543	136		678		551	137	688			557	138	695
17---	BEACH NOURISHMENT (**Initial** Contract) FY-14													
	DREDGING	40,030	9,207	23%	49,237	1.6%	40,661	9,352	50,013	Jul 2014	3.3%	42,008	9,662	51,670
	DREDGING (Mob & Demob) $995.5k (reference CEDEP for Cost Derivation)													
	DREDGING (Hopper) $39,035k (reference CEDEP for Cost Derivation)													
	BEACH WORK	5,559	1,279	23%	6,838	1.6%	5,647	1,299	6,946	Jul 2014	3.3%	5,834	1,342	7,176
	PLANTING	2,000	460	23%	2,460	1.6%	2,032	467	2,499	Jul 2014	3.3%	2,099	482	2,581
		47,589	10,946		58,535		48,340	11,118	59,458			49,941	11,486	61,427
22---	ENVIRONMENTAL	150	35	23%	185	1.6%	152	36	188	Jul 2014	3.3%	157	37	194
	Total (Features 01, 17 & 22)	48,282	11,117		59,398		49,043	11,291	60,334			50,655	11,661	62,316
30---	PLANNING, ENGINEERING & DESIGN, **3%+-**	1,448	333	23%	1,781	0.1%	1,450	333	1,783	Oct 2013	3.1%	1,494	343	1,837
31---	CONSTRUCTION MANAGEMENT, **2% +-**	966	222	23%	1,188	0.1%	967	222	1,189	Jul 2014	4.3%	1,009	232	1,241
	FEDERAL & Non-FEDERAL SUBTOTAL	50,696	11,672		62,367		51,460	11,846	63,306			53,158	12,236	65,394

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " LPP " DISTRICT: MOBILE

LOCATION: Walton County, Fl P.O.C.: Joseph H. Ellsworth/ Rita B.Perkins

		CURRENT MCACES (MII & CEDEP) ESTIMATE PREPARED: Jan 2012 EFFECTIVE PRICING LEVEL: Sep 2011				AUTHORIZ./BUDGET YEAR: FY - 12 EFFECTIVE PRICING LEVEL: Sep 2011				.....FULLY FUNDED ESTIMATE.....				
ACCOUNT No.	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
17---	Beach Renourishment- 1st Contract (2024)													
	DREDGING	19,224	4,422	23%	23,646	1.6%	19,527	4,492	24,019	Jul 23	23.3%	24,075	5,538	29,613
	DREDGING (Mob & Demob) $995.5k (reference CEDEP for Cost Derivation)													
	DREDGING (Hopper) $18,228.5k (reference CEDEP for Cost Derivation)													
		19,224	4,422		23,646		19,527	4,492	24,019			24,075	5,538	29,613
22---	ENVIRONMENTAL	75	17	23%	92	1.6%	76	17	93	Jul 23	23.3%	94	21	115
	Total (Feature 17 & 22)	19,299	4,439		23,738		19,603	4,509	24,112			24,169	5,559	29,728
30---	PLANNING, ENGINEERING & DESIGN, **3%+-**	579	133	23%	712	0.1%	580	133	713	Oct 22	22.9%	713	163	876
31---	CONSTRUCTION MANAGEMENT, **2% +-**	386	89	23%	475	0.1%	386	89	475	Jul 23	24.5%	480	111	591
	FEDERAL & Non-FEDERAL SUBTOTAL	20,264	4,661		24,925		20,569	4,731	25,300			25,362	5,833	31,195

**** TOTAL CONTRACT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " LPP "
DISTRICT: MOBILE
LOCATION: Walton County, Fl
P.O.C.: Joseph H. Ellsworth/ Rita B.Perkins

ACCOUNT No.	FEATURE DESCRIPTION	CURRENT MCACES (MII & CEDEP) ESTIMATE PREPARED: Jan 2012 EFFECTIVE PRICING LEVEL: Sep 2011 COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	AUTHORIZ./BUDGET YEAR: FY - 12 EFFECTIVE PRICING LEVEL: Sep 2011 OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	.....FULLY FUNDED ESTIMATE..... FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
17---	Beach Renourishment- 2nd Contract (2034)													
	DREDGING	19,224	4,422	23%	23,646	1.6%	19,527	4,492	24,019	Jul 33	55.5%	30,359	6,984	37,343
	DREDGING (Mob & Demob) $995.5k (reference CEDEP for Cost Derivation)													
	DREDGING (Hopper) $18,228.5k (reference CEDEP for Cost Derivation)													
		19,224	4,422		23,646		19,527	4,492	24,019			30,359	6,984	37,343
22---	ENVIRONMENTAL	75	17	23%	92	1.6%	76	17	93	Jul 33	55.5%	118	26	144
	Total (Feature 17 & 22)	19,299	4,439		23,738		19,603	4,509	24,112			30,477	7,010	37,487
30---	PLANNING, ENGINEERING & DESIGN, **3%+-**	579	133	23%	712	0.1%	580	133	713	Oct 32	47.0%	853	195	1,048
31---	CONSTRUCTION MANAGEMENT, **2% +-**	386	89	23%	475	0.1%	386	89	475	Jul 33	48.9%	575	132	707
	FEDERAL & Non-FEDERAL SUBTOTAL	20,264	4,661		24,925		20,569	4,731	25,300			31,905	7,337	39,242

**** TOTAL CONTRACT COST SUMMARY ****

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " LPP "
DISTRICT: MOBILE
LOCATION: Walton County, Fl
P.O.C.: Joseph H. Ellsworth/ Rita B.Perkins

ACCOUNT No.	FEATURE DESCRIPTION	CURRENT MCACES (MII & CEDEP) ESTIMATE PREPARED: Jan 2012 EFFECTIVE PRICING LEVEL: Sep 2011 COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	AUTHORIZ./BUDGET YEAR: FY - 12 EFFECTIVE PRICING LEVEL: Sep 2011 OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	.....FULLY FUNDED ESTIMATE..... FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
17---	Beach Renourishment- 3rd Contract (2044)													
	DREDGING	19,224	4,422	23%	23,646	1.6%	19,527	4,492	24,019	Jul 43	85.8%	36,289	8,348	44,637
	DREDGING (Mob & Demob) $995.5k (reference CEDEP for Cost Derivation)													
	DREDGING (Hopper) $18,228.5k (reference CEDEP for Cost Derivation)													
		19,224	4,422		23,646		19,527	4,492	24,019			36,289	8,348	44,637
22---	ENVIRONMENTAL	75	17	23%	92	1.6%	76	17	93	Jul 43	85.8%	141	32	173
	Total (Feature 17 & 22)	19,299	4,439		23,738		19,603	4,509	24,112			36,430	8,380	44,810
30---	PLANNING, ENGINEERING & DESIGN, **3%+-**	579	133	23%	712	0.1%	580	133	713	Oct 42	76.4%	1,023	235	1,258
31---	CONSTRUCTION MANAGEMENT, **2% +-**	386	89	23%	475	0.1%	386	89	475	Jul 43	78.2%	688	159	847
	FEDERAL & Non-FEDERAL SUBTOTAL	20,264	4,661		24,925		20,569	4,731	25,300			38,141	8,774	46,915

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " LPP "

DISTRICT: MOBILE

LOCATION: Walton County, Fl

P.O.C.: Joseph H. Ellsworth/ Rita B.Perkins

	CURRENT MCACES (MII & CEDEP) ESTIMATE PREPARED: Jan 2012 EFFECTIVE PRICING LEVEL: Sep 2011					AUTHORIZ./BUDGET YEAR: FY - 12 EFFECTIVE PRICING LEVEL: Sep 2011				.....FULLY FUNDED ESTIMATE.....				
ACCOUNT No.	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
17---	Beach Renourishment- 4th Contract (2054)													
	DREDGING	19,224	4,422	23%	23,646	1.6%	19,527	4,492	24,019	Jul 53	110.6%	41,115	9,458	50,573
	DREDGING (Mob & Demob) $995.5k (reference CEDEP for Cost Derivation) DREDGING (Hopper) $18,228.5k (reference CEDEP for Cost Derivation)													
		19,224	4,422		23,646		19,527	4,492	24,019			41,115	9,458	50,573
22---	ENVIRONMENTAL	75	17	23%	92	1.6%	76	17	93	Jul 53	110.6%	160	36	196
	Total (Feature 17 & 22)	19,299	4,439		23,738		19,603	4,509	24,112			41,275	9,494	50,769
30---	PLANNING, ENGINEERING & DESIGN, **3%+-**	579	133	23%	712	0.1%	580	133	713	Oct 52	111.8%	1,228	282	1,510
31---	CONSTRUCTION MANAGEMENT, **2% +-**	386	89	23%	475	0.1%	386	89	475	Jul 53	113.4%	824	190	1,014
	FEDERAL & Non-FEDERAL SUBTOTAL	20,264	4,661		24,925		20,569	4,731	25,300			43,327	9,966	53,293

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " NED & LPP " DISTRICT: MOBILE

LOCATION: Walton County, Fl P.O.C.: Joseph H. Ellsworth / Rita B. Perkins

Derivation of Cost Escalation using the Civil Works Construction Cost Index System (CWCCIS) 30 Sep 2011 for Features 01, 17 & 22

Derivation of Cost Escalation using EC 11-2-200 31 MAR 2011 for Features 30 & 31

	Effective Pricing Level (SEP 2011) to Authorization Budget Year/Month (SEP FY 12)		***Index***	***OMB %***
01---	LANDS and DAMAGES	Sep 2012	795.65	
	PCA	Sep 2011	783.31	1.6%
01---	LANDS and DAMAGES	Sep 2012	795.65	
	EASEMENTS ACQUISITION	Sep 2011	783.31	1.6%
17---	BEACH RENOURISHMENT	Sep 2012	795.65	
	DREDGING	Sep 2011	783.31	1.6%
	BEACH WORK	Sep 2012	795.65	
		Sep 2011	783.31	1.6%
	PLANTING	Sep 2012	795.65	
		Sep 2011	783.31	1.6%
22---	ESI & Environmental	Sep 2012	795.65	
		Sep 2011	783.31	1.6%
		EC 11-2-200%		
30---	PLANNING, ENGINEERING & DESIGN, **3%+-**	Sep 2012	1.014	
		Sep 2011	1.013	0.1%
31---	CONSTRUCTION MANAGEMENT, **2% +-**	Sep 2012	1.014	
		Sep 2011	1.013	0.1%

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " NED & LPP " DISTRICT: MOBILE

LOCATION: Walton County, Fl P.O.C.: Joseph H. Ellsworth / Rita B. Perkins

Derivation of Cost Escalation using the Civil Works Construction Cost Index System (CWCCIS) 30 Sep 2010 for each Feature
Derivation of Cost Escalation using EC 11-2-200 31 MAR 2011 for Features 30 & 31

fully funded 2014

Initial Beach Nourishment (2014)		*Index*	*OMB %*
01--- LANDS and DAMAGES	Apr 2013	804.75	
PCA	Sep 2012	795.65	1.1%
01--- LANDS and DAMAGES	Apr 2013	804.75	
EASEMENTS ACQUISITION	Sep 2012	795.65	1.1%
17--- BEACH RENOURISHMENT	Jul 2014	822.00	
DREDGING	Sep 2012	795.65	3.3%
22--- ENVIRONMENTAL	Jul 2014	822.00	
	Sep 2012	795.65	3.3%
	EC 11-2-200%		
30--- PLANNING, ENGINEERING & DESIGN, **3%+-**	Oct 2013	1.045	
	Sep 2012	1.014	3.1%
31--- CONSTRUCTION MANAGEMENT, **2% +-**	Jul 2014	1.058	
	Sep 2012	1.014	4.3%

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " NED & LPP " DISTRICT: MOBILE

LOCATION: Walton County, Fl P.O.C.: Joseph H. Ellsworth / Rita B. Perkins

Derivation of Cost Escalation using the Civil Works Construction Cost Index System (CWCCIS) 30 Sep 2010 for each Feature

Derivation of Cost Escalation using EC 11-2-200 31 MAR 2011 for Features 30 & 31

fully funded 2024

1 st Beach Re-Nourishment Contract (2024)

			Index	***OMB %***
01---	LANDS and DAMAGES PCA	Oct 2023	967.82	
		Sep 2012	795.65	21.6%
01---	LANDS and DAMAGES EASEMENTS ACQUISITION	Oct 2023	967.82	
		Sep 2012	795.65	21.6%
17---	BEACH RENOURISHMENT DREDGING	Jul 2024	980.97	
		Sep 2012	795.65	23.3%
22---	ENVIRONMENTAL	Jul 2024	980.97	
		Sep 2012	795.65	23.3%
		EC 11-2-200%		
30---	PLANNING, ENGINEERING & DESIGN, **3%+-**	Oct 2023	1.246	
		Sep 2012	1.014	22.9%
31---	CONSTRUCTION MANAGEMENT, **2% +-**	Jul 2024	1.262	
		Sep 2012	1.014	24.5%

Derivation of EC 11-2-200% Indexes

OCT FY 32	1.437	July FY32	1.456
OCT FY 31	1.411	July FY31	1.430
Oct 2033	1.490	July 2034	1.509
Oct 2043	1.789	July 2044	1.807
Oct 2053	2.147	July 2054	2.164

Derivation of Indexes @ 1.8% avg per year

OCTOBER		JULY	
2022	950.71	2022	946.59
2023	967.82	2023	963.63
2024	985.24	2024	980.97
2025	1002.98	2025	998.63
2026	1021.03	2026	1016.61
2027	1039.41	2027	1034.91
2028	1058.12	2028	1053.53
2029	1077.17	2029	1072.50
2030	1096.55	2030	1091.80
2031	1116.29	2031	1111.46
2032	1136.39	2032	1131.46
2033	1156.84	2033	1151.83
2034	1177.66	2034	1172.56
2035	1198.86	2035	1193.67
2036	1220.44	2036	1215.15
2037	1242.41	2037	1237.03
2038	1264.77	2038	1259.29
2039	1287.54	2039	1281.96
2040	1310.71	2040	1305.03
2041	1334.31	2041	1328.52
2042	1358.32	2042	1352.44
2043	1382.77	2043	1376.78
2044	1407.66	2044	1401.56
2045	1433.00	2045	1426.79
2046	1458.80	2046	1452.47
2047	1485.05	2047	1478.62
2048	1511.79	2048	1505.23
2049	1539.00	2049	1532.33
2050	1566.70	2050	1559.91
2051	1594.90	2051	1587.99
2052	1623.61	2052	1616.57
2053	1652.83	2053	1645.67
2054	1682.58	2054	1675.29
2055	1712.87	2055	1705.45

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " NED & LPP " DISTRICT: MOBILE

LOCATION: Walton County, Fl P.O.C.: Joseph H. Ellsworth / Rita B. Perkins

Derivation of Cost Escalation using the Civil Works Construction Cost Index System (CWCCIS) 30 Sep 2010 for each Feature

Derivation of Cost Escalation using EC 11-2-200 31 MAR 2011 for Features 30 & 31

2 nd Beach Re-Nourishment Contract (2034)

			Index	OMB %
01---	LANDS and DAMAGES PCA	Oct 2033	1,220.44	
		Sep 2012	795.65	53.4%
01---	LANDS and DAMAGES EASEMENTS ACQUISITION	Oct 2033	1,220.44	
		Sep 2012	795.65	53.4%
17---	BEACH RENOURISHMENT DREDGING	Jul 2034	1,237.03	
		Sep 2012	795.65	55.5%
22---	ENVIRONMENTAL	Jul 2034	1,237.03	
		Sep 2012	795.65	55.5%
		EC 11-2-200%		
30---	PLANNING, ENGINEERING & DESIGN, **3%+-**	Oct 2033	1.490	
		Sep 2012	1.014	47.0%
31---	CONSTRUCTION MANAGEMENT, **2% +-**	Jul 2034	1.509	
		Sep 2012	1.014	48.9%

Derivation of EC 11-2-200% Indexes

OCT FY 32	1.437	July FY32	1.456
OCT FY 31	1.411	July FY31	1.430
Oct 2033	1.490	July 2034	1.509
Oct 2043	1.789	July 2044	1.807
Oct 2053	2.147	July 2054	2.164

Derivation of Indexes @ 1.8% avg per year

OCTOBER		JULY	
2022	950.71	2022	946.59
2023	967.82	2023	963.63
2024	985.24	2024	980.97
2025	1002.98	2025	998.63
2026	1021.03	2026	1016.61
2027	1039.41	2027	1034.91
2028	1058.12	2028	1053.53
2029	1077.17	2029	1072.50
2030	1096.55	2030	1091.80
2031	1116.29	2031	1111.46
2032	1136.39	2032	1131.46
2033	1156.84	2033	1151.83
2034	1177.66	2034	1172.56
2035	1198.86	2035	1193.67
2036	1220.44	2036	1215.15
2037	1242.41	2037	1237.03
2038	1264.77	2038	1259.29
2039	1287.54	2039	1281.96
2040	1310.71	2040	1305.03
2041	1334.31	2041	1328.52
2042	1358.32	2042	1352.44
2043	1382.77	2043	1376.78
2044	1407.66	2044	1401.56
2045	1433.00	2045	1426.79
2046	1458.80	2046	1452.47
2047	1485.05	2047	1478.62
2048	1511.79	2048	1505.23
2049	1539.00	2049	1532.33
2050	1566.70	2050	1559.91
2051	1594.90	2051	1587.99
2052	1623.61	2052	1616.57
2053	1652.83	2053	1645.67
2054	1682.58	2054	1675.29
2055	1712.87	2055	1705.45

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " NED & LPP " DISTRICT: MOBILE

LOCATION: Walton County, Fl P.O.C.: Joseph H. Ellsworth / Rita B. Perkins

Derivation of Cost Escalation using the Civil Works Construction Cost Index System (CWCCIS) 30 Sep 2010 for each Feature

Derivation of Cost Escalation using EC 11-2-200 31 MAR 2011 for Features 30 & 31

3 rd Beach Re-Nourishment Contract (2044)

			Index	OMB %
01---	LANDS and DAMAGES PCA	Oct 2043	1,458.80	
		Sep 2012	795.65	83.3%
01---	LANDS and DAMAGES EASEMENTS ACQUISITION	Oct 2043	1,458.80	
		Sep 2012	795.65	83.3%
17---	BEACH RENOURISHMENT DREDGING	Jul 2044	1,478.62	
		Sep 2012	795.65	85.8%
22---	ENVIRONMENTAL	Jul 2044	1,478.62	
		Sep 2012	795.65	85.8%
		EC 11-2-200%		
30---	PLANNING, ENGINEERING & DESIGN, **3%+-**	Oct 2043	1.789	
		Sep 2012	1.014	76.4%
31---	CONSTRUCTION MANAGEMENT, **2% +-**	Jul 2044	1.807	
		Sep 2012	1.014	78.2%

Derivation of EC 11-2-200% Indexes

OCT FY 32	1.437	July FY32	1.456
OCT FY 31	1.411	July FY31	1.430
Oct 2033	1.490	July 2034	1.509
Oct 2043	1.789	July 2044	1.807
Oct 2053	2.147	July 2054	2.164

Derivation of Indexes @ 1.8% avg per year

OCTOBER		JULY	
2022	950.71	2022	946.59
2023	967.82	2023	963.63
2024	985.24	2024	980.97
2025	1002.98	2025	998.63
2026	1021.03	2026	1016.61
2027	1039.41	2027	1034.91
2028	1058.12	2028	1053.53
2029	1077.17	2029	1072.50
2030	1096.55	2030	1091.80
2031	1116.29	2031	1111.46
2032	1136.39	2032	1131.46
2033	1156.84	2033	1151.83
2034	1177.66	2034	1172.56
2035	1198.86	2035	1193.67
2036	1220.44	2036	1215.15
2037	1242.41	2037	1237.03
2038	1264.77	2038	1259.29
2039	1287.54	2039	1281.96
2040	1310.71	2040	1305.03
2041	1334.31	2041	1328.52
2042	1358.32	2042	1352.44
2043	1382.77	2043	1376.78
2044	1407.66	2044	1401.56
2045	1433.00	2045	1426.79
2046	1458.80	2046	1452.47
2047	1485.05	2047	1478.62
2048	1511.79	2048	1505.23
2049	1539.00	2049	1532.33
2050	1566.70	2050	1559.91
2051	1594.90	2051	1587.99
2052	1623.61	2052	1616.57
2053	1652.83	2053	1645.67
2054	1682.58	2054	1675.29
2055	1712.87	2055	1705.45

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE General Information Study "GI" (Feasibility Study), DATED: Jan 2012

PROJECT: Walton County Storm Damage Reduction Project, GI Study " NED & LPP " DISTRICT: MOBILE

LOCATION: Walton County, Fl P.O.C.: Joseph H. Ellsworth / Rita B. Perkins

Derivation of Cost Escalation using the Civil Works Construction Cost Index System (CWCCIS) 30 Sep 2010 for each Feature

Derivation of Cost Escalation using EC 11-2-200 31 MAR 2011 for Features 30 & 31

4 th Beach Re-Nourishment Contract (2054)

		Index	OMB %
01--- LANDS and DAMAGES PCA	Oct 2053	1,652.83	
	Sep 2012	795.65	107.7%
01--- LANDS and DAMAGES EASEMENTS ACQUISITION	Oct 2053	1,652.83	
	Sep 2012	795.65	107.7%
17--- BEACH RENOURISHMENT DREDGING	Jul 2054	1,675.29	
	Sep 2012	795.65	110.6%
22--- ENVIRONMENTAL	Jul 2054	1,675.29	
	Sep 2012	795.65	110.6%
	EC 11-2-200%		
30--- PLANNING, ENGINEERING & DESIGN, **3%+-**	Oct 2053	2.147	
	Sep 2012	1.014	111.8%
31--- CONSTRUCTION MANAGEMENT, **2% +-**	Jul 2054	2.164	
	Sep 2012	1.014	113.4%

Derivation of EC 11-2-200% Indexes

OCT FY 32	1.437	July FY32	1.456
OCT FY 31	1.411	July FY31	1.430
Oct 2033	1.490	July 2034	1.509
Oct 2043	1.789	July 2044	1.807
Oct 2053	2.147	July 2054	2.164

Derivation of Indexes @ 1.8% avg per year

OCTOBER		JULY	
2022	950.71	2022	946.59
2023	967.82	2023	963.63
2024	985.24	2024	980.97
2025	1002.98	2025	998.63
2026	1021.03	2026	1016.61
2027	1039.41	2027	1034.91
2028	1058.12	2028	1053.53
2029	1077.17	2029	1072.50
2030	1096.55	2030	1091.80
2031	1116.29	2031	1111.46
2032	1136.39	2032	1131.46
2033	1156.84	2033	1151.83
2034	1177.66	2034	1172.56
2035	1198.86	2035	1193.67
2036	1220.44	2036	1215.15
2037	1242.41	2037	1237.03
2038	1264.77	2038	1259.29
2039	1287.54	2039	1281.96
2040	1310.71	2040	1305.03
2041	1334.31	2041	1328.52
2042	1358.32	2042	1352.44
2043	1382.77	2043	1376.78
2044	1407.66	2044	1401.56
2045	1433.00	2045	1426.79
2046	1458.80	2046	1452.47
2047	1485.05	2047	1478.62
2048	1511.79	2048	1505.23
2049	1539.00	2049	1532.33
2050	1566.70	2050	1559.91
2051	1594.90	2051	1587.99
2052	1623.61	2052	1616.57
2053	1652.83	2053	1645.67
2054	1682.58	2054	1675.29
2055	1712.87	2055	1705.45

ATTACHMENT II

PROGRAMMING & PLANNING COST ESTIMATE SUMMARY

PROGRAMMING & PLANNING COST ESTIMATE SUMMARY

PROJECT:	Walton County Storm Damage Reduction Project	ITEM NO.		DATE	Dec 2009/ Jan 2012
	General Investigation Study (GI)	SHEET NO.	1	OF	6
LOCATION:	Walton County, Florida	PREPARED:	Ellsworth/ Perkins	CHECKED:	Rita B.Perkins
WORK ITEM:	Alternative Formulation Briefing (AFB) Estimate	BASIS OF ESTIMATE:		info per PD Team	
	NED PLAN	FILE NAME:			

Summary-walton-county-fl-storm-damage-reduction-feasibility-ned-lp-plan-Dec 11.xls

DESCRIPTION	Quantity	Unit	Unit Price	ESTIMATED AMOUNT
17 - Initial Beach Nourishment (2014)				
Dredging				
Mobilization, Preparatory Work, Demobilization (CEDEP)	1	ls	allow	$995,500
Dredging, Hopper Dredge (CEDEP)	3,273,000	cy	9.16	29,980,680
Disposal Area Activities	1	job	allow	75,000
Beach Shaping & Grading	11	mo	80,000	880,000
Sea Turtle / Gulf Strugeon Observer	330	days	625	206,250
Mob & Demob Sea Turtle / Strugeon Trawler	1	job	allow	22,000
Sea Turtle / Gulf Strugeon Trawling	330	days	5800	1,914,000
			subtotal	**$34,073,430**
Beach Work Items				
CrossOvers, Wood type (531 EA @ 50 LF/EA @ 90%)	23,895	lf	200	4,779,000
CrossOvers, Trex type (531 EA @ 50 LF/EA @ 10%)	2,655	lf	275	730,125
Misc. Site Items (storm drainage, debris removals, signage, ect.)	1	ls	allow	50,000
			subtotal	**$5,559,125**
Planting (Cost per designer, Mike McKown, per sponors on going contract)				
Sea Oats	2,720,000	plants	0.70	1,904,000
Sand Fencing	75,000	lf	1.28	96,000
			subtotal	**$2,000,000**
				$41,632,555
				rounded

$12.72 per cy	"NED" Current Contract Cost, FY 10	**$41,630,000**

01 Account, Lands & Damage (PCA & Easements)	* reference TPCS
22 EIS & Environmental	* reference TPCS
30 Account, Plan, Engr.& Design	* reference TPCS
31 Account, Constr. Management	* reference TPCS
CONTINGENCY	* reference TPCS
ESCALATION	* reference TPCS
TOTAL PROJECT COST, Fully Funded, FY-54	* reference TPCS

NOTES

Price Level, NOV 11

Unit Cost based on Historical Data, Recent Pricing, & Estimator's Judgment

Reference CEDEP estimate for derivation of Unit Dredging Cost

* Reference TPCS, Total Project Cost Summary, for Fully Funded Cost

PROGRAMMING & PLANNING COST ESTIMATE SUMMARY

PROJECT:	Walton County Storm Damage Reduction Project	ITEM NO.		DATE	ec 2009/ Jan 201
	General Investigation Study (GI)	SHEET NO.	2	OF	6
LOCATION:	Walton County, Florida	PREPARED:	Ellsworth/ Perkins	CHECKED:	
WORK ITEM:	Alternative Formulation Briefing (AFB) Estimate	BASIS OF ESTIMATE:		info per PD Team	
	LP PLAN	FILE NAME:			

Summary-walton-county-fl-storm-damage-reduction-feasibility-ned-lp-plan-Dec 11.xls

DESCRIPTION	Quantity	Unit	Unit Price	ESTIMATED AMOUNT
17 - Initial Beach Nourishment (2014)				
Dredging				
Mobilization, Preparatory Work, Demobilization (CEDEP)	1	ls	allow	$995,500
Dredging, Hopper Dredge (CEDEP)	3,868,000	cy	9.15	35,392,200
Disposal Area Activities	1	job	allow	75,000
Beach Shaping & Grading	13	mo	80,000	1,040,000
Sea Turtle / Gulf Strugeon Observer	390	days	625	243,750
Mob & Demob Sea Turtle / Strugeon Trawler	1	job	allow	22,000
Sea Turtle / Gulf Strugeon Trawling	390	days	5800	2,262,000
			subtotal	**$40,030,450**
Beach Work Items				
CrossOvers, Wood type (531 EA @ 50 LF/EA @ 90%)	23,895	lf	200	4,779,000
CrossOvers, Trex type (531 EA @ 50 LF/EA @ 10%)	2,655	lf	275	730,125
Misc. Site Items (storm drainage, debris removals, signage, ect.)	1	ls	allow	50,000
			subtotal	**$5,559,125**
Planting (Cost per designer, Mike McKown, per sponors on going contract)				
Sea Oats	2,720,000	plants	0.70	1,904,000
Sand Fencing	75,000	lf	1.28	96,000
			subtotal	**$2,000,000**
				$47,589,575
				rounded

$12.30 per cy	"LP" Current Contract Cost, FY 10	**$47,590,000**

01 Account, Lands & Damage (PCA & Easements)	* reference TPCS
22 EIS & Environmental	* reference TPCS
30 Account, Plan, Engr.& Design	* reference TPCS
31 Account, Constr. Management	* reference TPCS
CONTINGENCY	* reference TPCS
ESCALATION	* reference TPCS
TOTAL PROJECT COST, Fully Funded, FY-54	* reference TPCS

NOTES

Price Level, NOV 11

Unit Cost based on Historical Data, Recent Pricing, & Estimator's Judgment

Reference CEDEP estimate for derivation of Unit Dredging Cost

* Reference TPCS, Total Project Cost Summary, for Fully Funded Cost

PROGRAMMING & PLANNING COST ESTIMATE SUMMARY

PROJECT:	Walton County Storm Damage Reduction Project	ITEM NO.		DATE	ec 2009/ Jan 201
	General Investigation Study (GI)	SHEET NO.	3	OF	6
LOCATION:	Walton County, Florida	PREPARED:	Joseph H. Ellsworth	CHECKED:	
WORK ITEM:	Alternative Formulation Briefing (AFB) Estimate	BASIS OF ESTIMATE:		info per PD Team	
	Typical NED Renourishment	FILE NAME:			

Summary-walton-county-fl-storm-damage-reduction-feasibility-ned-lp-plan-Dec 11.xls

DESCRIPTION	Quantity	Unit	Unit Price	ESTIMATED AMOUNT
17 - Beach Renourishment (2024, 2034, 2044, 2054)				
Dredging				
Mobilization, Preparatory Work, Demobilization (CEDEP)	1	ls	allow	$995,500
Dredging, Hopper Dredge (CEDEP)	1,585,000	cy	9.24	14,645,400
Disposal Area Activities	1	job	allow	75,000
Beach Shaping & Grading	5	mo	80,000	400,000
Sea Turtle / Gulf Strugeon Observer	150	days	625	93,750
Mob & Demob Sea Turtle / Strugeon Trawler	1	job	allow	22,000
Sea Turtle / Gulf Strugeon Trawling	150	days	5800	870,000
				$17,101,650
				rounded

$10.79 per cy	"Typical" Current Contract Cost, FY 1	**$17,100,000**

01 Account, Lands & Damage (PCA & Easements)	* reference TPCS
22 EIS & Environmental	* reference TPCS
30 Account, Plan, Engr.& Design	* reference TPCS
31 Account, Constr. Management	* reference TPCS
CONTINGENCY	* reference TPCS
ESCALATION	* reference TPCS
Typical NED Renourishment TOTAL PROJECT COST, Fully Funded	* reference TPCS

NOTES

Price Level, NOV 11

Unit Cost based on Historical Data, Recent Pricing, & Estimator's Judgment

Reference CEDEP estimate for derivation of Unit Dredging Cost

* Reference TPCS, Total Project Cost Summary, for Fully Funded Cost

PROGRAMMING & PLANNING COST ESTIMATE SUMMARY

PROJECT:	Walton County Storm Damage Reduction Project	ITEM NO.		DATE	ec 2009/ Jan 201
	General Investigation Study (GI)	SHEET NO.	4	OF	6
LOCATION:	Walton County, Florida	PREPARED:	Joseph H. Ellsworth	CHECKED:	
WORK ITEM:	Alternative Formulation Briefing (AFB) Estimate	BASIS OF ESTIMATE:		info per PD Team	
	Typical LLP Renourishment	FILE NAME:			

Summary-walton-county-fl-storm-damage-reduction-feasibility-ned-lp-plan-Dec 11.xls

DESCRIPTION	Quantity	Unit	Unit Price	ESTIMATED AMOUNT
17 - Beach Renourishment (2024, 2034, 2044, 2054)				
Dredging				
Mobilization, Preparatory Work, Demobilization (CEDEP)	1	ls	allow	$995,500
Dredging, Hopper Dredge (CEDEP)	1,789,000	cy	9.22	16,494,580
Disposal Area Activities	1	job	allow	75,000
Beach Shaping & Grading	6	mo	80,000	480,000
Sea Turtle / Gulf Strugeon Observer	180	days	625	112,500
Mob & Demob Sea Turtle / Strugeon Trawler	1	job	allow	22,000
Sea Turtle / Gulf Strugeon Trawling	180	days	5800	1,044,000
				$19,223,580
				rounded

$10.75 per cy	"Typical" Current Contract Cost, FY 1	**$19,220,000**

01 Account, Lands & Damage (PCA & Easements)	* reference TPCS
22 EIS & Environmental	* reference TPCS
30 Account, Plan, Engr.& Design	* reference TPCS
31 Account, Constr. Management	* reference TPCS
CONTINGENCY	* reference TPCS
ESCALATION	* reference TPCS
Typical LPP Renourishment TOTAL PROJECT COST, Fully Funded	* reference TPCS

NOTES

Price Level, NOV 11

Unit Cost based on Historical Data, Recent Pricing, & Estimator's Judgment

Reference CEDEP estimate for derivation of Unit Dredging Cost

* Reference TPCS, Total Project Cost Summary, for Fully Funded Cost

BASIS of COST ESTIMATE and RATIONALE

PROJECT:	Walton County Storm Damage Reduction Project	ITEM NO.		DATE	Dec 2009/ Jan 2012
	General Investigation Study (GI) Feasibility	SHEET NO.	5	OF	6
LOCATION:	Walton County, Florida	PREPARED:	Joseph H. Ellsworth	CHECKED:	
WORK ITEM:		BASIS OF ESTIMATE:		info per PD Team	
		FILE NAME:			

Summary-walton-county-fl-storm-damage-reduction-feasibility-ned-lp-plan-Dec 11.xls

Estimates are Comparative-Level Type and are based on Historical Data, Recent Pricing, and Estimator's Judgment. Estimate is structured and priced as a general prime dredging contractor supported by minor subcontractors. Anticipated bidding conditions and construction duration with reasonable schedules are considered Normal. Unit cost as shown in estimates, are fair and reasonable rates based on fair market value.

Estimate Format is an Excel Summary spreadsheet, MII (MCACES) structured by feature accounts, and Corps of Engineer Dredge Estimating Program (CEDEP) incorporated into the Total Project Cost Summary (TPCS).

> ***Excel Spreadsheet*** was used for Summarizing and Narrative for Basis of Estimate and Rationale.
>
> ***MII (MCACES 2nd generation)*** was structured by feature account incorporating input cost from CEDEP. MII itemized the supporting items for Beach work and Planting cost.
>
> ***Corps of Engineers Dredge Estimating Program (CEDEP)*** was used for development of the Dredging Cost.
>
> ***Total Project Cost Summary (TPCS)*** was prepared for both the NED and the LP Plan.

Price Level of Estimate is FY 11 (SEP 11)

Authorized Year is FY 12

Initial Construction Start is FY 14

Renourishment Construction, four required over life of project (2024, 2034, 2044, & 2054)

Quantities listed within the estimates represent Major Elements of the Project Scope and were furnished by the Project Delivery Team. Where quantities were not available, assumptions were made based on historical information and Estimator's judgment.

Markups for both prime and subcontractors are included in the unit prices and include such items as field overheads, home office expenses, profit, bond and insurance. Reference CECEP estimates for detail backup.

Construction Contingency was developed using the Cost Risk Analysis method. Risk Analysis is a requirement for development of contingency on Civil Works for all decision documents requiring authorization for projects exceeding 40 million dollars. The contingency factor used does not vary throughout the cost estimate except for Real Estate which is 25% determined by the Real Estate team. Risk Analysis was developed as a team effort by the PD Team and Walla Walla DX (Glen Matlock).

Cost Risk Analysis was prepared for the the Draft Feasibility Report. A Risk Register was developed by the PD Team. The Risk Model was prepared by Walla Walla, Glenn Matlock and was customized using commercially available "Crystal Ball" software. After the model was run the results were documented by extracting the sensitivity chart, the forecast chart and the percentiles table for major items. The percentiles were used to determine the contingency at the 80% confidence level.

BASIS of COST ESTIMATE and RATIONALE

PROJECT:	Walton County Storm Damage Reduction Project	ITEM NO.		DATE	Dec 2009/ Jan 2012
	General Investigation Study (GI) Feasibility	SHEET NO.	6	OF	6
LOCATION:	Walton County, Florida	PREPARED:	Joseph H. Ellsworth	CHECKED:	
WORK ITEM:		BASIS OF ESTIMATE:		info per PD Team	
		FILE NAME:			

Summary-walton-county-fl-storm-damage-reduction-feasibility-ned-lp-plan-Dec 11.x

EIS & Environmental (22 feature account) were provided Study Manager, Joseph Paine.

Real Estate Cost (01 feature account) was prepared by the Mobile District Real Estate Divison.

Planning, Engineering & Design (30 feature account) was developed and assigned at 3% by the PDT. This is the percentage that has historically been used for these types of civil works projects.

Construction Management (31 feature account) was developed and assigned at 2% by the PDT. This is the percentage that has historically been used for these type of civil works projects.

Escalation factor are based on the CWCCIS and were used in the TPCS to escalate the effective pricing level to the anticipated feature midpoint.

POC's Listed are all Cost Engineering Personnel that worked or furnish Cost information.

Joseph H. Ellsworth	Lead Cost Engineer	CESAM	251-690-2628
Rita B.Perkins	Cost Engineer	CESAM	251-694-3749
George F. Rush	Civil Engineer -Dredging	CESAM	251-694-3715
John G. Miller	Hydraulic Engineer	CESAM	251-690-3115
Elizabeth S. Godsey	Planning Engineer	CESAM	251-694-3848
Russell W Blount	Real Estate Specialist	CESAM	251-694-3675
Joseph W. Paine	Planning Study Manager	CESAM	251-694-3832
Larry E. Parsons	Planning Environmental	CESAM	251-690-3139

Dredging unit prices, including Mobilization & Demobilization were derived from CEDEP and compared to Historical Data. Estimates were reviewed and coordinated with Mobile District Operations Divison personnel. CEDEP estimates are available upon request. These estimates are not included in the Report.

Beach & Dune Planting (Sea Oats & Sand Fencing) are based on recent cost provided by the Local Sponsor and reviewed by Planning.

Beach Cross-Overs are based on recent cost provided by the Local sponsor.

ATTACHMENT III

MCACES (MII) OUTPUT REPORT

Walton County Storm Damage Reduction-Feasibilty, Florida "NED" Plan

BASIS of COST ESTIMATE and RATIONALE

Reference excel file:wlaton-county-fl-storm-damage-reduction-feasibility-summary-ned-lp-plan-jan12.xls for a complete Narrative for Basis of Estimate and Rationale.

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-MII (MCACES 2nd generation) was structured by feature account incorporating input cost from CEDEP. MII itemized the supporting items for Beach work and Planting cost.

Price Level of Estimate is FY 11 (Sep 11)

Authorized Year is FY 12

Construction Start is FY 14

Estimated by	CESAM-EN-E, Cost Engineering Branch
Designed by	CESAM-EN-E, Mobile District, Corps of Engineers
Prepared by	Joseph Ellsworth/ Rita Perkins
Preparation Date	9/1/2011
Effective Date of Pricing	9/1/2011
Estimated Construction Time	Days

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project file: walton-county-fl-storm damage reduction-feasibility-NED plan-jan12.mlp

report file: Walton-feasibilty standard report selection-NED plan.mrp

output file: walton-county-fl-storm damage reduction-feasibility-NED plan-jan12.doc

Description	Quantity	UOM	CostToPrime	JOOH	HOOH	Profit	Bond	Excise	ContractCost
Contract Cost Summary Report			**41,632,555**	**0**	**0**	**0**	**0**	**0**	**41,632,555**
			12.43						*12.43*
Beach Renourishment "NED" Plan	**3,350,000.00**	**CY**	**41,632,555**	**0**	**0**	**0**	**0**	**0**	**41,632,555**
17 Federal / Non-Federa Costs	**1.00**	**LS**	**41,632,555**	**0**	**0**	**0**	**0**	**0**	**41,632,555**
			12.43						*12.43*
17 Beach Replenishment Dredging	**3,350,000.00**	**CY**	**41,632,555**	**0**	**0**	**0**	**0**	**0**	**41,632,555**
Mobilization, Demobilization, Preparatory Work	**1.00**	**LS**	**995,500**	**0**	**0**	**0**	**0**	**0**	**995,500**
(Note: Reference CEDEP for Cost Derivation. Mob / Demob to and from job)									
			995,500.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*995,500.00*
USR Mob & Demob - Hopper (CEDEP)	1.00	EA	995,500	0	0	0	0	0	995,500
(Note: Cost from CEDEP)									
			9.87						*9.87*
Hopper Dredging	**3,350,000.00**	**CY**	**33,077,930**	**0**	**0**	**0**	**0**	**0**	**33,077,930**
(Note: Referenc CEDEP for Cost Derivation)									
			9.16	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*9.16*
USR Sand Borrow (by Hopper Dredge)	3,273,000.00	CY	29,980,680	0	0	0	0	0	29,980,680
(Note: Referenc CEDEP for Cost Derivation)									
			80,000.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*80,000.00*
USR Beach Grading & Shaping	11.00	MO	880,000	0	0	0	0	0	880,000
(Note: Land base Equipment, Loaders, dosers, ect. Unit Cost base on Historical data)									
			625.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*625.00*
USR Sea Turtle / Gulf Strugeon Observer	330.00	DAY	206,250	0	0	0	0	0	206,250
(Note: Cost based on recent on going Hopper projects within area)									
USR Mob & Demob Sea Turtle/Strugeon Trawler	1.00	LS	22,000	0	0	0	0	0	22,000
(Note: Cost based on recent on going Hopper projects within area)									
			5,800.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*5,800.00*
USR Sea Turtle / Gulf Strugeon Trawling	330.00	DAY	1,914,000	0	0	0	0	0	1,914,000
(Note: Cost based on recent on going Hopper projects within area)									
USR Disposal Area Activities	1.00	LS	75,000	0	0	0	0	0	75,000
(Note: Cost based on Historical Data)									
Beach & Dune Planting	**1.00**	**LS**	**2,000,000**	**0**	**0**	**0**	**0**	**0**	**2,000,000**

Walton County Storm Damage Reduction-Feasibilty, Florida "LP" Plan

BASIS of COST ESTIMATE and RATIONALE

Reference excel file:wlaton-county-fl-storm-damage-reduction-feasibility-summary-ned-lp-plan-jan12.xls for a complete Narrative for Basis of Estimate and Rationale.

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-MII (MCACES 2nd generation) was structured by feature account incorporating input cost from CEDEP. MII itemized the supporting items for Beach work and Planting cost.

Price Level of Estimate is FY 11 (SEP 11)

Authorized Year is FY 12

Construction Start is FY 14

Estimated by	CESAM-EN-E, Cost Engineering Branch
Designed by	CESAM-EN-E, Mobile District, Corps of Engineers
Prepared by	Joseph Ellsworth/ Rita Perkins
Preparation Date	9/1/2011
Effective Date of Pricing	9/1/2011
Estimated Construction Time	Days

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project file: walton-county-fl-storm damage reduction-feasibility-LP plan-jan12.mlp

report file: Walton-feasibilty standard report selection-LP plan.mrp

output file: walton-county-fl-storm damage reduction-feasibility-lp plan-jan12.doc

Description	Quantity	UOM	CostToPrime	JOOH	HOOH	Profit	Bond	Excise	ContractCost
Contract Cost Summary Report			**47,589,575**	**0**	**0**	**0**	**0**	**0**	**47,589,575**
			14.21						*14.21*
Beach Renourishment "LP" Plan	**3,350,000.00**	**CY**	**47,589,575**	**0**	**0**	**0**	**0**	**0**	**47,589,575**
17 Federal / Non-Federa Costs	**1.00**	**LS**	**47,589,575**	**0**	**0**	**0**	**0**	**0**	**47,589,575**
			14.21						*14.21*
17 Beach Replenishment Dredging	**3,350,000.00**	**CY**	**47,589,575**	**0**	**0**	**0**	**0**	**0**	**47,589,575**
Mobilization, Demobilization, Preparatory Work	**1.00**	**LS**	**995,500**	**0**	**0**	**0**	**0**	**0**	**995,500**
(Note: Reference CEDEP for Cost Derivation. Mob / Demob to and from job)									
			995,500.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*995,500.00*
USR Mob & Demob - Hopper (CEDEP)	1.00	EA	995,500	0	0	0	0	0	995,500
(Note: Cost from CEDEP)									
			11.65						*11.65*
Hopper Dredging	**3,350,000.00**	**CY**	**39,034,950**	**0**	**0**	**0**	**0**	**0**	**39,034,950**
(Note: Referenc CEDEP for Cost Derivation)									
			9.15	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*9.15*
USR Sand Borrow (by Hopper Dredge)	3,868,000.00	CY	35,392,200	0	0	0	0	0	35,392,200
(Note: Referenc CEDEP for Cost Derivation)									
			80,000.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*80,000.00*
USR Beach Grading & Shaping	13.00	MO	1,040,000	0	0	0	0	0	1,040,000
(Note: Land base Equipment, Loaders, dosers, ect. Unit Cost base on Historical data)									
			625.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*625.00*
USR Sea Turtle / Gulf Strugeon Observer	390.00	DAY	243,750	0	0	0	0	0	243,750
(Note: Cost based on recent on going Hopper projects within area)									
USR Mob & Demob Sea Turtle/Strugeon Trawler	1.00	LS	22,000	0	0	0	0	0	22,000
(Note: Cost based on recent on going Hopper projects within area)									
			5,800.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*5,800.00*
USR Sea Turtle / Gulf Strugeon Trawling	390.00	DAY	2,262,000	0	0	0	0	0	2,262,000
(Note: Cost based on recent on going Hopper projects within area)									
USR Disposal Area Activities	1.00	LS	75,000	0	0	0	0	0	75,000
(Note: Cost based on Historical Data)									
Beach & Dune Planting	**1.00**	**LS**	**2,000,000**	**0**	**0**	**0**	**0**	**0**	**2,000,000**

Description	Quantity	UOM	CostToPrime	JOOH	HOOH	Profit	Bond	Excise	ContractCost
			0.70	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.70*
USR Sea Oats	2,720,000.00	EA	1,904,000	0	0	0	0	0	1,904,000
(Note: Contractor shall be required to guarantee that 80% of the planted vegetation is in good condition one (1) year after initial planting. Planting shall be accomplished by hand. Fertilizer shall be placed in the bottom of hole at required rate. Cost furnished by Sponsor for on going project within area.)									
			1.28	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*1.28*
USR Sand Fencing	75,000.00	EA	96,000	0	0	0	0	0	96,000
Beach Work Items	**1.00**	**LS**	**5,559,125**	**0**	**0**	**0**	**0**	**0**	**5,559,125**
(Note: Quantities for Beach Cross-Overs were furnished by the Project Delivery Team. The type Cross-Overs were based on the Local Sponsors' previously constructed designs. Wood type is estimated at 531 ea @ 50 LF/EA @ 90% = 23,895 lf. Trex type is estimated at 531 ea @ 50 LF/EA @ 10% = 2,655 lf. Total unit cost (Cost to Prime) for material, labor, and equipment was developed and based on reported costs from prior projects from the Local Sponsor. Even though the Cross-Overs are derived from recently constructed projects, the linear foot cost appears to be fair and reasonable as compared to historical data of similar construction along the Gulf Coast Area. Currently construction prices appear to remain unusually low for the general area. It is anticipated that the final unit prices will be updated to reflect the detailed design when completed.)									
			200.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*200.00*
USR CrossOvers, Wood type	23,895.00	LF	4,779,000	0	0	0	0	0	4,779,000
(Note: (Estimate 531 cross-overs @ 50 lf/ea @ 90% = 23,895 lf))									
			275.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*275.00*
USR CrossOvers, Trex type	2,655.00	LF	730,125	0	0	0	0	0	730,125
(Note: (Estimate 531 cross-overs @ 50 lf/ea @ 10% = 2,655 lf))									
USR Misc Site Items	1.00	LS	50,000	0	0	0	0	0	50,000
(Note: Storm Drainage, Debris removals, Signage, etc)									

Walton County Storm Damage Reduction-Feasibilty, Florida "LP" Plan

BASIS of COST ESTIMATE and RATIONALE

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Price Level of Estimate is FY 11 (SEP 11)

Authorized Year is FY 12

Construction Start is FY 14

Estimated by	CESAM-EN-E, Cost Engineering Branch
Designed by	CESAM-EN-E, Mobile District, Corps of Engineers
Prepared by	Joseph Ellsworth/ Rita Perkins
Preparation Date	9/1/2011
Effective Date of Pricing	9/1/2011
Estimated Construction Time	Days

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report file: Walton-feasibilty standard report selection-LP plan.mrp

output file: walton-county-fl-storm damage reduction-feasibility-lp plan-jan12.doc

Description	Quantity	UOM	CostToPrime	JOOH	HOOH	Profit	Bond	Excise	ContractCost
Contract Cost Summary Report			**47,589,575**	**0**	**0**	**0**	**0**	**0**	**47,589,575**
			14.21						*14.21*
Beach Renourishment "LP" Plan	**3,350,000.00**	**CY**	**47,589,575**	**0**	**0**	**0**	**0**	**0**	**47,589,575**
17 Federal / Non-Federa Costs	**1.00**	**LS**	**47,589,575**	**0**	**0**	**0**	**0**	**0**	**47,589,575**
			14.21						*14.21*
17 Beach Replenishment Dredging	**3,350,000.00**	**CY**	**47,589,575**	**0**	**0**	**0**	**0**	**0**	**47,589,575**
Mobilization, Demobilization, Preparatory Work	**1.00**	**LS**	**995,500**	**0**	**0**	**0**	**0**	**0**	**995,500**
(Note: Reference CEDEP for Cost Derivation. Mob / Demob to and from job)									
			995,500.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*995,500.00*
USR Mob & Demob - Hopper (CEDEP)	1.00	EA	995,500	0	0	0	0	0	995,500
(Note: Cost from CEDEP)									
			11.65						*11.65*
Hopper Dredging	**3,350,000.00**	**CY**	**39,034,950**	**0**	**0**	**0**	**0**	**0**	**39,034,950**
(Note: Referenc CEDEP for Cost Derivation)									
			9.15	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*9.15*
USR Sand Borrow (by Hopper Dredge)	3,868,000.00	CY	35,392,200	0	0	0	0	0	35,392,200
(Note: Referenc CEDEP for Cost Derivation)									
			80,000.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*80,000.00*
USR Beach Grading & Shaping	13.00	MO	1,040,000	0	0	0	0	0	1,040,000
(Note: Land base Equipment, Loaders, dosers, ect. Unit Cost base on Historical data)									
			625.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*625.00*
USR Sea Turtle / Gulf Strugeon Observer	390.00	DAY	243,750	0	0	0	0	0	243,750
(Note: Cost based on recent on going Hopper projects within area)									
USR Mob & Demob Sea Turtle/Strugeon Trawler	1.00	LS	22,000	0	0	0	0	0	22,000
(Note: Cost based on recent on going Hopper projects within area)									
			5,800.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*5,800.00*
USR Sea Turtle / Gulf Strugeon Trawling	390.00	DAY	2,262,000	0	0	0	0	0	2,262,000
(Note: Cost based on recent on going Hopper projects within area)									
USR Disposal Area Activities	1.00	LS	75,000	0	0	0	0	0	75,000
(Note: Cost based on Historical Data)									
Beach & Dune Planting	**1.00**	**LS**	**2,000,000**	**0**	**0**	**0**	**0**	**0**	**2,000,000**

Description	Quantity	UOM	CostToPrime	JOOH	HOOH	Profit	Bond	Excise	ContractCost
			0.70	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.70*
USR Sea Oats	2,720,000.00	EA	1,904,000	0	0	0	0	0	1,904,000
(Note: Contractor shall be required to guarantee that 80% of the planted vegetation is in good condition one (1) year after initial planting. Planting shall be accomplished by hand. Fertilizer shall be placed in the bottom of hole at required rate. Cost furnished by Sponsor for on going project within area.)									
			1.28	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*1.28*
USR Sand Fencing	75,000.00	EA	96,000	0	0	0	0	0	96,000
Beach Work Items	**1.00**	**LS**	**5,559,125**	**0**	**0**	**0**	**0**	**0**	**5,559,125**
(Note: Quantities for Beach Cross-Overs were furnished by the Project Delivery Team. The type Cross-Overs were based on the Local Sponsors' previously constructed designs. Wood type is estimated at 531 ea @ 50 LF/EA @ 90% = 23,895 lf. Trex type is estimated at 531 ea @ 50 LF/EA @ 10% = 2,655 lf. Total unit cost (Cost to Prime) for material, labor, and equipment was developed and based on reported costs from prior projects from the Local Sponsor. Even though the Cross-Overs are derived from recently constructed projects, the linear foot cost appears to be fair and reasonable as compared to historical data of similar construction along the Gulf Coast Area. Currently construction prices appear to remain unusually low for the general area. It is anticipated that the final unit prices will be updated to reflect the detailed design when completed.)									
			200.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*200.00*
USR CrossOvers, Wood type	23,895.00	LF	4,779,000	0	0	0	0	0	4,779,000
(Note: (Estimate 531 cross-overs @ 50 lf/ea @ 90% = 23,895 lf))									
			275.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*275.00*
USR CrossOvers, Trex type	2,655.00	LF	730,125	0	0	0	0	0	730,125
(Note: (Estimate 531 cross-overs @ 50 lf/ea @ 10% = 2,655 lf))									
USR Misc Site Items	1.00	LS	50,000	0	0	0	0	0	50,000
(Note: Storm Drainage, Debris removals, Signage, etc)									

Walton County Storm Damage Reduction-Feasibilty, Florida NED "Renourishment" Plan

BASIS of COST ESTIMATE and RATIONALE

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Price Level of Estimate is FY 11 (Sep 11)

Authorized Year is FY 12

Construction Start is FY 14

Estimated by	CESAM-EN-E, Cost Engineering Branch
Designed by	CESAM-EN-E, Mobile District, Corps of Engineers
Prepared by	Joseph Ellsworth/ Rita Perkins
Preparation Date	12/1/2011
Effective Date of Pricing	9/1/2011
Estimated Construction Time	Days

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report file: Walton-feasibilty standard report selection-renourishment.mrp

output file: walton-county-fl-storm damage reduction-feasibility-renourishment-jan12.doc

Description	Quantity	UOM	CostToPrime	JOOH	HOOH	Profit	Bond	Excise	ContractCost
Contract Cost Summary Report			**17,101,650**	**0**	**0**	**0**	**0**	**0**	**17,101,650**
			8.55						*8.55*
Beach Renourishment Typical Cost (2024, 2034, 2044, 2054)	**2,000,000.00**	**CY**	**17,101,650**	**0**	**0**	**0**	**0**	**0**	**17,101,650**
17 Federal / Non-Federal Costs	**1.00**	**LS**	**17,101,650**	**0**	**0**	**0**	**0**	**0**	**17,101,650**
			8.55						*8.55*
17 Beach Replenishment Dredging Typical Cost for One (1) Renourishment	**2,000,000.00**	**CY**	**17,101,650**	**0**	**0**	**0**	**0**	**0**	**17,101,650**
Mobilization, Demobilization, Preparatory Work	**1.00**	**LS**	**995,500**	**0**	**0**	**0**	**0**	**0**	**995,500**
(Note: Reference CEDEP for Cost Derivation. Mob / Demob to and from job)									
			995,500.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*995,500.00*
USR Mob & Demob - Hopper (CEDEP)	1.00	EA	995,500	0	0	0	0	0	995,500
(Note: Cost from CEDEP)									
			8.05						*8.05*
Hopper Dredging	**2,000,000.00**	**CY**	**16,106,150**	**0**	**0**	**0**	**0**	**0**	**16,106,150**
(Note: Referenc CEDEP for Cost Derivation)									
			9.24	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*9.24*
USR Sand Borrow (by Hopper Dredge)	1,585,000.00	CY	14,645,400	0	0	0	0	0	14,645,400
(Note: Referenc CEDEP for Cost Derivation)									
			80,000.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*80,000.00*
USR Beach Grading & Shaping	5.00	MO	400,000	0	0	0	0	0	400,000
(Note: Land base Equipment, Loaders, dosers, ect. Unit Cost base on Historical data)									
			625.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*625.00*
USR Sea Turtle / Gulf Strugeon Observer	150.00	DAY	93,750	0	0	0	0	0	93,750
(Note: Cost based on recent on going Hopper projects within area)									
USR Mob & Demob Sea Turtle/Strugeon Trawler	1.00	LS	22,000	0	0	0	0	0	22,000
(Note: Cost based on recent on going Hopper projects within area)									
			5,800.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*5,800.00*
USR Sea Turtle / Gulf Strugeon Trawling	150.00	DAY	870,000	0	0	0	0	0	870,000
(Note: Cost based on recent on going Hopper projects within area)									
USR Disposal Area Activities	1.00	LS	75,000	0	0	0	0	0	75,000
(Note: Cost based on Historical Data)									

Walton County Storm Damage Reduction-Feasibilty, Florida LP "Renourishment" Plan

BASIS of COST ESTIMATE and RATIONALE

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-MII (MCACES 2nd generation) was structured by feature account incorporating input cost from CEDEP. MII itemized the supporting items for Beach work and Planting cost.

Price Level of Estimate is FY 11 (Sep 11)

Authorized Year is FY 12

Construction Start is FY 14

Estimated by	CESAM-EN-E, Cost Engineering Branch
Designed by	CESAM-EN-E, Mobile District, Corps of Engineers
Prepared by	Joseph Ellsworth/ Rita Perkins
Preparation Date	12/1/2011
Effective Date of Pricing	9/1/2011
Estimated Construction Time	Days

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project file: walton-county-fl-storm damage reduction-feasibility-renourishment-LP-jan12.mlp

report file: Walton-feasibilty standard report selection-renourishment.mrp

output file: walton-county-fl-storm damage reduction-feasibility-renourishment-LP-jan12.doc

Description	Quantity	UOM	CostToPrime	JOOH	HOOH	Profit	Bond	Excise	ContractCost
Contract Cost Summary Report			**19,223,580**	**0**	**0**	**0**	**0**	**0**	**19,223,580**
			9.61						*9.61*
Beach Renourishment Typical Cost (2024, 2034, 2044, 2054)	**2,000,000.00**	**CY**	**19,223,580**	**0**	**0**	**0**	**0**	**0**	**19,223,580**
17 Federal / Non-Federal Costs	**1.00**	**LS**	**19,223,580**	**0**	**0**	**0**	**0**	**0**	**19,223,580**
			9.61						*9.61*
17 Beach Replenishment Dredging Typical Cost for One (1) Renourishment	**2,000,000.00**	**CY**	**19,223,580**	**0**	**0**	**0**	**0**	**0**	**19,223,580**
Mobilization, Demobilization, Preparatory Work	**1.00**	**LS**	**995,500**	**0**	**0**	**0**	**0**	**0**	**995,500**
(Note: Reference CEDEP for Cost Derivation. Mob / Demob to and from job)									
			995,500.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*995,500.00*
USR Mob & Demob - Hopper (CEDEP)	1.00	EA	995,500	0	0	0	0	0	995,500
(Note: Cost from CEDEP)									
			10.19						*10.19*
Hopper Dredging	**1,789,000.00**	**CY**	**18,228,080**	**0**	**0**	**0**	**0**	**0**	**18,228,080**
(Note: Referenc CEDEP for Cost Derivation)									
			9.22	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*9.22*
USR Sand Borrow (by Hopper Dredge)	1,789,000.00	CY	16,494,580	0	0	0	0	0	16,494,580
(Note: Referenc CEDEP for Cost Derivation)									
			80,000.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*80,000.00*
USR Beach Grading & Shaping	6.00	MO	480,000	0	0	0	0	0	480,000
(Note: Land base Equipment, Loaders, dosers, ect. Unit Cost base on Historical data)									
			625.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*625.00*
USR Sea Turtle / Gulf Strugeon Observer	180.00	DAY	112,500	0	0	0	0	0	112,500
(Note: Cost based on recent on going Hopper projects within area)									
USR Mob & Demob Sea Turtle/Strugeon Trawler	1.00	LS	22,000	0	0	0	0	0	22,000
(Note: Cost based on recent on going Hopper projects within area)									
			5,800.00	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*0.00%*	*5,800.00*
USR Sea Turtle / Gulf Strugeon Trawling	180.00	DAY	1,044,000	0	0	0	0	0	1,044,000
(Note: Cost based on recent on going Hopper projects within area)									
USR Disposal Area Activities	1.00	LS	75,000	0	0	0	0	0	75,000
(Note: Cost based on Historical Data)									

ATTACHMENT IV

PROJECT COST AND SCHEDULE RISK ANALYSIS REPORT

US Army Corps
of Engineers®

WALTON COUNTY HURRICANE AND STORM DAMAGE REDUCTION WALTON COUNTY, FLORIDA GENERAL INVESTIGATIONS STUDY

Project Cost and Schedule Risk Analysis Report

Prepared for:

U.S. Army Corps of Engineers,
Mobile District

Prepared by:

U.S. Army Corps of Engineers
Cost Engineering Directory of Expertise, Walla Walla

March 10, 2010

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APPENDIX

APPENDIX A includes

Detailed Risk Analysis

- Risk Register Summary
- Sensitivity Charts
- Project Cost Presentation
- Project Confidence Curves

EXECUTIVE SUMMARY

Under the auspices of the U.S. Army Corps of Engineers (USACE), Mobile District District, this report presents a recommendation for the total project cost and schedule contingencies for the Walton County Hurricane and Storm Damage Reduction General Investigations Study. In compliance with Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated September 15, 2008, a formal risk analysis study was conducted for the development of contingency on the total project cost. The purpose of this risk analysis study was to establish project contingencies by identifying and measuring the cost and schedule impact of project uncertainties with respect to the estimated total project cost.

Specific to the Walton County project, the most likely project cost is estimated at approximately $47 Million. Based on the results of the analysis, the Cost Engineering Directory of Expertise for Civil Works (Walla Walla District) recommends a contingency value of $9 Million, or 23%.

The Project Delivery Team (PDT) conducted a brainstorming session to identify the risks associated with the project. Walla Walla Cost Dx performed risk analysis using the *Monte Carlo* technique, producing the aforementioned contingencies and identifying key risk drivers.

The following table ES-1 portrays the development of contingencies for the project. The contingency is based on an 80% confidence level, as per accepted USACE Civil Works guidance.

Table ES-1. Contingency Development Summary

Contingency on Baseline Estimate	80% Confidence Project Cost
Baseline Estimate Cost (Most Likely) ->	**$38,472,000**
Baseline Estimate Cost Contingency Amount ->	$7,591,139
Baseline Estimate Construction Cost (80% Confidence) ->	**$46,063,139**

Contingency on Schedule	80% Confidence Schedule
Project Schedule Duration (Most Likely) ->	**24.0 Months**
Schedule Contingency Duration ->	13.2 Months
Project Schedule Duration (80% Confidence) ->	**37.2 Months**
Project Schedule Contingency Amount (80% Confidence) ->	**$1,269,854**

Project Contingency	80% Confidence Project Cost
Project Contingency Amount (80% Confidence) ->	**$8,860,993**
Project Contingency Percentage (80% Confidence) ->	**23%**

Project Cost (80% Confidence) ->	**$47,332,993**

KEY FINDINGS/OBSERVATIONS RECOMMENDATIONS

The key cost risk drivers identified through sensitivity analysis are Risks I-1 (Scope Definition) and I-2 (Scope Growth/Reduction), which together contribute nearly 90 percent of the statistical cost variance.

The key schedule risk drivers identified through sensitivity analysis are Risks I-7 (Environmental Windows) and I-2 (Scope Growth/Reduction), which together contribute 62 percent of the statistical schedule variance. Other notable schedule risk drivers were Risks I-1 (Scope Definition) and E-1 (Weather), which together contribute 30 percent of the statistical schedule variance.

Recommendations, as detailed within the main report, include the implementation of contingencies, further iterative study of risks throughout the project life-cycle, potential mitigation throughout the PED phase, and proactive monitoring and control of risks identified in this study.

Table ES-2. Contingency Analysis Table

Most Likely Cost Estimate	$38,472,000	
Confidence Level	**Value**	**Contingency**
0%	**$35,293,791**	**-8.26%**
5%	**$38,801,544**	**0.86%**
10%	**$39,724,133**	**3.25%**
15%	**$40,450,909**	**5.14%**
20%	**$41,070,682**	**6.75%**
25%	**$41,640,540**	**8.24%**
30%	**$42,155,547**	**9.57%**
35%	**$42,665,159**	**10.90%**
40%	**$43,173,806**	**12.22%**
45%	**$43,705,224**	**13.60%**
50%	**$44,217,387**	**14.93%**
55%	**$44,716,681**	**16.23%**
60%	**$45,242,860**	**17.60%**
65%	**$45,749,684**	**18.92%**
70%	**$46,225,243**	**20.15%**
75%	**$46,780,580**	**21.60%**
80%	**$47,332,993**	**23.03%**
85%	**$47,972,359**	**24.69%**
90%	**$48,727,749**	**26.66%**
95%	**$49,670,609**	**29.11%**
100%	**$54,281,913**	**41.09%**

Risk is comprised of cost and schedule risk elements. This analysis considers schedule elements only in terms of significant “Hotel” costs, as this project is not susceptible to uncaptured escalation. The following tables tabulate the results of the risk analysis currently identified as 23%.

Figure ES-1. Cumulative Frequency Chart (Cost)

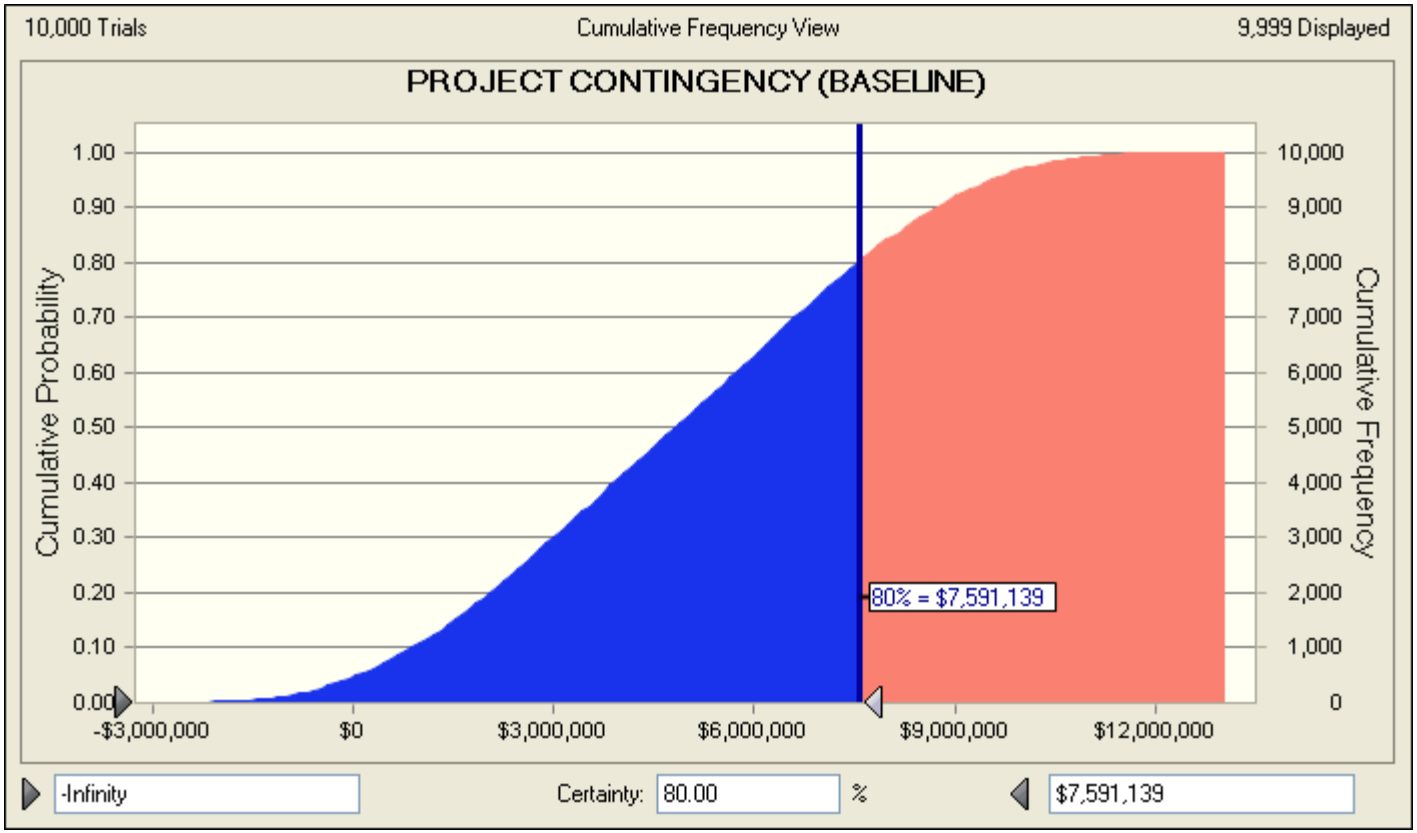


Figure ES-2. Sensitivity Chart (Cost)

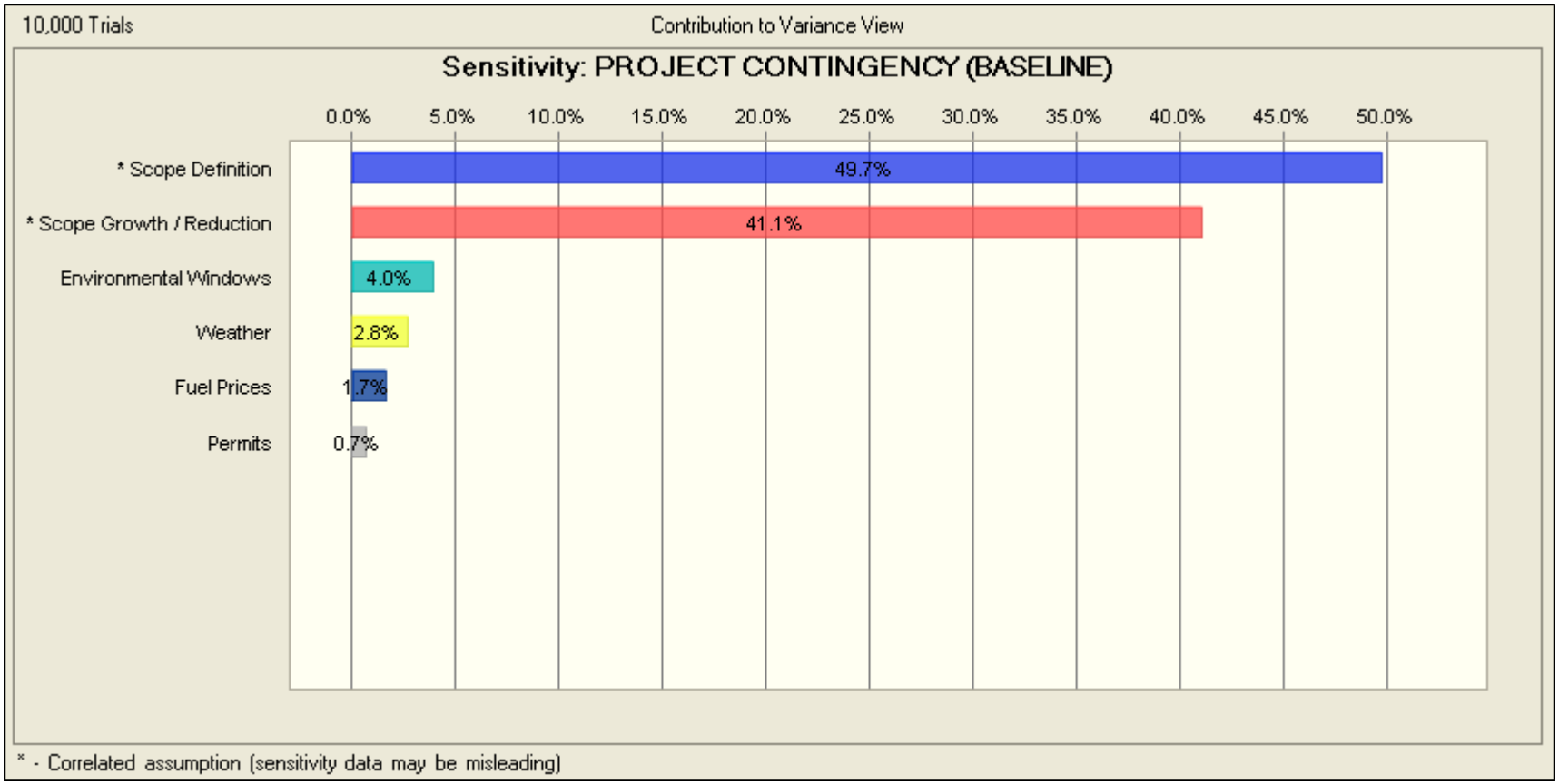


Figure ES-3. Cumulative Frequency Chart (Schedule)

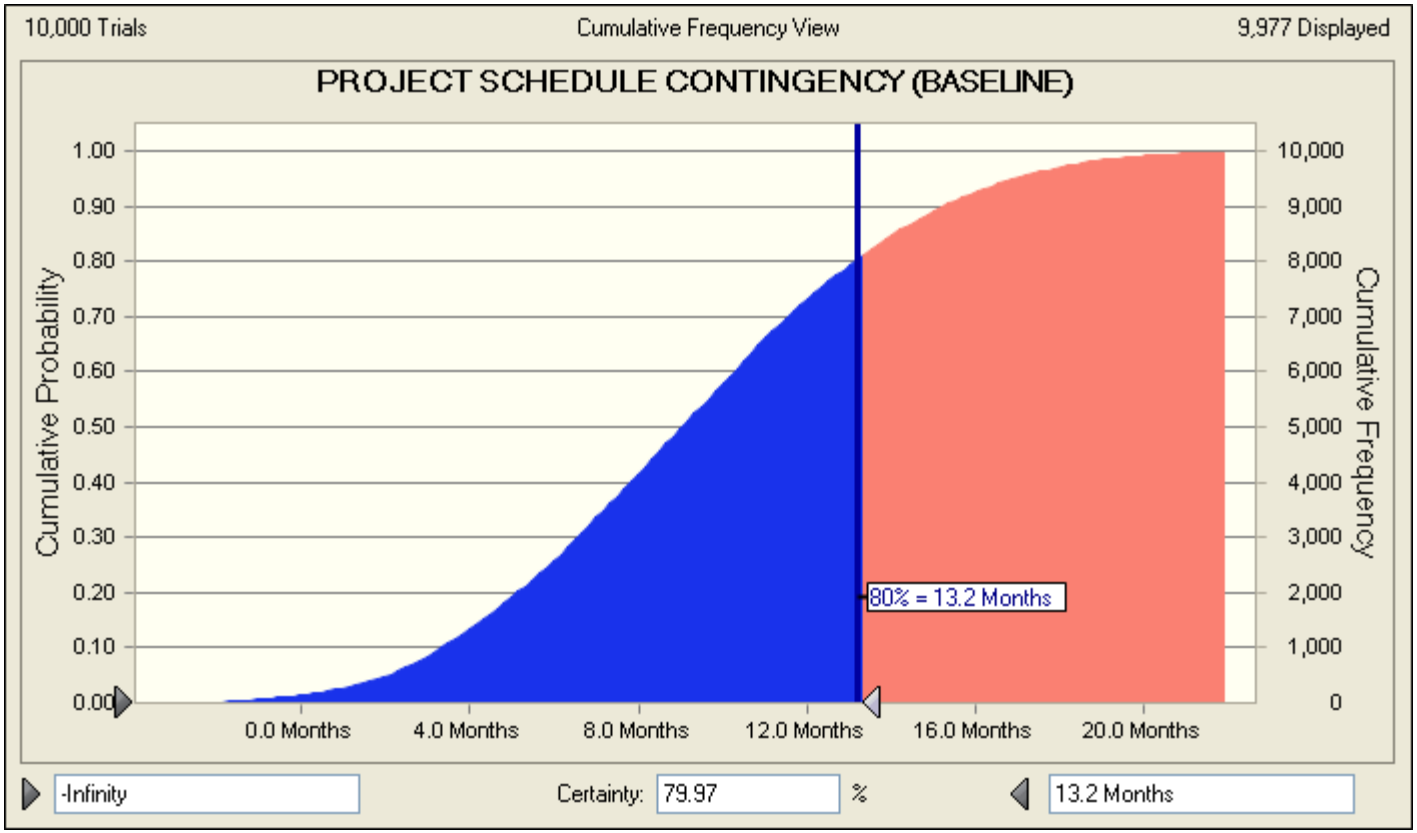
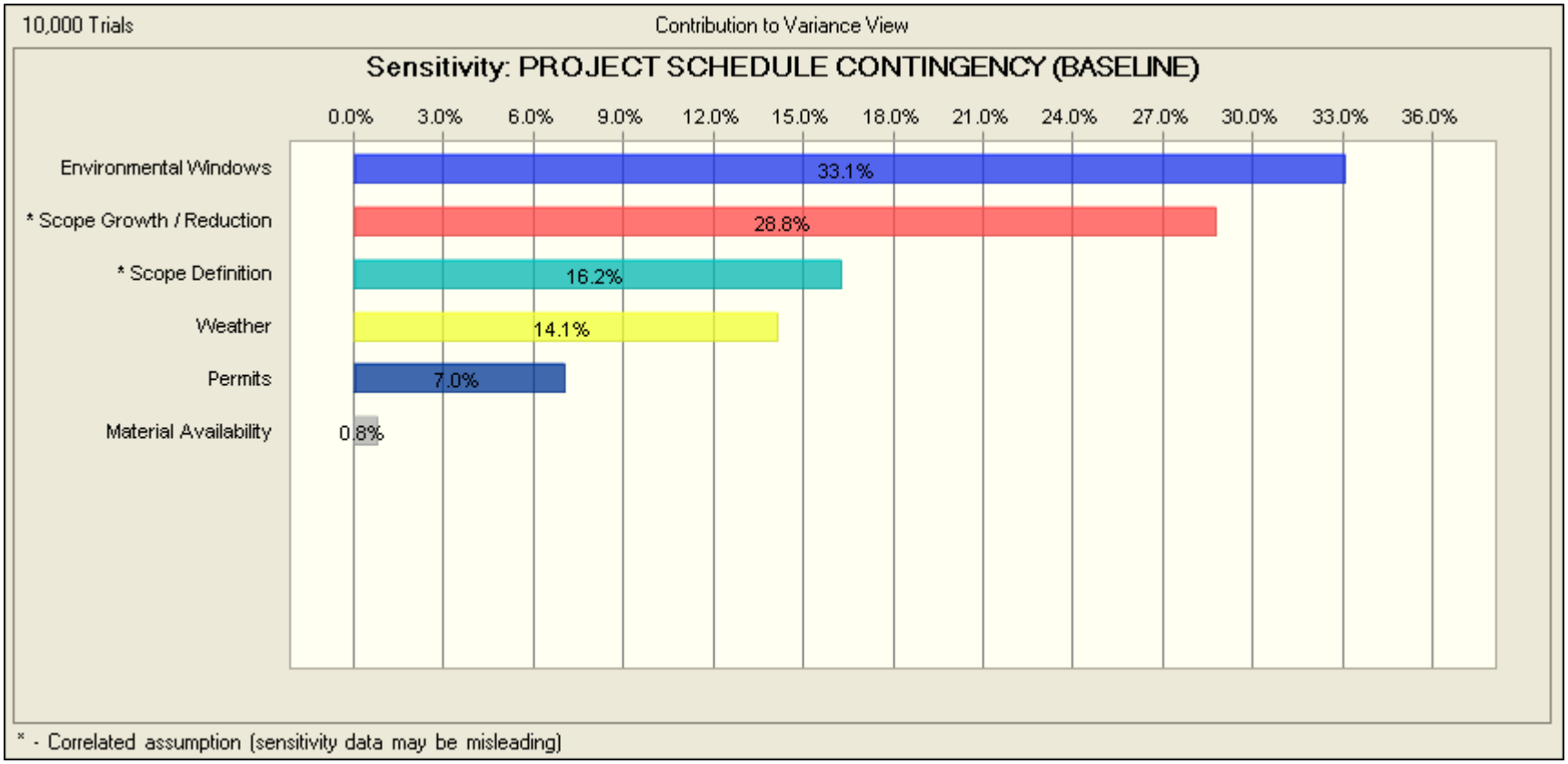


Figure ES-4. Sensitivity Chart (Schedule)



1. PURPOSE

This Risk Analysis is based on Walton County Hurricane and Storm Damage Reduction General Investigations Study. The purpose for a cost and schedule risk analysis (CSRA) is to briefly present discussion of the studied elements related to cost and schedule with an outcome contingency calculation at the recommended confidence level for both cost and schedule that are measured in terms of dollars. The most common and recommended contingency has been established at 80% confidence.

2. BACKGROUND

Walton County is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet. The western two-thirds of Walton County are comprised of a coastal peninsula extending from the mainland, and the eastern third is comprised of mainland beaches. Choctawhatchee Bay lies north of the peninsula. Walton County includes 11.9 miles of state-designated critically eroding areas and three State of Florida park areas that cover approximately six miles of the 26-mile shoreline.

The Walton County shoreline is characterized by high dune elevations partly due to the presence of Pleistocene bluffs formed as a result of an exposed submarine berm formed during inundation of the Florida Peninsula during that geologic period. Primary dune elevations in Walton County range from 11.5 to 44.5 feet North American Vertical Datum, 1988 (NAVD88) and average 25.5 feet. Along the mid-section of Walton County, Bluff elevations exceed 60 feet in height. Bluff erosion and undercutting occur in this area due to the interface of relatively low flat beaches and the bluff toe. An unusual attribute of the Walton County shoreline is the presence of coastal dune lakes. These lakes are rare worldwide and are almost exclusive to the Gulf Coast within the United States. The lakes are about five feet deep and intermittently breach the dune system and discharge directly into the Gulf of Mexico.

Mild winters and warm hot summers characterize the project area, with an average in excess of 280 days a year of sunshine. The average daily temperature is 67 degrees Fahrenheit and the average water temperature is about 70 degrees Fahrenheit. The months from June through November constitute the hurricane storm season, and this area is subject to tropical storm and strong hurricane conditions. The highest period of rainfall occurs during the storm season, with an average annual rainfall of 64 inches.

Walton County's shoreline is receding; the protective dunes and high bluffs are being destroyed by hurricane and storm forces that are occurring more frequently than before. The impacts of these storms to property and infrastructure are considerable and can possibly be reduced through a beach restoration and stabilization project.

3. REPORT SCOPE

The scope of the risk analysis report is to calculate and present the cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes, as mandated by U.S. Army Corps of Engineers (USACE) Engineer Regulation (ER) 1110-2-1150, Engineering and Design for Civil Works, ER 1110-2-1302, Civil Works Cost Engineering, and Engineer Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works. The report presents the contingency results for cost risks for all project features. The study and presentation does not include consideration for operation and maintenance or life cycle costs.

3.1 Project Scope

The scope of this study addresses the identification of problems, needs, opportunities and potential solutions that are viable from an economic, environmental, and engineering viewpoint.

3.2 USACE Risk Analysis Process

The risk analysis process follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering Directory of Expertise for Civil Works (Cost Dx). The risk analysis process reflected within the risk analysis report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. The risk analysis results are intended to serve several functions – one being the establishment of reasonable contingencies reflective of an 80 percent confidence level to successfully accomplish the project work within that established contingency amount. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as provide tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analyses should be considered as an ongoing process conducted concurrent to, and iteratively with, other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting, and scheduling.

In addition to broadly defined risk analysis standards and recommended practices, the risk analysis is performed to meet the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Cost Dx.
- Memorandum from Major General Don T. Riley (US Army Director of Civil Works), dated July 3, 2007.

- Engineering and Construction Bulletin issued by James C. Dalton, P.E. (Chief, Engineering and Construction, Directorate of Civil Works), dated September 10, 2007.
- Engineering Regulation ER 1110-2-1150 dated August 31, 1999.
- Engineering Regulation ER 1110-2-1302 dated September 15, 2008.
- Engineering Technical Letter 1110-2-573 dated September 30, 2008.

4. METHODOLOGY/PROCESS

The Cost Dx provided a senior civil cost engineer to perform the quantitative risk analysis, relying on the local Mobile District cost estimator to provide cost and schedule input details and information gathering.

The Mobile District PDT conducted risk identification and qualitative analysis to produce a risk register that served as the framework for the risk analysis. The formal meeting included the following:

Name	Title
Joseph H. Ellsworth	Lead Cost Engineer
Bernard E. Moseby	Planning Economics
Julie M. Watkins	Planning Economics
Elizabeth S. Godsey	Hydraulic Engineer
Michael A. McKown	Structural Engineer - GeoTech
Russell W Blount	Real Estate Specialist
Joseph W. Paine	Planning Study Manager
Larry E. Parsons	Planning Environmental

The Cost Dx conducted several subsequent iterations of the cost risk model at the request of Mobile District, based on results of new research and the implementation of risk mitigation efforts. The cost risk model was completed and results reported on February 11, 2010.

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve any desired level of cost confidence.

In simple terms, contingency is an amount added to an estimate to allow for items, conditions or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept risk of project overruns. The less risk that project leadership is willing to accept the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost Dx guidance for cost and schedule risk analysis generally focuses on the 80-percent level of confidence (P80) for cost contingency calculation. It should be noted

that use of P80 as a decision criteria is a risk averse approach (whereas the use of P50 would be a risk neutral approach, and use of levels less than 50 percent would be risk seeking). Thus, a P80 confidence level results in greater contingency as compared to a P50 confidence level. The selection of contingency at a particular confidence level is ultimately the decision and responsibility of the project's District and/or Division management.

The risk analysis process uses *Monte Carlo* techniques to determine probabilities and contingency. The *Monte Carlo* techniques are facilitated computationally by a commercially available risk analysis software package (Crystal Ball) that is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. The level of detail recreated in the Excel-format schedule is sufficient for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in section 6.

4.1 Identify and Assess Risk Factors

Identifying the risk factors via the PDT is considered a qualitative process that results in establishing a risk register that serves as the document for the quantitative study using the Crystal Ball risk software. Risk factors are events and conditions that may influence or drive uncertainty in project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

Checklists or historical databases of common risk factors are sometimes used to facilitate risk factor identification. However, key risk factors are often unique to a project and not readily derivable from historical information. Therefore, input from the entire PDT is obtained using creative processes such as brainstorming or other facilitated risk assessment meetings. In practice, a combination of professional judgment from the PDT and empirical data from similar projects is desirable and is considered.

Formal PDT meetings are held for the purposes of identifying and assessing risk factors. The meetings should include capable and qualified representatives from multiple project team disciplines and functions, for example:

- Project/Program managers
- Contracting/acquisition
- Real Estate
- Relocations
- Environmental
- Civil and Coastal Design
- Cost and schedule engineers
- Construction

- Key Sponsors

The initial formal meetings should focus primarily on risk factor identification using brainstorming techniques, but also include some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Subsequent meetings should focus primarily on risk factor assessment and quantification.

Additionally, numerous conference calls and informal meetings are conducted throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment.

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on project plans are analyzed using a combination of professional judgment, empirical data, and analytical techniques. Risk factor impacts are quantified using probability distributions (density functions), because risk factors are entered into the Crystal Ball software in the form of probability density functions.

Similar to the identification and assessment process, risk factor quantification involves multiple project team disciplines and functions. However, the quantification process relies more extensively on collaboration between cost engineering, designers, and risk analysis team members with lesser inputs from other functions and disciplines.

The following is an example of the PDT quantifying risk factor impacts by using an iterative, consensus-building approach to estimate the elements of each risk factor:

- Maximum possible value for the risk factor.
- Minimum possible value for the risk factor.
- Most likely value (the statistical mode), if applicable.
- Nature of the probability density function used to approximate risk factor uncertainty.
- Mathematical correlations between risk factors.
- Affected cost estimate and schedule elements.

The resulting product from the PDT discussions is captured within a risk register as presented in section 6 for both cost and schedule risk concerns. Note that the risk register records the PDT's risk concerns, discussions related to those concerns, and potential impacts to the current cost and schedule estimates. The concerns and discussions are meant to support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations are performed by applying the risk factors (quantified as probability density functions) to the

appropriate estimated cost and schedule elements identified by the PDT. Contingencies are calculated by applying only the moderate and high level risks identified for each option (i.e., low-level risks are typically not considered, but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate, the contingency is calculated as the difference between the P80 cost forecast and the baseline cost estimate. Each option-specific contingency is then allocated on a civil works feature level based on the dollar-weighted relative risk of each feature as quantified by *Monte Carlo* simulation. Standard deviation is used as the feature-specific measure of risk for contingency allocation purposes. This approach results in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

5. PROJECT ASSUMPTIONS

The following data sources and assumptions were used in quantifying the costs associated with the with- and without-project conditions at Walton County.

a. The estimate uses the Corps of Engineers Dredge Estimating Program (CEDEP) and assumes hopper dredging methodology. The estimate assumes an effective work time of 90%.

b. The cost comparisons and risk analyses performed and reflected within this report are based on design scope and estimates that are at the feasibility level.

c. The schedule was analyzed for impact to the total project cost only in terms of "Hotel" costs (unavoidable fixed contract costs and/or languishing federal administration costs incurred continuously throughout delay). The local market at the project location is not susceptible to uncaptured escalation (local market inflation notably higher than national average).

d. Per the data in the estimate, the FOOH amount for the Contract Cost comprises approximately 6% of the Project Cost at Baseline. Thus, the assumed "Hotel" rate for this project is 6%.

e. The Cost Dx guidance generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (P80) was used. It should be noted that the use of P80 as a decision criteria is a moderately risk averse approach, generally resulting in higher cost contingencies. However, the P80 level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to capture actual project costs.

f. Only high and moderate risk level impacts, as identified in the risk register, were considered for the purposes of calculating cost contingency. Low level risk impacts should be maintained in project management documentation, and reviewed at each

project milestone to determine if they should be placed on the risk “watch list” for further monitoring and evaluation.

6. RISK ANALYSIS RESULTS

The following table summarizes the results of the risk analysis currently identified as a 23% contingency amount based on 80% confidence level. The complete list of tables and figures are included within Appendix A.

Table 1. Contingency Development Summary

Contingency on Baseline Estimate	80% Confidence Project Cost
Baseline Estimate Cost (Most Likely) ->	**$38,472,000**
Baseline Estimate Cost Contingency Amount ->	$7,591,139
Baseline Estimate Construction Cost (80% Confidence) ->	**$46,063,139**

Contingency on Schedule	80% Confidence Schedule
Project Schedule Duration (Most Likely) ->	**24.0 Months**
Schedule Contingency Duration ->	13.2 Months
Project Schedule Duration (80% Confidence) ->	**37.2 Months**
Project Schedule Contingency Amount (80% Confidence) ->	**$1,269,854**

Project Contingency	80% Confidence Project Cost
Project Contingency Amount (80% Confidence) ->	**$8,860,993**
Project Contingency Percentage (80% Confidence) ->	**23%**

Project Cost (80% Confidence) ->	**$47,332,993**

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The actual risk register is provided in Appendix A. The complete risk register includes low level risks, as well as additional information regarding the nature and impacts of each risk.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact.
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context

of project controls.

- Communicating risk management issues.
- Providing a mechanism for eliciting feedback and project control input.
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans.

6.2 Cost Risk Analysis – Project Cost Contingency Results

Table 2 provides the construction cost contingencies calculated for the P80 confidence level and rounded to the nearest thousand. The construction cost contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes only.

Contingency was quantified as approximately $9 Million at the P80 confidence level (23% of the baseline cost estimate). For comparison, the cost contingency at the P50 and P100 confidence levels was quantified as 15% and 41% of the baseline cost estimate, respectively.

Table 2. Total Project Cost Contingency Summary

Risk Analysis Forecast	Baseline Estimate ($K)	Total Contingency[1] ($K)	Total Contingency (%)
50% Confidence Level			
Total Project Cost	$38,472	$5,745	14.9%
80% Confidence Level			
Total Project Cost	$38,472	$8,861	23.0%
100% Confidence Level			
Total Project Cost	$38,472	$15,810	41.1%

Note: 1) These figures combine uncertainty in the baseline cost estimates and schedule.
2) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of "unknown unknowns") makes 100% confidence a theoretical impossibility.

6.3 Schedule Risk Analysis – Total Project Duration Contingency Results

Table 3 provides the schedule duration contingencies calculated for the P80 confidence level. The schedule duration contingencies for the P50 and P100 confidence levels are also provided for illustrative purposes.

Schedule duration contingency was quantified as 13 months based on the P80 level of confidence. These contingencies were used to calculate the projected "Hotel" cost impact of project delays that are included in the Tables 1 and 2 presentation of total cost contingency. The schedule contingencies were calculated by applying the high level schedule risks identified in the risk register for each option to the durations of critical path and near critical path tasks.

The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented. Schedule contingency impacts presented in this analysis are based solely on projected "Hotel" costs. Resource impacts related to potential schedule delays could not be evaluated.

See Appendix A for detailed tables and charts.

Table 3. Schedule Duration Contingency Summary

Risk Analysis Forecast	Baseline Schedule Duration (months)	Contingency[1] (months)	Contingency (%)
50% Confidence Level			
Total Project Duration	24	9	38.0%
80% Confidence Level			
Total Project Duration	24	13	55.0%
100% Confidence Level			
Total Project Duration	24	26	110.0%

Note: 1) The schedule was not resource loaded and contained open-ended tasks and non-zero lags (gaps in the logic between tasks) that limit the overall utility of the schedule risk analysis. These issues should be considered as limitations in the utility of the schedule contingency data presented in Table 3.
2) A P100 confidence level is an abstract concept for illustration only, as the nature of risk and uncertainty (specifically the presence of "unknown unknowns") makes 100% confidence a theoretical impossibility.

7. MITIGATION RECOMMENDATIONS

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, *4th edition*, states that "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project." Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that the proactive management of risks not conclude with the study completed in this report.

The Cost and Schedule Risk Analysis (CSRA) produced by the PDT identifies issues that require the development of subsequent risk response and mitigation plans. This section provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all inclusive and should not substitute a formal risk management and response plan.

1. Key Cost Risk Drivers: The key cost risk drivers identified through sensitivity analysis are Risks I-1 (Scope Definition) and I-2 (Scope Growth/Reduction), which together contribute nearly 90 percent of the statistical cost variance. Another notable cost risk driver is Risk I-7 (Environmental Windows), which contributes 6 percent to the statistical cost variance.

a) Scope Definition: With respect to Scope Definition (Risk I-1), project leadership should attempt to capture and finalize the scope for the permitting configuration of the project to the maximum extent possible.

b) Scope Growth/Reduction: With respect to Scope Growth/Reduction (Risk I-2), project leadership should conduct value engineering and research on the pumping plant feature to fully capture the configuration and scope of the project.

c) Environmental Windows: With respect to Environmental Windows (Risk I-7), the PDT should further research and confirm the habitat issues related to threatened wildlife (such as Gulf sturgeon and sea turtles) during the winter and spring months. If “no-dredge” windows or other limitations are a possibility, then a portion of the reserve should be maintained as a fallback response to this risk during construction.

2. Key Schedule Risk Drivers: The key schedule risk drivers identified through sensitivity analysis are Risks I-7 (Environmental Windows) and I-2 (Scope Growth/Reduction), which together contribute 62 percent of the statistical schedule variance. Other notable schedule risk drivers were Risks I-1 (Scope Definition) and E-1 (Weather), which together contribute 30 percent of the statistical schedule variance.

a) Environmental Windows: With respect to Environmental Windows (Risk I-7), the PDT should further research and confirm the habitat issues related to threatened wildlife (such as Gulf sturgeon and sea turtles) during the winter and spring months. If “no-dredge” windows or other limitations are possible, then a portion of the reserve should be maintained as a fallback response to this risk during construction. The implementation schedule may also require revision to more accurately reflect realistic productivity based on environmental restrictions.

b) Scope Growth/Reduction: Scope Growth/Reduction (Risk I-2), project leadership should conduct value engineering and research on the pumping plant feature to fully capture the configuration and scope of the project.

c) Scope Definition: With respect to Scope Definition (Risk I-1), project leadership should attempt to capture and finalize the scope for the permitting configuration of the project to the maximum extent possible. Changes to anticipated permit timelines should be communicated to management in a timely manner.

d) Weather: With respect to Weather (Risk E-1), the PDT should account for the probability of impacts to the overall implementation schedule due to weather. A portion of the reserve should be maintained as a response to this risk during construction.

3. Risk Management: Project leadership should use of the outputs created during the risk analysis effort as tools in future risk management processes. The risk register should be updated at each major project milestone. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings.

4. Risk Analysis Updates: Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life-cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

APPENDIX A

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - PDT Risk Register

Risk Level

Likelihood of Occurrence	Negligible	Marginal	Significant	Critical	Crisis
Very Likely	Low	Moderate	High	High	High
Likely	Low	Moderate	High	High	High
Unlikely	Low	Low	Moderate	Moderate	High
Very Unlikely	Low	Low	Low	Low	High

Impact or Consequence of Occurrence

Risk No.	Risk/Opportunity Event	Discussion and Concerns	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component	Project Implications
			Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)					
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
I-1	Scope Definition	Scope is fairly well defined for standard civil works features. Scope may change based on permitting.	LIKELY	SIGNIFICANT	HIGH		VERY Unlikely	MARGINAL	LOW		UNIFORM	I-2	Project Manager/Planner	Construction Cost	Cost & Schedule
I-2	Scope Growth / Reduction	Scope is fairly well defined for standard civil works features. The pumping plant has potential of VE savings through better data and VE.	LIKELY	MARGINAL	MODERATE		LIKELY	MARGINAL	MODERATE		UNIFORM	I-1	Project Manager/Planner	Construction Cost	Cost & Schedule
I-3	Equipment Availability/Pricing	Estimate assumes medium size hopper dredges will performed the subject work. Availability is not a problem. Based on passed similar projects within the area medium size hoppers were used, Panama City Beaches being the most recent.	UNLIKELY	MARGINAL	LOW		UNLIKELY	MARGINAL	LOW		TRIANGULAR	I-8	Cost Engineering	Equipment/Production Rates	Cost & Schedule
I-4	Material Availability	Borrow sources are provided and indicated on drawings. Per the design Engineer and based on current surveys, quality and quantity of beach fill material is available at all sites.	UNLIKELY	MARGINAL	LOW		LIKELY	MARGINAL	MODERATE		TRIANGULAR	I-1	Design Engineer	Material Costs	Cost & Schedule
I-5	Fuel Prices	$2.65 per gallon was used in the Dec 09 CEDEP Estimates, increases will effect equipment and delivery or materials. Fuel cost fluctuations can significantly impact dredging cost.	VERY LIKELY	SIGNIFICANT	HIGH		UNLIKELY	NEGLIGIBLE	LOW		TRIANGULAR		Cost Engineering	Equipment	Cost
I-6	Permits	Permitting delays may occur due to Florida State policy.	LIKELY	MARGINAL	MODERATE		LIKELY	MARGINAL	MODERATE		TRIANGULAR		Planning/Regulatory	PED/Lands & Damages	Schedule
I-7	Environmental Windows	Project site is a natural habitat for various species of threatened wildlife that utilize the project vicinity during Spring and Winter months. Gulf sturgeon incidental takes during dredging and Sea Turtle and Bird Nesting may have Impact during Construction.	LIKELY	SIGNIFICANT	HIGH		LIKELY	SIGNIFICANT	HIGH		TRIANGULAR		Project Manager/Planner	Construction Cost	Cost & Schedule
I-8	Acquisition Plan (Strategy)	The estimate was based on full and open competition, with minimal tiering of contractor subs. The Acq Plan has not been finalized, therefore there is a potential for additional tiering of the contracts.	UNLIKELY	MARGINAL	LOW		UNLIKELY	MARGINAL	LOW		TRIANGULAR		Acquisition Strategy Board	Construction Cost	Cost & Schedule
I-9	VE Study	VE study will be performed prior to Final Feasibility Report	UNLIKELY	MARGINAL	LOW		UNLIKELY	MARGINAL	LOW		TRIANGULAR		Project Manager/Planner	Construction Cost	Cost & Schedule
External Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)															
E-1	Weather	Florida is subject to bad weather during Hurricane Season which can cause Schedule delays. Weather days are generally incorporated into schedule.	LIKELY	MARGINAL	MODERATE		LIKELY	MARGINAL	MODERATE		TRIANGULAR		N/A	Labor/Production Rates	Schedule
E-2	Congressional Funding	PM feels Adequate Congressional funding to complete project will be available.	UNLIKELY	MARGINAL	LOW		UNLIKELY	MARGINAL	LOW		UNIFORM		Project Manager	Construction Cost	Cost & Schedule

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - PDT Risk Register

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** Likelihood of the event is the same for both Cost and Schedule.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may not be the same for impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low**, **Moderate**, or **High**. Refer to top matrix table.
6. Variance Distribution refers to the behavior of the individual risk item with respect to its potential effects on Project Cost and Schedule. For example, an item with clearly defined parameters and a solid most likely scenario would probably follow a triangular or normal distribution. An risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.
7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

Contingency on Base Estimate	80% Confidence Project Cost
Baseline Estimate Cost (Most Likely) ->	**$38,472,000**
Baseline Estimate Cost Contingency Amount ->	$7,591,139
Baseline Estimate Construction Cost (80% Confidence) ->	**$46,063,139**

Contingency on Schedule	80% Confidence Project Schedule
Project Schedule Duration (Most Likely) ->	**24.0 Months**
Schedule Contingency Duration ->	13.2 Months
Project Schedule Duration (80% Confidence) ->	**37.2 Months**
Project Schedule Contingency Amount (80% Confidence) ->	**$1,269,854**

Project Contingency	80% Confidence Project Cost
Project Contingency Amount (80% Confidence) ->	**$8,860,993**
Project Contingency Percentage (80% Confidence) ->	**23%**

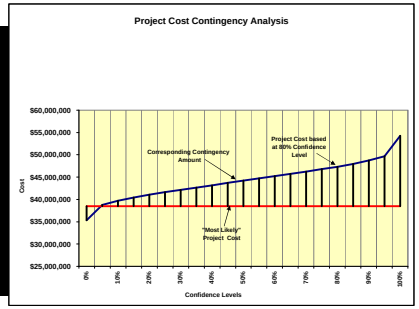
Project Cost (80% Confidence) ->	**$47,332,993**

- PROJECT CONTINGENCY DEVELOPMENT -

Contingency Analysis

Most Likely Cost Estimate	$38,472,000

Confidence Level	Value	Contingency
0%	$35,293,791	-8.26%
5%	$38,801,544	0.86%
10%	$39,724,133	3.25%
15%	$40,450,909	5.14%
20%	$41,070,682	6.75%
25%	$41,640,540	8.24%
30%	$42,155,547	9.57%
35%	$42,665,159	10.90%
40%	$43,173,806	12.22%
45%	$43,705,224	13.60%
50%	$44,217,387	14.93%
55%	$44,716,681	16.23%
60%	$45,242,860	17.60%
65%	$45,749,684	18.92%
70%	$46,225,243	20.15%
75%	$46,780,580	21.60%
80%	**$47,332,993**	**23.03%**
85%	$47,972,359	24.69%
90%	$48,727,749	26.66%
95%	$49,670,609	29.11%
100%	$54,281,913	41.09%

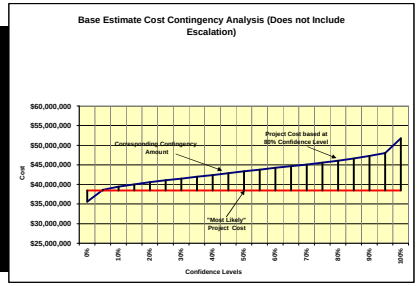


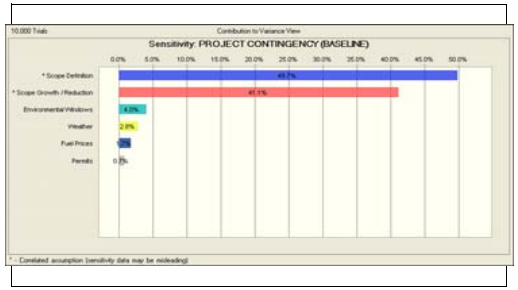
- BASE CONTINGENCY DEVELOPMENT -

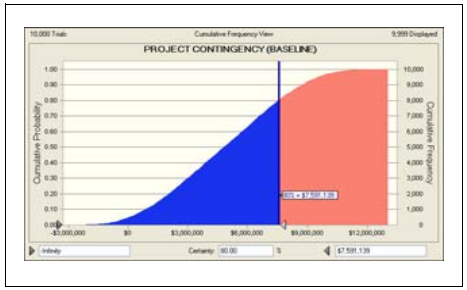
Contingency Analysis

Most Likely Cost Estimate	$38,472,000

Confidence Level	Value	Contingency
0%	$35,612,681	-7.43%
5%	$38,596,444	0.32%
10%	$39,400,105	2.41%
15%	$40,031,858	4.05%
20%	$40,570,924	5.46%
25%	$41,066,212	6.74%
30%	$41,518,581	7.92%
35%	$41,966,737	9.08%
40%	$42,414,355	10.25%
45%	$42,887,489	11.48%
50%	$43,340,841	12.66%
55%	$43,780,340	13.80%
60%	$44,247,516	15.01%
65%	$44,697,803	16.18%
70%	$45,106,847	17.25%
75%	$45,590,341	18.50%
80%	**$46,063,139**	**19.73%**
85%	$46,614,494	21.16%
90%	$47,253,783	22.83%
95%	$48,036,761	24.86%
100%	$51,742,319	34.49%



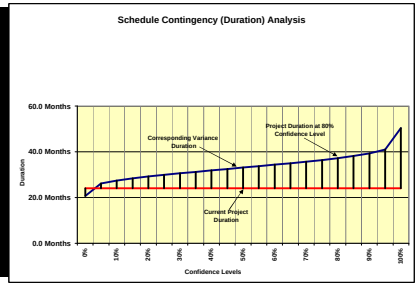


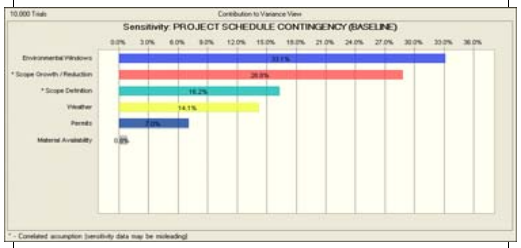


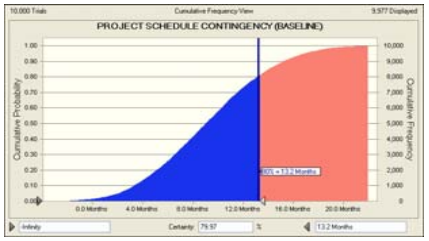
- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Contingency Analysis

Most Likely Cost Estimate	24.0 Months	
Confidence Level	**Value**	**Contingency**
0%	20.7 Months	-13.81%
5%	26.1 Months	8.89%
10%	27.4 Months	14.04%
15%	28.4 Months	18.15%
20%	29.2 Months	21.65%
25%	30.0 Months	24.88%
30%	30.6 Months	27.59%
35%	31.3 Months	30.26%
40%	31.9 Months	32.90%
45%	32.5 Months	35.43%
50%	33.1 Months	37.97%
55%	33.7 Months	40.56%
60%	34.3 Months	43.12%
65%	34.9 Months	45.57%
70%	35.6 Months	48.45%
75%	36.4 Months	51.56%
80%	37.2 Months	55.01%
85%	38.1 Months	58.82%
90%	39.3 Months	63.85%
95%	41.0 Months	70.78%
100%	50.4 Months	110.02%



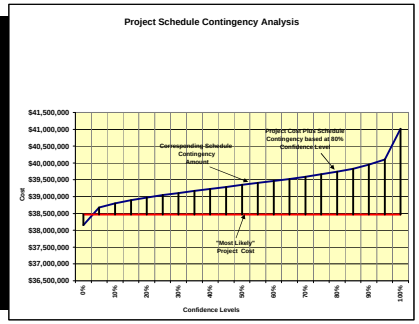




- SCHEDULE CONTINGENCY (AMOUNT) DEVELOPMENT -

Contingency Analysis

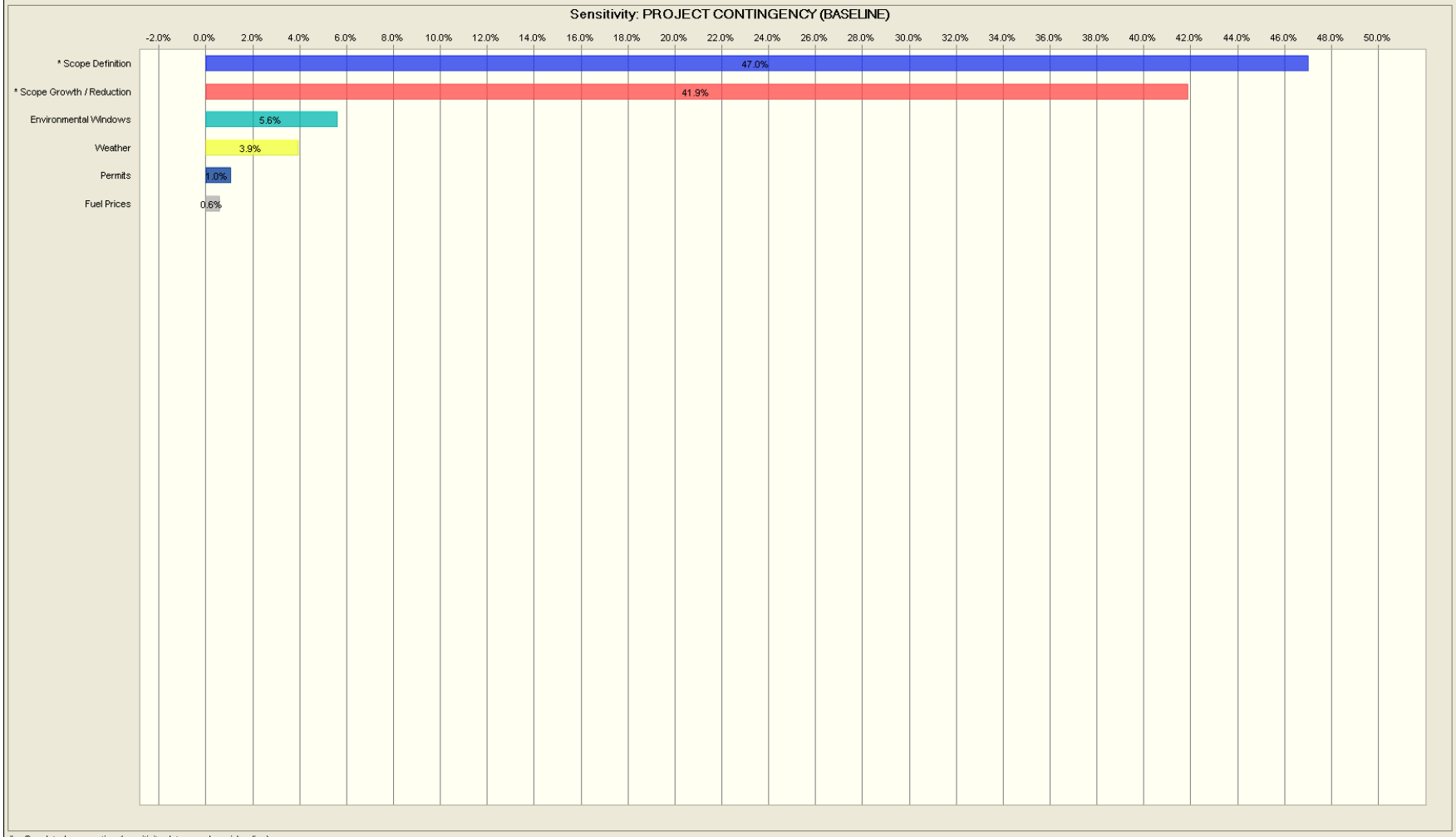
Most Likely Cost Estimate	$38,472,000	
Confidence Level	**Value**	**Contingency**
0%	$(318,890)	-0.83%
5%	$205,100	0.53%
10%	$324,029	0.84%
15%	$419,051	1.09%
20%	$499,758	1.30%
25%	$574,328	1.49%
30%	$636,966	1.66%
35%	$698,422	1.82%
40%	$759,451	1.97%
45%	$817,735	2.13%
50%	$876,546	2.28%
55%	$936,341	2.43%
60%	$995,344	2.59%
65%	$1,051,881	2.73%
70%	$1,118,395	2.91%
75%	$1,190,238	3.09%
80%	$1,269,854	3.30%
85%	$1,357,865	3.53%
90%	$1,473,866	3.83%
95%	$1,633,848	4.25%
100%	$2,539,595	6.60%



Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Cost Risk Analysis Model

10,000 Trials

Contribution to Variance View



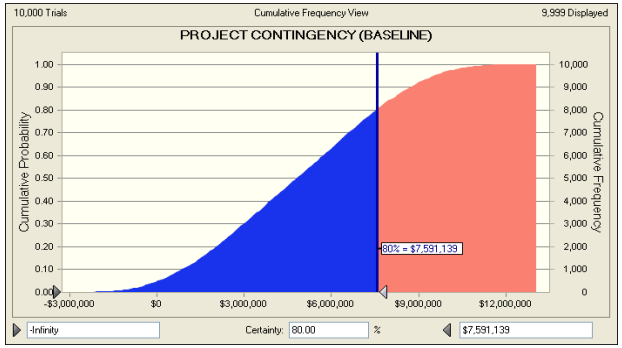
* - Correlated assumption (sensitivity data may be misleading)

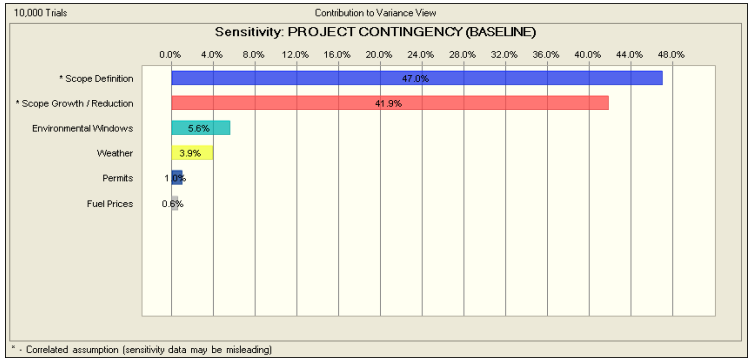
Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Cost Risk Analysis Model

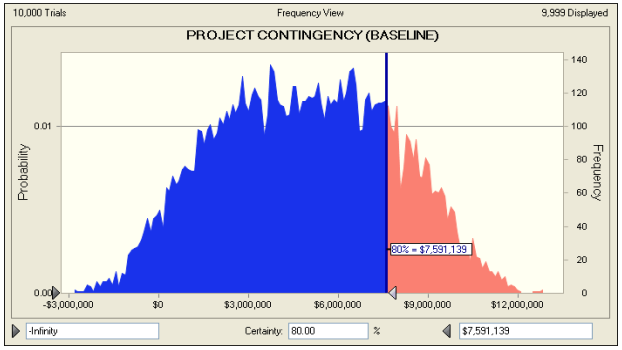
Risk No.	Risk/Opportunity Event	Project Cost: Likelihood*	Project Cost: Impact*	Project Cost: Risk Level*	Variance Distribution	Correlation to Other(s)	Crystal Ball Simulation Expected Values ($$$): Low	Most Likely	High		Crystal Ball Simulation Expected Values (%s): Low	Most Likely	High
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)													
I-1	Scope Definition	LIKELY	SIGNIFICANT	HIGH	UNIFORM	I-2	$0	$0	$5,771,000		0.00%	0.00%	15.00%
I-2	Scope Growth / Reduction	LIKELY	MARGINAL	MODERATE	UNIFORM	I-1	($1,924,000)	$0	$1,924,000		-5.00%	0.00%	5.00%
I-5	Fuel Prices	VERY LIKELY	SIGNIFICANT	HIGH	TRIANGULAR		($750,000)	$0	$750,000		-1.95%	0.00%	1.95%
I-6	Permits	LIKELY	MARGINAL	MODERATE	TRIANGULAR		$0	$0	$1,924,000		0.00%	0.00%	5.00%
I-7	Environmental Windows	LIKELY	SIGNIFICANT	HIGH	TRIANGULAR		$0	$0	$3,847,000		0.00%	0.00%	10.00%
External Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)													
E-1	Weather	LIKELY	MARGINAL	MODERATE	TRIANGULAR		($1,924,000)	$0	$1,924,000		-5.00%	0.00%	5.00%
										Not Part of Study - Placeholder for Project Summation Purposes Only			
								$0					

Percentages are calculated as the variance from the assumption value to facilitate iteration of the model should the cost values change throughout the project phases. Uniform distribution percentages reflect variation from the total project cost.

PROJECT CONTINGENCY (BASELINE)	Percentile	Baseline TPC	Contingency	Baseline w/ Contingency	Contingency %
	0%	$38,472,000	($2,859,319)	$35,612,681	-7.43%
	5%	$38,472,000	$124,444	$38,596,444	0.32%
	10%	$38,472,000	$928,105	$39,400,105	2.41%
	15%	$38,472,000	$1,559,858	$40,031,858	4.05%
	20%	$38,472,000	$2,098,924	$40,570,924	5.46%
	25%	$38,472,000	$2,594,212	$41,066,212	6.74%
	30%	$38,472,000	$3,046,581	$41,518,581	7.92%
	35%	$38,472,000	$3,494,737	$41,966,737	9.08%
	40%	$38,472,000	$3,942,355	$42,414,355	10.25%
	45%	$38,472,000	$4,415,489	$42,887,489	11.48%
	50%	$38,472,000	$4,868,841	$43,340,841	12.66%
	55%	$38,472,000	$5,308,340	$43,780,340	13.80%
	60%	$38,472,000	$5,775,516	$44,247,516	15.01%
	65%	$38,472,000	$6,225,803	$44,697,803	16.18%
	70%	$38,472,000	$6,634,847	$45,106,847	17.25%
	75%	$38,472,000	$7,118,341	$45,590,341	18.50%
	80%	$38,472,000	$7,591,139	$46,063,139	19.73%
	85%	$38,472,000	$8,142,494	$46,614,494	21.16%
	90%	$38,472,000	$8,781,783	$47,253,783	22.83%
	95%	$38,472,000	$9,564,761	$48,036,761	24.86%
	100%	$38,472,000	$13,270,319	$51,742,319	34.49%







Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Cost Risk Analysis Model

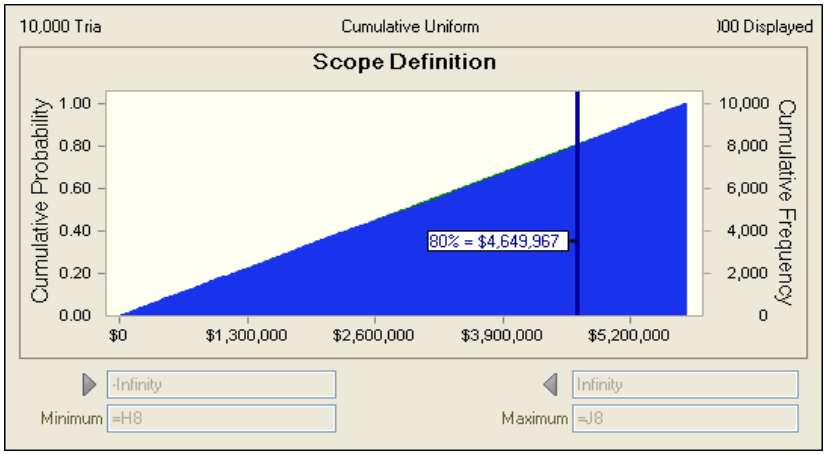
Risk Refer No.	Risk Event	Low	Most Likely	High
I-1	Scope Definition	$0	$0	$5,771,000

Notes: This item captures the risk that issues with the definition of the current scope of the project will cause a variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes no change from the baseline estimate.

High High assumes that the baseline estimate could increase by up to 15% due to changes to scope after project authorization (per WRDA and current regulations, up to 20% is permitted).



Assumption: **Scope Definition**

Percentile	Assumption values
0%	$332
10%	$576,305
20%	$1,160,312
30%	$1,727,779
40%	$2,313,833
50%	$2,931,407
60%	$3,503,393
70%	$4,097,497
80%	$4,649,967
90%	$5,206,247
100%	$5,770,976

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Cost Risk Analysis Model

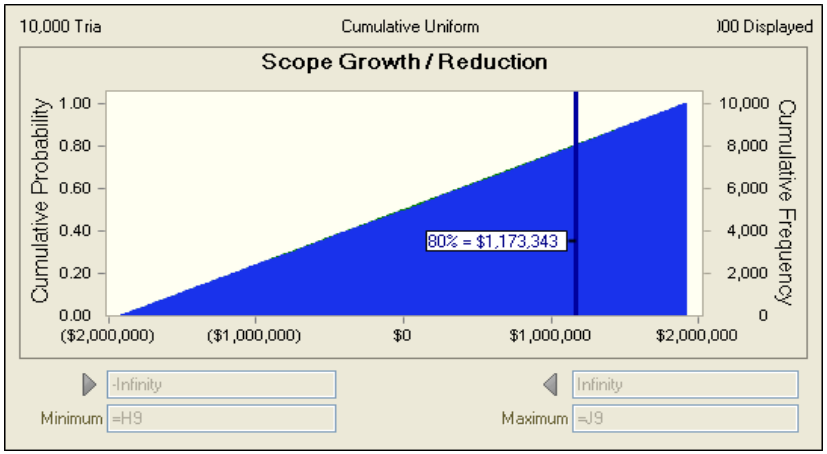
Risk Refer No.	Risk Event	Low	Most Likely	High
I-2	Scope Growth / Reduction	($1,924,000)	$0	$1,924,000

Notes: This item captures the risk that issues with growth or reduction to scope (not caused by project definition) will cause a variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes that the current baseline estimate could be reduced by up to 5% due to reductions in scope.

High High assumes that the current baseline estimate could increase by up to 5% due to increases in scope.



Assumption: **Scope Growth / Reduction**

Percentile	Assumption values
0%	($1,923,934)
10%	($1,530,481)
20%	($1,146,348)
30%	($747,510)
40%	($368,864)
50%	$33,049
60%	$402,639
70%	$794,810
80%	$1,173,343
90%	$1,543,359
100%	$1,923,345

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Cost Risk Analysis Model

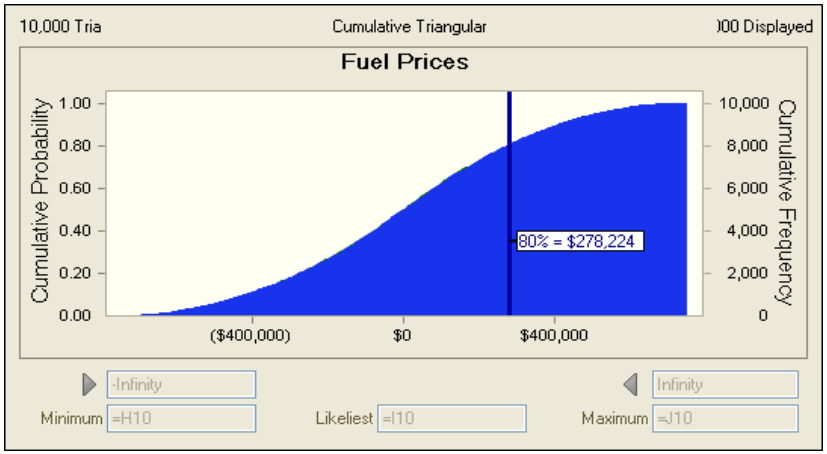
Risk Refer No.	Risk Event	Low	Most Likely	High
I-5	Fuel Prices	($750,000)	$0	$750,000

Notes: This item captures the risk that fluctuations in fuel prices for marine diesel will cause a variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes that lower than anticipated fuel prices could reduce the costs as compared to the current baseline estimate by up to 10%.

High High assumes that higher than anticipated fuel prices could increase the costs as compared to the current baseline estimate by up to 10%.



Assumption: **Fuel Prices**

Percentile	Assumption values
0%	($741,997)
10%	($416,090)
20%	($273,222)
30%	($162,251)
40%	($75,242)
50%	$2,786
60%	$83,618
70%	$174,715
80%	$278,224
90%	$413,933
100%	$742,030

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Cost Risk Analysis Model

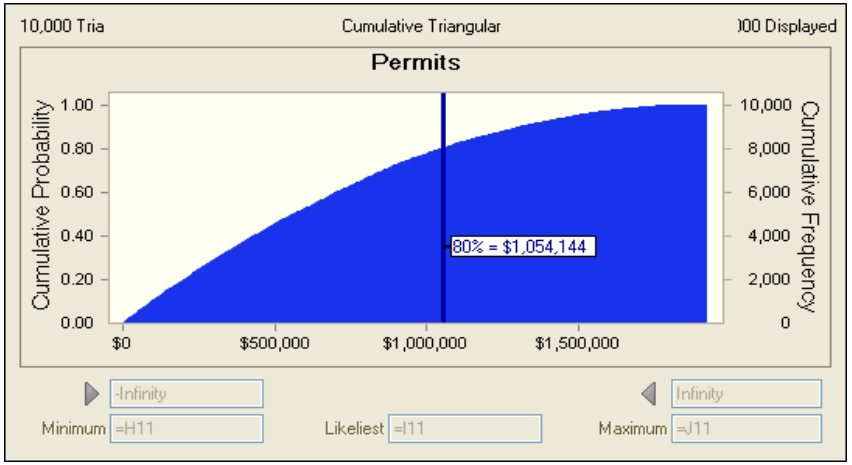
Risk Refer No.	Risk Event	Low	Most Likely	High
I-6	Permits	$0	$0	$1,924,000

Notes: This item captures the risk that issues with obtaining permits for the project will cause a variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes no change from the baseline estimate.

High High assumes that delays in the issuing of Florida State permits could increase the costs by up to 5% due to escalation and other costs associated with delays.



Assumption: **Permits**

Percentile	Assumption values
0%	$54
10%	$95,944
20%	$200,555
30%	$312,947
40%	$432,457
50%	$562,305
60%	$705,927
70%	$858,641
80%	$1,054,144
90%	$1,314,537
100%	$1,893,853

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Cost Risk Analysis Model

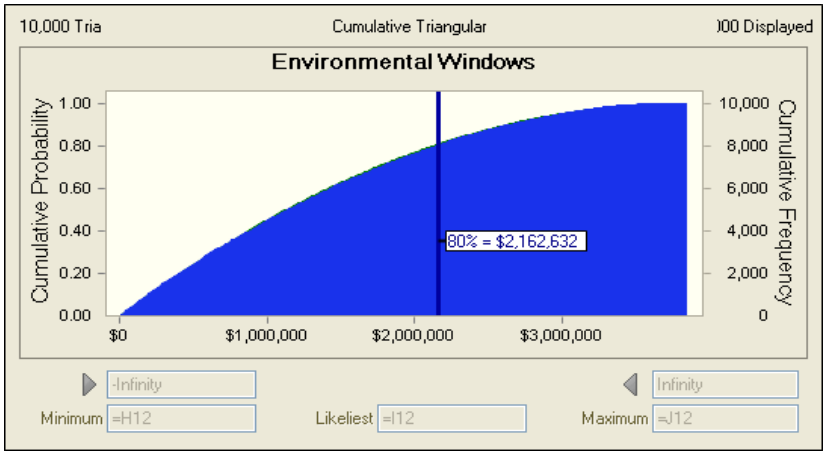
Risk Refer No.	Risk Event	Low	Most Likely	High
I-7	Environmental Windows	$0	$0	$3,847,000

Notes: This item captures the risk that delays and complications caused by environmental windows and restrictions will cause a variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes no change from the baseline estimate.

High High assumes that environmental windows and restrictions to have a significant impact on dredging operations and effective work times, potentially increasing the overall costs by up to 10%.



Assumption: **Environmental Windows**

Percentile	Assumption values
0%	$133
10%	$196,413
20%	$403,777
30%	$630,497
40%	$884,321
50%	$1,147,135
60%	$1,438,285
70%	$1,774,541
80%	$2,162,632
90%	$2,660,809
100%	$3,817,397

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Cost Risk Analysis Model

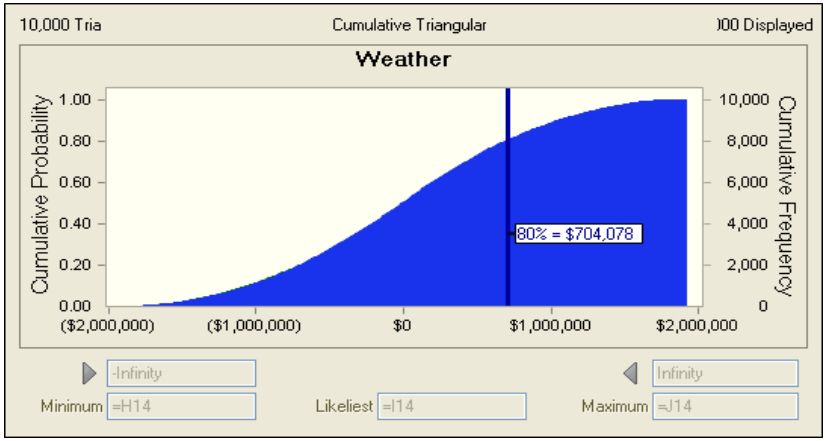
Risk Refer No.	Risk Event	Low	Most Likely	High
E-1	Weather	($1,924,000)	$0	$1,924,000

Notes: This item captures the risk that weather will cause a variance from the current baseline estimate.

Likely Likely assumes no change from the baseline estimate.

Low Low assumes that weather has less impact on dredging operations and effective work time than currently contemplated in the current baseline estimate, reducing the overall costs by up to 5%.

High High assumes that weather has more impact on dredging operations and effective work time than currently contemplated in the current baseline estimate, increasing the overall costs by up to 5%.



Assumption: **Weather**

Percentile	Assumption values
0%	($1,888,030)
10%	($1,047,992)
20%	($697,912)
30%	($442,145)
40%	($204,879)
50%	$1,821
60%	$198,198
70%	$434,272
80%	$704,078
90%	$1,060,952
100%	$1,856,796

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - PDT Risk Register

Risk Level

Likelihood of Occurrence	Negligible	Marginal	Significant	Critical	Crisis
Very Likely	Low	Moderate	High	High	High
Likely	Low	Moderate	High	High	High
Unlikely	Low	Low	Moderate	Moderate	High
Very Unlikely	Low	Low	Low	Low	High

Impact or Consequence of Occurrence

Risk No.	Risk/Opportunity Event	Discussion and Concerns	Project Cost				Project Schedule				Variance Distribution	Correlation to Other(s)	Responsibility/POC	Affected Project Component	Project Implications
			Likelihood*	Impact*	Risk Level*	Rough Order Impact ($)	Likelihood*	Impact*	Risk Level*	Rough Order Impact (mo)					
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)															
I-1	Scope Definition	Scope is fairly well defined for standard civil works features. Scope may change based on permitting.	LIKELY	SIGNIFICANT	HIGH		VERY Unlikely	MARGINAL	LOW		UNIFORM	I-2	Project Manager/Planner	Construction Cost	Cost & Schedule
I-2	Scope Growth / Reduction	Scope is fairly well defined for standard civil works features. The pumping plant has potential of VE savings through better data and VE.	LIKELY	MARGINAL	MODERATE		LIKELY	MARGINAL	MODERATE		UNIFORM	I-1	Project Manager/Planner	Construction Cost	Cost & Schedule
I-3	Equipment Availability/Pricing	Estimate assumes medium size hopper dredges will performed the subject work. Availability is not a problem. Based on passed similar projects within the area medium size hoppers were used, Panama City Beaches being the most recent.	UNLIKELY	MARGINAL	LOW		UNLIKELY	MARGINAL	LOW		TRIANGULAR	I-8	Cost Engineering	Equipment/Production Rates	Cost & Schedule
I-4	Material Availability	Borrow sources are provided and indicated on drawings. Per the design Engineer and based on current surveys, quality and quantity of beach fill material is available at all sites.	UNLIKELY	MARGINAL	LOW		LIKELY	MARGINAL	MODERATE		TRIANGULAR	I-1	Design Engineer	Material Costs	Cost & Schedule
I-5	Fuel Prices	$2.65 per gallon was used in the Dec 09 CEDEP Estimates, increases will effect equipment and delivery or materials. Fuel cost fluctuations can significantly impact dredging cost.	VERY LIKELY	SIGNIFICANT	HIGH		UNLIKELY	NEGLIGIBLE	LOW		TRIANGULAR		Cost Engineering	Equipment	Cost
I-6	Permits	Permitting delays may occur due to Florida State policy.	LIKELY	MARGINAL	MODERATE		LIKELY	MARGINAL	MODERATE		TRIANGULAR		Planning/Regulatory	PED/Lands & Damages	Schedule
I-7	Environmental Windows	Project site is a natural habitat for various species of threatened wildlife that utilize the project vicinity during Spring and Winter months. Gulf sturgeon incidental takes during dredging and Sea Turtle and Bird Nesting may have Impact during Construction.	LIKELY	SIGNIFICANT	HIGH		LIKELY	SIGNIFICANT	HIGH		TRIANGULAR		Project Manager/Planner	Construction Cost	Cost & Schedule
I-8	Acquisition Plan (Strategy)	The estimate was based on full and open competition, with minimal tiering of contractor subs. The Acq Plan has not been finalized, therefore there is a potential for additional tiering of the contracts.	UNLIKELY	MARGINAL	LOW		UNLIKELY	MARGINAL	LOW		TRIANGULAR		Acquisition Strategy Board	Construction Cost	Cost & Schedule
I-9	VE Study	VE study will be performed prior to Final Feasibility Report	UNLIKELY	MARGINAL	LOW		UNLIKELY	MARGINAL	LOW		TRIANGULAR		Project Manager/Planner	Construction Cost	Cost & Schedule
External Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)															
E-1	Weather	Florida is subject to bad weather during Hurricane Season which can cause Schedule delays. Weather days are generally incorporated into schedule.	LIKELY	MARGINAL	MODERATE		LIKELY	MARGINAL	MODERATE		TRIANGULAR		N/A	Labor/Production Rates	Schedule
E-2	Congressional Funding	PM feels Adequate Congressional funding to complete project will be available.	UNLIKELY	MARGINAL	LOW		UNLIKELY	MARGINAL	LOW		UNIFORM		Project Manager	Construction Cost	Cost & Schedule

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - PDT Risk Register

*Likelihood, Impact, and Risk Level to be verified through market research and analysis (conducted by cost engineer).

1. Risk/Opportunity identified with reference to the Risk Identification Checklist and through deliberation and study of the PDT.
2. Discussions and Concerns elaborates on Risk/Opportunity Events and includes any assumptions or findings (should contain information pertinent to eventual study and analysis of event's impact to project).
3. Likelihood is a measure of the probability of the event occurring -- **Very Unlikely**, **Unlikely**, **Moderately Likely**, **Likely**, **Very Likely.** Likelihood of the event is the same for both Cost and Schedule.
4. Impact is a measure of the event's effect on project objectives with relation to scope, cost, and/or schedule -- **Negligible**, **Marginal**, **Significant**, **Critical**, or **Crisis.** Impacts on Project Cost may not be the same for impacts on Project Schedule.
5. Risk Level is the resultant of Likelihood and Impact **Low**, **Moderate**, or **High**. Refer to top matrix table.
6. Variance Distribution refers to the behavior of the individual risk item with respect to its potential effects on Project Cost and Schedule. For example, an item with clearly defined parameters and a solid most likely scenario would probably follow a triangular or normal distribution. An risk item for which the PDT has little data or probability of modeling with respect to effects on cost or schedule (i.e. "anyone's guess") would probably follow a uniform or discrete uniform distribution.
7. The responsibility or POC is the entity responsible as the Subject Matter Expert (SME) on the PDT for the identified risk or opportunity.
8. Correlation recognizes those risk events that may be related to one another. Care should be given to ensure the risks are handled correctly without a "double counting."
9. Affected Project Component identifies the specific item of the project to which the risk directly or strongly correlates.
10. Project Implications identifies whether or not the risk item affects project cost, project schedule, or both. The PDT is responsible for conducting studies for both Project Cost and for Project Schedule.
11. Results of the risk identification process are studied and further developed by the Cost Engineer, then analyzed through the Monte Carlo Analysis Method for Cost (Contingency) and Schedule (Escalation) Growth.

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Cost & Schedule Risk Analysis

Contingency on Base Estimate	80% Confidence Project Cost
Baseline Estimate Cost (Most Likely) ->	**$38,472,000**
Baseline Estimate Cost Contingency Amount ->	$7,591,139
Baseline Estimate Construction Cost (80% Confidence) ->	**$46,063,139**

Contingency on Schedule	80% Confidence Project Schedule
Project Schedule Duration (Most Likely) ->	**24.0 Months**
Schedule Contingency Duration ->	13.2 Months
Project Schedule Duration (80% Confidence) ->	**37.2 Months**
Project Schedule Contingency Amount (80% Confidence) ->	**$1,269,854**

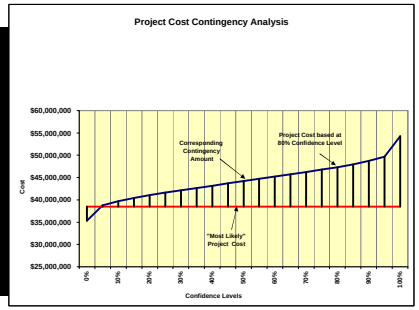
Project Contingency	80% Confidence Project Cost
Project Contingency Amount (80% Confidence) ->	**$8,860,993**
Project Contingency Percentage (80% Confidence) ->	**23%**

Project Cost (80% Confidence) ->	**$47,332,993**

- PROJECT CONTINGENCY DEVELOPMENT -

Contingency Analysis

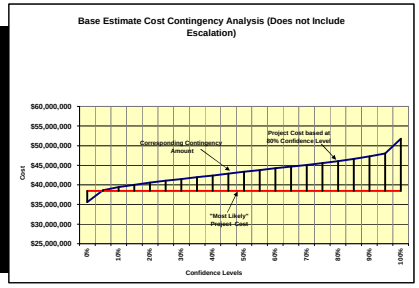
Most Likely Cost Estimate	$38,472,000	
Confidence Level	**Value**	**Contingency**
0%	$35,293,791	-8.26%
5%	$38,801,544	0.86%
10%	$39,724,133	3.25%
15%	$40,450,909	5.14%
20%	$41,070,682	6.75%
25%	$41,640,540	8.24%
30%	$42,155,547	9.57%
35%	$42,665,159	10.90%
40%	$43,173,806	12.22%
45%	$43,705,224	13.60%
50%	$44,217,387	14.93%
55%	$44,716,681	16.23%
60%	$45,242,860	17.60%
65%	$45,749,684	18.92%
70%	$46,225,243	20.15%
75%	$46,780,580	21.60%
80%	**$47,332,993**	**23.03%**
85%	$47,972,359	24.69%
90%	$48,727,749	26.66%
95%	$49,670,609	29.11%
100%	$54,281,913	41.09%

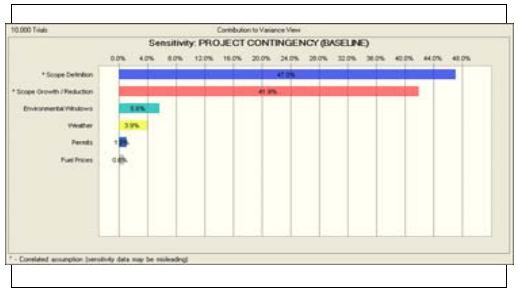


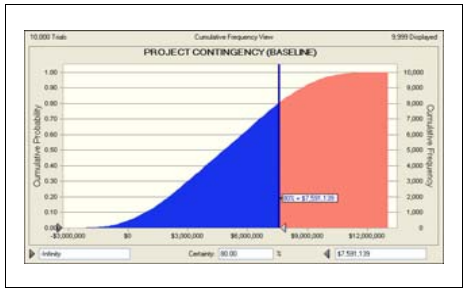
- BASE CONTINGENCY DEVELOPMENT -

Contingency Analysis

Most Likely Cost Estimate	$38,472,000	
Confidence Level	**Value**	**Contingency**
0%	$35,612,681	-7.43%
5%	$38,596,444	0.32%
10%	$39,400,105	2.41%
15%	$40,031,858	4.05%
20%	$40,570,924	5.46%
25%	$41,066,212	6.74%
30%	$41,518,581	7.92%
35%	$41,966,737	9.08%
40%	$42,414,355	10.25%
45%	$42,887,489	11.48%
50%	$43,340,841	12.66%
55%	$43,780,340	13.80%
60%	$44,247,516	15.01%
65%	$44,697,803	16.19%
70%	$45,106,647	17.25%
75%	$45,590,341	18.50%
80%	**$46,063,139**	**19.73%**
85%	$46,614,494	21.16%
90%	$47,253,783	22.83%
95%	$48,036,761	24.86%
100%	$51,742,319	34.49%



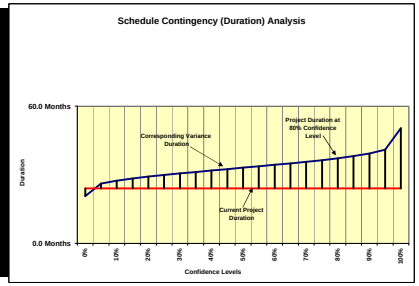


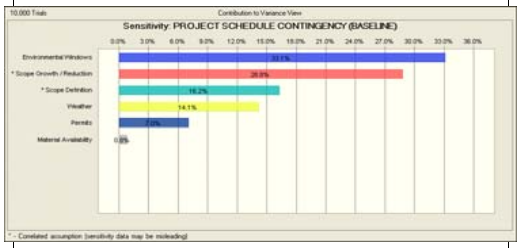


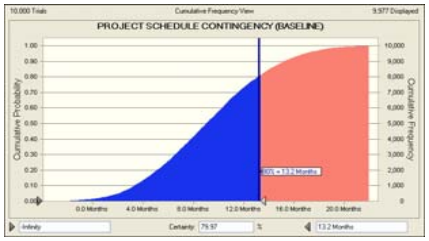
- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Contingency Analysis

Most Likely Schedule	24.0 Months	
Confidence Level	**Value**	**Contingency**
0%	20.7 Months	-13.81%
5%	26.1 Months	8.89%
10%	27.4 Months	14.04%
15%	28.4 Months	18.15%
20%	29.2 Months	21.65%
25%	30.0 Months	24.88%
30%	30.6 Months	27.59%
35%	31.3 Months	30.26%
40%	31.9 Months	32.90%
45%	32.5 Months	35.43%
50%	33.1 Months	37.97%
55%	33.7 Months	40.56%
60%	34.3 Months	43.12%
65%	34.9 Months	45.57%
70%	35.6 Months	48.45%
75%	36.4 Months	51.56%
80%	37.2 Months	55.01%
85%	38.1 Months	58.82%
90%	39.3 Months	63.85%
95%	41.0 Months	70.78%
100%	50.4 Months	110.02%



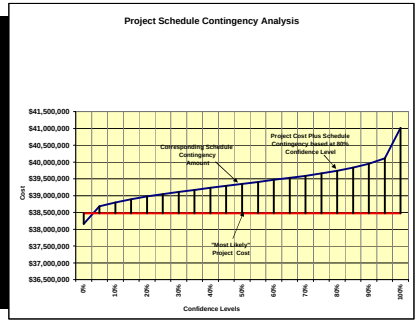




- SCHEDULE CONTINGENCY (AMOUNT) DEVELOPMENT -

Contingency Analysis

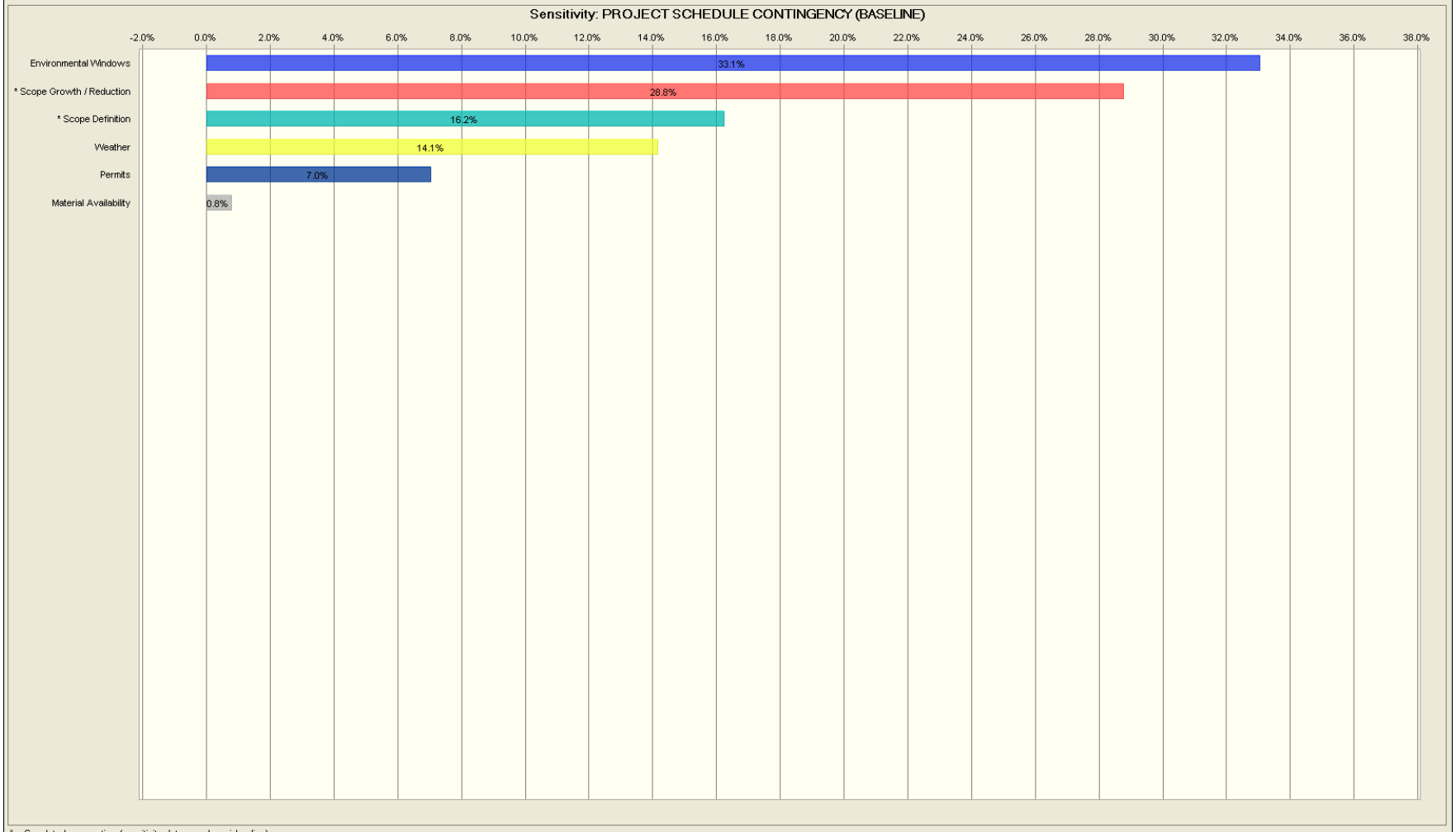
Most Likely Cost Estimate	$38,472,000	
Confidence Level	**Value**	**Contingency**
0%	$(318,890)	-0.83%
5%	$205,100	0.53%
10%	$324,029	0.84%
15%	$419,051	1.09%
20%	$499,758	1.30%
25%	$574,328	1.49%
30%	$636,966	1.66%
35%	$698,422	1.82%
40%	$759,451	1.97%
45%	$817,735	2.13%
50%	$876,546	2.28%
55%	$936,341	2.43%
60%	$995,344	2.59%
65%	$1,051,881	2.73%
70%	$1,118,395	2.91%
75%	$1,190,238	3.09%
80%	$1,269,854	3.30%
85%	$1,357,865	3.53%
90%	$1,473,966	3.83%
95%	$1,633,848	4.25%
100%	$2,539,595	6.60%



Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Schedule Risk Analysis Model

10,000 Trials

Contribution to Variance View



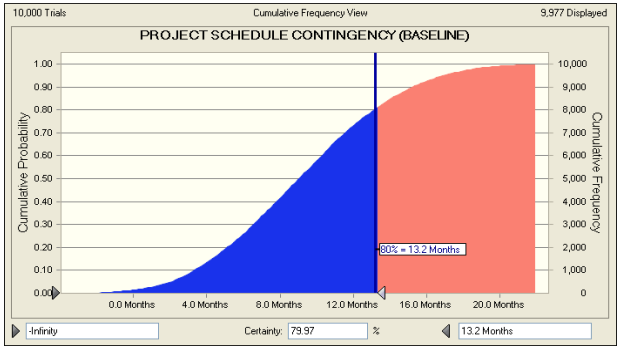
* - Correlated assumption (sensitivity data may be misleading)

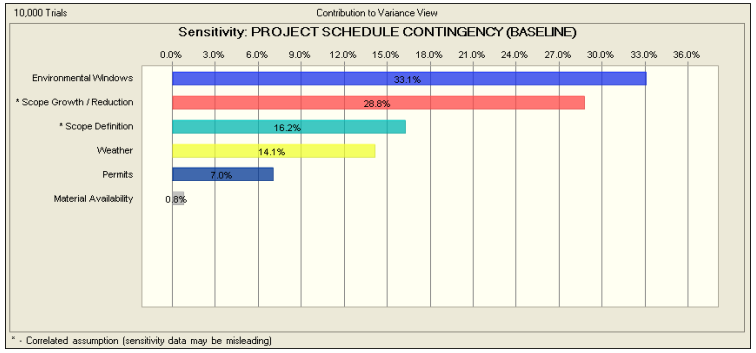
Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Schedule Risk Analysis Model

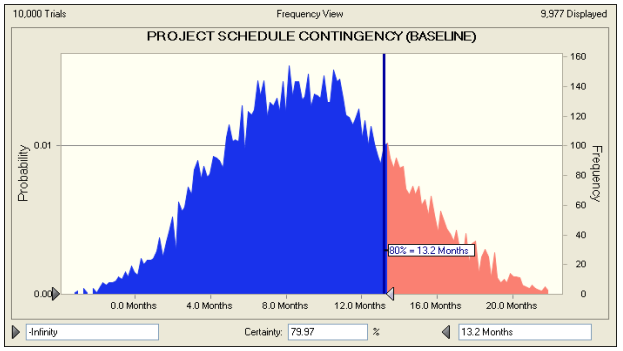
Risk No.	Risk/Opportunity Event	Project Schedule: Likelihood*	Project Schedule: Impact*	Project Schedule: Risk Level*	Variance Distribution	Correlation to Other(s)	Crystal Ball Simulation Expected Values (mos.): Low	Most Likely	High		Crystal Ball Simulation Expected Values (%s): Low	Most Likely	High
Internal Risks (Internal Risk Items are those that are generated, caused, or controlled within the PDT's sphere of influence.)													
I-1	Scope Definition	LIKELY	MARGINAL	MODERATE	UNIFORM	I-2	0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	50.01%
I-2	Scope Growth / Reduction	LIKELY	MARGINAL	MODERATE	UNIFORM	I-1	-3.0 Months	0.0 Months	6.0 Months		-12.50%	0.00%	25.00%
I-4	Material Availability	LIKELY	MARGINAL	MODERATE	TRIANGULAR		0.0 Months	0.0 Months	2.0 Months		0.00%	0.00%	8.33%
I-6	Permits	LIKELY	MARGINAL	MODERATE	TRIANGULAR		0.0 Months	0.0 Months	6.0 Months		0.00%	0.00%	25.00%
I-7	Environmental Windows	LIKELY	SIGNIFICANT	HIGH	TRIANGULAR		0.0 Months	0.0 Months	12.0 Months		0.00%	0.00%	50.01%
External Risks (External Risk Items are those that are generated, caused, or controlled exclusively outside the PDT's sphere of influence.)													
E-1	Weather	LIKELY	MARGINAL	MODERATE	TRIANGULAR		-3.0 Months	0.0 Months	6.0 Months		-12.50%	0.00%	25.00%
										Not Part of Study - Placeholder for Project Summation Purposes Only			
								0.0 Months					

Percentages are calculated as the variance from the assumption value to facilitate iteration of the model should the cost values change throughout the project phases. Uniform distribution percentages reflect variation from the total project cost.

PROJECT SCHEDULE CONTINGENCY (BASELINE)	Percentile	Baseline Schedule Duration	Contingency (Duration)	Baseline w/ Contingency	Contingency %
	0%	24.0 Months	-3.3 Months	20.7 Months	-13.81%
	5%	24.0 Months	2.1 Months	26.1 Months	8.89%
	10%	24.0 Months	3.4 Months	27.4 Months	14.04%
	15%	24.0 Months	4.4 Months	28.4 Months	18.15%
	20%	24.0 Months	5.2 Months	29.2 Months	21.65%
	25%	24.0 Months	6.0 Months	30.0 Months	24.88%
	30%	24.0 Months	6.6 Months	30.6 Months	27.59%
	35%	24.0 Months	7.3 Months	31.3 Months	30.26%
	40%	24.0 Months	7.9 Months	31.9 Months	32.90%
	45%	24.0 Months	8.5 Months	32.5 Months	35.43%
	50%	24.0 Months	9.1 Months	33.1 Months	37.97%
	55%	24.0 Months	9.7 Months	33.7 Months	40.56%
	60%	24.0 Months	10.3 Months	34.3 Months	43.12%
	65%	24.0 Months	10.9 Months	34.9 Months	45.57%
	70%	24.0 Months	11.6 Months	35.6 Months	48.45%
	75%	24.0 Months	12.4 Months	36.4 Months	51.56%
	80%	24.0 Months	**13.2 Months**	**37.2 Months**	**55.01%**
	85%	24.0 Months	14.1 Months	38.1 Months	58.82%
	90%	24.0 Months	15.3 Months	39.3 Months	63.85%
	95%	24.0 Months	17.0 Months	41.0 Months	70.78%
	100%	24.0 Months	26.4 Months	50.4 Months	110.02%







Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Schedule Risk Analysis Model	
Estimated Total Project Cost (Price Level)	**$38,472,000**
Max. Anticipated Annual Amount	**$19,249,175**
Enter Current OMB Escalation Rate	**2.06%**
Enter Current Project Location Escalation Rate	**2.06%**
Enter Assumed Hotel Rate	**6.00%**

	Date	Escalation Delta Amount	Hotel Amount	Total Schedule Contingency
Enter Current Project Start	1-Jan-12			
Enter Baseline Project Completion	31-Dec-13			
Project Completion at 0% Confidence	21-Sep-13		($318,890.10)	($318,890.10)
Project Completion at 5% Confidence	5-Mar-14		$205,099.50	$205,099.50
Project Completion at 10% Confidence	12-Apr-14		$324,028.70	$324,028.70
Project Completion at 15% Confidence	12-May-14		$419,050.93	$419,050.93
Project Completion at 20% Confidence	7-Jun-14		$499,758.31	$499,758.31
Project Completion at 25% Confidence	30-Jun-14		$574,327.88	$574,327.88
Project Completion at 30% Confidence	20-Jul-14		$636,965.97	$636,965.97
Project Completion at 35% Confidence	8-Aug-14		$698,422.06	$698,422.06
Project Completion at 40% Confidence	28-Aug-14		$759,450.77	$759,450.77
Project Completion at 45% Confidence	15-Sep-14		$817,734.89	$817,734.89
Project Completion at 50% Confidence	4-Oct-14		$876,546.19	$876,546.19
Project Completion at 55% Confidence	23-Oct-14		$936,340.77	$936,340.77
Project Completion at 60% Confidence	10-Nov-14		$995,344.00	$995,344.00
Project Completion at 65% Confidence	28-Nov-14		$1,051,880.58	$1,051,880.58
Project Completion at 70% Confidence	19-Dec-14		$1,118,395.46	$1,118,395.46
Project Completion at 75% Confidence	11-Jan-15		$1,190,238.45	$1,190,238.45
Project Completion at 80% Confidence	5-Feb-15		$1,269,854.46	$1,269,854.46
Project Completion at 85% Confidence	5-Mar-15		$1,357,865.48	$1,357,865.48
Project Completion at 90% Confidence	11-Apr-15		$1,473,966.48	$1,473,966.48
Project Completion at 95% Confidence	31-May-15		$1,633,847.83	$1,633,847.83
Project Completion at 100% Confidence	13-Mar-16		$2,539,594.74	$2,539,594.74

Entry Required
Do Not Overwrite
Summary Data -- Do Not Overwrite

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Schedule Risk Analysis Model

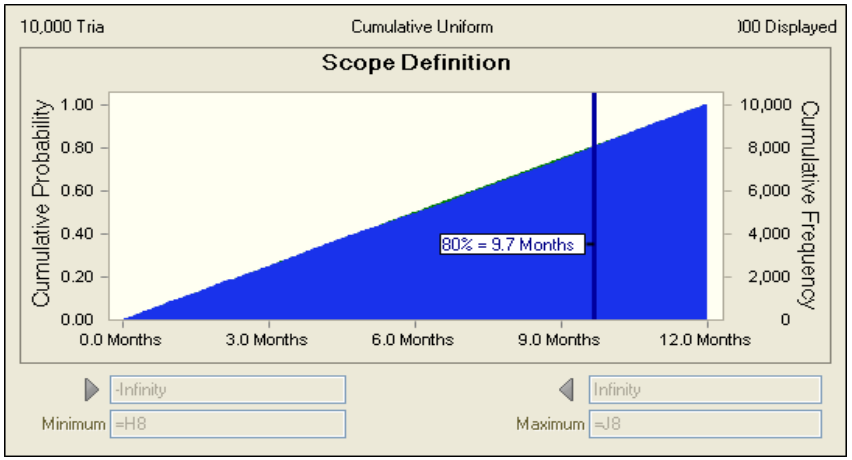
Risk Refer No.	Risk Event	Low	Most Likely	High
I-1	Scope Definition	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that issues with the definition of the current scope of the project will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

Low Low assumes no change from the baseline schedule.

High High assumes that the project completion date could change due to increase in scope, by up to 12 months.



Assumption: **Scope Definition**

Percentile	Assumption values
0%	0.0 Months
10%	1.2 Months
20%	2.4 Months
30%	3.6 Months
40%	4.8 Months
50%	6.1 Months
60%	7.3 Months
70%	8.5 Months
80%	9.7 Months
90%	10.8 Months
100%	12.0 Months

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Schedule Risk Analysis Model

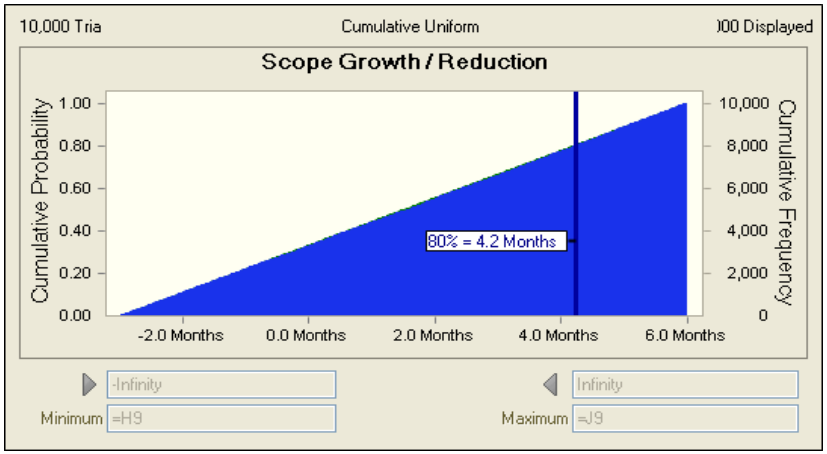
Risk Refer No.	Risk Event	Low	Most Likely	High
I-2	Scope Growth / Reduction	-3.0 Months	0.0 Months	6.0 Months

Notes: This item captures the risk that issues with growth or reduction to scope (not caused by project definition) will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

Low Low assumes that the project completion date could finish early due to reduction in scope, by up to 3 months.

High High assumes that the project completion date could change due to increase in scope, by up to 6 months.



Assumption: **Scope Growth / Reduction**

Percentile	Assumption values
0%	'-3.0 Months
10%	'-2.1 Months
20%	'-1.2 Months
30%	'-0.2 Months
40%	0.6 Months
50%	1.6 Months
60%	2.4 Months
70%	3.4 Months
80%	4.2 Months
90%	5.1 Months
100%	6.0 Months

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Schedule Risk Analysis Model

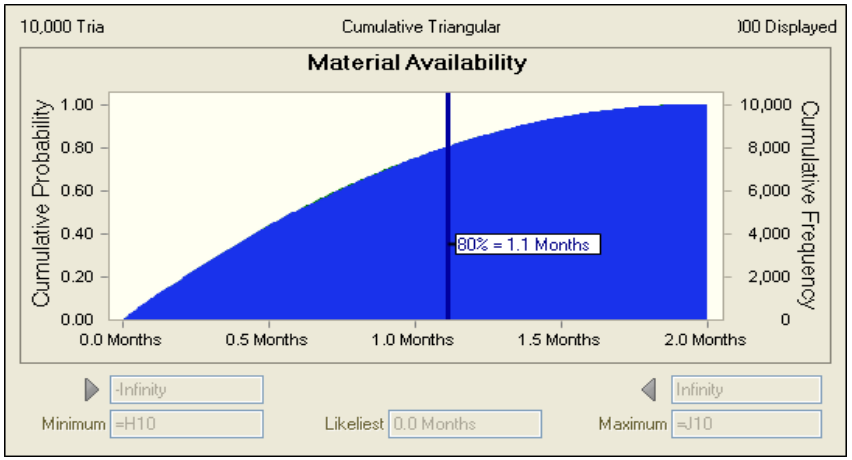
Risk Refer No.	Risk Event	Low	Most Likely	High
I-4	Material Availability	0.0 Months	0.0 Months	2.0 Months

Notes: This item captures the risk that issues with material availability will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

Low Low assumes no change from the baseline schedule.

High High assumes that issues with material and equipment availability could delay the project completion date by up to 2 months.



Assumption: **Material Availability**

Percentile	Assumption values
0%	0.0 Months
10%	0.1 Months
20%	0.2 Months
30%	0.3 Months
40%	0.5 Months
50%	0.6 Months
60%	0.7 Months
70%	0.9 Months
80%	1.1 Months
90%	1.4 Months
100%	2.0 Months

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Schedule Risk Analysis Model

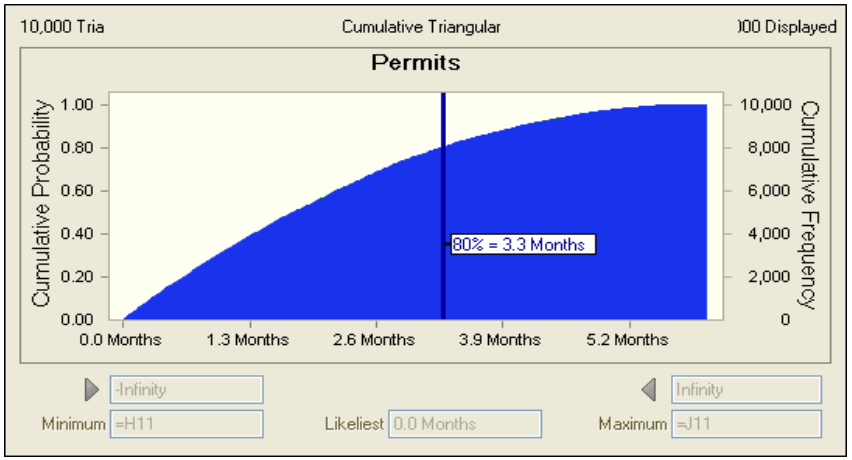
Risk Refer No.	Risk Event	Low	Most Likely	High
I-6	Permits	0.0 Months	0.0 Months	6.0 Months

Notes: This item captures the risk that issues with growth or reduction to scope (not caused by project definition) will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

Low Low assumes no change from the baseline schedule.

High High assumes that issues with issuing of permits from the State of Florida could delay the project completion date by up to 6 months.



Assumption: **Permits**

Percentile	Assumption values
0%	0.0 Months
10%	0.3 Months
20%	0.6 Months
30%	1.0 Months
40%	1.3 Months
50%	1.8 Months
60%	2.2 Months
70%	2.7 Months
80%	3.3 Months
90%	4.1 Months
100%	5.9 Months

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Schedule Risk Analysis Model

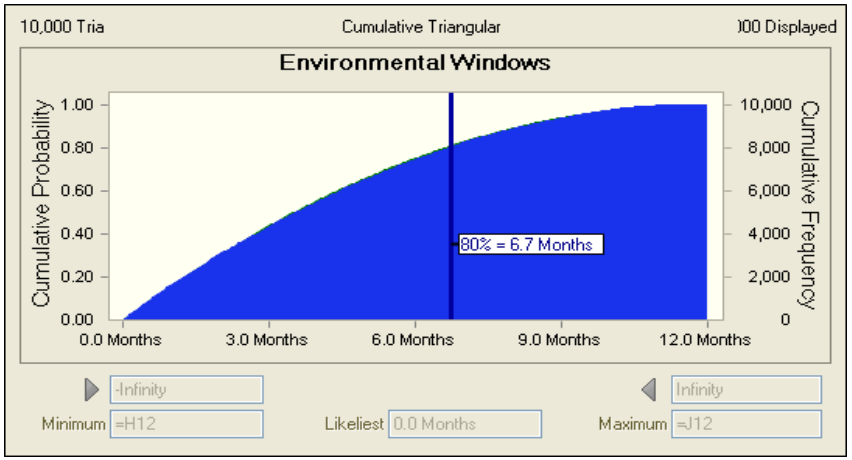
Risk Refer No.	Risk Event	Low	Most Likely	High
I-7	Environmental Windows	0.0 Months	0.0 Months	12.0 Months

Notes: This item captures the risk that issues with growth or reduction to scope (not caused by project definition) will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

Low Low assumes no change from the baseline schedule.

High High assumes that the project completion date could change due to challenges with environmental work windows and restrictions, by up to 12 months.



Assumption: **Environmental Windows**

Percentile	Assumption values
0%	0.0 Months
10%	0.6 Months
20%	1.3 Months
30%	2.0 Months
40%	2.8 Months
50%	3.6 Months
60%	4.5 Months
70%	5.5 Months
80%	6.7 Months
90%	8.3 Months
100%	11.9 Months

Walton County Storm Damage Reduction Project, GI Study - "NED & LP" Plans - Schedule Risk Analysis Model

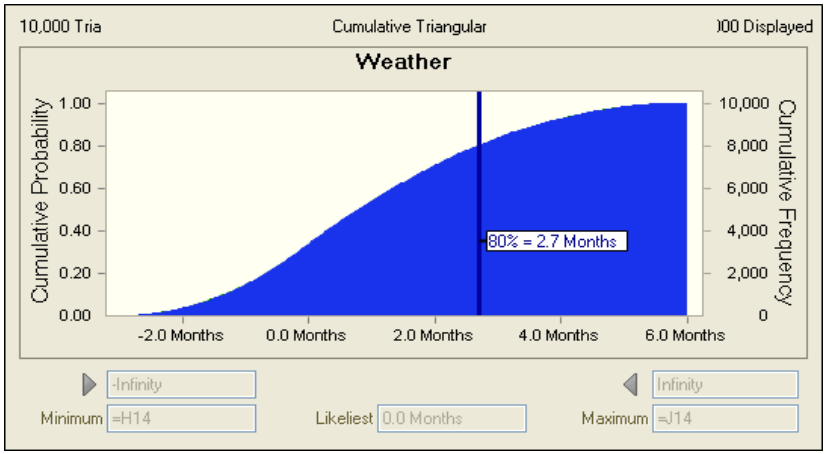
Risk Refer No.	Risk Event	Low	Most Likely	High
E-1	Weather	-3.0 Months	0.0 Months	6.0 Months

Notes: This item captures the risk that issues with growth or reduction to scope (not caused by project definition) will cause a variance from the current baseline schedule.

Likely Likely assumes no change from the baseline schedule.

Low Low assumes that favorable weather conditions could improve the schedule by up to 3 months.

High High assumes that unfavorable weather conditions could delay the schedule by up to 6 months.



Assumption: **Weather**

Percentile	Assumption values
0%	'-2.9 Months
10%	'-1.3 Months
20%	'-0.7 Months
30%	'-0.2 Months
40%	0.3 Months
50%	0.8 Months
60%	1.3 Months
70%	2.0 Months
80%	2.7 Months
90%	3.7 Months
100%	5.8 Months

ATTACHMENT V

PROJECT SCHEDULE

Walton County, Florida
Hurricane and Storm Damage Reduction Project
Project Schedule

ID	Task Name	Duration	Start	Finish	Predecessors
1	**Walton County HSDR Project**	**15,145 days**	**Tue, 5/14/2013**	**Fri, 10/30/2054**	
2	**Authorization**	**1 days**	**Tue, 5/14/2013**	**Tue, 5/14/2013**	
3	**Initial Construction**	**397 days**	**Fri, 7/12/2013**	**Tue, 1/20/2015**	
4	Funding	1 days	Fri, 7/12/2013	Fri, 7/12/2013	2
5	Design	120 days	Fri, 8/16/2013	Thu, 1/30/2014	4
6	Advertise	30 days	Mon, 2/17/2014	Fri, 3/28/2014	5
7	Award	1 day	Mon, 4/14/2014	Mon, 4/14/2014	6
8	Construct	200 days	Tue, 4/15/2014	Tue, 1/20/2015	7
9					
10	**First Renourishment**	**400 days**	**Mon, 4/17/2023**	**Fri, 10/25/2024**	
11	**Surveys**	**44 days**	**Mon, 4/17/2023**	**Thu, 6/15/2023**	
12	Borrow Availability	14 days	Mon, 4/17/2023	Thu, 5/4/2023	
13	Beach Template	30 days	Fri, 5/5/2023	Thu, 6/15/2023	12
14	Quantity Estimate	14 days	Fri, 6/16/2023	Wed, 7/5/2023	13
15	**Environmental Coordination**	**156 days**	**Mon, 6/12/2023**	**Mon, 1/15/2024**	
16	Permit Preparation	90 days	Mon, 6/12/2023	Fri, 10/13/2023	
17	Permit Approval	66 days	Mon, 10/16/2023	Mon, 1/15/2024	16
18	Plan Preparation	207 days	Mon, 4/17/2023	Tue, 1/30/2024	
19	Advertise	30 days	Fri, 2/16/2024	Thu, 3/28/2024	18
20	Award Construct	1 day	Tue, 4/2/2024	Fri, 4/12/2024	19
21	Construct	140 days	Fri, 4/5/2024	Fri, 10/25/2024	20
22					
23	**Second Renourishment**	**400 days**	**Mon, 4/18/2033**	**Fri, 10/27/2034**	
24	**Surveys**	**44 days**	**Mon, 4/18/2033**	**Thu, 6/16/2033**	
25	Borrow Availability	14 days	Mon, 4/18/2033	Thu, 5/5/2033	
26	Beach Template	30 days	Fri, 5/6/2033	Thu, 6/16/2033	25
27	Quantity Estimate	14 days	Fri, 6/17/2033	Wed, 7/6/2033	26
28	**Environmental Coordination**	**156 days**	**Mon, 6/13/2033**	**Mon, 1/16/2034**	
29	Permit Preparation	90 days	Mon, 6/13/2033	Fri, 10/14/2033	
30	Permit Approval	66 days	Mon, 10/17/2033	Mon, 1/16/2034	29
31	Plan Preparation	207 days	Mon, 4/18/2033	Tue, 1/31/2034	
32	Advertise	30 days	Fri, 2/17/2034	Thu, 3/30/2034	31
33	Award Construct	1 day	Fri, 4/14/2034	Fri, 4/14/2034	32
34	Construct	140 days	Mon, 4/17/2034	Fri, 10/27/2034	33
35					
36	**Third Renourishment**	**400 days**	**Mon, 4/20/2043**	**Fri, 10/28/2044**	
37	**Surveys**	**44 days**	**Mon, 4/20/2043**	**Thu, 6/18/2043**	
38	Borrow Availability	14 days	Mon, 4/20/2043	Thu, 5/7/2043	
39	Beach Template	30 days	Fri, 5/8/2043	Thu, 6/18/2043	38
40	Quantity Estimate	14 days	Fri, 6/19/2043	Wed, 7/8/2043	39
41	**Environmental Coordination**	**156 days**	**Mon, 6/16/2042**	**Fri, 1/15/2044**	
42	Permit Preparation	90 days	Mon, 6/15/2043	Thu, 10/15/2043	
43	Permit Approval	66 days	Mon, 10/19/2043	Fri, 1/15/2044	42
44	Plan Preparation	207 days	Mon, 4/20/2043	Mon, 2/1/2044	
45	Advertise	30 days	Fri, 2/19/2044	Thu, 3/31/2044	44
46	Award Construct	1 day	Fri, 4/15/2044	Tue, 4/5/2044	45
47	Construct	140 days	Mon, 4/18/2044	Fri, 10/28/2044	46
48					
49	**Fourth Renourishment**	**400 days**	**Mon, 4/21/2053**	**Fri, 10/30/2054**	
50	**Surveys**	**44 days**	**Mon, 4/21/2053**	**Thu, 6/19/2053**	
51	Borrow Availability	14 days	Mon, 4/21/2053	Thu, 5/8/2053	
52	Beach Template	30 days	Fri, 5/9/2053	Fri, 6/19/1953	51
53	Quantity Estimate	14 days	Fri, 6/20/2053	Wed, 7/9/2053	52
54	**Environmental Coordination**	**156 days**	**Mon, 6/16/2053**	**Fri, 1/16/2054**	
55	Permit Preparation	90 days	Mon, 6/16/2053	Thu, 10/16/2053	
56	Permit Approval	66 days	Mon, 10/20/2053	Fri, 1/16/2054	55
57	Plan Preparation	207 days	Mon, 4/21/2053	Mon, 2/2/2054	
58	Advertise	30 days	Thu, 2/18/1954	Thu, 4/2/2054	57
59	Award Construct	1 day	Fri, 4/17/2054	Fri, 4/17/2054	58
60	Construct	140 days	Mon, 4/20/2054	Fri, 10/30/2054	59

APPENDIX B

ECONOMIC INVESTIGATIONS

WALTON COUNTY, FLORIDA
HURRICANE AND STORM DAMAGE REDUCTION
GENERAL INVESTIGATIONS STUDY

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HURRICANE AND STORM DAMAGE REDUCTION
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WALTON COUNTY, FLORIDA
HURRICANE AND STORM DAMAGE REDUCTION
GENERAL INVESTIGATIONS STUDY

APPENDIX B – ECONOMIC INVESTIGATIONS

1.0 INTRODUCTION

The Mobile District of the U.S. Army Corps of Engineers (Corps) has evaluated the feasibility of a hurricane and storm damage reduction project in Walton County, Florida. The results of those investigations are presented here and in the accompanying attachments.

1.1 PROBLEM STATEMENT

Walton County's shore line is receding; portions of the study area have experienced steady erosion which has resulted in increased exposure and risk of structural damage. The protective dunes and high bluffs are being destroyed by hurricane and storm forces. The impacts of these storms to property and infrastructure are considerable and can possibly be reduced through a beach restoration and stabilization project.

1.2 PURPOSE

The purpose of this Economic Appendix is to document the economic investigations completed to determine the National Economic Development (NED) Plan and to formulate a hurricane and storm damage reduction project for Walton County, Florida, which will reduce the damaging effects of hurricanes and severe storms to properties along the coast and stabilize or restore the shoreline. The project will be constructible, acceptable to the public, environmentally sustainable and justified by an economic evaluation.

1.3 STUDY AREA

Walton County comprises 26 miles of shoreline including six miles of state parks. A coastal peninsula extending west from the mainland characterizes the western two-thirds of the coastline, and a mainland beach characterizes the eastern third. The Walton County shoreline is characterized by high dune elevations along the mid-section of Walton County. Choctawhatchee Bay lies north of the peninsula. Behind the dune system, upland drainage feeds several freshwater lakes that intermittently breach the dune system and discharge directly into the gulf. Primary dune elevations range from 13 to 45 feet National Geodetic Vertical Datum (NGVD) and average 26 feet NGVD. During the late 1990s, the area endured several

strong hurricanes resulting in extensive shoreline erosion (Taylor Engineering, 2003). In 2004 the area was affected by Hurricane Ivan and early in the 2005 hurricane season it was impacted again by Hurricanes Arlene and Dennis.

1.4 FEDERAL INTEREST

Congress has authorized Federal participation in hurricane and storm damage reduction projects to prevent or reduce damages caused by wind and tidal generated waves and currents along the Nation's ocean coasts and Great Lakes shores.

1.5 ASSUMPTIONS AND CONSTRAINTS

The economic analysis is based on the following assumptions and constraints:

Assumptions:

- The Federal discount rate of 4-1/8 percent is used in this evaluation. The period of analysis is 54 years, beginning in 2010 and concludes after the year 2063 there are three pre-base years from 2010 thru 2013. The base year is 2014.
- The price level is in constant 2011 dollars.
- The analysis will consider expected future beachfront development.
- Critically eroding beach along Reach 1 will be protected to some level by local project to be constructed as a one-time fill funded by state and county jointly.
- Structure values will be based on depreciated replacement costs.
- Land use zoning and construction codes will not change during the period of analysis.
- Damaged or destroyed properties will be repaired to pre-storm conditions.
- Lost land will be valued at near shore prices.
- Empirical storm frequencies based on historical records for the study area are assumed to be predictive of the probability of future events.
- Beach mice will continue to be a protected species and there will be no changes to existing environmental laws.
- Existing state and county owned public park limits would remain the same in the future.

Constraints:

- The analysis recognizes the State of Florida Coastal Zone Management as well as the Threatened and Endangered Species Act and the Coastal Barrier Resources Act.
- The analysis also assumes that there will be a sufficient quantity of suitable sand for placement on the beaches.
- There is a requirement for the benefit-to-cost ratio to be greater than 1-to-1.

The project will be formulated to avoid impacts to dune, lake and Gulf connections.

2.0 SOCIO-ECONOMIC OVERVIEW

2.1 DEMOGRAPHICS

Walton County is located in the State of Florida. Today the County incorporates 1,058 square miles the 2009 estimated population is 55,105 persons, a 35.7 percent increase over the base population estimate of 40,601 in 2000 making it one of the fastest growing counties in Florida. The estimated number of housing units in 2008 was 41,859 and 52 persons per square mile. The median household income was $43,779. Fourteen point nine percent of Walton's population was living below the poverty level. The median value of owner-occupied housing was $96,400. The makeup of the county in 2008 was estimated at 88.8 percent white, 7.6 percent African American 1.1 percent American Indian and Alaska Native, 0.7 percent Asian, 1.8 percent reported two or more races and there were 3.8 percent of Hispanic or Latino origin. Because the Gulf of Mexico borders Walton County to the south, the county along with neighboring counties share over 200 miles of beautiful beaches. In Figure B-1 starting from the west side of Florida going east, the counties are as followed: Santa Rosa, Okaloosa, Walton, Bay, and Gulf.

2.2 POPULATION

The population of the five counties is shown for 1980, 1990, 2000 and 2009 in Table B-1. All five counties experienced population growth from 1980 to 2009. Combined the counties grew by about 91 percent, equaling the growth rate of Florida for that same time frame. Out of the five counties, Okaloosa County has the highest population, 178,473 and Gulf County the lowest 15,755. Most the growth took place in Santa Rosa and Walton Counties. Santa Rosa County led in growth from 1980 to 2009 by increasing over 171 percent followed by Walton County growth of 159 percent.

FIGURE B-1. COUNTIES OF INTEREST

TABLE B-1
SELECTED POPULATION CHARACTERISTICS[1]

Counties	Population 1980	Population 1990	Population 2000	Population 2009 est	Percent Change 1980-1990	Percent Change 1980-2000	Percent Change 1980-2009	Land Area Year 2000 Sq. Miles	2000 Persons Per Sq. Mile	2009 Persons Per Sq. Mile
Florida	9,746,324	12,937,926	15,982,378	18,537,969	33%	64%	90%	53,926	296.4	343.8
Santa Rosa	55,988	81,608	117,743	151,759	46%	110%	171%	1,016	115.8	149.2
Okaloosa	109,920	143,777	170,498	178,473	31%	55%	62%	936	182.2	190.7
Walton	21,300	27,759	40,601	55,105	30%	91%	159%	1,058	38.4	52.1
Bay	97,740	126,994	148,217	164,767	30%	52%	69%	764	194	215.7
Gulf	10,658	11,504	13,332	15,755	8%	25%	48%	555	24	28.4
Total ROI	295,606	391,642	490,391	565,859	32%	66%	91%	4,329	554.4	130.7

[1] Geostat Center: County and City Data Book
http://fisher.lib.virginia.edu/collections/stats/ccdb/
http://quickfacts.census.gov/qfd/states/12/12131.html

2.3 EMPLOYMENT

From 1990 to 2009 the number of persons in Florida's labor force increased by 48.1 percent. Four of the five counties in the study area exceeded the State's increase except for Gulf County which had only a 28.5 percent increase. The highest percentage labor force increase occurred in Walton County, a 140.8 percent increase, Santa Rosa County was the second highest gaining county with an 85.2 percentage increase. The State's unemployment rate for 2009 was a high 12 percent but all five counties in the study area had significantly lower rates. Gulf County the highest with 9.6 percent and the lowest was 7.1 percent in Okaloosa County.

TABLE B-2
SELECTED EMPLOYMENT CHARACTERISTICS[2]

Counties	Civil Labor Force				Civil Unemployment	
	1990	2000	2009	1990-2009	2009	rate in 2009
Florida	6,167,236	7,490,307	9,135,500	48.13%	1,096,260	12.0%
Santa Rosa	37,398	53,318	69,280	85.25%	5,791	8.4%
Okaloosa	62,371	82,486	94,982	52.29%	6,736	7.1%
Walton	12,354	16,404	29,748	140.80%	2334	7.8%
Bay	57,068	64,938	86,775	52.06%	8,089	9.3%
Gulf	4,834	4,861	6,213	28.53%	599	9.6%
Total	174,025	222,007	286,998	64.92%	1,893	4.6%

2.4 INDUSTRY EMPLOYMENT

Selected employment characteristics by place of work for the state and counties for 2007 are shown in Table B-3. Florida had 10,679,883 non-farm workers employed in 2007. The Finance and Service trade industry leads all industries by having 6,080,653 workers within the state. Similarly, the greatest numbers of non-farm workers for the five counties combined are employed in the Finance and Service trade industry also. Okaloosa County had the highest numbers of non-farm workers employed with 130,560 and Gulf County with least amount with 6,118 non-farm workers employed.

2.5 HOUSEHOLDS

Table B-4 displays selected household characteristics for Florida and the five counties. All five counties experienced a significant increase in the number of households from

[2] Geostat Center: County and City Data Book
http://fisher.lib.virginia.edu/collections/stats/ccdb/
http://quickfacts.census.gov/qfd/states/12000.html

TABLE B-3
EMPLOYMENT BY INDUSTRY[3]

Counties	2007						
	Total	Agriculture, Mining, & Construction	Manufacturing	Transportation	Wholesale & Retail Trade	Finance and Services	Government
Florida	10,679,883	1,010,779	420,891	350,553	1,608,023	6,080,653	1,208,984
Santa Rosa	51,132	7,337	1,163	1,001	6,926	26,690	8,015
Okaloosa	130,560	10,085	4,641	1,803	16,869	66,057	31,105
Walton	28,759	4,951	639	508	4,407	15,045	3,209
Bay	102,871	10,594	3,597	1,956	15,691	52,890	18,143
Gulf	6,118	940	205	211	665	2,568	1,529
Total	319,440	33,907	10,245	5,479	44,558	163,250	62,001

TABLE B-4
SELECTED HOUSEHOLD CHARACTERISTICS[4]

Counties	Household		Percent Change	Median Household Income			Percent Change
	1990	2000	1990-00	1989	1999	2008	1989-2008
Florida	5,134,869	6,337,929	23.4	$27,483	$38,819	$47,802	73.9%
Santa Rosa	29,900	43,793	46.5	$27,584	$41,881	$54,174	96.4%
Okaloosa	53,313	66,269	24.3	$27,941	$41,474	$54,420	94.8%
Walton	11,294	16,548	46.5	$21,297	$32,407	$43,779	105.6%
Bay	48,938	59,597	21.8	$24,684	$36,092	$45,655	85.0%
Gulf	4,324	4,931	14.0	$21,866	$30,276	$38,632	76.7%

1990 to 2000. With increases of over 46 percent, Santa Rosa and Walton Counties had the greatest growth in the number of households. Of the five counties, Okaloosa led with 66,269 households in 2000. The median household income also increased from 1989 to 2007 for the five counties. Of the five counties, Okaloosa County had the highest median household income in 2008, but Walton County had the greatest percentage increase from 1989 to 2008, 105.6 percent. The median household income for Santa Rosa and Okaloosa Counties both were higher than that of the State of Florida in 2008.

[3] Bureau of Economic Analysis
http://www.bea.doc.gov/bea/regional/reis/
http://quickfacts.census.gov/qfd/states/12000.html

[4] Geostat Center: County and City Data Book
http://fisher.lib.virginia.edu/collections/stats/ccdb/
http://quickfacts.census.gov/qfd/states/12000.html

2.6 PER CAPITA INCOME

Table B-5 displays the per capita income for Florida and the five counties. In 2007, Okaloosa had the highest per capita income out of the five counties; however, except for Okaloosa the remaining counties had a lower per capita income compared to the State of Florida. Florida per capita income was $38,417 in 2007 and Okaloosa County per capita income was $39,158 for that same year. Gulf and Walton Counties had higher percentages of persons living below the poverty level when compared to the State of Florida.

TABLE B-5
PER CAPITA INCOME

Counties	Per Capita Income			Percent Change	Percent Change	Percent Persons
	1990	1998	2007	1990-98	1998-2007	Below Poverty Level - 2007
Florida	$18,539	$26,845	$38,417	44.8%	43.1%	13.3%
Santa Rosa	$13,565	$21,808	$31,145	60.8%	42.8%	10.6%
Okaloosa	$15,803	$24,655	$39,158	56.0%	58.8%	8.7%
Walton	$11,588	$16,664	$28,235	43.8%	69.4%	14.9%
Bay	$14,814	$22,163	$33,106	49.6%	49.4%	11.9%
Gulf	$12,429	$16,754	$23,233	34.8%	38.7%	21.2%

2.7 TRANSPORTATION AND UTILITIES

Walton County is services by one Federal interstate, I-10, and three U.S. highways; US90, US98 and US331 and four state highways; SR-20, SR81, SR83 and SR-85. One railroad provides rail service, the CSX Main Line. The nearest airport with scheduled commercial airline service is in neighboring Okaloosa Regional Airport. A general aviation airport is located at the DeFuniak Springs Municipal Airport. The local deep water port is 45 miles to the east in neighboring Bay County, the Panama City Port Authority.

There are two natural gas companies providing service, City of DeFuniak Springs and Okaloosa County Gas District. One telephone company, Sprint, provides residential and business services. Five water and sewer companies, City of DeFuniak Springs, City of Freeport, Regional Utilities, South Walton Utilities and Mossy Head Water Works compete in the area.

There are five elementary and five secondary public schools with a current enrollment of 6,522 students served by 323 educators for the county. Okaloosa-Walton Community College and the Walton County Vocational Technical School provide for education beyond the secondary level.

Walton County has three local radio stations two locally printed newspapers 12 banks, three credit unions and two hospitals, Health Mark Regional Medical Center and Sacred Heart Hospital on the Emerald Coast.

3.0 STUDY METHODOLOGY

3.1 EVALUATION FRAMEWORK

Shore protection projects are formulated to provide hurricane and storm damage reduction while recreation benefits are incidental. ER 1165-2-130 provides policies and guidelines for determining the extent of Federal participation in potential Federal projects for protection from shore erosion, hurricanes, and abnormal tidal and lake flooding that result in damages or losses to coastal resources and/or development. Federal participation in shore protection projects must produce economic justification from storm damage reduction benefits or a combination of damage reduction benefits and recreation benefits not to exceed 50 percent of the total benefits required for justification.

The specific methodologies that will be used for the benefit study are based on the general principles and guidelines contained in the Principles and Guidelines (P&G) and are documented in Engineering Regulation (ER) 1105-2-100, 22 April 2000, Planning – Planning Guidance Notebook, Section I – Hurricane and Storm Damage Reduction, and Appendix D – Economic and Social Considerations.

The general economic principles and guidelines for assessing NED benefits are documented in the Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, Chapter II - National Economic Development Benefit Evaluation Procedures (March 10, 1983). This document is referred to as P&G; furthermore P&G recommends a life-cycle approach and risk and uncertainty analysis:

> "Storm damage reduction studies should adopt a life cycle approach and probabilistic analysis (and display) of benefits and costs. Key considerations are listed below. At a minimum, those with the greatest effect on plan formulation should be explicitly incorporated in the analysis.
>
> a) The erosion damage function
> b) The stage-damage function
> c) The wave-damage function
> d) Storm-related parameters such as peak wave height and period storm duration, peak surge elevation, and timing with respect to tidal phasing
> e) Wave height above the dune
> f) Wave penetration
> g) The shoreline retreat or eroded volume
> h) The natural post-storm recovery

3.2 INCORPORATING RISK AND UNCERTAINTY

The benefits and costs of shoreline protection and storm damage reduction projects are highly uncertain. Predicted costs and benefits are dependent upon a variety of engineering and economic models and assumptions. Future damages are dependent on the sequence of storms, their characteristics, property inventory, erosion, wind, and wave effects and a multitude of other factors.

In order to provide analytical support for projects involving shoreline protection and storm damage reduction, a unified risk-based engineering-economic model has been developed and is being applied to the Walton County Feasibility Study as a test bed application for the estimation of expected annual benefits of various hurricane and storm damage reduction alternatives using the newly developed hurricane and storm damage simulation model, Beach-*fx*.

3.3 BEACH-*FX* THE HURRICANE AND STORM DAMAGE SIMULATION MODEL

The Beach-*fx* model is an engineering-economic Monte Carlo simulation model that relates beach profile change to storms, coastal processes, and nourishment programs. It is an event-based, data-driven Monte Carlo simulation model. This structure has been used successfully in the past in a large number of Corps studies.

Beach-*fx* represents an improvement on previous models in this arena by being strongly based on representation of the coastal and engineering processes, incorporating the impact of multiple storms, and incorporating uncertainty in damage functions, physical characteristics of structures, and economic valuations. Expected structural damages generated through the simulations are expressed as losses due to flooding, erosion and waves.

3.4 MONTE CARLO SIMULATION

The complexities of the combined engineering-economic problem of risk-based analysis, in which there are uncertainties associated with the physical performance of systems and the economic consequences of that performance, are typically addressed through the use of Monte Carlo simulation techniques. Monte Carlo simulation is particularly useful for physically based real-world problems, where the results of the simulation can be tested against historical and reasonable behaviors.

3.5 ENGINEERING

3.5.1 Representative Profiles

Costal process models need to use a detailed distance vs. elevation (x, z) representation of the shoreline. The amount of data required for such a representation is not needed in an economic-engineering type model such as Beach-*fx* and so a simplified representation for the profile has been adopted. This simplified

representation for the profile uses five key features, which are dune width, dune height, dune slope, berm width, and berm height.

Figure B-2 is a depiction of the simplified Beach-*fx* profile. This representation is founded on three assumptions: 1) a single dune, 2) a single berm (no separate construction berm), and 3) an equilibrium submerged profile.

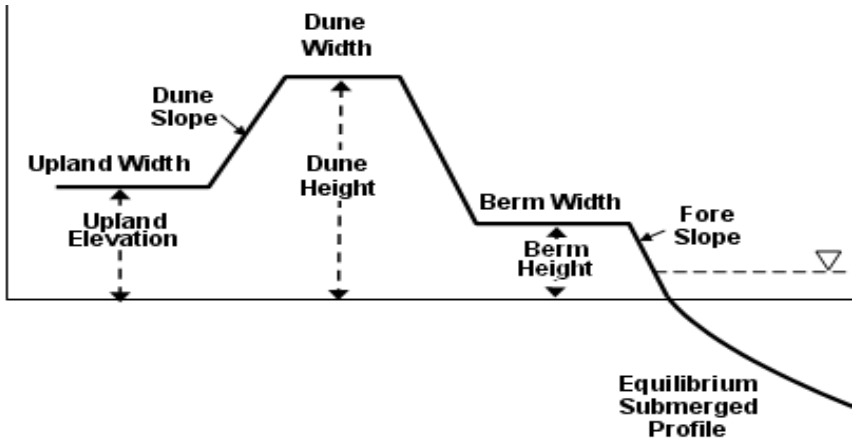


FIGURE B-2. BEACH-*FX* SIMPLIFIED BEACH PROFILE

The beach variables that change with storms are dune width, dune height, berm width, and upland elevation. Beach variables that are unchanged and remain constant throughout the analysis are upland elevation, dune slope, berm height, foreslope, and shape of the submerged profile. Thus, in response to a given storm, the berm can be eroded or accreted (change in berm width), the dune can change height and/or width, and can translate landward or seaward (change in upland width).

Figure B-3 is a depiction of the simplified Beach-*fx* profile with damage elements viewed in Beach-*fx* model.

3.6 STORM SET

The set of plausible storms include all historical storms that have occurred in the Walton County area and have caused at least one foot of surge.

The Monte Carlo simulation uses the same set of storms that were used to create the SRD. As a given storm event from the simulated sequence takes place, the current profile is used to look up the results that are associated with that storm in the SRD for the profile that is ‘closest’ to the pre-storm profile as tracked in the simulation. These results are then used to define the post-storm profile, to track volume changes, and to determine within-storm erosion, wave heights and water elevations due to the storm along the cross-shore profile.

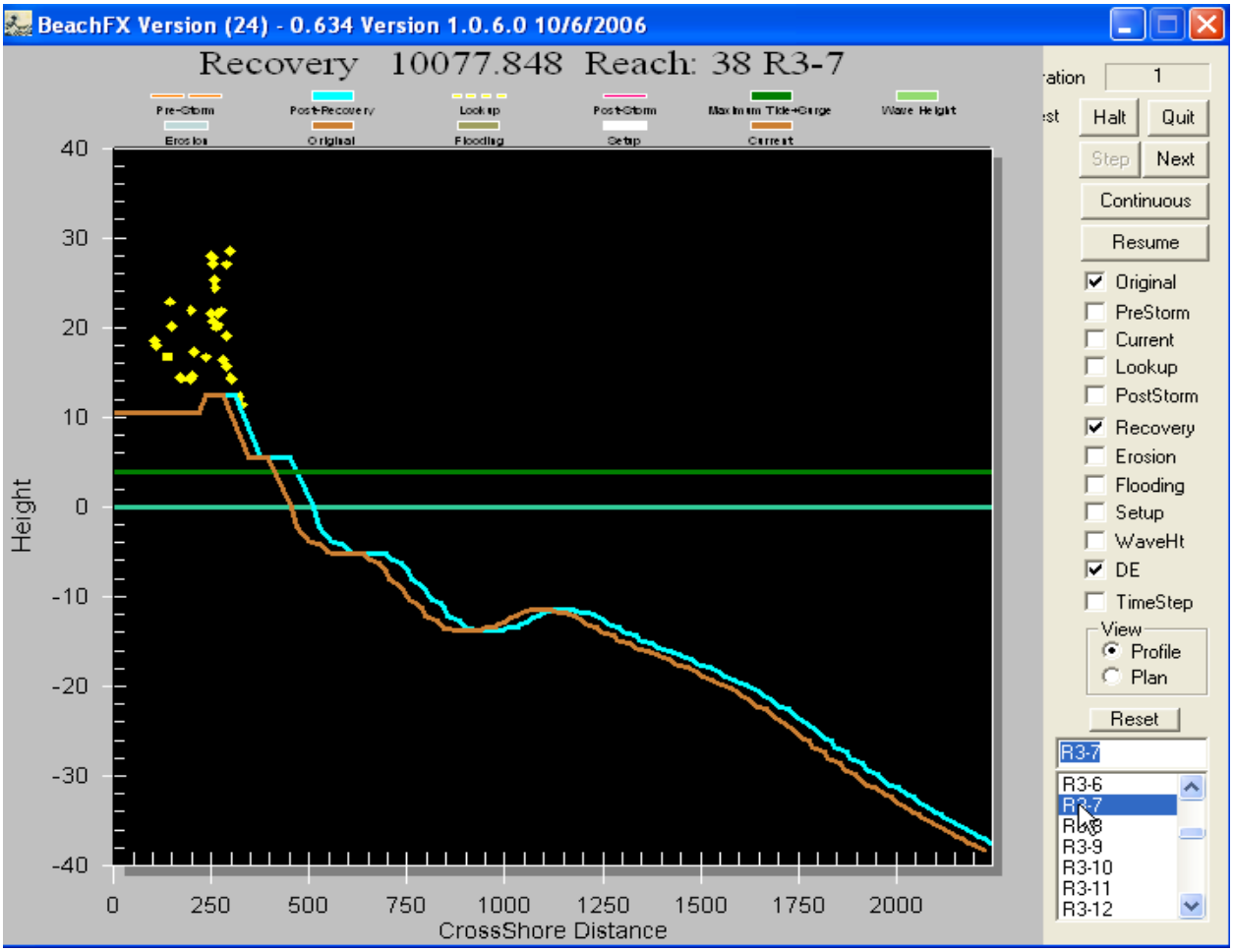


FIGURE B-3. CHARACTERIZATION OF A REPRESENTATIVE PROFILE WITH DAMAGE ELEMENTS IN BEACH-*FX*

3.6.1 Storm Seasons and Probability

There are three storm seasons for hurricanes season one June and July, season two August and September and season three October and November. The number of storms in a season divided by the number of years gives the probability of a storm in that season (see Table B-6).

3.6.2 Storm-Induced Beach Change Model (SBEACH)

A pre-computed database of beach profile responses to storms for a range of storms and profiles was generated utilizing the Storm-Induced BEAch CHange Model (SBEACH), (Larson and Kraus 1989).

SBEACH provided estimates of the short-term cross-shore response to a suite of plausible tropical storm events derived from the historical record of tropical storms impacting the Walton County area.

TABLE B-6
STORM SEASONS

Storm Seasons						
Description	Start Month	Start Day	End Month	End Day	Probability	Probability Of Tropical Storm
No Storms	December	1	May	31	0	0
June Storms	June	1	June	30	0	0.0252
July Storms	July	1	July	31	0	0.042
August Storms	August	1	August	31	0	0.0672
September Storm	September	1	September	30	0	0.1849
October Storms	October	1	October	31	0	0.0588
November Storms	November	1	November	30	0	0.0084
	0	0	0	0	0	0

3.6.3 Shoreline Response Database

The Shoreline Response Database (SRD) is a relational database used to pre-store results of SBEACH runs for all plausible storms, and a range of pre-defined profiles, as expressed by ranges of berm width, dune width, and dune height. Two kinds of results are stored: changes in berm width, dune width, dune height, and upland width, and cross-shore profiles of erosion, wave height, and water depth. The SRD is site and study specific, that is, it is created for each hurricane and storm damage reduction study. The SRD, once generated, is used as a 'lookup table' by the Monte Carlo simulation. Within the Monte Carlo simulation, the shoreline modifications are tracked continuously by the simplified profile representation (primarily dune width and height and berm width). The driving force for profile change is the list of plausible storms. These plausible storms are then used to create SBEACH input, which is run against a range of profiles that is expected to cover the range of natural and managed profiles.

For each such pair (storm and profile), both simplified and detailed SBEACH results are stored in the SRD. The output of SBEACH for a given run is an ASCII file that describes the initial, final, maximum, and minimum cross-shore profiles, and the water and wave heights along the cross-shore. This file must be post-processed by software that extracts the values of changes in berm width, dune width, and dune height, and stores the information in the SRD.

The Monte Carlo simulation uses the same set of storms that were used to create the SRD. As a given storm event from the simulated sequence takes place, the current profile is used to look up the results that are associated with that storm in the SRD for the profile that is 'closest' to the pre-storm profile as tracked in the simulation. These results are then used to define the post-storm profile, to track volume changes, and to determine within-storm erosion, wave heights and water elevations due to the storm along the cross-shore profile.

3.6.4 Generalized Model for Simulating Shoreline Change (GENESIS)

The Generalized Model for Simulating Shoreline Change (GENESIS) (Hanson and Kraus 1989) provided estimates of long-term shoreline response to existing and without project conditions.

The SBEACH and GENESIS models were developed by the Corps Research and Development Center (ERDC-CHL). Beach-*fx* is run for multiple project life-cycles and provides statistics on probable benefits and costs of the evaluated hurricane and storm damage reduction design alternatives, which is used to determine the economic justification of the project.

Beach-*fx* simulates beach response over time as storms, natural recovery, and management methods alter the beach profile. Events of interest (storms, beach nourishment) take place at calculated times. As each event takes place, the model simulates the physical and economic responses associated with that event. A set of simplified beach profiles, as defined by key data points, are tracked by the simulation model as the beach profile evolves over time.

The model makes use of an SRD that is a pre-generated set of beach profile responses to storms, for a range of storms and profiles. The model uses “plausible storms”, based on historic storms, as initiating events.

The shoreline modification due to a storm is determined through use of a shoreline response model. The SBEACH, cross-shore storm response model and the GENESIS long-term shoreline response model were used to evaluate existing and without project configurations for this study. With project alternatives are currently under evaluation. The SRD contains information on the input (pre-storm) profile, the storm, and the response (post-storm) profile, for many combinations of storms and pre-storm profiles. Beach-*fx* then reads information from the SRD as needed to determine shoreline change following a storm event.

As each storm is processed, the shoreline response is determined, and a post-storm beach configuration is calculated, as well as profiles of maximum water level, wave height, and erosion during the storm. This information is used to determine economic damages, based on empirical curves (damage functions) relating the percentage loss of value of structure and contents to “damage-driving parameters” calculated from the aforementioned profiles and characteristics of the structure. A flowchart of the Beach-*fx* modeling methodology is provided in Figure B-4.

Beach-*fx* relies on external coastal process models to predict the morphologic response of the beach profile to storm events and shoreline response to long-term processes.

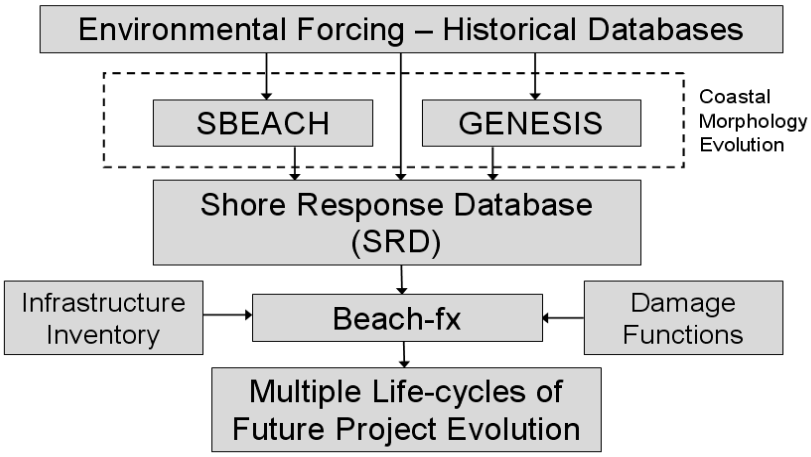


FIGURE B-4. BEACH-*FX* MODELING METHODOLOGY

4.0 EXISTING CONDITIONS

Walton County's 26 miles of coastline initially was subdivided into reaches that very nearly coincided with the neighborhood divisions that already existed in the county's coastal community. That division resulted in 10 major reaches initially formulated for economic reach delineation (see Table B-7).

Due to the effects of Hurricane Ivan on the beach the PDT decided that the project existing conditions had changed significantly. As a result new surveys of the beach were ordered and obtained. A new existing condition was established and named post-Ivan. That existing condition then became the initial point of beach condition (base condition) for the 54-year period of analysis accommodating a 50-year project life.

Further the PDT sought out, briefed and obtained from all the affected stakeholders approval of an expedited study plan which resulted in a revised PMP. That plan included reducing the number of study reaches to five. Table B-8 and Figure B-5 lays out the revised major study reaches. Within these reaches there are 117 sub-reaches or Beach-*fx* model reaches, which are the same except for their naming convention. The sub-reaches average about 1,000 feet in length and are numbered from west to east.

TABLE B-7
INITIAL MAJOR STUDY REACHES

Reach	Reach Name
1	Miramar Beach to Sandestin
2	Sandestin and 4 Mile Village
3	Topsail Hill Preserve State Park
4	Beach Highlands and Dune Allen
5	Santa Rosa Beach
6	Blue Mountain Beach
7	Gulf Trace, Grayton Beach, Grayton Beach State Park and Watercolor
8	Seaside and Seagrove
9	Dear Lake State Recreation Area, Watersound and Seacrest West
10	Seacrest West, Rosemary beach and Inlet Beach

TABLE B-8
REVISED MAJOR STUDY REACHES

Reach	Reach Name
1	Miramar Beach, Sandestin and Four Mile Village
2	Topsail Hill Preserve State Park
3	Beach Highlands, Dune Allen, Santa Rosa Beach, Blue Mountain and Gulf Trace
4	Grayton Beach State Park, Grayton Beach,
5	Watercolor, Seaside, Seagrove, Watersound Seacrest Rosemary and Inlet Beach

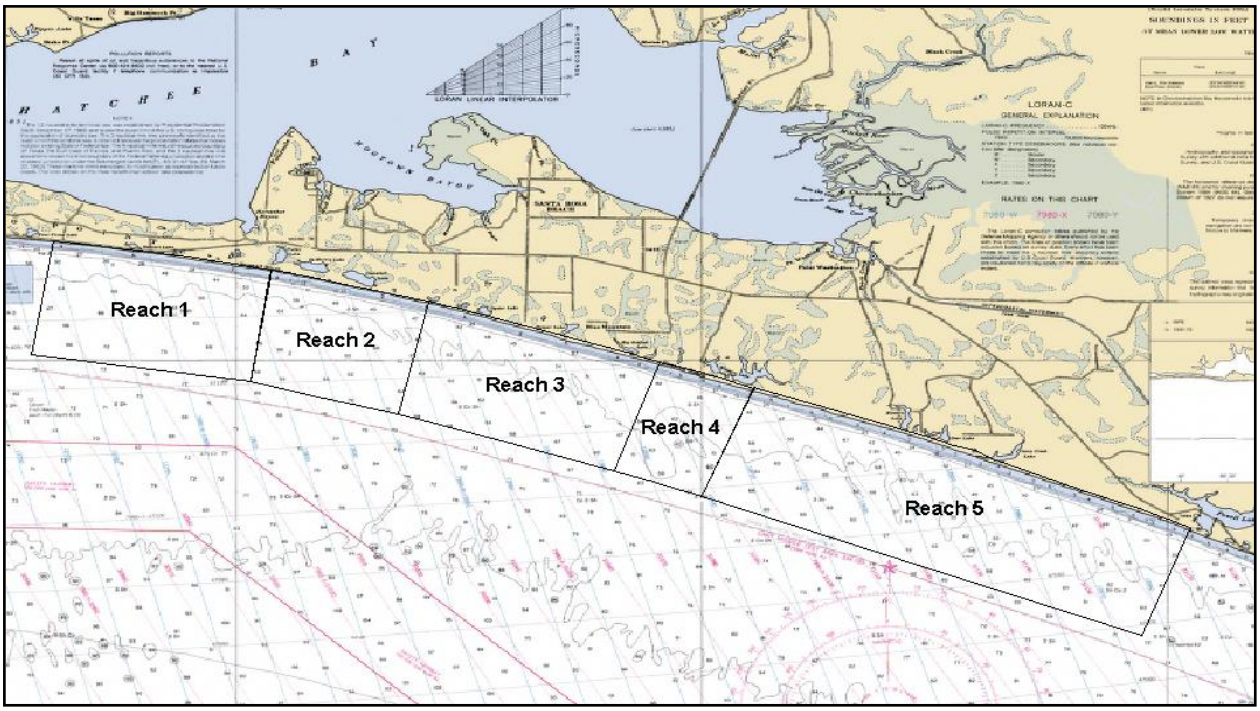


FIGURE B-5. REVISED STUDY REACHES

The post-Ivan survey data was employed to produce revised representative profiles. The result of which reduced the number of representative profiles to 11. Reaches 1, 2, 3, and 4 could be represented by two profiles each while reach 5 required 3 representative profiles. These representative profiles characterized the typical without project beach morphology for input into Beach-*fx*.

In the with project condition these profiles are combined with alternative design templates to characterize that condition for various beach fill alternatives. Table B-9 lists the various reaches and associated profiles.

TABLE B-9
WALTON COUNTY STUDY AREA
SUB-REACHES, MODEL REACHES AND PROFILES

Model Reach	FDEP Monument	BeachFx Reach	Representative Profile	Study Reach
1	R-1	R1-1	R1P1	**1**
2	R-2	R1-2	R1P1	**1**
3	R-3	R1-3	R1P1	**1**
4	R-3A	R1-4	R1P1	**1**
5	R-4	R1-5	R1P1	**1**
6	R-5	R1-6	R1P1	**1**
7	R-6	R1-7	R1P1	**1**
8	R-6A	R1-8	R1P1	**1**
9	R-7	R1-9	R1P1	**1**
10	R-8	R1-10	R1P1	**1**
11	R-9	R1-11	R1P1	**1**
12	R-10	R1-12	R1P1	**1**
13	R-11	R1-13	R1P1	**1**
14	R-12	R1-14	R1P1	**1**
15	R-13	R1-15	R1P2	**1**
16	R-14	R1-16	R1P2	**1**
17	R-15	R1-17	R1P2	**1**
18	R-16	R1-18	R1P2	**1**
19	R-17	R1-19	R1P2	**1**
20	R-18	R1-20	R1P2	**1**
21	R-19	R1-21	R1P1	**1**
22	R-20	R1-22	R1P1	**1**
23	R-21	R1-23	R1P1	**1**
24	R-22	R1-24	R1P1	**1**
25	R-23	R2-1	R2P1	**2**
26	R-24	R2-2	R2P1	**2**
27	R-25	R2-3	R2P2	**2**
28	R-27	R2-4	R2P1	**2**
29	R-29	R2-5	R2P2	**2**
30	R-30	R2-6	R2P1	**2**
31	R-40	R2-7	R2P1	**2**
32	R-41	R3-1	R3P1	**3**

TABLE B-9 (CONTINUED)
WALTON COUNTY STUDY AREA
SUB-REACHES, MODEL REACHES AND PROFILES

33	R-42	R3-2	R3P1	**3**
34	R-43	R3-3	R3P1	**3**
35	R-44	R3-4	R3P2	**3**
36	R-45	R3-5	R3P2	**3**
37	R-46	R3-6	R3P2	**3**
38	R-47	R3-7	R3P2	**3**
39	R-48	R3-8	R3P1	**3**
40	R-49	R3-9	R3P1	**3**
41	R-50	R3-10	R3P1	**3**
42	R-51	R3-11	R3P1	**3**
43	R-52	R3-12	R3P1	**3**
44	R-53	R3-13	R3P1	**3**
45	R-54	R3-14	R3P1	**3**
46	R-55	R3-15	R3P1	**3**
47	R-56	R3-16	R3P1	**3**
48	R-57	R3-17	R3P1	**3**
49	R-58	R3-18	R3P1	**3**
50	R-59	R3-19	R3P1	**3**
51	R-60	R3-20	R3P1	**3**
52	R-61	R3-21	R3P1	**3**
53	R-62	R3-22	R3P1	**3**
54	R-63	R3-23	R3P1	**3**
55	R-64	R3-24	R3P2	**3**
56	R-65	R3-25	R3P2	**3**
57	R-66	R3-26	R4P1	**4**
58	R-67	R4-1	R4P1	**4**
59	R-68	R4-2	R4P1	**4**
60	R-69	R4-3	R4P2	**4**
61	R-70	R4-4	R4P2	**4**
62	R-71	R4-5	R4P1	**4**
63	R-72	R4-6	R4P2	**4**
64	R-73	R4-7	R4P2	**4**
65	R-74	R4-8	R4P1	**4**
66	R-76	R4-9	R4P1	**4**
67	R-78	R5-1	R5P2	**5**
68	R-79	R5-2	R5P2	**5**
69	R-80	R5-3	R5P2	**5**
70	R-81	R5-4	R5P2	**5**
71	R-82	R5-5	R5P2	**5**
72	R-83	R5-6	R5P1	**5**
73	R-84	R5-7	R5P1	**5**
74	R-85	R5-8	R5P1	**5**
75	R-86	R5-9	R5P2	**5**
76	R-87	R5-10	R5P2	**5**
77	R-88	R5-11	R5P2	**5**
78	R-89	R5-12	R5P2	**5**
79	R-90	R5-13	R5P2	**5**

TABLE B-9 (CONTINUED)
WALTON COUNTY STUDY AREA
SUB-REACHES, MODEL REACHES AND PROFILES

80	R-91	R5-14	R5P2	**5**
81	R-92	R5-15	R5P2	**5**
82	R-93	R5-16	R5P2	**5**
83	R-94	R5-17	R5P3	**5**
84	R-95	R5-18	R5P2	**5**
85	R-96	R5-19	R5P3	**5**
86	R-97	R5-20	R5P2	**5**
87	R-98	R5-21	R5P2	**5**
88	R-99	R5-22	R5P3	**5**
89	R-100	R5-23	R5P3	**5**
90	R-101	R5-24	R5P2	**5**
91	R-102	R5-25	R5P2	**5**
92	R-103	R5-26	R5P1	**5**
93	R-103A	R5-27	R5P3	**5**
94	R-104	R5-28	R5P3	**5**
95	R-105	R5-29	R5P2	**5**
96	R-106	R5-30	R5P2	**5**
97	R-107	R5-31	R5P2	**5**
98	R-108	R5-32	R5P1	**5**
99	R-109	R5-33	R5P1	**5**
100	R-110	R5-34	R5P1	**5**
101	R-111	R5-35	R5P1	**5**
102	R-112	R5-36	R5P1	**5**
103	R-113	R5-37	R5P1	**5**
104	R-114	R5-38	R5P1	**5**
105	R-115	R5-39	R5P1	**5**
106	R-116	R5-40	R5P2	**5**
107	R-117	R5-41	R5P2	**5**
108	R-118	R5-42	R5P2	**5**
109	R-119	R5-43	R5P2	**5**
110	R-120	R5-44	R5P2	**5**
111	R-121	R5-45	R5P2	**5**
112	R-122	R5-46	R5P2	**5**
113	R-123	R5-47	R5P2	**5**
114	R-124	R5-48	R5P3	**5**
115	R-125	R5-49	R5P3	**5**
116	R-126	R5-50	R5P3	**5**
117	R-127	R5-51	R5P3	**5**

4.1 LAND USE

The coastal beach community layout is somewhat typical of other beach and shoreline development along the Gulf Coast; a checkerboard pattern of single and multi-family residential areas intermixed with few commercial areas. Walton County's beach shore side development has less commercial trade on the front row shoreline probably due to the high cost of the land and real estate taxes which affects profitability. Instead most commercial trade establishments prefer to locate on the north side of the beach road.

The current trend in land use on the shoreline continues to be principally single and multi-family development, with little commercial trade development.

4.2 FUTURE DEVELOPMENT

Development is both ongoing and continuous at Walton County, as it is likely to continue into the immediate and the near future until the small amount of remaining beachfront, save the state and county properties, is completely developed. The characteristic of the existing beachfront is composed of single and multi-family housing. The multi-family housing includes 29 multi-floored condominiums and resort complexes consisting of four floors or more.

4.3 PROPERTY INVENTORY

Recent beach front development in Walton County has predominately been high-rise condominiums, residential-resorts and residential communities. Most of the coastal area that is not state or county property is highly developed. Construction of new single and multi-family residential structures is on-going at a brisk pace. The few remaining undeveloped large private holdings are showing signs of infrastructure preparations for development. The real estate market is very hot and property turnover is commonplace.

In the spring of 2004 a complete property inventory of existing structures that may benefit from a storm damage reduction project was undertaken. In 2010 a windshield survey of the study area was undertaken. That survey revealed no significant changes had occurred since the last inventory was completed. Some structures that were under construction are now fully constructed. They were already entered in the initial property inventory along with their values. The 2004 property inventory structure values were also updated. A sample of structures by type was collected and an update factor was computed. That factor was used to update structure values. The purpose of this inventory is to gather data required for the Beach-*fx* data inputs and to obtain a database that would facilitate the gathering of critical metrics that locate the structure spatially in relation to the shoreline and the beach profile as well as its elevation.

Beach-*fx* considers the inventory of structures (damage elements) as items that are containerized in 'lots'. Lots form boundaries that contain damage elements. Lots are defined as quadrilaterals that approximate lot parcels as delineated in the tax

assessor's files, databases and Geographic Interface Systems (GIS). An aggregation of lots that are for the most part contiguous composes a reach. All reaches taken in aggregate compose the study area.

Photos of structures along with pertinent statistics of construction and foundation type, number of floors, and accompanying detached structures that may benefit from a project were also collected.

The result of that inventory is displayed in Table B-10.

TABLE B-10
STRUCTURE INVENTORY COUNT BY REACH BY TYPE

Damage Element	Major Study Reaches				
	1	2	3	4	5
Commercial	10		1	7	13
Single-Family	99		268	118	348
Multi-Family	62		37	21	99
Walkovers	151		189	20	263
Pool	36		12	9	84
Gazebo	4		7		7
Jacuzzi	4				
Total	366		514	175	814
Grand Total	1869				

4.4 VALUE OF COASTAL INVENTORY

4.4.1 Structure Value

The value of structures in the study area required for economic analysis to determine NED benefits, need to be expressed in terms of depreciated replacement costs.

The Mobile District Real Estate Division (RE) conducted investigations to determine the depreciated replacement cost for single family residential structures. Tax Assessor's records were examined and studied on the current inventory. Variables of interest relating to assessed value, date of construction, type of construction, number of floors, square footage, recent sales and selling prices, along with other information was analyzed. Sampling techniques, professional judgment, professional guidelines, and consultations with the Tax Assessor's office and field visits composed of methods used to complete the investigations.

Some of the findings from that analysis were that there were two significantly different classes of valuations between the types of development in Walton County: pre-1990 construction and post-1990 construction. The handful of pre-1990 typical construction was generally less than 1,800 square foot one story structures. Many were on grade and most were of masonry or brick construction and only a few made of wood. Assessed values for these structures were very low when compared to calculated depreciated replacement costs. The value of the land has outgrown the value of the structure. When these structures are sold they are usually torn down for larger and more expensive ones. On average they were assessed about one-half of their depreciated replacement cost. The Walton inventory for these structures saw their assessed value increased by 200 percent to arrive at their true depreciated replacement cost.

Post-1990 construction was much larger than 1,800 square feet and most are multi-storied structures the majority of which are higher than four floors. The division between masonry, and wood was about equal for the majority of structure while the remaining minority was brick or wood. Selling prices over the most recent past have been much above what would normally be expected in the market place. Turnovers are occurring in as little as two years and there are large increases in the selling price when compared to purchased prices. Most of the increasing value was carried in the land. The agreed upon methodology for determining depreciated replacement cost was to estimate replacement cost as 125 percent of assessed value.

A relationship between assessed values and depreciated replacement cost for multi-family structures was found to be highly variable and not reliable. The methodology that would render the best estimate of depreciated replacement cost for these structures was to begin with current per square foot construction costs and depreciates that value by two percent each year of age. Current construction costs developed from recent activity was estimated to be $160.00 a square foot for construction less than 20,000 square feet and $175.00 per square foot for construction greater than 20,000 square feet.

Walkovers were valued at an average $200.00 per linear foot for wood structures and $275.00 per square foot for structures constructed from a commercially produced composite called ‘Trex’ that was used for public access provided by the Tourist Development Council’s public accesses. Pool values were based on an average updated composite value obtained by interviews and sampling for an earlier study in neighboring Bay County. The few jacuzzis and tennis court values were based on typical sized units at current costs.

4.4.2 Content Value – Structure-Content Ratio

The National Flood Insurance Agency claims database was searched for paid claim history in Walton and the neighboring counties of Bay, Okaloosa and Fort Walton. These records show the date of the loss and what was paid for building and content loss for each claim. No claims were found for any of these counties.

A web search of trade associations of homeowner casualty underwriters revealed that insurers generally use a content to structure ratio between 50 and 75 percent of replacement cost. The Walton County inventory is valued at depreciated replacement cost not full replacement cost. The average insurers' content to structure ratio of 62.5 percent was used to estimate the value of contents for Walton County based on depreciated structure replacement cost.

Table B-11 presents the structure and content value of damageable property value based on depreciated replacement cost. Damageable property value is used here to reflect that only the lower two (2) floors of multi-storied structures were valued in the property inventory as they alone were susceptible to modeling damages.

TABLE B-11
VALUE OF WALTON COUNTY
STRUCTURE AND CONTENT VALUE BY REACH
(DOLLARS IN MILLIONS)

	Reach				
	1	2	3	4	5
Damage Elements	366		514	175	814
Structure Value	$317.3		$164.9	$33.7	$276.9
Content Value	$156.1		$78.9	$16.2	$133.5
Total	$473.4		$243.8	$49.9	$410.4
Grand Total	$1,177.5				

5.0 ECONOMIC BENEFIT EVALUATION

5.1 ASSUMPTIONS

The economic benefits are from four categories: storm damage reduction, lost land reduction, elimination of emergency nourishment costs and increased recreation. The primary benefit category is the storm damage reduction as mandated in ER 1105-2-100, hurricane and storm damage reduction projects are to be formulated to provide for storm damage reduction.

Benefits are stated in constant Fiscal Year (FY) 2011 dollars. The period of analysis is 50 years from January, 2014 through and including all of the year 2063, there are four pre-project base years, 2010 through 2013, making the period of study 54 years. The base year is 2014. The structure inventory is valued at FY 2011 dollars.

5.2 STORM DAMAGE REDUCTION

Beach-*fx* calculates the storm damage reduction from inundation, storm-induced erosion, long-term erosion and wave attack on a damage element-by-damage element basis for each storm event for the study period for a large number of iterations.

5.2.1 Damage Functions

The damage functions used in Beach-*fx* are those developed for the Institute for Water Resources (IWR). A Coastal Storm Damage Workshop (CSDW) was held in Alexandria, Virginia to solicit expert-opinion for economic consequence assessment of coastal storm damage. The workshop is part of longer-term research effort whose objective is to develop a peer-reviewed, step-by-step methodology for estimating coastal storm damages.

The objective of that workshop was to discuss and recommend damage relationships needed to predict structural damage from coastal storms as functions of hazard intensity levels, with associated uncertainties, resulting from erosion, waves, inundation, and their combined effects. Because information on the relationship between residential structural damage and storm parameters is limited, this workshop used expert-opinion as a means of gaining information on these relationships (see Ayyub 2001). A report describing the results of the workshop both in terms of damage relationships and future information needs identified by the experts at the workshop is included in Attachment II – Coastal Storm Damage Relationships Based on Expert Opinion Elicitation.

The CSDW, resulted in a set of lookup curves, defined for various damage types and foundation types, to calculate percentage loss associated with structure and contents. For each damage type, the input to these curves, or the “damage driving parameter”, has been defined by the CSDW. The appropriate damage-driving parameters for each damage type are:

Flooding:
- Depth of water over walking surface of lowest walking floor

Waves:
- Difference between the top of wave (crest) and the bottom of the lowest horizontal member

Erosion:
- Percent of footprint compromised

Damage functions for each damage type (erosion, inundation, and wave) are currently associated with damage element type (single family residential, multi-family residential, walkway, etc.) foundation type (shallow piles, deep piles, slab, etc.) and construction type (wood frame concrete, masonry, etc.) and armor type (No armor, sheet pile, etc.) are used to select the appropriate damage function.

Damages are calculated at the damage element level, following each storm. For each damage type, a damage driving parameter is calculated for each damage element, and used as a lookup into stored damage functions.

5.2.2 Damage Element

Damages are estimated based on the concept of a “damage element”. Damage elements are structures, walkways, etc., anything that can incur economic losses. In Beach-*fx*’s system hierarchy reaches contain lots, and lots contain damage elements. For each storm, damages are estimated by examining the reach, lots, and damage elements within the lots. Thus, the basic unit on which damages are calculated at present is the damage element. Damage elements have attributes relating to type, geographic location, and value. Each damage element has information relating to structure and content value (treated as a three-parameter distribution for purposes of incorporating uncertainty). For location information, a structure’s center point is referenced, as well as its width and length. A single value of ground elevation is specified, which also includes a three-parameter distribution for describing the first floor elevation and uncertainty.

5.2.3 Damage Estimation

Damages are estimated, based on calculation of the value of a “damage-driving parameter” for the damage element, which is then used as the independent variable to use for lookup into the stored damage functions. These damage functions provide the percentage loss for structure and contents.

5.2.4 Structure and Content Damages

The determination of structure and content damage was calculated using the IWR damage functions. These damage functions generally give the percent damage as related to a water level for inundation damages, and the percent of structure footprint compromised to calculate storm induced and long-term erosion damages.

5.2.5 Inundation Damages

Inundation damages occur when storm surge elevations exceed the elevation of the dune line, or when waves break over the dunes. Inundation damages were assumed to begin for existing conditions when the maximum water level exceeded the first floor elevation of structure, since there is not always a continuous dune system.

5.3 LOST LAND REDUCTION

P&G states that erosion protection benefits include loss of land, structural damage prevention, reduced emergency costs, reduced maintenance of existing structures and incidental benefits. The loss of land benefit is measured as the value of near shore upland. Near shore upland is sufficiently removed from the shore to lose its significant increment of value because of its proximity to the shore, when compared to adjacent parcels that are more distant (inland) from the shore.

A hurricane and storm damage reduction project that prevents the loss of land due to erosion accrues benefits to that project alternative. The land lost reduction benefit was calculated for eroding reaches by calculating amount of land that would be lost during the study period times the value of near shore upland.

5.4 LOSS OF LAND BENEFIT

With a project in place land that would be lost in the without project future condition would be preserved by a project. The design template that represents the project that provides full benefits to protected properties would be in place for the period of analysis preserved through of process of periodic renourishment. This benefit is based upon the value of near shore lands. Normally determinations of the market value for the land losses are based on the value of near shore upland. Near shore upland is sufficiently removed from the shore to lose its significant increment of value because of its proximity to the shore, when compared to adjacent parcels that are more distant (inland) from the shore. Other valuation methods could be acceptable, if it can be shown that the use of near shore values does not provide a realistic estimate of the value of lost land. For this project, near shore values were estimated by RE. The criterion used was near shore lands are those parcels that are sufficiently removed from the shore to lose any direct water frontage value. These parcels have; no Gulf frontage, no view of the water, no access point to the Gulf as part of any deeded subdivision rights. The methodology used was to track 2005 and 2006 sales of near shore parcels in Walton County. Since property values varied according to location and sale prices also varied broadly due to the pause in the market caused by the storm activity on the Gulf in 2004 and 2005, a range of values, a low and a high, price per square foot was calculated. Then the average of the high and low was used to estimate the value of land lost. The value used represents a long-term value suitable for the period of evaluation.

Table B-12 shows near shore value, annual erosion rate and land lost benefit by reach. Accreting reaches have positive values and eroding reaches show negative values.

5.5 RECREATION

To determine the recreation benefits of a plan, an economic value must be placed on the recreation experience at the Walton County Beaches. This value can be applied to the increase in visitation which results from the project to determine the NED recreation benefits. For this report, unit day values (UDV's) are used to determine the economic value of recreation using a point system that takes into account the following factors: recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental (esthetics) quality. A good deal of judgment is required in the assessment of point values. A group of planning professionals with knowledge of the study area made independent judgments of the UDV values which were averaged. The UDV point totals convert to a recreation value of $5.07 for the without project condition and $5.16 for the with project condition. These values were applied to the increase in visitation over the study period. The difference between the without and with project value of recreation determines the NED and LPP recreation benefits. The complete recreation analysis can to found in the attachments to the economic appendix.

TABLE B-12
VALUE OF LAND LOST BY REACH

Sub-Reach	Model Reach	Reach Length (ft)	Representative Profile	Average Annual Erosion	Near Shore Land Value per Sq. Ft.	Value of Land Loss
1	R1-1	1149.8	R1P1	0.6808	$70.00	$54,794.87
2	R1-2	1101.6	R1P1	0.6435	$70.00	$49,621.57
3	R1-3	1043.6	R1P1	0.5137	$70.00	$37,526.81
4	R1-4	1001.8	R1P1	0.3958	$70.00	$27,755.87
5	R1-5	1061.8	R1P1	0.3077	$70.00	$22,870.11
6	R1-6	1044.6	R1P1	0.0926	$70.00	$6,771.10
7	R1-7	1002.7	R1P1	0.0063	$70.00	$442.19
8	R1-8	1061.4	R1P1	0.0156	$70.00	$1,159.05
9	R1-9	1013.6	R1P1	0.0284	$70.00	$2,015.04
10	R1-10	959.4	R1P1	0.0926	$70.00	$6,218.83
11	R1-11	1021.2	R1P1	0.1216	$70.00	$8,692.45
12	R1-12	1056.7	R1P1	0.0508	$70.00	$3,757.63
13	R1-13	1040.1	R1P2	-0.0008	$70.00	-$58.25
14	R1-14	1050.6	R1P2	-0.1008	$70.00	-$7,413.03
15	R1-15	997.9	R1P2	-0.1155	$70.00	-$8,068.02
16	R1-16	1024.7	R1P2	-0.1263	$85.00	-$11,000.67
17	R1-17	1113.6	R1P2	-0.1183	$85.00	-$11,197.80
18	R1-18	1133.1	R1P2	-0.1323	$85.00	-$12,742.28
19	R1-19	1058.4	R1P2	-0.0633	$85.00	-$5,694.72
20	R1-20	961	R1P1	0.1033	$85.00	$8,438.06
21	R1-21	952.1	R1P1	0.1122	$85.00	$9,080.18
22	R1-22	1028	R1P1	0.2459	$85.00	$21,486.74
23	R1-23	1085.9	R1P1	0.3952	$85.00	$36,477.55
24	R1-24	1038.7	R1P1	0.4652	$85.00	$41,072.28
25	R2-1	990	R2P1	0.3687	$85.00	$31,026.11
26	R2-2	935.5	R2P1	0.2417	$45.00	$10,174.97
27	R2-3	2160.3	R2P2	0.3044	$45.00	$29,591.79
28	R2-4	2065.5	R2P1	0.2417	$45.00	$22,465.41
29	R2-5	1001.3	R2P2	0.1844	$45.00	$8,308.79
30	R2-6	10078.2	R2P1	-0.5495	$45.00	-$249,208.69
31	R2-7	1040.4	R2P1	0.3869	$45.00	$18,113.88
32	R3-1	1147	R3P1	0.4031	$45.00	$20,806.01
33	R3-2	1037.4	R3P1	0.4283	$45.00	$19,994.33
34	R3-3	1051.6	R3P1	0.4316	$45.00	$20,424.18
35	R3-4	1026	R3P2	0.5535	$45.00	$25,555.10
36	R3-5	1120.7	R3P2	0.4180	$45.00	$21,080.37
37	R3-6	1184.9	R3P2	0.2885	$45.00	$15,382.96
38	R3-7	1155.8	R3P2	0.0960	$45.00	$4,993.06
39	R3-8	1102.9	R3P1	-0.2985	$45.00	-$14,814.70

TABLE B-12 (CONTINUED)
VALUE OF LAND LOST BY REACH

Sub-Reach	Model Reach	Reach Length (ft)	Representative Profile	Average Annual Erosion	Near Shore Land Value per Sq. Ft.	Value of Land Loss
40	R3-9	1057.8	R3P1	-0.3588	$45.00	-$17,079.24
41	R3-10	1068.2	R3P1	-0.4446	$45.00	-$21,371.48
42	R3-11	1044.7	R3P1	-0.5076	$45.00	-$23,863.04
43	R3-12	1006.8	R3P1	-0.4978	$75.00	-$37,588.88
44	R3-13	1004	R3P1	-0.5924	$75.00	-$44,607.72
45	R3-14	1345	R3P1	-0.7700	$75.00	-$77,673.75
46	R3-15	1061.8	R3P1	-0.8489	$75.00	-$67,602.15
47	R3-16	731.7	R3P1	-0.9596	$75.00	-$52,660.45
48	R3-17	1016.6	R3P1	-1.0926	$75.00	-$83,305.29
49	R3-18	1039.4	R3P1	-1.1151	$75.00	-$86,927.62
50	R3-19	1036	R3P1	-1.0589	$75.00	-$82,276.53
51	R3-20	1026.7	R3P1	-1.0373	$75.00	-$79,874.69
52	R3-21	1029	R3P1	-1.0106	$75.00	-$77,993.06
53	R3-22	978	R3P1	-0.9243	$75.00	-$67,797.41
54	R3-23	855.4	R3P1	-0.8319	$75.00	-$53,370.54
55	R3-24	1115	R3P2	-0.5435	$75.00	-$45,450.19
56	R3-25	1274	R3P2	-0.3414	$75.00	-$32,620.77
57	R3-26	1082.2	R4P1	-0.3292	$75.00	-$26,719.52
58	R4-1	1082	R4P1	-0.6703	$75.00	-$54,394.85
59	R4-2	1125.7	R4P1	-0.5439	$75.00	-$45,920.12
60	R4-3	981.5	R4P2	0.0509	$75.00	$3,746.88
61	R4-4	942.1	R4P2	0.1131	$75.00	$7,991.36
62	R4-5	998.1	R4P1	-0.2903	$75.00	-$21,731.13
63	R4-6	971.4	R4P2	0.0925	$75.00	$6,739.09
64	R4-7	1060.9	R4P2	-0.1046	$75.00	-$8,322.76
65	R4-8	2119.2	R4P1	-0.5521	$75.00	-$87,750.77
66	R4-9	2074.7	R4P1	-0.9889	$75.00	-$153,875.31
67	R5-1	993.1	R5P2	-0.8973	$112.50	-$100,249.72
68	R5-2	1003	R5P2	-0.6237	$112.50	-$70,376.75
69	R5-3	1039.4	R5P2	-0.3263	$112.50	-$38,155.07
70	R5-4	1303.7	R5P2	-0.0772	$112.50	-$11,322.63
71	R5-5	1009.2	R5P2	0.1001	$112.50	$11,364.85
72	R5-6	1061.5	R5P1	-0.2592	$112.50	-$30,953.34
73	R5-7	1037.5	R5P1	-0.3266	$112.50	-$38,120.34
74	R5-8	991.6	R5P1	-0.4109	$67.50	-$27,502.77
75	R5-9	1026.5	R5P2	-0.2260	$67.50	-$15,659.26
76	R5-10	1010.7	R5P2	-0.2626	$67.50	-$17,915.16
77	R5-11	1022.2	R5P2	-0.2847	$67.50	-$19,643.87

TABLE B-12 (CONTINUED)
VALUE OF LAND LOST BY REACH

Sub-Reach	Model Reach	Reach Length (ft)	Representative Profile	Average Annual Erosion	Near Shore Land Value per Sq. Ft.	Value of Land Loss
78	R5-12	1018	R5P2	-0.2734	$67.50	-$18,786.68
79	R5-13	1016.5	R5P2	-0.2876	$67.50	-$19,733.31
80	R5-14	1005.3	R5P2	-0.2623	$67.50	-$17,799.09
81	R5-15	1011	R5P2	-0.3549	$67.50	-$24,219.26
82	R5-16	1035.2	R5P2	-0.3543	$67.50	-$24,757.07
83	R5-17	942.6	R5P3	-0.2078	$67.50	-$13,221.38
84	R5-18	999.9	R5P2	-0.3578	$67.50	-$24,149.08
85	R5-19	1010.9	R5P3	-0.0820	$35.00	-$2,901.28
86	R5-20	1028.6	R5P2	0.0051	$35.00	$183.61
87	R5-21	1122	R5P2	-0.0141	$35.00	-$553.71
88	R5-22	1029.7	R5P3	-0.0545	$35.00	-$1,964.15
89	R5-23	1013.1	R5P3	-0.0144	$35.00	-$510.60
90	R5-24	1021.7	R5P2	-0.1929	$35.00	-$6,898.01
91	R5-25	1054.4	R5P2	-0.4140	$35.00	-$15,278.26
92	R5-26	884.4	R5P1	-0.4138	$35.00	-$12,808.77
93	R5-27	1044.2	R5P3	-0.2764	$35.00	-$10,101.59
94	R5-28	1058.5	R5P3	-0.3145	$35.00	-$11,651.44
95	R5-29	986.7	R5P2	-0.4391	$87.50	-$37,910.25
96	R5-30	1021.8	R5P2	-0.3674	$87.50	-$32,848.32
97	R5-31	1014.9	R5P2	-0.3815	$87.50	-$33,878.63
98	R5-32	984.6	R5P1	-0.7184	$87.50	-$61,891.96
99	R5-33	1025.3	R5P1	-0.6970	$87.50	-$62,530.48
100	R5-34	1037.8	R5P1	-0.5918	$87.50	-$53,739.88
101	R5-35	1002.2	R5P1	-0.6019	$87.50	-$52,782.12
102	R5-36	943.7	R5P1	-0.6839	$87.50	-$56,472.19
103	R5-37	1019.9	R5P1	-0.9037	$87.50	-$80,647.32
104	R5-38	1094.1	R5P1	-0.9874	$87.50	-$94,527.50
105	R5-39	1024.2	R5P1	-1.1019	$87.50	-$98,749.52
106	R5-40	1009.7	R5P2	-0.5617	$87.50	-$49,625.49
107	R5-41	1003.7	R5P2	-0.5106	$87.50	-$44,842.81
108	R5-42	1022.6	R5P2	-0.3367	$87.50	-$30,127.07
109	R5-43	1002.2	R5P2	-0.2136	$87.50	-$18,731.12
110	R5-44	1000.5	R5P2	-0.0640	$87.50	-$5,602.80
111	R5-45	968.6	R5P2	0.0031	$87.50	$262.73
112	R5-46	987.6	R5P2	0.0848	$87.50	$7,327.99
113	R5-47	1030.6	R5P2	0.0123	$77.50	$982.42
114	R5-48	1026.4	R5P3	0.0289	$77.50	$2,298.88
115	R5-49	1041.1	R5P3	-0.1516	$77.50	-$12,231.88
116	R5-50	1031.8	R5P3	-0.2372	$77.50	-$18,967.58
117	R5-51	1025.9	R5P3	-0.3640	$77.50	-$28,940.64

5.6 STORM INDUCED AND LONG-TERM EROSION DAMAGES

Storm induced erosion is defined as the horizontal distance from 0 NGVD on the pre-storm profile to the landward most position where vertical erosion during the storm exceeds 0.5 feet. Recession is calculated, averaged and a standard deviation computed for each model reach over the simulation period.

A project-induced planform change rate, which accounts for the longshore dispersion of the beach nourishment material, is specified for each Beach-*fx* reach. GENESIS was used to estimate the long-term planform change rate for the future without and future without project conditions. GENESIS simulates changes in shoreline position due to the presence and combinations of beach fills and near shore structures such as groins, jetties, seawalls, and breakwaters. GENESIS was used to predict and optimize the performance of the NED Plan and renourishment requirements given various design transitions.

5.7 WAVE ATTACK DAMAGES

Wave conditions, which drive the model, consist of wave height, period, and direction and can originate from multiple sources. Predictive simulations estimate the performance of any proposed beach fill or structural modifications.

Damage elements along the shoreline can be damaged from wave run-up or from waves breaking directly on the damage element when storm surge elevations are high. These damages are determined using the IWR expert elicitation damage functions.

5.8 EMERGENCY NOURISHMENT

In the without project condition it is assumed that emergency nourishment will be performed as needed, over the 54-year period of study When a disaster is declared for a particular county, the Federal Emergency Management Agency (FEMA) will provide up to six cubic yards (cy) per square foot to mitigate for loss. There is a cost sharing provision requirement by FEMA that can be as low as zero percent (0%). The non-Federal sponsor indicated that, in the absence of a Federal project, they will, acquire funding to pursue the FEMA renourishing action after each significant storm. Historically, on at least six previous occasions FEMA has provided this emergency nourishment action.

The non-Federal sponsor has just completed a dune restoration project to partially replace the erosion losses due to Hurricane Ivan to provide storm protection for existing infrastructure, mainly Scenic Highway 98 and Gulf-front development. The current most threatened areas are the beneficiaries of this effort; Miramar Beach, Dune Allen and the Inlet Beach areas. The funding was provided by FEMA.

The fact that the non-Federal sponsor has deferred emergency work in anticipation of a project should be viewed as a temporary anomaly that will be accomplished if project implementation is delayed for some reason.

Beach-*fx* executes a nourishing action after each hurricane event, which averages about 125,000 cy of material on the beach. This material is trucked in for placement on the beach and has a cost of about $30 per cy. Reach 2, which is all State Park Lands and Reach 4 which is primarily State Park Lands do not receive emergency nourishment. Table B-13 presents the emergency nourishment template and accompanying nourishment triggers.

TABLE B-13
EMERGENCY NOURISHMENT TRIGGERS AND TEMPLATES

	Emergency Nourishment Trigger			Emergency Template		
Rep Profile	**Dune Width**	**Dune Height**	**Berm Width**	**Dune Width**	**Dune Height**	**Berm Width**
R1P1	0	56	0	22.2	69.7	6.3
R1P2	0	100	0	13.6	128.3	11.7
R2P1	0	0	0	0	0	0
R2P2	0	0	0	0	0	0
R3P1	0	45	0	12.5	79.0	16.0
R3P2	0	76.5	0	23.0	95.0	31.5
R4P1	0	0	0	0	0	0
R4P2	0	0	0	0	0	0
R5P1	0	65	0	24.0	78.5	38.5
R5P2	0	184.3	0	32.0	190.3	34.0
R5P3	0	50	0	15.5	69.5	46.0

5.9 REBUILDING

The model allows the user to define a distribution (triangular, you provide minimum, most likely, and maximum) of the number of days required for rebuilding, at the damage element (DE) level, that is, the distribution can be changed for each damage element. Thus, the user might enter 350, 365, or 380 to get a distribution around one year. At the start of each iteration, a value is drawn for the sample, setting the rebuilding time for the damage element for that iteration. The Walton County existing condition rebuilding parameters for single and multi-family construction was 365, 730 and 1,825 days. Walkovers, pools, jacuzzis, were assigned 365, 548 and 730 days. The number of times rebuilding could occur was unlimited if sufficient room on the lot permitted rebuilding.

If a DE is damaged to any degree, and has not been "rebuilt" more times than the maximum allowable, then a "rebuilding event" is set at a time in the future corresponding to the random rebuilding time. When the simulation reaches that time,

the lot on which the DE exists is checked to see if it is buildable. At present, the model makes a simple check based on whether or not the landward toe of the dune has retreated past the center point of the lot. If so, the lot is not buildable, and rebuilding does not take place.

If the lot is rebuildable at the time of rebuilding, then structure and contents values are restored to their initial values at the start of the simulation, such that they are able to be taken as damages again at the next storm event, and the number of times the damage element is rebuilt is incremented by one.

5.10 COMBINING DAMAGES – COMPOSITE DAMAGE FUNCTION

Total damage element damages are calculated using a composite damage function that takes into account damages for all damage mechanisms present while avoiding double counting. Because a structure may be damaged by more than one storm damage hazard a methodology was needed to be developed for combining the damages. This methodology was defined during the IWR workshop and is included in Attachment II – Coastal Storm Damage Relationships Based on Expert Opinion Elicitation.

6.0 FUTURE WITHOUT PROJECT CONDITION

6.1 DAMAGES

Table B-14 presents the summary statistics from 100 Beach-*Fx* iterations showing existing damages to structure and content by model reach. Also shown is the average cost of emergency nourishment. Table B-14a shows average annual damages by type for the future without project condition to illustrate what is being damaged comparatively.

7.0 WITH PROJECT CONDITION

7.1 PLAN FORMULATION

ER 1105-2-100 requires that the effects of alternatives are to be determined and evaluated in terms of four accounts: national economic development (NED); environmental quality (EQ); regional economic development (RED) and other social effects (OSE). The relevant effects of a hurricane and storm damage project for Walton County are: Prevention of land loss and other physical damage; reduction in maintenance costs of existing protection works; reduction of emergency costs to structures; increased recreational usage; changes in shore processes and equilibrium conditions; accretion or erosion along down-drift shores and prevention of loss of historic and scenic aspects of the environment.

Various beach fill alternatives were developed based on the experience gained from the Hurricane and storm Damage Reduction Project in neighboring Bay County.

Planning Hurricane and storm damage reduction measures developed for evaluation took into account some heuristics and prior experience from similar constructed projects. The PDT decided that any alternative plans would not change the existing natural berm or dune height.

Dune height alternatives were not evaluated because the predominate morphology type was high upland. Walton County beaches are essentially bluff-backed beaches and increasing the elevation of the bluffs was not considered necessary and lowering of the bluff was not considered practical.

Berm height alternatives were not evaluated. Beaches have a natural berm height. Constructing a beach higher than the natural berm height results in scarping; likewise, building a beach lower than the natural berm height results in ponding. The Mobile District has experienced both (severe scarping and ponding) at a nearby project. Historical surveys were used to determine the natural berm elevation at Walton County.

Projects are formulated in accordance with policies, principles and procedures contained in ER 1105-2-100 and related regulations (e.g., ER 200-2-2) describing the planning process developed to implement the Water Resources Council's Principles and Guidelines, the National Environmental Policy Act, Executive Order (EO) 11988, EO 11990 and other requirements. Consideration should be given to structural and nonstructural solutions. Plan formulation should be accomplished systematically to arrive at the best solution, considering all factors, including engineering, economic, environmental, and social.

Hurricane and storm damage reduction projects are formulated first to provide for hurricane and storm damage reduction. Recreation associated with this type of project is considered incidental for cost sharing purposes, although recreation benefits are National Economic Development (NED) benefits to be included in the economic analysis.

TABLE B-14

WITHOUT PROJECT DAMAGES

AVERAGE VALUES - PER 53-YEAR ITERATION (EXCEPT AVERAGE ANNUAL VALUES)

Sub-Reach	Model Reach	Average Structure Damage	Average Content Damage	Average Total Damage	Average Annual Damages	Average Emergency Nourishment	Average Annual Emergency Nourishment	Average Planned Nourishment
1	R1-1	$50,117	$427	$50,545	$2,715	$210,235	$11,294	$0
2	R1-2	$40,446	$0	$40,446	$2,173	$202,076	$10,856	$0
3	R1-3	$64,666	$0	$64,666	$3,474	$193,084	$10,373	$0
4	R1-4	$32,576	$0	$32,576	$1,750	$188,153	$10,108	$0
5	R1-5	$14,520	$287	$14,807	$795	$202,570	$10,883	$0
6	R1-6	$41,270	$0	$41,270	$2,217	$205,658	$11,048	$0
7	R1-7	$53,340	$0	$53,340	$2,866	$200,548	$10,774	$0
8	R1-8	$30,294	$0	$30,294	$1,627	$211,196	$11,346	$0
9	R1-9	$93,288	$727	$94,015	$5,051	$200,816	$10,788	$0
10	R1-10	$137,835	$0	$137,835	$7,405	$188,602	$10,132	$0
11	R1-11	$1,673,284	$814,249	$2,487,533	$133,636	$199,266	$10,705	$0
12	R1-12	$153,035	$0	$153,035	$8,221	$209,070	$11,232	$0
13	R1-13	$2,483,443	$1,167,888	$3,651,331	$196,158	$207,395	$11,142	$0
14	R1-14	$1,311,396	$623,940	$1,935,337	$103,971	$210,513	$11,309	$0
15	R1-15	$4,145,546	$1,996,276	$6,141,823	$329,953	$227,928	$12,245	$0
16	R1-16	$2,810,420	$1,362,102	$4,172,523	$224,157	$233,960	$12,569	$0
17	R1-17	$81,623	$1,669	$83,291	$4,475	$254,152	$13,654	$0
18	R1-18	$163,611	$18,038	$181,649	$9,759	$258,933	$13,910	$0
19	R1-19	$213,952	$1,878	$215,830	$11,595	$240,546	$12,923	$0
20	R1-20	$292,531	$1,295	$293,825	$15,785	$215,394	$11,571	$0
21	R1-21	$42,898	$0	$42,898	$2,305	$184,809	$9,928	$0
22	R1-22	$109,209	$747	$109,955	$5,907	$194,173	$10,431	$0
23	R1-23	$26,547	$0	$26,547	$1,426	$202,474	$10,877	$0
24	R1-24	$73,102	$21,646	$94,748	$5,090	$192,222	$10,327	$0
25	R2-1	$9,908	$0	$9,908	$532	$181,819	$9,768	$0
26	R2-2	$0	$0	$0	$0	$0	$0	$0
27	R2-3	$0	$0	$0	$0	$0	$0	$0
28	R2-4	$0	$0	$0	$0	$0	$0	$0
29	R2-5	$0	$0	$0	$0	$0	$0	$0
30	R2-6	$0	$0	$0	$0	$0	$0	$0
31	R2-7	$0	$0	$0	$0	$0	$0	$0
32	R3-1	$207,420	$530	$207,950	$11,172	$820,547	$44,082	$0
33	R3-2	$1,932,007	$694,282	$2,626,289	$141,090	$741,838	$39,853	$0
34	R3-3	$247,201	$398	$247,599	$13,302	$751,778	$40,387	$0
35	R3-4	$21,358	$1,229	$22,587	$1,213	$286,621	$15,398	$0
36	R3-5	$280,340	$117	$280,457	$15,067	$314,992	$16,922	$0
37	R3-6	$163,071	$12,307	$175,378	$9,422	$335,789	$18,039	$0
38	R3-7	$147,602	$0	$147,602	$7,930	$337,549	$18,134	$0
39	R3-8	$293,875	$1,778	$295,653	$15,883	$812,055	$43,625	$0
40	R3-9	$735,296	$0	$735,296	$39,502	$780,096	$41,909	$0
41	R3-10	$4,002,045	$1,538,725	$5,540,770	$297,663	$785,917	$42,221	$0
42	R3-11	$961,646	$161,692	$1,123,339	$60,348	$768,099	$41,264	$0

TABLE B-14 (CONTINUED)
WITHOUT PROJECT DAMAGES
AVERAGE VALUES - PER 53-YEAR ITERATION (EXCEPT AVERAGE ANNUAL VALUES)

Sub-Reach	Model Reach	Average Structure Damage	Average Content Damage	Average Total Damage	Average Annual Damages	Average Emergency Nourishment	Average Annual Emergency Nourishment	Average Planned Nourishment
43	R3-12	$2,291,254	$966,434	$3,257,688	$175,010	$738,643	$39,682	$0
44	R3-13	$153,720	$39,309	$193,030	$10,370	$740,706	$39,792	$0
45	R3-14	$1,432,360	$261,037	$1,693,397	$90,973	$1,008,234	$54,165	$0
46	R3-15	$44,152	$0	$44,152	$2,372	$800,802	$43,021	$0
47	R3-16	$17,318	$0	$17,318	$930	$556,499	$29,896	$0
48	R3-17	$152,269	$0	$152,269	$8,180	$778,391	$41,817	$0
49	R3-18	$403,306	$0	$403,306	$21,666	$796,171	$42,772	$0
50	R3-19	$218,233	$42,849	$261,082	$14,026	$790,257	$42,454	$0
51	R3-20	$3,243,409	$1,402,474	$4,645,883	$249,587	$780,754	$41,944	$0
52	R3-21	$1,511,011	$0	$1,511,011	$81,175	$781,102	$41,963	$0
53	R3-22	$442,603	$0	$442,603	$23,778	$739,214	$39,712	$0
54	R3-23	$318,197	$0	$318,197	$17,094	$643,180	$34,553	$0
55	R3-24	$28,729	$0	$28,729	$1,543	$349,327	$18,767	$0
56	R3-25	$305,862	$143,211	$449,074	$24,125	$394,881	$21,214	$0
57	R3-26	$0	$0	$0	$0	$0	$0	$0
58	R4-1	$151,745	$0	$151,745	$8,152	$804,015	$43,194	$0
59	R4-2	$674,262	$0	$674,262	$36,223	$830,989	$44,643	$0
60	R4-3	$0	$0	$0	$0	$0	$0	$0
61	R4-4	$0	$0	$0	$0	$0	$0	$0
62	R4-5	$1,244,757	$590,213	$1,834,970	$98,579	$722,149	$38,795	$0
63	R4-6	$1,792,369	$964,484	$2,756,852	$148,104	$279,394	$15,010	$0
64	R4-7	$0	$0	$0	$0	$306,342	$16,457	$0
65	R4-8	$0	$0	$0	$0	$0	$0	$0
66	R4-9	$0	$0	$0	$0	$0	$0	$0
67	R5-1	$107,028	$0	$107,028	$5,750	$442,843	$23,791	$0
68	R5-2	$45,667	$0	$45,667	$2,453	$416,320	$22,366	$0
69	R5-3	$344,988	$130,902	$475,890	$25,566	$410,365	$22,046	$0
70	R5-4	$52,778	$1,604	$54,381	$2,921	$497,669	$26,736	$0
71	R5-5	$104,374	$28,540	$132,915	$7,140	$372,486	$20,011	$0
72	R5-6	$2,083,512	$772,412	$2,855,923	$153,427	$597,458	$32,097	$0
73	R5-7	$2,627,546	$1,074,778	$3,702,324	$198,897	$588,485	$31,615	$0
74	R5-8	$1,283,261	$478,631	$1,761,892	$94,653	$568,693	$30,551	$0
75	R5-9	$81,080	$0	$81,080	$4,356	$398,857	$21,427	$0
76	R5-10	$100,176	$0	$100,176	$5,382	$394,823	$21,211	$0
77	R5-11	$286,009	$27,790	$313,799	$16,858	$401,084	$21,547	$0
78	R5-12	$172,319	$0	$172,319	$9,257	$398,147	$21,389	$0
79	R5-13	$350,899	$133,846	$484,745	$26,042	$398,685	$21,418	$0
80	R5-14	$129,147	$0	$129,147	$6,938	$391,709	$21,044	$0
81	R5-15	$101,192	$0	$101,192	$5,436	$398,018	$21,382	$0
82	R5-16	$202,544	$72,417	$274,961	$14,772	$406,363	$21,831	$0
83	R5-17	$89,887	$25	$89,913	$4,830	$229,470	$12,328	$0

TABLE B-14 (CONTINUED)
WITHOUT PROJECT DAMAGES
AVERAGE VALUES - PER 53-YEAR ITERATION (EXCEPT AVERAGE ANNUAL VALUES)

Sub-Reach	Model Reach	Average Structure Damage	Average Content Damage	Average Total Damage	Average Annual Damages	Average Emergency Nourishment	Average Annual Emergency Nourishment	Average Planned Nourishment
84	R5-18	$184,933	$1,379	$186,312	$10,009	$393,436	$21,136	$0
85	R5-19	$346,545	$486	$347,031	$18,643	$245,542	$13,191	$0
86	R5-20	$127,695	$8,744	$136,439	$7,330	$375,168	$20,155	$0
87	R5-21	$115,553	$0	$115,553	$6,208	$413,353	$22,206	$0
88	R5-22	$0	$0	$0	$0	$0	$0	$0
89	R5-23	$0	$0	$0	$0	$0	$0	$0
90	R5-24	$0	$0	$0	$0	$0	$0	$0
91	R5-25	$0	$0	$0	$0	$0	$0	$0
92	R5-26	$0	$0	$0	$0	$0	$0	$0
93	R5-27	$0	$0	$0	$0	$0	$0	$0
94	R5-28	$0	$0	$0	$0	$0	$0	$0
95	R5-29	$0	$0	$0	$0	$0	$0	$0
96	R5-30	$104,662	$143	$104,805	$5,630	$397,892	$21,376	$0
97	R5-31	$159,905	$54,514	$214,419	$11,519	$395,055	$21,223	$0
98	R5-32	$1,521,295	$385,609	$1,906,904	$102,443	$572,711	$30,767	$0
99	R5-33	$622,017	$0	$622,017	$33,416	$590,106	$31,702	$0
100	R5-34	$253,618	$0	$253,618	$13,625	$585,324	$31,445	$0
101	R5-35	$407,198	$0	$407,198	$21,876	$566,648	$30,442	$0
102	R5-36	$1,549,347	$504,940	$2,054,288	$110,361	$540,441	$29,034	$0
103	R5-37	$255,864	$0	$255,864	$13,746	$606,722	$32,594	$0
104	R5-38	$619,179	$0	$619,179	$33,264	$659,680	$35,440	$0
105	R5-39	$113,477	$0	$113,477	$6,096	$628,131	$33,745	$0
106	R5-40	$10,764	$0	$10,764	$578	$400,241	$21,502	$0
107	R5-41	$31,317	$0	$31,317	$1,682	$398,352	$21,400	$0
108	R5-42	$13,030	$0	$13,030	$700	$382,964	$20,574	$0
109	R5-43	$25,748	$0	$25,748	$1,383	$368,776	$19,812	$0
110	R5-44	$158,802	$78,936	$237,738	$12,772	$360,811	$19,384	$0
111	R5-45	$748,064	$371,844	$1,119,908	$60,164	$342,801	$18,416	$0
112	R5-46	$229,544	$64,593	$294,137	$15,802	$343,659	$18,462	$0
113	R5-47	$427,506	$178,669	$606,175	$32,565	$362,261	$19,462	$0
114	R5-48	$9,480	$2,929	$12,409	$667	$238,738	$12,826	$0
115	R5-49	$175,814	$87,341	$263,155	$14,137	$243,899	$13,103	$0
116	R5-50	$32,351	$9	$32,360	$1,738	$242,799	$13,044	$0
117	R5-51	$95,314	$20,604	$115,918	$6,227	$239,386	$12,860	$0

TABLE B-14A
AVERAGE ANNUAL WITHOUT PROJECT STRUCTURE AND CONTENT DAMAGES BY TYPE

Type	Average Annual Structure Damage	Average Annual Content Damage
Private Access	$6,976	$0
Public Access	$18,796	$0
Commercial	$13,161	$6,191
Gazebo	$48,243	$4,189
Jacuzzi	$682	$0
Small Multi-Family	$49,485	$19,637
Medium Multi Family	$329,994	$162,168
Large Multi Family	$305	$14,859
Pool	$74,320	$2,594
Single Family Residential	$1,343,119	$629,710
Walkovers	$689,815	$0
Average Annual Damages	$2,574,895	$839,346

7.1.1 Non-Structural Alternatives

Beach nourishment and periodic renourishment will meet the study objectives for shoreline erosion protection in the most economically efficient and environmentally acceptable manner. Hard structures, such as groins, breakwaters and seawalls would have a negative impact on endangered species such as nesting sea turtles, therefore these types of structures were not considered for this analysis.

A non-structural measure, property acquisition, was considered as a hurricane and storm damage reduction measure. Property acquisition would involve the purchase of the damageable property and relocating the residents. This alternative for hurricane and storm damage reduction would eliminate storm damage to approximately eighty one percent of the approximately 814 damage elements in the study area. To evaluate this alternative the value of the acquisition would have to be determined and compared to other evaluated alternatives to determine if this is a least costly alternative.

The typical 50-foot front row lot averages one million dollars each, appraised value. There are approximately 20 lots per sub-reach, multiplied by 117 sub-reaches equals about 2,340 lots. At one million dollars each lot, multiplied by 2,340 lots yields about $2.34 billion dollars in land value. When this land value is added to $1.18 billion dollars in damageable structure value (remember only the first two floor's value, for multi-storied structures were counted in the damageable structure inventory), the approximate $3.42 billion dollars would more than eclipse the cost of any beach fill alternative. Thus, the alternative measure of property acquisition was dismissed from further consideration

7.1.2 Structural Alternatives - Beach Fill Alternatives

A range of beach fill alternative plans were formulated by the PDT. Since both berm width and dune width alternatives were to be evaluated phase one would involve maximizing berm width which would be followed by phase two to optimize dune width.

8.0 NED BENEFIT ANALYSIS

8.1 PHASE ONE BERM WIDTH OPTIMIZATION

Table B-15 displays the six berm width optimization alternatives that were evaluated and their specifications. The existing dune height was not altered.

TABLE B-15
BERM WIDTH OPTIMIZATION

Reach	Representative Profile	Existing Dune Height (Feet)	Existing Dune Width (Feet)	Alternative Dune Width (Feet)	Alternative Berm Width (Feet)					
					Zero	MiniMin	Min	Small	Medium	Maximum
1	R1P1	22.2	55	75	0	10	25	50	75	100
	R1P2	13.6	100	120	0	25	50	75	100	125
3	R3P1	23	75	95	0	25	50	75	100	125
	R3P2	12.5	45	65	0	25	50	75	100	125
4	R4P1	23	50	70	0	25	50	75	100	125
	R4P2	10	82	100	0	25	50	75	100	125
5	R5P1	32	185	205	0	25	50	75	100	125
	R5P2	24	65	85	0	25	50	75	100	125
	R5P3	15.5	50	70	0	25	50	75	100	125

8.1.1 Berm Width Optimization Alternatives

The phase one berm width optimization was formulated around six alternative berm width templates; Zero, MiniMin, Minimum, Small, Medium and Maximum. In order to maintain consistency for comparison and evaluation purposes each alternative was run with +20 feet of dune width added to the existing dune width. Phase one berm width alternative specifications are shown in Table B-16.

8.1.2 Results of Berm Width Optimization

The results of these runs indicated that the minimum berm template was the alternative with the greatest net benefits (see Table B-17 – B-22). Also, there were significant added benefits that accrue to alternative designs that included additional dune width. All alternatives were formulated with a +20 added dune width. Table B-23 presents the summarized berm width optimization.

8.2 FORMULATION OF CONSTRUCTION REACHES

Another revelation from the runs was that not all model reaches were going to be cost justified. When the cost of construction per unit of benefited shore length is not reasonable uniform for the entire project area, the project should be subdivided into elements (reaches) within which this condition is met.

Five possible construction reaches (Table B-24) were forming as candidates for economic justification. Those five construction reaches were identified, numbered 1 through 5 from the west to east which formed the basis for subsequent alternative analyses.

8.3 BERM WIDTH OPTIMIZATION BY CONSTRUCTION REACH

The PDT team noted that the MiniMin Berm width alternative maximized net benefits when all construction reaches as a whole are evaluated, but the minimum alternative maximized net benefits in construction reach one.

TABLE B-16
BERM WIDTH OPTIMIZATION TEMPLATE

Sub-Reach	Model Reach	Profile	Zero Berm Width Template	+20 Feet Added Dune Width	MiniMin Berm Width Template	+20 Feet Added Dune Width	Minimum Berm Width Template	+20 Feet Added Dune Width	Small Berm Width Template	+20 Feet Added Dune Width	Medium Berm Width Template	+20 Feet Added Dune Width	Maximum Berm Width Template	+20 Feet Added Dune Width
1	R1-1	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
2	R1-2	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
3	R1-3	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
4	R1-4	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
5	R1-5	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
6	R1-6	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
7	R1-7	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
8	R1-8	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
9	R1-9	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
10	R1-10	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
11	R1-11	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
12	R1-12	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
13	R1-13	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
14	R1-14	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
15	R1-15	R1P2	0	120	25	120	50	120	75	120	100	120	125	120
16	R1-16	R1P2	0	120	25	120	50	120	75	120	100	120	125	120
17	R1-17	R1P2	0	120	25	120	50	120	75	120	100	120	125	120
18	R1-18	R1P2	0	120	25	120	50	120	75	120	100	120	125	120
19	R1-19	R1P2	0	120	25	120	50	120	75	120	100	120	125	120
20	R1-20	R1P2	0	120	10	120	50	120	75	120	100	120	125	120
21	R1-21	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
22	R1-22	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
23	R1-23	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
24	R1-24	R1P1	0	75	10	75	25	75	50	75	75	75	100	75
25	R2-1	R2P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
26	R2-2	R2P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
27	R2-3	R2P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

TABLE B-16 (CONTINUED)
BERM WIDTH OPTIMIZATION TEMPLATE

Sub-Reach	Model Reach	Profile	Zero Berm Width Template	+20 Feet Added Dune Width	MiniMin Berm Width Template	+20 Feet Added Dune Width	Minimum Berm Width Template	+20 Feet Added Dune Width	Small Berm Width Template	+20 Feet Added Dune Width	Medium Berm Width Template	+20 Feet Added Dune Width	Maximum Berm Width Template	+20 Feet Added Dune Width
28	R2-4	R2P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
29	R2-5	R2P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
30	R2-6	R2P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
31	R2-7	R2P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
32	R3-1	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
33	R3-2	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
34	R3-3	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
35	R3-4	R3P2	0	65	25	65	50	65	75	65	100	65	125	65
36	R3-5	R3P2	0	65	25	65	50	65	75	65	100	65	125	65
37	R3-6	R3P2	0	65	25	65	50	65	75	65	100	65	125	65
38	R3-7	R3P2	0	65	25	65	50	65	75	65	100	65	125	65
39	R3-8	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
40	R3-9	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
41	R3-10	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
42	R3-11	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
43	R3-12	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
44	R3-13	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
45	R3-14	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
46	R3-15	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
47	R3-16	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
48	R3-17	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
49	R3-18	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
50	R3-19	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
51	R3-20	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
52	R3-21	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
53	R3-22	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
54	R3-23	R3P1	0	95	25	95	50	95	75	95	100	95	125	95
55	R3-24	R3P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

TABLE B-16 (CONTINUED)
BERM WIDTH OPTIMIZATION TEMPLATE

Sub-Reach	Model Reach	Profile	Zero Berm Width Template	+20 Feet Added Dune Width	MiniMin Berm Width Template	+20 Feet Added Dune Width	Minimum Berm Width Template	+20 Feet Added Dune Width	Small Berm Width Template	+20 Feet Added Dune Width	Medium Berm Width Template	+20 Feet Added Dune Width	Maximum Berm Width Template	+20 Feet Added Dune Width
56	R3-25	R3P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
57	R3-26	R4P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
58	R4-1	R4P1	0	70	25	70	50	70	75	70	100	70	125	70
59	R4-2	R4P1	0	70	25	70	50	70	75	70	100	70	125	70
60	R4-3	R4P2	0	105	25	105	50	105	75	105	100	105	125	105
61	R4-4	R4P2	0	105	25	105	50	105	75	105	100	105	125	105
62	R4-5	R4P1	0	70	25	70	50	70	75	70	100	70	125	70
63	R4-6	R4P2	0	105	25	105	50	105	75	105	100	105	125	105
64	R4-7	R4P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
65	R4-8	R4P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
66	R4-9	R4P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
67	R5-1	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
68	R5-2	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
69	R5-3	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
70	R5-4	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
71	R5-5	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
72	R5-6	R5P1	0	205	25	205	50	205	75	205	100	205	125	205
73	R5-7	R5P1	0	205	25	205	50	205	75	205	100	205	125	205
74	R5-8	R5P1	0	205	25	205	50	205	75	205	100	205	125	205
75	R5-9	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
76	R5-10	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
77	R5-11	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
78	R5-12	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
79	R5-13	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
80	R5-14	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
81	R5-15	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
82	R5-16	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
83	R5-17	R5P3	0	70	25	70	50	70	75	70	100	70	125	70

TABLE B-16 (CONTINUED)
BERM WIDTH OPTIMIZATION TEMPLATE

Sub-Reach	Model Reach	Profile	Zero Berm Width Template	+20 Feet Added Dune Width	MiniMin Berm Width Template	+20 Feet Added Dune Width	Minimum Berm Width Template	+20 Feet Added Dune Width	Small Berm Width Template	+20 Feet Added Dune Width	Medium Berm Width Template	+20 Feet Added Dune Width	Maximum Berm Width Template	+20 Feet Added Dune Width
84	R5-18	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
85	R5-19	R5P3	0	70	25	70	50	70	75	70	100	70	125	70
86	R5-20	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
87	R5-21	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
88	R5-22	R5P3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
89	R5-23	R5P3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
90	R5-24	R5P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
91	R5-25	R5P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
92	R5-26	R5P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
93	R5-27	R5P3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
94	R5-28	R5P3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
95	R5-29	R5P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
96	R5-30	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
97	R5-31	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
98	R5-32	R5P1	0	205	25	205	50	205	75	205	100	205	125	205
99	R5-33	R5P1	0	205	25	205	50	205	75	205	100	205	125	205
100	R5-34	R5P1	0	205	25	205	50	205	75	205	100	205	125	205
101	R5-35	R5P1	0	205	25	205	50	205	75	205	100	205	125	205
102	R5-36	R5P1	0	205	25	205	50	205	75	205	100	205	125	205
103	R5-37	R5P1	0	205	25	205	50	205	75	205	100	205	125	205
104	R5-38	R5P1	0	205	25	205	50	205	75	205	100	205	125	205
105	R5-39	R5P1	0	205	25	205	50	205	75	205	100	205	125	205
106	R5-40	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
107	R5-41	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
108	R5-42	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
109	R5-43	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
110	R5-44	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
111	R5-45	R5P2	0	85	25	85	50	85	75	85	100	85	125	85

TABLE B-16 (CONTINUED)
BERM WIDTH OPTIMIZATION TEMPLATE

Sub-Reach	Model Reach	Profile	Zero Berm Width Template	+20 Feet Added Dune Width	MiniMin Berm Width Template	+20 Feet Added Dune Width	Minimum Berm Width Template	+20 Feet Added Dune Width	Small Berm Width Template	+20 Feet Added Dune Width	Medium Berm Width Template	+20 Feet Added Dune Width	Maximum Berm Width Template	+20 Feet Added Dune Width
112	R5-46	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
113	R5-47	R5P2	0	85	25	85	50	85	75	85	100	85	125	85
114	R5-48	R5P3	0	70	25	70	50	70	75	70	100	70	125	70
115	R5-49	R5P3	0	70	25	70	50	70	75	70	100	70	125	70
116	R5-50	R5P3	0	70	25	70	50	70	75	70	100	70	125	70
117	R5-51	R5P3	0	70	25	70	50	70	75	70	100	70	125	70

Note: Shaded areas are State Park Areas which received neither emergency nor planned nourishments
Alternative Berm Widths
Existing Dune width + 20 feet of additive dune width

TABLE B-17
BERM WIDTH OPTIMIZATION ZERO BERM WIDTH

Model Reach	Damage Reduction ZERO Added Berm Width	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional Cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits ZERO Added Berm Width	Summed Net Benefits ZERO Added Berm Width
R1-1	$1,948	$109	$54,795	$109	$50,461	$2,818	0.0386	-$2,709	
R1-2	$3,826	$214	$49,622	$214	$307,103	$17,148	0.0125	-$16,934	
R1-3	$4,595	$257	$37,527	$257	$289,566	$16,169	0.0159	-$15,912	
R1-4	$8,113	$453	$27,756	$453	$315,586	$17,622	0.0257	-$17,169	
R1-5	$2,489	$139	$22,870	$139	$310,413	$17,333	0.0080	-$17,194	
R1-6	$9,389	$524	$6,771	$524	$390,468	$21,803	0.0240	-$21,279	
R1-7	$19,099	$1,066	$442	$1,066	$365,607	$20,415	0.0522	-$19,348	
R1-8	$10,983	$613	$1,159	$613	$369,255	$20,618	0.0297	-$20,005	
R1-9	$20,923	$1,168	$2,015	$1,168	$338,711	$18,913	0.0618	-$17,745	
R1-10	$10,259	$573	$6,219	$573	$290,304	$16,210	0.0353	-$15,637	
R1-11	$1,172,970	$65,496	$8,692	$65,496	$825,107	$46,072	1.4216	$19,424	
R1-12	$84,001	$4,690	$3,758	$4,690	$789,098	$44,062	0.1065	-$39,371	
R1-13	$3,426,140	$191,309	-$58	$191,367	$704,870	$39,359	4.8621	$152,009	
R1-14	$1,919,253	$107,167	-$7,413	$114,580	$773,596	$43,196	2.6526	$71,384	
R1-15	$1,999,896	$111,670	-$8,068	$119,738	$686,273	$38,320	3.1247	$81,418	
R1-16	$2,781,169	$155,295	-$11,001	$166,296	$272,863	$15,236	10.9145	$151,060	**$435,924**
R1-17	$43,837	$2,448	-$11,198	$13,646	$233,472	$13,037	1.0467	$609	
R1-18	$57,515	$3,212	-$12,742	$15,954	$244,312	$13,642	1.1695	$2,312	
R1-19	$44,420	$2,480	-$5,695	$8,175	$284,463	$15,884	0.5147	-$7,709	
R1-20	$47,614	$2,659	$8,438	$2,659	$237,378	$13,255	0.2006	-$10,596	
R1-21	$132	$7	$9,080	$7	$327,538	$18,289	0.0004	-$18,282	
R1-22	$10,380	$580	$21,487	$580	$346,408	$19,343	0.0300	-$18,763	
R1-23	$3,509	$196	$36,478	$196	$319,206	$17,824	0.0110	-$17,628	
R1-24	$69,363	$3,873	$41,072	$3,873	$337,696	$18,856	0.2054	-$14,983	
R2-1	-$113	-$6	$31,026	-$6	$21,736	$1,214	-	-	
R2-2	$0	$0	$10,175	$0	$0	$0	-	-	
R2-3	$0	$0	$29,592	$0	$0	$0	-	-	
R2-4	$0	$0	$22,465	$0	$0	$0	-	-	
R2-5	$0	$0	$8,309	$0	$0	$0	-	-	
R2-6	$0	$0	-$249,209	$249,209	$0	$0	-	-	
R2-7	$0	$0	$18,114	$0	$0	$0	-	-	
R3-1	$180,060	$10,054	$20,806	$10,054	$510,349	$28,497	0.3528	-$18,443	
R3-2	$2,127,566	$118,799	$19,994	$118,799	$420,973	$23,506	5.0539	$95,293	
R3-3	$185,528	$10,360	$20,424	$10,360	$418,120	$23,347	0.4437	-$12,988	
R3-4	$16,961	$947	$25,555	$947	$116,056	$6,480	0.1461	-$5,533	
R3-5	$38,865	$2,170	$21,080	$2,170	$170,861	$9,541	0.2275	-$7,370	
R3-6	$36,127	$2,017	$15,383	$2,017	$180,985	$10,106	0.1996	-$8,089	
R3-7	$49,783	$2,780	$4,993	$2,780	$153,870	$8,592	0.3235	-$5,812	
R3-8	$77,074	$4,304	-$14,815	$19,118	$1,188,033	$66,337	0.2882	-$47,219	
R3-9	$434,870	$24,282	-$17,079	$41,362	$983,765	$54,932	0.7530	-$13,570	
R3-10	$2,275,811	$127,077	-$21,371	$148,448	$871,568	$48,667	3.0503	$99,782	
R3-11	$689,120	$38,479	-$23,863	$62,342	$707,891	$39,527	1.5772	$22,815	
R3-12	$1,301,736	$72,686	-$37,589	$110,275	$627,570	$35,042	3.1469	$75,233	
R3-13	$216,357	$12,081	-$44,608	$56,689	$595,132	$33,231	1.7059	$23,458	

TABLE B-17 (CONTINUED)
BERM WIDTH OPTIMIZATION ZERO BERM WIDTH

Model Reach	Damage Reduction ZERO Added Berm Width	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional Cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits ZERO Added Berm Width	Summed Net Benefits ZERO Added Berm Width
R3-14	$1,392,192	$77,737	-$77,674	$155,411	$915,085	$51,097	3.0415	$104,314	
R3-15	$19,409	$1,084	-$67,602	$68,686	$631,136	$35,241	1.9490	$33,444	
R3-16	$5,471	$306	-$52,660	$52,966	$449,998	$25,127	2.1079	$27,839	
R3-17	$112,493	$6,281	-$83,305	$89,587	$704,264	$39,325	2.2781	$50,262	
R3-18	$261,843	$14,621	-$86,928	$101,548	$748,371	$41,788	2.4301	$59,761	
R3-19	$312,734	$17,462	-$82,277	$99,739	$752,150	$41,999	2.3748	$57,740	
R3-20	$3,906,773	$218,147	-$79,875	$298,021	$879,468	$49,108	6.0687	$248,914	
R3-21	$826,335	$46,141	-$77,993	$124,134	$1,095,124	$61,150	2.0300	$62,984	
R3-22	$230,587	$12,876	-$67,797	$80,673	$1,241,432	$69,319	1.1638	$11,354	
R3-23	$198,400	$11,078	-$53,371	$64,449	$577,522	$32,248	1.9986	$32,201	**$904,813**
R3-24	$5,384	$301	-$45,450	$45,751	$0	$0	-	$45,751	
R3-25	$0	$0	-$32,621	$32,621	$0	$0	-	$32,621	
R3-26	$0	$0	-$26,720	$26,720	$0	$0	-	$26,720	
R4-1	-$3,878	-$217	-$54,395	$54,178	$21,736	$1,214	44.6383	$52,965	
R4-2	-$52,104	-$2,909	-$45,920	$43,011	$108,682	$6,069	7.0874	$36,942	
R4-3	$0	$0	$3,747	$0	$131,501	$7,343	0.0000	-$7,343	
R4-4	$0	$0	$7,991	$0	$63,490	$3,545	0.0000	-$3,545	
R4-5	-$7,370	-$412	-$21,731	$21,320	$36,227	$2,023	10.5393	$19,297	
R4-6	$0	$0	$6,739	$0	$7,245	$405	0.0000	-$405	**$97,911**
R4-7	$0	$0	-$8,323	$8,323	$0	$0	-	$8,323	
R4-8	$0	$0	-$87,751	$87,751	$0	$0	-	$87,751	
R4-9	$0	$0	-$153,875	$153,875	$0	$0	-	$153,875	
R5-1	$15,438	$862	-$100,250	$101,112	$610,041	$34,064	2.9683	$67,048	
R5-2	$17,990	$1,005	-$70,377	$71,381	$450,461	$25,153	2.8379	$46,228	
R5-3	$22,538	$1,258	-$38,155	$39,414	$254,921	$14,234	2.7689	$25,179	
R5-4	$15,298	$854	-$11,323	$12,177	$150,467	$8,402	1.4493	$3,775	
R5-5	$88,997	$4,969	$11,365	$4,969	$109,553	$6,117	0.8124	-$1,148	
R5-6	$2,650,675	$148,009	-$30,953	$178,962	$681,942	$38,078	4.6998	$140,884	
R5-7	$3,625,676	$202,451	-$38,120	$240,571	$671,166	$37,477	6.4192	$203,095	
R5-8	$1,610,350	$89,919	-$27,503	$117,422	$666,522	$37,217	3.1550	$80,204	
R5-9	$26,850	$1,499	-$15,659	$17,159	$148,123	$8,271	2.0746	$8,888	
R5-10	$28,066	$1,567	-$17,915	$19,482	$124,348	$6,943	2.8059	$12,539	
R5-11	$162,780	$9,089	-$19,644	$28,733	$154,963	$8,653	3.3207	$20,080	
R5-12	$29,720	$1,660	-$18,787	$20,446	$98,745	$5,514	3.7082	$14,932	
R5-13	$107,222	$5,987	-$19,733	$25,720	$173,554	$9,691	2.6541	$16,030	
R5-14	$36,816	$2,056	-$17,799	$19,855	$143,238	$7,998	2.4824	$11,857	
R5-15	$34,184	$1,909	-$24,219	$26,128	$149,193	$8,331	3.1364	$17,797	
R5-16	$169,360	$9,457	-$24,757	$34,214	$155,831	$8,701	3.9320	$25,512	
R5-17	$11,667	$651	-$13,221	$13,873	$186,092	$10,391	1.3351	$3,482	
R5-18	$55,805	$3,116	-$24,149	$27,265	$231,108	$12,905	2.1128	$14,360	**$710,743**
R5-19	$25,774	$1,439	-$2,901	$4,340	$284,340	$15,877	0.2734	-$11,537	
R5-20	$24,031	$1,342	$184	$1,342	$492,932	$27,524	0.0488	-$26,183	
R5-21	$24,141	$1,348	-$554	$1,902	$52,932	$2,956	0.6434	-$1,054	
R5-22	$0	$0	-$1,964	$1,964	$0	$0	$0	$1,964	
R5-23	$0	$0	-$511	$511	$0	$0	$0	$511	

TABLE B-17 (CONTINUED)
BERM WIDTH OPTIMIZATION ZERO BERM WIDTH

Model Reach	Damage Reduction ZERO Added Berm Width	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional Cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits ZERO Added Berm Width	Summed Net Benefits ZERO Added Berm Width
R5-24	$0	$0	-$6,898	$6,898	$0	$0	$0	$6,898	
R5-25	$0	$0	-$15,278	$15,278	$0	$0	$0	$15,278	
R5-26	$0	$0	-$12,809	$12,809	$0	$0	$0	$12,809	
R5-27	$0	$0	-$10,102	$10,102	$0	$0	$0	$10,102	
R5-28	$0	$0	-$11,651	$11,651	$0	$0	$0	$11,651	
R5-29	$0	$0	-$37,910	$37,910	$0	$0	$0	$37,910	
R5-30	$21,881	$1,222	-$32,848	$34,070	$570,396	$31,850	1.0697	$2,220	
R5-31	$190,849	$10,657	-$33,879	$44,535	$445,772	$24,891	1.7892	$19,644	
R5-32	$1,168,474	$65,245	-$61,892	$127,137	$914,183	$51,046	2.4906	$76,091	
R5-33	$448,520	$25,044	-$62,530	$87,575	$810,845	$45,276	1.9342	$42,299	
R5-34	$186,335	$10,405	-$53,740	$64,144	$728,303	$40,667	1.5773	$23,477	
R5-35	$281,354	$15,710	-$52,782	$68,492	$665,830	$37,179	1.8422	$31,314	
R5-36	$1,475,011	$82,362	-$56,472	$138,834	$689,576	$38,505	3.6056	$100,329	
R5-37	$199,615	$11,146	-$80,647	$91,793	$704,586	$39,343	2.3332	$52,451	
R5-38	$462,079	$25,802	-$94,528	$120,329	$822,896	$45,949	2.6188	$74,380	
R5-39	$93,495	$5,221	-$98,750	$103,970	$697,510	$38,948	2.6695	$65,022	
R5-40	$5,107	$285	-$49,625	$49,911	$117,928	$6,585	7.5796	$43,326	
R5-41	$13,715	$766	-$44,843	$45,609	$121,375	$6,777	6.7296	$38,831	
R5-42	$4,930	$275	-$30,127	$30,402	$125,668	$7,017	4.3326	$23,385	
R5-43	$8,731	$488	-$18,731	$19,219	$100,872	$5,632	3.4121	$13,586	
R5-44	$0	$0	-$5,603	$5,603	$98,536	$5,502	1.0183	$101	
R5-45	$0	$0	$263	$0	$101,165	$5,649	0.0000	-$5,649	
R5-46	$151,476	$8,458	$7,328	$8,458	$119,182	$6,655	1.2710	$1,803	
R5-47	$342,659	$19,133	$982	$19,133	$157,559	$8,798	2.1748	$10,336	
R5-48	$1,667	$93	$2,299	$93	$157,803	$8,811	0.0106	-$8,718	
R5-49	$59	$3	-$12,232	$12,235	$251,788	$14,059	0.8703	-$1,824	
R5-50	-$1,386	-$77	-$18,968	$18,890	$414,026	$23,118	0.8171	-$4,228	
R5-51	$15,690	$876	-$28,941	$29,817	$142,154	$7,938	3.7564	$21,879	**$636,087**

TABLE B-18
BERM WIDTH OPTIMIZATION MINIMIN

Model Reach	Damage Reduction MiniMin	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional Cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits MiniMin	Summed Net Benefits MiniMin
R1-1	$2,041	$114	$54,795	$114	$274,975	$15,354	0.007	-$15,240	
R1-2	$2,937	$164	$49,622	$164	$259,078	$14,466	0.011	-$14,302	
R1-3	$6,090	$340	$37,527	$340	$262,142	$14,638	0.023	-$14,297	
R1-4	$14,228	$794	$27,756	$794	$260,803	$14,563	0.055	-$13,768	
R1-5	$3,159	$176	$22,870	$176	$289,454	$16,163	0.011	-$15,986	
R1-6	$11,961	$668	$6,771	$668	$319,307	$17,829	0.037	-$17,162	
R1-7	$12,727	$711	$442	$711	$320,142	$17,876	0.040	-$17,165	
R1-8	$6,970	$389	$1,159	$389	$337,451	$18,843	0.021	-$18,453	
R1-9	$45,221	$2,525	$2,015	$2,525	$317,766	$17,743	0.142	-$15,218	
R1-10	$69,776	$3,896	$6,219	$3,896	$290,478	$16,220	0.240	-$12,324	
R1-11	$1,209,040	$67,510	$8,692	$67,510	$305,451	$17,056	3.958	$50,455	
R1-12	$52,096	$2,909	$3,758	$2,909	$326,404	$18,226	0.160	-$15,317	
R1-13	$2,635,212	$147,145	-$58	$147,203	$328,141	$18,323	8.034	$128,881	
R1-14	$1,687,921	$94,250	-$7,413	$101,663	$358,888	$20,040	5.073	$81,624	
R1-15	$2,135,356	$119,234	-$8,068	$127,302	$417,759	$23,327	5.457	$103,975	
R1-16	$1,387,942	$77,500	-$11,001	$88,501	$422,690	$23,602	3.750	$64,898	**$414,516**
R1-17	$22,827	$1,275	-$11,198	$12,472	$449,252	$25,085	0.497	-$12,613	
R1-18	$45,418	$2,536	-$12,742	$15,278	$467,280	$26,092	0.586	-$10,814	
R1-19	$71,857	$4,012	-$5,695	$9,707	$432,380	$24,143	0.402	-$14,436	
R1-20	$86,383	$4,823	$8,438	$4,823	$381,923	$21,326	0.226	-$16,502	
R1-21	$758	$42	$9,080	$42	$298,425	$16,663	0.003	-$16,621	
R1-22	$32,710	$1,826	$21,487	$1,826	$283,634	$15,838	0.115	-$14,011	
R1-23	$3,143	$175	$36,478	$175	$289,250	$16,151	0.011	-$15,976	
R1-24	$78,386	$4,377	$41,072	$4,377	$258,932	$14,458	0.303	-$10,081	
R2-1	$0	$0	$0	$0	$0	$0	-	$0	
R2-2	$0	$0	$0	$0	$0	$0	-	$0	
R2-3	$0	$0	$0	$0	$0	$0	-	$0	
R2-4	$0	$0	$0	$0	$0	$0	-	$0	
R2-5	$0	$0	$0	$0	$0	$0	-	$0	
R2-6	$0	$0	$0	$0	$0	$0	-	$0	
R2-7	$0	$0	$0	$0	$0	$0	-	$0	
R3-1	$152,011	$8,488	$20,806	$8,488	$182,143	$10,171	0.835	-$1,683	
R3-2	$1,580,357	$88,244	$19,994	$88,244	$135,295	$7,555	11.681	$80,689	
R3-3	$142,895	$7,979	$20,424	$7,979	$118,312	$6,606	1.208	$1,373	
R3-4	$4,762	$266	$25,555	$266	$228,754	$12,773	0.021	-$12,507	
R3-5	$35,529	$1,984	$21,080	$1,984	$258,804	$14,451	0.137	-$12,467	
R3-6	$15,315	$855	$15,383	$855	$285,477	$15,940	0.054	-$15,085	
R3-7	$568,877	$31,765	$4,993	$31,765	$300,837	$16,798	1.891	$14,967	
R3-8	$6,113,916	$341,389	-$14,815	$356,204	$144,408	$8,063	44.175	$348,140	
R3-9	$430,930	$24,062	-$17,079	$41,142	$136,660	$7,631	5.391	$33,511	
R3-10	$2,308,403	$128,897	-$21,371	$150,268	$139,959	$7,815	19.228	$142,453	
R3-11	$578,808	$32,320	-$23,863	$56,183	$139,268	$7,776	7.225	$48,406	
R3-12	$1,273,739	$71,123	-$37,589	$108,712	$142,474	$7,955	13.665	$100,757	

TABLE B-18 (CONTINUED)
BERM WIDTH OPTIMIZATION MINIMIN

Model Reach	Damage Reduction MiniMiN	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional Cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits MiniMin	Summed Net Benefits MiniMin
R3-13	$126,295	$7,052	-$44,608	$51,660	$151,976	$8,486	6.088	$43,174	
R3-14	$1,006,547	$56,204	-$77,674	$133,877	$235,616	$13,156	10.176	$120,721	
R3-15	$8,570	$479	-$67,602	$68,081	$185,633	$10,365	6.568	$57,715	
R3-16	$1,186	$66	-$52,660	$52,727	$133,781	$7,470	7.058	$45,257	
R3-17	$78,722	$4,396	-$83,305	$87,701	$200,161	$11,177	7.847	$76,524	
R3-18	$213,582	$11,926	-$86,928	$98,854	$212,061	$11,841	8.348	$87,013	
R3-19	$211,341	$11,801	-$82,277	$94,077	$200,097	$11,173	8.420	$82,904	
R3-20	$3,331,546	$186,027	-$79,875	$265,902	$200,283	$11,183	23.776	$254,718	
R3-21	$882,610	$49,283	-$77,993	$127,276	$197,209	$11,012	11.558	$116,265	
R3-22	$271,324	$15,150	-$67,797	$82,948	$180,633	$10,086	8.224	$72,861	
R3-23	$188,911	$10,548	-$53,371	$63,919	$151,593	$8,465	7.551	$55,454	**$1,742,843**
R3-24	-$2,376	-$133	-$45,450	$45,318	-$88,842	-$4,961	-9.135	$50,278	
R3-25	$12,626	$705	-$32,621	$33,326	-$95,074	-$5,309	-6.278	$38,635	
R3-26	$0	$0	-$26,720	$26,720	$0	$0	-	$26,720	
R4-1	$106,031	$5,921	-$54,395	$60,315	-$25,737	-$1,437	-41.970	$61,753	
R4-2	$434,853	$24,281	-$45,920	$70,201	-$35,420	-$1,978	-35.496	$72,179	
R4-3	$0	$0	$3,747	$0	$37,319	$2,084	-	-$2,084	
R4-4	$0	$0	$7,991	$0	$35,780	$1,998	-	-$1,998	
R4-5	$75,567	$4,220	-$21,731	$25,951	-$24,814	-$1,386	-18.730	$27,336	
R4-6	$113,924	$6,361	$6,739	$6,361	-$50,306	-$2,809	-2.265	$9,170	**$166,356**
R4-7	$0	$0	-$8,323	$8,323	-$82,072	-$4,583	-1.816	$12,905	
R4-8	$0	$0	-$87,751	$87,751	$0	$0	-	$87,751	
R4-9	$0	$0	-$153,875	$153,875	$0	$0	-	$153,875	
R5-1	$43,616	$2,435	-$100,250	$102,685	$142,449	$7,954	12.910	$94,731	
R5-2	$19,089	$1,066	-$70,377	$71,443	$132,534	$7,400	9.654	$64,042	
R5-3	$43,477	$2,428	-$38,155	$40,583	$117,872	$6,582	6.166	$34,001	
R5-4	$25,173	$1,406	-$11,323	$12,728	$148,012	$8,265	1.540	$4,464	
R5-5	$77,022	$4,301	$11,365	$4,301	$109,058	$6,090	0.706	-$1,789	
R5-6	$2,699,955	$150,760	-$30,953	$181,714	$263,263	$14,700	12.361	$167,014	
R5-7	$3,750,500	$209,421	-$38,120	$247,541	$256,600	$14,328	17.277	$233,213	
R5-8	$1,579,802	$88,213	-$27,503	$115,716	$246,338	$13,755	8.413	$101,961	
R5-9	$26,153	$1,460	-$15,659	$17,120	$110,886	$6,192	2.765	$10,928	
R5-10	$32,678	$1,825	-$17,915	$19,740	$113,228	$6,322	3.122	$13,417	
R5-11	$157,366	$8,787	-$19,644	$28,431	$115,561	$6,453	4.406	$21,978	
R5-12	$57,724	$3,223	-$18,787	$22,010	$113,589	$6,343	3.470	$15,667	
R5-13	$102,154	$5,704	-$19,733	$25,437	$114,631	$6,401	3.974	$19,037	
R5-14	$45,814	$2,558	-$17,799	$20,357	$112,306	$6,271	3.246	$14,086	
R5-15	$34,303	$1,915	-$24,219	$26,135	$118,865	$6,637	3.938	$19,497	
R5-16	$159,543	$8,909	-$24,757	$33,666	$119,141	$6,653	5.061	$27,013	
R5-17	$14,763	$824	-$13,221	$14,046	$128,126	$7,154	1.963	$6,891	
R5-18	$89,871	$5,018	-$24,149	$29,167	$117,340	$6,552	4.452	$22,615	**$868,767**
R5-19	$65,847	$3,677	-$2,901	$6,578	$125,655	$7,016	0.938	-$438	
R5-20	$48,044	$2,683	$184	$2,683	$115,197	$6,432	0.417	-$3,750	
R5-21	$33,664	$1,880	-$554	$2,433	$130,899	$7,309	0.333	-$4,876	

TABLE B-18 (CONTINUED)
BERM WIDTH OPTIMIZATION MINIMIN

Model Reach	Damage Reduction MiniMiN	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional Cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits MiniMin	Summed Net Benefits MiniMin
R5-22	$0	$0	-$1,964	$1,964	$0	$0	-	$1,964	
R5-23	$0	$0	-$511	$511	$0	$0	-	$511	
R5-24	$0	$0	-$6,898	$6,898	$0	$0	-	$6,898	
R5-25	$0	$0	-$15,278	$15,278	$0	$0	-	$15,278	
R5-26	$0	$0	-$12,809	$12,809	$0	$0	-	$12,809	
R5-27	$0	$0	-$10,102	$10,102	$0	$0	-	$10,102	
R5-28	$0	$0	-$11,651	$11,651	$0	$0	-	$11,651	
R5-29	$0	$0	-$37,910	$37,910	$0	$0	-	$37,910	
R5-30	$40,984	$2,288	-$32,848	$35,137	$124,760	$6,966	5.044	$28,170	
R5-31	$243,829	$13,615	-$33,879	$47,494	$121,361	$6,777	7.008	$40,717	
R5-32	$1,311,296	$73,220	-$61,892	$135,112	$242,871	$13,561	9.963	$121,551	
R5-33	$504,917	$28,194	-$62,530	$90,724	$250,355	$13,979	6.490	$76,745	
R5-34	$212,729	$11,878	-$53,740	$65,618	$250,146	$13,968	4.698	$51,651	
R5-35	$323,740	$18,077	-$52,782	$70,859	$243,446	$13,594	5.213	$57,266	
R5-36	$1,566,492	$87,470	-$56,472	$143,942	$232,341	$12,973	11.095	$130,969	
R5-37	$221,294	$12,357	-$80,647	$93,004	$252,865	$14,119	6.587	$78,884	
R5-38	$512,353	$28,609	-$94,528	$123,136	$269,422	$15,044	8.185	$108,092	
R5-39	$100,001	$5,584	-$98,750	$104,333	$257,359	$14,370	7.260	$89,963	
R5-40	$4,749	$265	-$49,625	$49,891	$124,057	$6,927	7.202	$42,964	
R5-41	$12,566	$702	-$44,843	$45,544	$125,219	$6,992	6.514	$38,552	
R5-42	$5,003	$279	-$30,127	$30,406	$110,913	$6,193	4.910	$24,213	
R5-43	$7,974	$445	-$18,731	$19,176	$112,675	$6,292	3.048	$12,885	
R5-44	$1,173	$66	-$5,603	$5,668	$112,664	$6,291	0.901	-$623	
R5-45	$37,031	$2,068	$263	$2,068	$107,526	$6,004	0.344	-$3,936	
R5-46	$124,750	$6,966	$7,328	$6,966	$105,737	$5,904	1.180	$1,062	
R5-47	$299,564	$16,727	$982	$16,727	$121,527	$6,786	2.465	$9,941	
R5-48	-$137	-$8	$2,299	-$8	$132,480	$7,397	-0.001	-$7,405	
R5-49	$9,710	$542	-$12,232	$12,774	$167,165	$9,334	1.369	$3,440	
R5-50	$320	$18	-$18,968	$18,985	$208,754	$11,656	1.629	$7,329	
R5-51	$10,808	$603	-$28,941	$29,544	$168,378	$9,402	3.142	$20,142	**$932,571**

TABLE B-19
BERM WIDTH OPTIMIZATION MINIMUM

Model Reach	Damage Reduction Minimum	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional Cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits Minimum	Summed Net Benefits Minimum
R1-1	$ 7,892	$ 441	$ 54,795	$ 441	$ 503,608	$ 28,121	0.016	$ -27,680	
R1-2	$ 3,206	$ 179	$ 49,622	$ 179	$ 480,331	$ 26,821	0.007	$ -26,642	
R1-3	$ 11,050	$ 617	$ 37,527	$ 617	$ 469,071	$ 26,192	0.024	$ -25,575	
R1-4	$ 16,748	$ 935	$ 27,756	$ 935	$ 462,134	$ 25,805	0.036	$ -24,869	
R1-5	$ 4,134	$ 231	$ 22,870	$ 231	$ 505,522	$ 28,227	0.008	$ -27,997	
R1-6	$ 14,179	$ 792	$ 6,771	$ 792	$ 534,501	$ 29,846	0.027	$ -29,054	
R1-7	$ 13,108	$ 732	$ 442	$ 732	$ 531,757	$ 29,692	0.025	$ -28,960	
R1-8	$ 9,206	$ 514	$ 1,159	$ 514	$ 558,676	$ 31,195	0.016	$ -30,681	
R1-9	$ 50,118	$ 2,799	$ 2,015	$ 2,799	$ 526,231	$ 29,384	0.095	$ -26,585	
R1-10	$ 74,855	$ 4,180	$ 6,219	$ 4,180	$ 488,438	$ 27,273	0.153	$ -23,094	
R1-11	$ 1,425,818	$ 79,615	$ 8,692	$ 79,615	$ 513,690	$ 28,683	2.776	$ 50,931	
R1-12	$ 56,079	$ 3,131	$ 3,758	$ 3,131	$ 543,351	$ 30,340	0.103	$ -27,208	
R1-13	$ 2,671,857	$ 149,191	$ -58	$ 149,250	$ 543,541	$ 30,350	4.918	$ 118,899	
R1-14	$ 1,777,549	$ 99,255	$ -7,413	$ 106,668	$ 587,067	$ 32,781	3.254	$ 73,887	
R1-15	$ 3,078,837	$ 171,916	$ -8,068	$ 179,984	$ 713,334	$ 39,831	4.519	$ 140,153	
R1-16	$ 2,036,531	$ 113,716	$ -11,001	$ 124,717	$ 723,284	$ 40,387	3.088	$ 84,330	$ 440,993
R1-17	$ 25,204	$ 1,407	$ -11,198	$ 12,605	$ 779,482	$ 43,525	0.290	$ -30,920	
R1-18	$ 52,547	$ 2,934	$ -12,742	$ 15,676	$ 800,373	$ 44,691	0.351	$ -29,015	
R1-19	$ 89,401	$ 4,992	$ -5,695	$ 10,687	$ 744,199	$ 41,555	0.257	$ -30,868	
R1-20	$ 121,703	$ 6,796	$ 8,438	$ 6,796	$ 662,742	$ 37,006	0.184	$ -30,211	
R1-21	$ -34	$ -2	$ 9,080	$ -2	$ 502,158	$ 28,040	-0.000	$ -28,041	
R1-22	$ 38,887	$ 2,171	$ 21,487	$ 2,171	$ 492,109	$ 27,478	0.079	$ -25,307	
R1-23	$ 2,995	$ 167	$ 36,478	$ 167	$ 506,191	$ 28,265	0.006	$ -28,098	
R1-24	$ 80,930	$ 4,519	$ 41,072	$ 4,519	$ 461,076	$ 25,746	0.176	$ -21,227	
R2-1	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
R2-2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
R2-3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
R2-4	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
R2-5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
R2-6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
R2-7	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
R3-1	$ 150,199	$ 8,387	$ 20,806	$ 8,387	$ 290,733	$ 16,234	0.517	$ -7,847	
R3-2	$ 1,701,715	$ 95,020	$ 19,994	$ 95,020	$ 231,823	$ 12,945	7.341	$ 82,076	
R3-3	$ 152,882	$ 8,537	$ 20,424	$ 8,537	$ 222,029	$ 12,398	0.689	$ -3,861	
R3-4	$ 5,870	$ 328	$ 25,555	$ 328	$ 472,146	$ 26,364	0.012	$ -26,036	
R3-5	$ 48,294	$ 2,697	$ 21,080	$ 2,697	$ 528,293	$ 29,499	0.091	$ -26,802	
R3-6	$ 44,517	$ 2,486	$ 15,383	$ 2,486	$ 573,348	$ 32,015	0.078	$ -29,529	
R3-7	$ 1,065,098	$ 59,473	$ 4,993	$ 59,473	$ 580,324	$ 32,404	1.835	$ 27,069	
R3-8	$ 6,260,926	$ 349,598	$ -14,815	$ 364,413	$ 268,892	$ 15,014	24.271	$ 349,398	
R3-9	$ 454,907	$ 25,401	$ -17,079	$ 42,480	$ 263,438	$ 14,710	2.888	$ 27,770	
R3-10	$ 2,716,745	$ 151,698	$ -21,371	$ 173,069	$ 265,271	$ 14,812	11.684	$ 158,257	
R3-11	$ 647,190	$ 36,138	$ -23,863	$ 60,001	$ 264,251	$ 14,755	4.066	$ 45,246	
R3-12	$ 1,530,959	$ 85,486	$ -37,589	$ 123,075	$ 251,788	$ 14,059	8.754	$ 109,015	
R3-13	$ 131,842	$ 7,362	$ -44,608	$ 51,970	$ 261,368	$ 14,594	3.561	$ 37,375	
R3-14	$ 1,087,125	$ 60,703	$ -77,674	$ 138,377	$ 374,382	$ 20,905	6.619	$ 117,472	

TABLE B-19 (CONTINUED)
BERM WIDTH OPTIMIZATION MINIMUM

Model Reach	Damage Reduction Minimum	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional Cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits Minimum	Summed Net Benefits Minimum
R3-15	$ 7,229	$ 404	$ -67,602	$ 68,006	$ 304,471	$ 17,001	4.000	$ 51,005	
R3-16	$ 17	$ 1	$ -52,660	$ 52,661	$ 217,142	$ 12,125	4.343	$ 40,537	
R3-17	$ 85,986	$ 4,801	$ -83,305	$ 88,107	$ 314,729	$ 17,574	5.014	$ 70,533	
R3-18	$ 235,179	$ 13,132	$ -86,928	$ 100,060	$ 329,401	$ 18,393	5.440	$ 81,666	
R3-19	$ 212,623	$ 11,872	$ -82,277	$ 94,149	$ 314,241	$ 17,547	5.366	$ 76,602	
R3-20	$ 3,461,887	$ 193,305	$ -79,875	$ 273,180	$ 310,874	$ 17,359	15.737	$ 255,821	
R3-21	$ 951,735	$ 53,143	$ -77,993	$ 131,136	$ 309,901	$ 17,304	7.578	$ 113,832	
R3-22	$ 293,381	$ 16,382	$ -67,797	$ 84,179	$ 287,290	$ 16,042	5.248	$ 68,137	
R3-23	$ 204,513	$ 11,420	$ -53,371	$ 64,790	$ 244,743	$ 13,666	4.741	$ 51,124	$1,676,708
R3-24	$ -626	$ -35	$ -45,450	$ 45,415	$ -99,313	$ -5,545	-8.190	$ 50,961	
R3-25	$ -153	$ -9	$ -32,621	$ 32,612	$ -106,985	$ -5,974	-5.459	$ 38,586	
R3-26	$ -	$ -	$ -26,720	$ 26,720	$ -	$ -	-	$ 26,720	
R4-1	$ 106,445	$ 5,944	$ -54,395	$ 60,339	$ 292,684	$ 16,343	3.692	$ 43,996	
R4-2	$ 440,609	$ 24,603	$ -45,920	$ 70,523	$ 295,830	$ 16,519	4.269	$ 54,004	
R4-3	$ -	$ -	$ 3,747	$ -	$ 51,808	$ 2,893	-	$ -2,893	
R4-4	$ -	$ -	$ 7,991	$ -	$ 48,298	$ 2,697	-	$ -2,697	
R4-5	$ 47,026	$ 2,626	$ -21,731	$ 24,357	$ 253,245	$ 14,141	1.722	$ 10,216	
R4-6	$ 4,422	$ 247	$ 6,739	$ 247	$ -8,400	$ -469	-0.526	$ 716	$ 103,342
R4-7	$ -	$ -	$ -8,323	$ 8,323	$ -90,637	$ -5,061	-1.644	$ 13,384	
R4-8	$ -	$ -	$ -87,751	$ 87,751	$ -	$ -	-	$ 87,751	
R4-9	$ -	$ -	$ -153,875	$ 153,875	$ -	$ -	-	$ 153,875	
R5-1	$ 57,546	$ 3,213	$ -100,250	$ 103,463	$ 410,195	$ 22,905	4.517	$ 80,558	
R5-2	$ 18,932	$ 1,057	$ -70,377	$ 71,434	$ 399,628	$ 22,314	3.201	$ 49,119	
R5-3	$ 17,360	$ 969	$ -38,155	$ 39,124	$ 390,896	$ 21,827	1.792	$ 17,298	
R5-4	$ 25,354	$ 1,416	$ -11,323	$ 12,738	$ 472,071	$ 26,360	0.483	$ -13,621	
R5-5	$ 74,997	$ 4,188	$ 11,365	$ 4,188	$ 353,227	$ 19,723	0.212	$ -15,536	
R5-6	$ 2,641,306	$ 147,485	$ -30,953	$ 178,439	$ 495,493	$ 27,667	6.449	$ 150,771	
R5-7	$ 3,653,734	$ 204,017	$ -38,120	$ 242,138	$ 483,558	$ 27,001	8.968	$ 215,137	
R5-8	$ 1,532,336	$ 85,563	$ -27,503	$ 113,065	$ 460,545	$ 25,716	4.397	$ 87,350	
R5-9	$ 25,488	$ 1,423	$ -15,659	$ 17,082	$ 373,027	$ 20,829	0.820	$ -3,747	
R5-10	$ 34,347	$ 1,918	$ -17,915	$ 19,833	$ 371,421	$ 20,739	0.956	$ -906	
R5-11	$ 134,846	$ 7,530	$ -19,644	$ 27,173	$ 378,259	$ 21,121	1.287	$ 6,052	
R5-12	$ 67,648	$ 3,777	$ -18,787	$ 22,564	$ 373,000	$ 20,828	1.083	$ 1,736	
R5-13	$ 87,316	$ 4,876	$ -19,733	$ 24,609	$ 376,788	$ 21,039	1.170	$ 3,570	
R5-14	$ 47,104	$ 2,630	$ -17,799	$ 20,429	$ 369,208	$ 20,616	0.991	$ -187	
R5-15	$ 32,243	$ 1,800	$ -24,219	$ 26,020	$ 379,959	$ 21,216	1.226	$ 4,804	
R5-16	$ 175,148	$ 9,780	$ -24,757	$ 34,537	$ 388,329	$ 21,684	1.593	$ 12,853	
R5-17	$ 18,186	$ 1,015	$ -13,221	$ 14,237	$ 318,052	$ 17,759	0.802	$ -3,523	
R5-18	$ 101,263	$ 5,654	$ -24,149	$ 29,803	$ 375,009	$ 20,940	1.423	$ 8,864	$ 600,593
R5-19	$ 125,484	$ 7,007	$ -2,901	$ 9,908	$ 319,026	$ 17,814	0.556	$ -7,906	
R5-20	$ 50,883	$ 2,841	$ 184	$ 2,841	$ 365,008	$ 20,381	0.139	$ -17,540	
R5-21	$ 42,456	$ 2,371	$ -554	$ 2,924	$ 399,731	$ 22,320	0.131	$ -19,396	
R5-22	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
R5-23	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	

TABLE B-19 (CONTINUED)
BERM WIDTH OPTIMIZATION MINIMUM

Model Reach	Damage Reduction Minimum	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional Cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits Minimum	Summed Net Benefits Minimum
R5-24	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
R5-25	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
R5-26	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
R5-27	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
R5-28	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
R5-29	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	
R5-30	$ 45,922	$ 2,564	$ -32,848	$ 35,413	$ 385,009	$ 21,498	1.647	$ 13,914	
R5-31	$ 209,721	$ 11,710	$ -33,879	$ 45,589	$ 382,832	$ 21,377	2.133	$ 24,212	
R5-32	$ 1,337,460	$ 74,681	$ -61,892	$ 136,573	$ 453,964	$ 25,348	5.388	$ 111,225	
R5-33	$ 493,839	$ 27,575	$ -62,530	$ 90,105	$ 472,323	$ 26,374	3.417	$ 63,732	
R5-34	$ 208,706	$ 11,654	$ -53,740	$ 65,394	$ 475,927	$ 26,575	2.461	$ 38,819	
R5-35	$ 320,502	$ 17,896	$ -52,782	$ 70,678	$ 459,083	$ 25,634	2.757	$ 45,044	
R5-36	$ 1,577,668	$ 88,094	$ -56,472	$ 144,566	$ 435,732	$ 24,330	5.942	$ 120,236	
R5-37	$ 216,881	$ 12,110	$ -80,647	$ 92,758	$ 472,679	$ 26,393	3.514	$ 66,364	
R5-38	$ 503,723	$ 28,127	$ -94,528	$ 122,654	$ 503,394	$ 28,109	4.364	$ 94,546	
R5-39	$ 98,521	$ 5,501	$ -98,750	$ 104,251	$ 473,313	$ 26,429	3.945	$ 77,822	
R5-40	$ 4,536	$ 253	$ -49,625	$ 49,879	$ 392,403	$ 21,911	2.276	$ 27,968	
R5-41	$ 11,686	$ 653	$ -44,843	$ 45,495	$ 385,290	$ 21,514	2.115	$ 23,981	
R5-42	$ 4,836	$ 270	$ -30,127	$ 30,397	$ 381,023	$ 21,276	1.429	$ 9,122	
R5-43	$ 7,069	$ 395	$ -18,731	$ 19,126	$ 362,725	$ 20,254	0.944	$ -1,128	
R5-44	$ -2,515	$ -140	$ -5,603	$ 5,462	$ 353,716	$ 19,751	0.277	$ -14,288	
R5-45	$ 8,139	$ 454	$ 263	$ 454	$ 338,398	$ 18,895	0.024	$ -18,441	
R5-46	$ 126,084	$ 7,040	$ 7,328	$ 7,040	$ 340,711	$ 19,025	0.370	$ -11,984	
R5-47	$ 311,781	$ 17,409	$ 982	$ 17,409	$ 366,202	$ 20,448	0.851	$ -3,039	
R5-48	$ 4,488	$ 251	$ 2,299	$ 251	$ 318,501	$ 17,785	0.014	$ -17,534	
R5-49	$ -5,228	$ -292	$ -12,232	$ 11,940	$ 374,206	$ 20,895	0.571	$ -8,955	
R5-50	$ 3,368	$ 188	$ -18,968	$ 19,156	$ 421,657	$ 23,545	0.814	$ -4,389	
R5-51	$ 11,951	$ 667	$ -28,941	$ 29,608	$ 385,630	$ 21,533	1.375	$ 8,075	$ 645,301

TABLE B-20
SMALL BERM WIDTH ALTERNATIVE

Model Reach	Damage Reduction Small	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional Cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits Small	Summed Net Benefits Small
R1-1	$ 9,176	$ 512	$ 54,795	$ 512	$ 1,015,253	$ 56,690	0.009	$ -56,177	
R1-2	$ 3,314	$ 185	$ 49,622	$ 185	$ 948,708	$ 52,974	0.003	$ -52,789	
R1-3	$ 11,797	$ 659	$ 37,527	$ 659	$ 904,743	$ 50,519	0.013	$ -49,860	
R1-4	$ 17,026	$ 951	$ 27,756	$ 951	$ 880,934	$ 49,190	0.019	$ -48,239	
R1-5	$ 4,287	$ 239	$ 22,870	$ 239	$ 946,723	$ 52,863	0.005	$ -52,624	
R1-6	$ 14,393	$ 804	$ 6,771	$ 804	$ 973,586	$ 54,363	0.015	$ -53,559	
R1-7	$ 13,135	$ 733	$ 442	$ 733	$ 948,920	$ 52,986	0.014	$ -52,252	
R1-8	$ 9,594	$ 536	$ 1,159	$ 536	$ 1,000,692	$ 55,877	0.010	$ -55,341	
R1-9	$ 51,309	$ 2,865	$ 2,015	$ 2,865	$ 952,453	$ 53,183	0.054	$ -50,318	
R1-10	$ 77,136	$ 4,307	$ 6,219	$ 4,307	$ 888,389	$ 49,606	0.087	$ -45,299	
R1-11	$ 1,432,725	$ 80,001	$ 8,692	$ 80,001	$ 938,330	$ 52,395	1.527	$ 27,606	
R1-12	$ 56,458	$ 3,152	$ 3,758	$ 3,152	$ 983,136	$ 54,896	0.057	$ -51,744	
R1-13	$ 2,680,629	$ 149,681	$ -58	$ 149,739	$ 977,628	$ 54,589	2.743	$ 95,151	
R1-14	$ 1,783,427	$ 99,583	$ -7,413	$ 106,996	$ 1,020,682	$ 56,993	1.877	$ 50,003	
R1-15	$ 3,219,894	$ 179,793	$ -8,068	$ 187,861	$ 1,094,204	$ 61,098	3.075	$ 126,762	
R1-16	$ 2,055,151	$ 114,756	$ -11,001	$ 125,756	$ 1,113,819	$ 62,194	2.022	$ 63,563	**$ 311,341**
R1-17	$ 24,693	$ 1,379	$ -11,198	$ 12,577	$ 1,204,398	$ 67,251	0.187	$ -54,675	
R1-18	$ 53,453	$ 2,985	$ -12,742	$ 15,727	$ 1,231,009	$ 68,737	0.229	$ -53,010	
R1-19	$ 91,785	$ 5,125	$ -5,695	$ 10,820	$ 1,146,340	$ 64,009	0.169	$ -53,190	
R1-20	$ 126,344	$ 7,055	$ 8,438	$ 7,055	$ 1,035,242	$ 57,806	0.122	$ -50,751	
R1-21	$ -34	$ -2	$ 9,080	$ -2	$ 904,277	$ 50,493	-0.000	$ -50,495	
R1-22	$ 40,372	$ 2,254	$ 21,487	$ 2,254	$ 925,028	$ 51,652	0.044	$ -49,398	
R1-23	$ 3,013	$ 168	$ 36,478	$ 168	$ 989,278	$ 55,239	0.003	$ -55,071	
R1-24	$ 82,307	$ 4,596	$ 41,072	$ 4,596	$ 879,424	$ 49,105	0.094	$ -44,509	
R2-1	-	-	-	-	-	-	-	-	
R2-2	-	-	-	-	-	-	-	-	
R2-3	-	-	-	-	-	-	-	-	
R2-4	-	-	-	-	-	-	-	-	
R2-5	-	-	-	-	-	-	-	-	
R2-6	-	-	-	-	-	-	-	-	
R2-7	-	-	-	-	-	-	-	-	
R3-1	$ 152,810	$ 8,533	$ 20,806	$ 8,533	$ 701,247	$ 39,156	0.218	$ -30,624	
R3-2	$ 1,755,660	$ 98,033	$ 19,994	$ 98,033	$ 588,113	$ 32,839	2.985	$ 65,194	
R3-3	$ 158,305	$ 8,839	$ 20,424	$ 8,839	$ 580,848	$ 32,433	0.273	$ -23,594	
R3-4	$ 5,926	$ 331	$ 25,555	$ 331	$ 866,059	$ 48,359	0.007	$ -48,028	
R3-5	$ 49,758	$ 2,778	$ 21,080	$ 2,778	$ 956,547	$ 53,412	0.052	$ -50,633	
R3-6	$ 51,714	$ 2,888	$ 15,383	$ 2,888	$ 1,026,222	$ 57,302	0.050	$ -54,415	
R3-7	$ 1,258,860	$ 70,292	$ 4,993	$ 70,292	$ 1,019,942	$ 56,952	1.234	$ 13,341	
R3-8	$ 6,281,693	$ 350,758	$ -14,815	$ 365,572	$ 644,847	$ 36,007	10.153	$ 329,565	
R3-9	$ 468,968	$ 26,186	$ -17,079	$ 43,265	$ 623,166	$ 34,796	1.243	$ 8,469	
R3-10	$ 3,037,964	$ 169,634	$ -21,371	$ 191,006	$ 631,892	$ 35,284	5.413	$ 155,722	
R3-11	$ 688,435	$ 38,441	$ -23,863	$ 62,304	$ 625,019	$ 34,900	1.785	$ 27,404	
R3-12	$ 1,716,647	$ 95,854	$ -37,589	$ 133,443	$ 599,084	$ 33,452	3.989	$ 99,991	
R3-13	$ 135,826	$ 7,584	$ -44,608	$ 52,192	$ 604,537	$ 33,756	1.546	$ 18,436	

TABLE B-20 (CONTINUED)
SMALL BERM WIDTH ALTERNATIVE

Model Reach	Damage Reduction Small	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional Cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits Small	Summed Net Benefits Small
R3-14	$ 1,115,521	$ 62,289	$ -77,674	$ 139,962	$ 826,607	$ 46,156	3.032	$ 93,806	
R3-15	$ 7,229	$ 404	$ -67,602	$ 68,006	$ 661,119	$ 36,916	1.842	$ 31,090	
R3-16	$ 17	$ 1	$ -52,660	$ 52,661	$ 461,502	$ 25,769	2.044	$ 26,892	
R3-17	$ 90,784	$ 5,069	$ -83,305	$ 88,375	$ 658,922	$ 36,793	2.402	$ 51,582	
R3-18	$ 247,257	$ 13,806	$ -86,928	$ 100,734	$ 681,852	$ 38,073	2.646	$ 62,661	
R3-19	$ 215,887	$ 12,055	$ -82,277	$ 94,331	$ 664,039	$ 37,079	2.544	$ 57,253	
R3-20	$ 3,513,631	$ 196,194	$ -79,875	$ 276,069	$ 656,271	$ 36,645	7.534	$ 239,424	
R3-21	$ 995,982	$ 55,614	$ -77,993	$ 133,607	$ 653,170	$ 36,472	3.663	$ 97,135	
R3-22	$ 304,502	$ 17,003	$ -67,797	$ 84,800	$ 614,639	$ 34,320	2.471	$ 50,480	
R3-23	$ 211,931	$ 11,834	$ -53,371	$ 65,204	$ 530,014	$ 29,595	2.203	$ 35,609	**$ 1,287,383**
R3-24	$ -626	$ -35	$ -45,450	$ 45,415	$ -99,376	$ -5,549	-8.184	$ 50,964	
R3-25	$ -153	$ -9	$ -32,621	$ 32,612	$ -107,041	$ -5,977	-5.456	$ 38,589	
R3-26	$ -	$ -	$ -26,720	$ 26,720	$ -	$ -	-	$ 26,720	
R4-1	$ 104,716	$ 5,847	$ -54,395	$ 60,242	$ 693,703	$ 38,735	1.555	$ 21,507	
R4-2	$ 430,906	$ 24,061	$ -45,920	$ 69,981	$ 710,659	$ 39,682	1.764	$ 30,299	
R4-3	$ -	$ -	$ 3,747	$ -	$ 99,491	$ 5,555	-	$ -5,555	
R4-4	$ -	$ -	$ 7,991	$ -	$ 95,704	$ 5,344	-	$ -5,344	
R4-5	$ 46,487	$ 2,596	$ -21,731	$ 24,327	$ 623,914	$ 34,838	0.698	$ -10,511	
R4-6	$ 4,422	$ 247	$ 6,739	$ 247	$ 138,232	$ 7,719	0.032	$ -7,472	**$ 22,924**
R4-7	$ -	$ -	$ -8,323	$ 8,323	$ -90,640	$ -5,061	-1.644	$ 13,384	
R4-8	$ -	$ -	$ -87,751	$ 87,751	$ -	$ -	-	$ 87,751	
R4-9	$ -	$ -	$ -153,875	$ 153,875	$ -	$ -	-	$ 153,875	
R5-1	$ 59,809	$ 3,340	$ -100,250	$ 103,589	$ 787,654	$ 43,981	2.355	$ 59,608	
R5-2	$ 19,219	$ 1,073	$ -70,377	$ 71,450	$ 780,370	$ 43,574	1.640	$ 27,876	
R5-3	$ 17,377	$ 970	$ -38,155	$ 39,125	$ 783,145	$ 43,729	0.895	$ -4,604	
R5-4	$ 25,904	$ 1,446	$ -11,323	$ 12,769	$ 966,043	$ 53,942	0.237	$ -41,173	
R5-5	$ 74,100	$ 4,138	$ 11,365	$ 4,138	$ 727,985	$ 40,649	0.102	$ -36,512	
R5-6	$ 2,631,049	$ 146,913	$ -30,953	$ 177,866	$ 877,129	$ 48,977	3.632	$ 128,889	
R5-7	$ 3,646,101	$ 203,591	$ -38,120	$ 241,712	$ 854,230	$ 47,699	5.067	$ 194,013	
R5-8	$ 1,520,880	$ 84,923	$ -27,503	$ 112,426	$ 814,236	$ 45,465	2.473	$ 66,960	
R5-9	$ 26,646	$ 1,488	$ -15,659	$ 17,147	$ 1,406,397	$ 78,530	0.218	$ -61,383	
R5-10	$ 34,915	$ 1,950	$ -17,915	$ 19,865	$ 755,797	$ 42,202	0.471	$ -22,337	
R5-11	$ 141,856	$ 7,921	$ -19,644	$ 27,565	$ 763,795	$ 42,649	0.646	$ -15,084	
R5-12	$ 72,145	$ 4,028	$ -18,787	$ 22,815	$ 757,088	$ 42,274	0.540	$ -19,459	
R5-13	$ 86,268	$ 4,817	$ -19,733	$ 24,550	$ 757,425	$ 42,293	0.580	$ -17,743	
R5-14	$ 47,336	$ 2,643	$ -17,799	$ 20,442	$ 747,504	$ 41,739	0.490	$ -21,297	
R5-15	$ 32,476	$ 1,813	$ -24,219	$ 26,033	$ 761,324	$ 42,511	0.612	$ -16,478	
R5-16	$ 170,919	$ 9,544	$ -24,757	$ 34,301	$ 778,288	$ 43,458	0.789	$ -9,157	
R5-17	$ 18,900	$ 1,055	$ -13,221	$ 14,277	$ 668,898	$ 37,350	0.382	$ -23,073	
R5-18	$ 102,312	$ 5,713	$ -24,149	$ 29,862	$ 753,492	$ 42,074	0.710	$ -12,212	**$ 176,833**
R5-19	$ 140,173	$ 7,827	$ -2,901	$ 10,728	$ 697,446	$ 38,944	0.275	$ -28,216	
R5-20	$ 51,526	$ 2,877	$ 184	$ 2,877	$ 750,127	$ 41,886	0.069	$ -39,008	
R5-21	$ 43,232	$ 2,414	$ -554	$ 2,968	$ 821,592	$ 45,876	0.065	$ -42,908	
R5-22	-	-	-	-	-	-	-	-	

TABLE B-20 (CONTINUED)
SMALL BERM WIDTH ALTERNATIVE

Model Reach	Damage Reduction Small	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional Cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits Small	Summed Net Benefits Small
R5-23	-	-	-	-	-	-	-	-	
R5-24	-	-	-	-	-	-	-	-	
R5-25	-	-	-	-	-	-	-	-	
R5-26	-	-	-	-	-	-	-	-	
R5-27	-	-	-	-	-	-	-	-	
R5-28	-	-	-	-	-	-	-	-	
R5-29	-	-	-	-	-	-	-	-	
R5-30	$ 46,546	$ 2,599	$ -32,848	$ 35,447	$ 769,230	$ 42,952	0.825	$ -7,505	
R5-31	$ 209,791	$ 11,714	$ -33,879	$ 45,593	$ 764,591	$ 42,693	1.068	$ 2,900	
R5-32	$ 1,315,226	$ 73,440	$ -61,892	$ 135,332	$ 808,247	$ 45,131	2.999	$ 90,201	
R5-33	$ 487,339	$ 27,212	$ -62,530	$ 89,743	$ 841,029	$ 46,961	1.911	$ 42,781	
R5-34	$ 206,178	$ 11,513	$ -53,740	$ 65,252	$ 846,053	$ 47,242	1.381	$ 18,010	
R5-35	$ 317,192	$ 17,711	$ -52,782	$ 70,494	$ 816,666	$ 45,601	1.546	$ 24,892	
R5-36	$ 1,567,713	$ 87,538	$ -56,472	$ 144,010	$ 773,572	$ 43,195	3.334	$ 100,815	
R5-37	$ 214,192	$ 11,960	$ -80,647	$ 92,607	$ 838,153	$ 46,801	1.979	$ 45,807	
R5-38	$ 496,364	$ 27,716	$ -94,528	$ 122,243	$ 895,096	$ 49,980	2.446	$ 72,263	
R5-39	$ 97,773	$ 5,459	$ -98,750	$ 104,209	$ 839,227	$ 46,861	2.224	$ 57,348	
R5-40	$ 4,540	$ 254	$ -49,625	$ 49,879	$ 772,429	$ 43,131	1.156	$ 6,748	
R5-41	$ 11,686	$ 653	$ -44,843	$ 45,495	$ 761,534	$ 42,523	1.070	$ 2,973	
R5-42	$ 4,836	$ 270	$ -30,127	$ 30,397	$ 766,785	$ 42,816	0.710	$ -12,419	
R5-43	$ 7,083	$ 396	$ -18,731	$ 19,127	$ 739,402	$ 41,287	0.463	$ -22,160	
R5-44	$ -2,515	$ -140	$ -5,603	$ 5,462	$ 730,588	$ 40,795	0.134	$ -35,332	
R5-45	$ 8,139	$ 454	$ 263	$ 454	$ 704,259	$ 39,324	0.012	$ -38,870	
R5-46	$ 126,175	$ 7,045	$ 7,328	$ 7,045	$ 709,016	$ 39,590	0.178	$ -32,545	
R5-47	$ 312,126	$ 17,428	$ 982	$ 17,428	$ 755,623	$ 42,193	0.413	$ -24,764	
R5-48	$ 4,488	$ 251	$ 2,299	$ 251	$ 713,208	$ 39,824	0.006	$ -39,574	
R5-49	$ -5,228	$ -292	$ -12,232	$ 11,940	$ 782,716	$ 43,705	0.273	$ -31,765	
R5-50	$ 3,786	$ 211	$ -18,968	$ 19,179	$ 851,822	$ 47,564	0.403	$ -28,385	
R5-51	$ 12,342	$ 689	$ -28,941	$ 29,630	$ 781,092	$ 43,615	0.679	$ -13,985	**$ 177,435**

TABLE B-21
MEDIUM BERM WIDTH ALTERNATIVE

Model Reach	Damage Reduction Medium	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits Medium	Summed Net Benefits Medium
R1-1	$10,309	$576	$54,795	$576	$1,585,115	$88,510	0.007	-$87,934	
R1-2	$3,393	$189	$49,622	$189	$1,470,574	$82,114	0.002	-$81,925	
R1-3	$12,449	$695	$37,527	$695	$1,388,648	$77,539	0.009	-$76,844	
R1-4	$17,231	$962	$27,756	$962	$1,335,347	$74,563	0.013	-$73,601	
R1-5	$4,439	$248	$22,870	$248	$1,427,171	$79,690	0.003	-$79,443	
R1-6	$14,587	$815	$6,771	$815	$1,448,675	$80,891	0.010	-$80,077	
R1-7	$13,135	$733	$442	$733	$1,403,660	$78,378	0.009	-$77,644	
R1-8	$9,778	$546	$1,159	$546	$1,481,528	$82,726	0.007	-$82,180	
R1-9	$52,220	$2,916	$2,015	$2,916	$1,408,126	$78,627	0.037	-$75,711	
R1-10	$79,279	$4,427	$6,219	$4,427	$1,319,661	$73,687	0.060	-$69,261	
R1-11	$1,432,775	$80,003	$8,692	$80,003	$1,397,684	$78,044	1.025	$1,959	
R1-12	$56,614	$3,161	$3,758	$3,161	$1,457,664	$81,393	0.039	-$78,232	
R1-13	$2,691,015	$150,261	-$58	$150,319	$1,443,421	$80,598	1.865	$69,721	
R1-14	$1,783,738	$99,600	-$7,413	$107,014	$1,497,103	$83,595	1.280	$23,418	
R1-15	$3,211,165	$179,305	-$8,068	$187,373	$1,516,990	$84,706	2.212	$102,667	
R1-16	$2,063,909	$115,245	-$11,001	$126,245	$1,551,061	$86,608	1.458	$39,637	**$159,172**
R1-17	$23,555	$1,315	-$11,198	$12,513	$1,677,084	$93,645	0.134	-$81,132	
R1-18	$18,354	$1,025	-$12,742	$13,767	$1,713,788	$95,695	0.144	-$81,927	
R1-19	$92,392	$5,159	-$5,695	$10,854	$1,597,008	$89,174	0.122	-$78,320	
R1-20	$127,491	$7,119	$8,438	$7,119	$1,443,702	$80,614	0.088	-$73,495	
R1-21	-$34	-$2	$9,080	-$2	$1,345,694	$75,141	-0.000	-$75,143	
R1-22	$41,537	$2,319	$21,487	$2,319	$1,397,060	$78,009	0.030	-$75,690	
R1-23	$3,040	$170	$36,478	$170	$1,522,279	$85,001	0.002	-$84,831	
R1-24	$82,344	$4,598	$41,072	$4,598	$1,340,748	$74,865	0.061	-$70,267	
R2-1	-	-	-	-	-	-	-	-	
R2-2	-	-	-	-	-	-	-	-	
R2-3	-	-	-	-	-	-	-	-	
R2-4	-	-	-	-	-	-	-	-	
R2-5	-	-	-	-	-	-	-	-	
R2-6	-	-	-	-	-	-	-	-	
R2-7	-	-	-	-	-	-	-	-	
R3-1	$156,951	$8,764	$20,806	$8,764	$1,177,095	$65,727	0.133	-$56,963	
R3-2	$1,806,978	$100,898	$19,994	$100,898	$1,011,762	$56,495	1.786	$44,403	
R3-3	$162,447	$9,071	$20,424	$9,071	$1,007,524	$56,258	0.161	-$47,187	
R3-4	$5,955	$333	$25,555	$333	$1,304,791	$72,857	0.005	-$72,525	
R3-5	$49,724	$2,776	$21,080	$2,776	$1,432,849	$80,008	0.035	-$77,231	
R3-6	$54,941	$3,068	$15,383	$3,068	$1,528,578	$85,353	0.036	-$82,285	
R3-7	$1,296,393	$72,388	$4,993	$72,388	$1,507,226	$84,161	0.860	-$11,773	
R3-8	$6,289,117	$351,172	-$14,815	$365,987	$1,088,835	$60,798	6.020	$305,188	
R3-9	$479,887	$26,796	-$17,079	$43,875	$1,050,590	$58,663	0.748	-$14,788	
R3-10	$3,328,224	$185,842	-$21,371	$207,213	$1,057,204	$59,032	3.510	$148,181	
R3-11	$721,598	$40,293	-$23,863	$64,156	$1,036,322	$57,866	1.109	$6,289	
R3-12	$1,915,343	$106,949	-$37,589	$144,538	$995,527	$55,588	2.600	$88,950	
R3-13	$137,873	$7,699	-$44,608	$52,306	$998,387	$55,748	0.938	-$3,442	

TABLE B-21 (CONTINUED)
MEDIUM BERM WIDTH ALTERNATIVE

Model Reach	Damage Reduction Medium	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits Medium	Summed Net Benefits Medium
R3-14	$1,126,723	$62,914	-$77,674	$140,588	$1,355,326	$75,679	1.858	$64,909	
R3-15	$7,229	$404	-$67,602	$68,006	$1,075,196	$60,037	1.133	$7,969	
R3-16	$17	$1	-$52,660	$52,661	$743,931	$41,540	1.268	$11,122	
R3-17	$93,353	$5,213	-$83,305	$88,518	$1,050,443	$58,655	1.509	$29,863	
R3-18	$255,578	$14,271	-$86,928	$101,199	$1,078,613	$60,228	1.680	$40,971	
R3-19	$217,733	$12,158	-$82,277	$94,434	$1,060,681	$59,226	1.594	$35,208	
R3-20	$3,515,078	$196,275	-$79,875	$276,150	$1,049,099	$58,580	4.714	$217,570	
R3-21	$1,030,080	$57,518	-$77,993	$135,511	$1,050,589	$58,663	2.310	$76,848	
R3-22	$312,382	$17,443	-$67,797	$85,240	$991,818	$55,381	1.539	$29,859	
R3-23	$217,045	$12,119	-$53,371	$65,490	$861,084	$48,081	1.362	$17,409	**$815,509**
R3-24	-$626	-$35	-$45,450	$45,415	-$99,396	-$5,550	-8.183	$50,965	
R3-25	-$153	-$9	-$32,621	$32,612	-$107,051	-$5,978	(5.456	$38,590	
R3-26	$0	$0	-$26,720	$26,720	$0	$0	-	$26,720	
R4-1	$101,999	$5,695	-$54,395	$60,090	$1,145,680	$63,973	0.939	-$3,882	
R4-2	$418,257	$23,355	-$45,920	$69,275	$1,182,108	$66,007	1.050	$3,268	
R4-3	$0	$0	$3,747	$0	$441,076	$24,629	-	-$24,629	
R4-4	$0	$0	$7,991	$0	$417,647	$23,321	-	-$23,321	
R4-5	$46,548	$2,599	-$21,731	$24,330	$1,041,718	$58,167	0.418	-$33,837	
R4-6	$4,422	$247	$6,739	$247	$630,047	$35,181	0.007	-$34,934	**-$117,334**
R4-7	-	-	-	-	-	-	-	-	
R4-8	-	-	-	-	-	-	-	-	
R4-9	-	-	-	-	-	-	-	-	
R5-1	$59,591	$3,327	-$100,250	$103,577	$1,198,561	$66,925	1.548	$36,652	
R5-2	$19,416	$1,084	-$70,377	$71,461	$1,195,167	$66,736	1.071	$4,725	
R5-3	$17,381	$971	-$38,155	$39,126	$1,209,309	$67,525	0.579	-$28,400	
R5-4	$25,665	$1,433	-$11,323	$12,756	$1,504,034	$83,982	0.152	-$71,227	
R5-5	$74,321	$4,150	$11,365	$4,150	$1,152,305	$64,342	0.064	-$60,193	
R5-6	$2,619,573	$146,272	-$30,953	$177,225	$1,320,684	$73,744	2.403	$103,481	
R5-7	$3,639,343	$203,214	-$38,120	$241,334	$1,286,996	$71,863	3.358	$169,471	
R5-8	$1,512,868	$84,476	-$27,503	$111,978	$1,228,020	$68,570	1.633	$43,408	
R5-9	$25,972	$1,450	-$15,659	$17,109	$1,178,196	$65,788	0.260	-$48,679	
R5-10	$35,536	$1,984	-$17,915	$19,899	$1,161,017	$64,829	0.307	-$44,930	
R5-11	$160,038	$8,936	-$19,644	$28,580	$1,174,535	$65,584	0.436	-$37,004	
R5-12	$73,154	$4,085	-$18,787	$22,871	$1,166,462	$65,133	0.351	-$42,262	
R5-13	$86,268	$4,817	-$19,733	$24,550	$1,166,039	$65,109	0.377	-$40,559	
R5-14	$47,431	$2,648	-$17,799	$20,448	$1,150,395	$64,236	0.318	-$43,788	
R5-15	$32,605	$1,821	-$24,219	$26,040	$1,166,474	$65,134	0.400	-$39,094	
R5-16	$170,973	$9,547	-$24,757	$34,304	$1,192,336	$66,578	0.515	-$32,274	
R5-17	$19,071	$1,065	-$13,221	$14,286	$1,043,715	$58,279	0.245	-$43,993	
R5-18	$102,784	$5,739	-$24,149	$29,888	$1,150,078	$64,218	0.465	-$34,330	**-$208,993**
R5-19	$146,130	$8,160	-$2,901	$11,061	$1,100,401	$61,444	0.180	-$50,383	
R5-20	$52,076	$2,908	$184	$2,908	$1,164,980	$65,050	0.045	-$62,142	
R5-21	$43,783	$2,445	-$554	$2,998	$1,268,615	$70,837	0.042	-$67,839	

TABLE B-21 (CONTINUED)
MEDIUM BERM WIDTH ALTERNATIVE

Model Reach	Damage Reduction Medium	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits Medium	Summed Net Benefits Medium
R5-22	-	-	-	-	-	-	-	-	
R5-23	-	-	-	-	-	-	-	-	
R5-24	-	-	-	-	-	-	-	-	
R5-25	-	-	-	-	-	-	-	-	
R5-26	-	-	-	-	-	-	-	-	
R5-27	-	-	-	-	-	-	-	-	
R5-28	-	-	-	-	-	-	-	-	
R5-29	-	-	-	-	-	-	-	-	
R5-30	$47,012	$2,625	-$32,848	$35,473	$1,173,724	$65,538	0.541	-$30,065	
R5-31	$209,791	$11,714	-$33,879	$45,593	$1,165,878	$65,100	0.700	-$19,507	
R5-32	$1,309,143	$73,100	-$61,892	$134,992	$1,197,146	$66,846	2.019	$68,146	
R5-33	$485,176	$27,091	-$62,530	$89,622	$1,245,693	$69,557	1.288	$20,065	
R5-34	$205,399	$11,469	-$53,740	$65,209	$1,255,449	$70,102	0.930	-$4,893	
R5-35	$315,610	$17,623	-$52,782	$70,405	$1,210,541	$67,594	1.042	$2,811	
R5-36	$1,557,481	$86,967	-$56,472	$143,439	$1,143,984	$63,878	2.246	$79,561	
R5-37	$212,598	$11,871	-$80,647	$92,518	$1,238,610	$69,162	1.338	$23,357	
R5-38	$492,803	$27,517	-$94,528	$122,045	$1,323,893	$73,924	1.651	$48,121	
R5-39	$96,564	$5,392	-$98,750	$104,141	$1,239,818	$69,229	1.504	$34,912	
R5-40	$4,436	$248	-$49,625	$49,873	$1,164,996	$65,051	0.767	-$15,178	
R5-41	$11,110	$620	-$44,843	$45,463	$1,149,689	$64,196	0.708	-$18,733	
R5-42	$4,494	$251	-$30,127	$30,378	$1,158,034	$64,662	0.470	-$34,284	
R5-43	$6,658	$372	-$18,731	$19,103	$1,122,922	$62,702	0.305	-$43,599	
R5-44	-$2,515	-$140	-$5,603	$5,462	$1,112,408	$62,115	0.088	-$56,652	
R5-45	$8,139	$454	$263	$454	$1,072,186	$59,869	0.008	-$59,414	
R5-46	$122,651	$6,849	$7,328	$6,849	$1,089,110	$60,814	0.113	-$53,965	
R5-47	$307,357	$17,162	$982	$17,162	$1,149,106	$64,164	0.267	-$47,002	
R5-48	$4,116	$230	$2,299	$230	$1,112,680	$62,130	0.004	-$61,900	
R5-49	-$5,228	-$292	-$12,232	$11,940	$1,205,108	$67,291	0.177	-$55,351	
R5-50	$3,805	$212	-$18,968	$19,180	$1,291,714	$72,127	0.266	-$52,947	
R5-51	$12,271	$685	-$28,941	$29,626	$1,184,685	$66,151	0.448	-$36,525	**-$313,043**

TABLE B-22
MAXIMUM BERM WIDTH ALTERNATIVE

Model Reach	Damage Reduction Maximum	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional Cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits Maximum	Summed Net Benefits Maximum
R1-1	$10,762	$601	$54,795	$601	$2,134,999	$119,214	0.005	-$118,613	
R1-2	$3,432	$192	$49,622	$192	$1,967,387	$109,855	0.002	-$109,663	
R1-3	$12,629	$705	$37,527	$705	$1,845,597	$103,055	0.007	-$102,349	
R1-4	$17,325	$967	$27,756	$967	$1,774,179	$99,067	0.010	-$98,099	
R1-5	$4,474	$250	$22,870	$250	$1,889,553	$105,509	0.002	-$105,259	
R1-6	$14,700	$821	$6,771	$821	$1,902,621	$106,239	0.008	-$105,418	
R1-7	$13,135	$733	$442	$733	$1,837,455	$102,600	0.007	-$101,867	
R1-8	$9,823	$549	$1,159	$549	$1,939,851	$108,318	0.005	-$107,769	
R1-9	$52,475	$2,930	$2,015	$2,930	$1,842,605	$102,888	0.028	-$99,957	
R1-10	$80,208	$4,479	$6,219	$4,479	$1,727,641	$96,468	0.046	-$91,989	
R1-11	$1,432,785	$80,004	$8,692	$80,004	$1,827,729	$102,057	0.784	-$22,053	
R1-12	$56,670	$3,164	$3,758	$3,164	$1,904,588	$106,349	0.030	-$103,184	
R1-13	$2,691,068	$150,264	-$58	$150,322	$1,883,895	$105,193	1.429	$45,129	
R1-14	$1,783,823	$99,605	-$7,413	$107,018	$1,941,226	$108,394	0.987	-$1,376	
R1-15	$3,218,199	$179,698	-$8,068	$187,766	$1,938,980	$108,269	1.734	$79,497	
R1-16	$2,062,817	$115,184	-$11,001	$126,184	$1,983,231	$110,740	1.139	$15,445	$13,458
R1-17	$23,718	$1,324	-$11,198	$12,522	$2,148,197	$119,951	0.104	-$107,429	
R1-18	-$20,081	-$1,121	-$12,742	$11,621	$2,188,694	$122,212	0.095	-$110,591	
R1-19	$92,307	$5,154	-$5,695	$10,849	$2,042,219	$114,034	0.095	-$103,185	
R1-20	$128,005	$7,148	$8,438	$7,148	$1,853,636	$103,503	0.069	-$96,356	
R1-21	-$34	-$2	$9,080	-$2	$1,754,450	$97,965	-0.000	-$97,967	
R1-22	$41,974	$2,344	$21,487	$2,344	$1,846,677	$103,115	0.023	-$100,771	
R1-23	$3,053	$170	$36,478	$170	$2,026,061	$113,131	0.002	-$112,961	
R1-24	$82,352	$4,598	$41,072	$4,598	$1,781,496	$99,475	0.046	-$94,877	
R2-1	-	-	-	-	-	-	-	-	
R2-2	-	-	-	-	-	-	-	-	
R2-3	-	-	-	-	-	-	-	-	
R2-4	-	-	-	-	-	-	-	-	
R2-5	-	-	-	-	-	-	-	-	
R2-6	-	-	-	-	-	-	-	-	
R2-7	-	-	-	-	-	-	-	-	
R3-1	$157,105	$8,772	$20,806	$8,772	$1,694,786	$94,634	0.093	-$85,861	
R3-2	$1,804,751	$100,774	$19,994	$100,774	$1,451,670	$81,058	1.243	$19,715	
R3-3	$162,114	$9,052	$20,424	$9,052	$1,445,742	$80,727	0.112	-$71,675	
R3-4	$5,962	$333	$25,555	$333	$1,738,807	$97,092	0.003	-$96,759	
R3-5	$49,500	$2,764	$21,080	$2,764	$1,905,124	$106,378	0.026	-$103,614	
R3-6	$55,445	$3,096	$15,383	$3,096	$2,024,200	$113,027	0.027	-$109,932	
R3-7	$1,277,146	$71,313	$4,993	$71,313	$1,994,040	$111,343	0.640	-$40,030	
R3-8	$6,282,344	$350,794	-$14,815	$365,609	$1,542,687	$86,141	4.244	$279,468	
R3-9	$476,518	$26,608	-$17,079	$43,687	$1,482,119	$82,759	0.528	-$39,072	
R3-10	$3,298,864	$184,202	-$21,371	$205,574	$1,496,756	$83,576	2.460	$121,998	
R3-11	$712,559	$39,788	-$23,863	$63,651	$1,467,622	$81,949	0.777	-$18,298	
R3-12	$1,881,447	$105,056	-$37,589	$142,645	$1,414,410	$78,978	1.806	$63,667	
R3-13	$136,627	$7,629	-$44,608	$52,237	$1,414,466	$78,981	0.661	-$26,744	

TABLE B-22 (CONTINUED)
MAXIMUM BERM WIDTH ALTERNATIVE

Model Reach	Damage Reduction Maximum	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional Cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits Maximum	Summed Net Benefits Maximum
R3-14	$1,123,117	$62,713	-$77,674	$140,386	$1,912,906	$106,813	1.314	$33,574	
R3-15	$7,229	$404	-$67,602	$68,006	$1,515,538	$84,625	0.804	-$16,619	
R3-16	$17	$1	-$52,660	$52,661	$1,047,787	$58,506	0.900	-$5,845	
R3-17	$92,551	$5,168	-$83,305	$88,473	$1,465,190	$81,813	1.081	$6,660	
R3-18	$254,696	$14,222	-$86,928	$101,149	$1,504,550	$84,011	1.204	$17,138	
R3-19	$217,430	$12,141	-$82,277	$94,417	$1,484,583	$82,896	1.139	$11,521	
R3-20	$3,511,646	$196,084	-$79,875	$275,958	$1,468,553	$82,001	3.365	$193,957	
R3-21	$1,031,007	$57,569	-$77,993	$135,562	$1,466,275	$81,874	1.656	$53,688	
R3-22	$312,466	$17,447	-$67,797	$85,245	$1,385,542	$77,366	1.102	$7,879	
R3-23	$216,781	$12,105	-$53,371	$65,475	$1,205,636	$67,320	0.973	-$1,845	**$26**
R3-24	-$626	-$35	-$45,450	$45,415	-$99,388	-$5,550	-8.183	$50,965	
R3-25	-$153	-$9	-$32,621	$32,612	-$107,028	-$5,976	-5.457	$38,588	
R3-26	$0	$0	-$26,720	$26,720	$0	$0	-	$26,720	
R4-1	$101,728	$5,680	-$54,395	$60,075	$1,118,155	$62,436	0.962	-$2,360	
R4-2	$418,852	$23,388	-$45,920	$69,308	$1,153,386	$64,403	1.076	$4,905	
R4-3	$0	$0	$3,747	$0	$433,890	$24,228	-	-$24,228	
R4-4	$0	$0	$7,991	$0	$409,776	$22,881	-	-$22,881	
R4-5	$46,432	$2,593	-$21,731	$24,324	$1,013,088	$56,569	0.430	-$32,245	
R4-6	$4,422	$247	$6,739	$247		$0	-	$247	**-$76,562**
R4-7	$0	$0	-$8,323	$8,323		$0	-	$8,323	
R4-8	$0	$0	-$87,751	$87,751	$0	$0	-	$87,751	
R4-9	$0	$0	-$153,875	$153,875	$0	$0	-	$153,875	
R5-1	$59,698	$3,333	-$100,250	$103,583	$1,588,869	$88,719	1.168	$14,864	
R5-2	$19,564	$1,092	-$70,377	$71,469	$1,587,894	$88,665	0.806	-$17,196	
R5-3	$17,388	$971	-$38,155	$39,126	$1,619,658	$90,439	0.433	-$51,313	
R5-4	$25,685	$1,434	-$11,323	$12,757	$2,015,645	$112,550	0.113	-$99,793	
R5-5	$74,599	$4,165	$11,365	$4,165	$1,547,617	$86,416	0.048	-$82,250	
R5-6	$2,619,442	$146,265	-$30,953	$177,218	$1,738,919	$97,098	1.825	$80,120	
R5-7	$3,639,359	$203,215	-$38,120	$241,335	$1,695,245	$94,659	2.550	$146,676	
R5-8	$1,509,989	$84,315	-$27,503	$111,818	$1,617,198	$90,301	1.238	$21,516	
R5-9	$26,021	$1,453	-$15,659	$17,112	$1,576,822	$88,047	0.194	-$70,934	
R5-10	$35,994	$2,010	-$17,915	$19,925	$1,553,803	$86,761	0.230	-$66,836	
R5-11	$170,531	$9,522	-$19,644	$29,166	$1,570,939	$87,718	0.332	-$58,552	
R5-12	$73,446	$4,101	-$18,787	$22,888	$1,561,285	$87,179	0.263	-$64,291	
R5-13	$85,424	$4,770	-$19,733	$24,503	$1,559,447	$87,076	0.281	-$62,573	
R5-14	$46,453	$2,594	-$17,799	$20,393	$1,539,123	$85,942	0.237	-$65,549	
R5-15	$31,611	$1,765	-$24,219	$25,984	$1,555,814	$86,874	0.299	-$60,889	
R5-16	$170,952	$9,546	-$24,757	$34,303	$1,588,672	$88,708	0.387	-$54,406	
R5-17	$18,616	$1,039	-$13,221	$14,261	$1,403,496	$78,369	0.182	-$64,108	
R5-18	$101,654	$5,676	-$24,149	$29,825	$1,532,922	$85,595	0.348	-$55,770	**-$611,285**
R5-19	$145,101	$8,102	-$2,901	$11,003	$1,484,754	$82,906	0.133	-$71,902	
R5-20	$50,274	$2,807	$184	$2,807	$1,553,799	$86,761	0.032	-$83,954	
R5-21	$42,671	$2,383	-$554	$2,936	$1,692,035	$94,480	0.031	-$91,544	

TABLE B-22 (CONTINUED)
MAXIMUM BERM WIDTH ALTERNATIVE

Model Reach	Damage Reduction Maximum	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Benefits	Additional Cost	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits Maximum	Summed Net Benefits Maximum
R5-22	-	-	-	-	-	-	-	-	
R5-23	-	-	-	-	-	-	-	-	
R5-24	-	-	-	-	-	-	-	-	
R5-25	-	-	-	-	-	-	-	-	
R5-26	-	-	-	-	-	-	-	-	
R5-27	-	-	-	-	-	-	-	-	
R5-28	-	-	-	-	-	-	-	-	
R5-29	-	-	-	-	-	-	-	-	
R5-30	$45,897	$2,563	-$32,848	$35,411	$1,560,078	$87,112	0.407	-$51,701	
R5-31	$208,754	$11,656	-$33,879	$45,535	$1,548,130	$86,445	0.527	-$40,910	
R5-32	$1,284,362	$71,716	-$61,892	$133,608	$1,575,770	$87,988	1.518	$45,620	
R5-33	$476,279	$26,595	-$62,530	$89,125	$1,637,718	$91,447	0.975	-$2,322	
R5-34	$200,403	$11,190	-$53,740	$64,930	$1,650,238	$92,146	0.705	-$27,216	
R5-35	$309,448	$17,279	-$52,782	$70,061	$1,591,104	$88,844	0.789	-$18,783	
R5-36	$1,525,065	$85,157	-$56,472	$141,629	$1,502,376	$83,890	1.688	$57,739	
R5-37	$209,650	$11,706	-$80,647	$92,354	$1,622,994	$90,625	1.019	$1,729	
R5-38	$484,937	$27,078	-$94,528	$121,605	$1,737,112	$96,997	1.254	$24,608	
R5-39	$95,068	$5,308	-$98,750	$104,058	$1,625,177	$90,747	1.147	$13,311	
R5-40	$4,381	$245	-$49,625	$49,870	$1,535,101	$85,717	0.582	-$35,847	
R5-41	$11,110	$620	-$44,843	$45,463	$1,517,212	$84,718	0.537	-$39,255	
R5-42	$4,494	$251	-$30,127	$30,378	$1,538,287	$85,895	0.354	-$55,517	
R5-43	$6,658	$372	-$18,731	$19,103	$1,492,780	$83,354	0.229	-$64,251	
R5-44	-$2,515	-$140	-$5,603	$5,462	$1,480,759	$82,683	0.066	-$77,220	
R5-45	$8,139	$454	$263	$454	$1,431,074	$79,908	0.006	-$79,454	
R5-46	$120,290	$6,717	$7,328	$6,717	$1,454,580	$81,221	0.083	-$74,504	
R5-47	$302,612	$16,897	$982	$16,897	$1,531,887	$85,538	0.198	-$68,640	
R5-48	$4,116	$230	$2,299	$230	$1,495,274	$83,493	0.003	-$83,263	
R5-49	-$5,228	-$292	-$12,232	$11,940	$1,607,225	$89,744	0.133	-$77,804	
R5-50	$4,010	$224	-$18,968	$19,191	$1,717,824	$95,920	0.200	-$76,728	
R5-51	$12,352	$690	-$28,941	$29,630	$1,571,982	$87,776	0.338	-$58,146	**-$788,554**

TABLE B-23
SUMMARIZED BERM WIDTH OPTIMIZATION

Model Reach	Profile	Net Benefits Zero Berm option	Net Benefits MiniMin option	Net Benefits Minimum option	Net Benefits Small Alternative	Net Benefits Medium Alternative	Net Benefits Maximum Alternative	Maximum Net Benefit Alternative
R1-1	R1P1	-$2,709.00	-$15,240.00	-$27,680.00	-$56,177.00	-$87,934.00	-$118,613.00	Zero
R1-2	R1P1	-$16,934.00	-$14,302.00	-$26,642.00	-$52,789.00	-$81,925.00	-$109,663.00	MiniMin
R1-3	R1P1	-$15,912.00	-$14,297.00	-$25,575.00	-$49,860.00	-$76,844.00	-$102,349.00	MiniMin
R1-4	R1P1	-$17,169.00	-$13,768.00	-$24,869.00	-$48,239.00	-$73,601.00	-$98,099.00	MiniMin
R1-5	R1P1	-$17,194.00	-$15,986.00	-$27,997.00	-$52,624.00	-$79,443.00	-$105,259.00	MiniMin
R1-6	R1P1	-$21,279.00	-$17,162.00	-$29,054.00	-$53,559.00	-$80,077.00	-$105,418.00	MiniMin
R1-7	R1P1	-$19,348.00	-$17,165.00	-$28,960.00	-$52,252.00	-$77,644.00	-$101,867.00	MiniMin
R1-8	R1P1	-$20,005.00	-$18,453.00	-$30,681.00	-$55,341.00	-$82,180.00	-$107,769.00	MiniMin
R1-9	R1P1	-$17,745.00	-$15,218.00	-$26,585.00	-$50,318.00	-$75,711.00	-$99,957.00	MiniMin
R1-10	R1P1	-$15,637.00	-$12,324.00	-$23,094.00	-$45,299.00	-$69,261.00	-$91,989.00	MiniMin
R1-11	R1P1	$19,424.00	$50,455.00	$50,931.00	$27,606.00	$1,959.00	-$22,053.00	Minimum
R1-12	R1P1	-$39,371.00	-$15,317.00	-$27,208.00	-$51,744.00	-$78,232.00	-$103,184.00	MiniMin
R1-13	R1P1	$152,009.00	$128,881.00	$118,899.00	$95,151.00	$69,721.00	$45,129.00	Zero
R1-14	R1P1	$71,384.00	$81,624.00	$73,887.00	$50,003.00	$23,418.00	-$1,376.00	MiniMin
R1-15	R1P2	$81,418.00	$103,975.00	$140,153.00	$126,762.00	$102,667.00	$79,497.00	Minimum
R1-16	R1P2	$151,060.00	$64,898.00	$84,330.00	$63,563.00	$39,637.00	$15,445.00	Zero
R1-17	R1P2	$609.00	-$12,613.00	-$30,920.00	-$54,675.00	-$81,132.00	-$107,429.00	Zero
R1-18	R1P2	$2,312.00	-$10,814.00	-$29,015.00	-$53,010.00	-$81,927.00	-$110,591.00	Zero
R1-19	R1P2	-$7,709.00	-$14,436.00	-$30,868.00	-$53,190.00	-$78,320.00	-$103,185.00	Zero
R1-20	R1P2	-$10,596.00	-$16,502.00	-$30,211.00	-$50,751.00	-$73,495.00	-$96,356.00	Zero
R1-21	R1P1	-$18,282.00	-$16,621.00	-$28,041.00	-$50,495.00	-$75,143.00	-$97,967.00	MiniMin
R1-22	R1P1	-$18,763.00	-$14,011.00	-$25,307.00	-$49,398.00	-$75,690.00	-$100,771.00	MiniMin
R1-23	R1P1	-$17,628.00	-$15,976.00	-$28,098.00	-$55,071.00	-$84,831.00	-$112,961.00	MiniMin
R1-24	R1P1	-$14,983.00	-$10,081.00	-$21,227.00	-$44,509.00	-$70,267.00	-$94,877.00	MiniMin
R2-1	R2P1			-	-	-	-	
R2-2	R2P1			-	-	-	-	
R2-3	R2P2			-	-	-	-	
R2-4	R2P1			-	-	-	-	
R2-5	R2P2			-	-	-	-	
R2-6	R2P1			-	-	-	-	
R2-7	R2P1			-	-	-	-	
R3-1	R3P1	-$18,443.00	-$1,683.00	-$7,847.00	-$30,624.00	-$56,963.00	-$85,861.00	MiniMin
R3-2	R3P1	$95,293.00	$80,689.00	$82,076.00	$65,194.00	$44,403.00	$19,715.00	Zero
R3-3	R3P1	-$12,988.00	$1,373.00	-$3,861.00	-$23,594.00	-$47,187.00	-$71,675.00	MiniMin
R3-4	R3P2	-$5,533.00	-$12,507.00	-$26,036.00	-$48,028.00	-$72,525.00	-$96,759.00	Zero
R3-5	R3P2	-$7,370.00	-$12,467.00	-$26,802.00	-$50,633.00	-$77,231.00	-$103,614.00	Zero
R3-6	R3P2	-$8,089.00	-$15,085.00	-$29,529.00	-$54,415.00	-$82,285.00	-$109,932.00	Zero
R3-7	R3P2	-$5,812.00	$14,967.00	$27,069.00	$13,341.00	-$11,773.00	-$40,030.00	Minimum
R3-8	R3P1	-$47,219.00	$348,140.00	$349,398.00	$329,565.00	$305,188.00	$279,468.00	Minimum
R3-9	R3P1	-$13,570.00	$33,511.00	$27,770.00	$8,469.00	-$14,788.00	-$39,072.00	MiniMin
R3-10	R3P1	$99,782.00	$142,453.00	$158,257.00	$155,722.00	$148,181.00	$121,998.00	Minimum

TABLE B-23 (CONTINUED)
SUMMARIZED BERM WIDTH OPTIMIZATION

Model Reach	Profile	Net Benefits Zero Berm option	Net Benefits MiniMin option	Net Benefits Minimum option	Net Benefits Small Alternative	Net Benefits Medium Alternative	Net Benefits Maximum Alternative	Maximum Net Benefit Alternative
R3-11	R3P1	$22,815.00	$48,406.00	$45,246.00	$27,404.00	$6,289.00	-$18,298.00	MiniMin
R3-12	R3P1	$75,233.00	$100,757.00	$109,015.00	$99,991.00	$88,950.00	$63,667.00	Minimum
R3-13	R3P1	$23,458.00	$43,174.00	$37,375.00	$18,436.00	-$3,442.00	-$26,744.00	MiniMin
R3-14	R3P1	$104,314.00	$120,721.00	$117,472.00	$93,806.00	$64,909.00	$33,574.00	MiniMin
R3-15	R3P1	$33,444.00	$57,715.00	$51,005.00	$31,090.00	$7,969.00	-$16,619.00	MiniMin
R3-16	R3P1	$27,839.00	$45,257.00	$40,537.00	$26,892.00	$11,122.00	-$5,845.00	MiniMin
R3-17	R3P1	$50,262.00	$76,524.00	$70,533.00	$51,582.00	$29,863.00	$6,660.00	MiniMin
R3-18	R3P1	$59,761.00	$87,013.00	$81,666.00	$62,661.00	$40,971.00	$17,138.00	MiniMin
R3-19	R3P1	$57,740.00	$82,904.00	$76,602.00	$57,253.00	$35,208.00	$11,521.00	MiniMin
R3-20	R3P1	$248,914.00	$254,718.00	$255,821.00	$239,424.00	$217,570.00	$193,957.00	Minimum
R3-21	R3P1	$62,984.00	$116,265.00	$113,832.00	$97,135.00	$76,848.00	$53,688.00	MiniMin
R3-22	R3P1	$11,354.00	$72,861.00	$68,137.00	$50,480.00	$29,859.00	$7,879.00	MiniMin
R3-23	R3P1	$32,201.00	$55,454.00	$51,124.00	$35,609.00	$17,409.00	-$1,845.00	MiniMin
R3-24	R3P2	-	-	-	-	-	-	
R3-25	R3P2	-	-	-	-	-	-	
R3-26	R4P1	-	-	-	-	-	-	
R4-1	R4P1	$52,965.00	$61,753.00	$43,996.00	$21,507.00	-$3,882.00	-$2,360.00	MiniMin
R4-2	R4P1	$36,942.00	$72,179.00	$54,004.00	$30,299.00	$3,268.00	$4,905.00	MiniMin
R4-3	R4P2	-$7,343.00	-$2,084.00	-$2,893.00	-$5,555.00	-$24,629.00	-$24,228.00	MiniMin
R4-4	R4P2	-$3,545.00	-$1,998.00	-$2,697.00	-$5,344.00	-$23,321.00	-$22,881.00	MiniMin
R4-5	R4P1	$19,297.00	$27,336.00	$10,216.00	-$10,511.00	-$33,837.00	-$32,245.00	MiniMin
R4-6	R4P2	-$405.00	$9,170.00	$716.00	-$7,472.00	-$34,934.00	$247.00	MiniMin
R4-7	R4P2	-	-	-	-	-	-	
R4-8	R4P1	-	-	-	-	-	-	
R4-9	R4P1	-	-	-	-	-	-	
R5-1	R5P2	$67,048.00	$94,731.00	$80,558.00	$59,608.00	$36,652.00	$14,864.00	MiniMin
R5-2	R5P2	$46,228.00	$64,042.00	$49,119.00	$27,876.00	$4,725.00	-$17,196.00	MiniMin
R5-3	R5P2	$25,179.00	$34,001.00	$17,298.00	-$4,604.00	-$28,400.00	-$51,313.00	MiniMin
R5-4	R5P2	$3,775.00	$4,464.00	-$13,621.00	-$41,173.00	-$71,227.00	-$99,793.00	MiniMin
R5-5	R5P2	-$1,148.00	-$1,789.00	-$15,536.00	-$36,512.00	-$60,193.00	-$82,250.00	Zero
R5-6	R5P1	$140,884.00	$167,014.00	$150,771.00	$128,889.00	$103,481.00	$80,120.00	MiniMin
R5-7	R5P1	$203,095.00	$233,213.00	$215,137.00	$194,013.00	$169,471.00	$146,676.00	MiniMin
R5-8	R5P1	$80,204.00	$101,961.00	$87,350.00	$66,960.00	$43,408.00	$21,516.00	MiniMin
R5-9	R5P2	$8,888.00	$10,928.00	-$3,747.00	-$61,383.00	-$48,679.00	-$70,934.00	MiniMin
R5-10	R5P2	$12,539.00	$13,417.00	-$906.00	-$22,337.00	-$44,930.00	-$66,836.00	MiniMin
R5-11	R5P2	$20,080.00	$21,978.00	$6,052.00	-$15,084.00	-$37,004.00	-$58,552.00	MiniMin
R5-12	R5P2	$14,932.00	$15,667.00	$1,736.00	-$19,459.00	-$42,262.00	-$64,291.00	MiniMin
R5-13	R5P2	$16,030.00	$19,037.00	$3,570.00	-$17,743.00	-$40,559.00	-$62,573.00	MiniMin
R5-14	R5P2	$11,857.00	$14,086.00	-$187.00	-$21,297.00	-$43,788.00	-$65,549.00	MiniMin
R5-15	R5P2	$17,797.00	$19,497.00	$4,804.00	-$16,478.00	-$39,094.00	-$60,889.00	MiniMin
R5-16	R5P2	$25,512.00	$27,013.00	$12,853.00	-$9,157.00	-$32,274.00	-$54,406.00	MiniMin
R5-17	R5P3	$3,482.00	$6,891.00	-$3,523.00	-$23,073.00	-$43,993.00	-$64,108.00	MiniMin

TABLE B-23 (CONTINUED)
SUMMARIZED BERM WIDTH OPTIMIZATION

Model Reach	Profile	Net Benefits Zero Berm option	Net Benefits MiniMin option	Net Benefits Minimum option	Net Benefits Small Alternative	Net Benefits Medium Alternative	Net Benefits Maximum Alternative	Maximum Net Benefit Alternative
R5-18	R5P2	$14,360.00	$22,615.00	$8,864.00	-$12,212.00	-$34,330.00	-$55,770.00	MiniMin
R5-19	R5P3	-$11,537.00	-$438.00	-$7,906.00	-$28,216.00	-$50,383.00	-$71,902.00	MiniMin
R5-20	R5P2	-$26,183.00	-$3,750.00	-$17,540.00	-$39,008.00	-$62,142.00	-$83,954.00	MiniMin
R5-21	R5P2	-$1,054.00	-$4,876.00	-$19,396.00	-$42,908.00	-$67,839.00	-$91,544.00	Zero
R5-22	R5P3	$1,964.00	$1,964.00	$1,964.00	$1,964.00	$1,964.00	$1,964.00	Zero
R5-23	R5P3	$511.00	$511.00	$511.00	$511.00	$511.00	$511.00	Minimum
R5-24	R5P2	$6,898.00	$6,898.00	$6,898.00	$6,898.00	$6,898.00	$6,898.00	Zero
R5-25	R5P2	$15,278.00	$15,278.00	$15,278.00	$15,278.00	$15,278.00	$15,278.00	Zero
R5-26	R5P1	$12,809.00	$12,809.00	$12,809.00	$12,809.00	$12,809.00	$12,809.00	Minimum
R5-27	R5P3	$10,102.00	$10,102.00	$10,102.00	$10,102.00	$10,102.00	$10,102.00	Minimum
R5-28	R5P3	$11,651.00	$11,651.00	$11,651.00	$11,651.00	$11,651.00	$11,651.00	Zero
R5-29	R5P2	$37,910.00	$37,910.00	$37,910.00	$37,910.00	$37,910.00	$37,910.00	Zero
R5-30	R5P2	$2,220.00	$28,170.00	$13,914.00	-$7,505.00	-$30,065.00	-$51,701.00	MiniMin
R5-31	R5P2	$19,644.00	$40,717.00	$24,212.00	$2,900.00	-$19,507.00	-$40,910.00	MiniMin
R5-32	R5P1	$76,091.00	$121,551.00	$111,225.00	$90,201.00	$68,146.00	$45,620.00	MiniMin
R5-33	R5P1	$42,299.00	$76,745.00	$63,732.00	$42,781.00	$20,065.00	-$2,322.00	MiniMin
R5-34	R5P1	$23,477.00	$51,651.00	$38,819.00	$18,010.00	-$4,893.00	-$27,216.00	MiniMin
R5-35	R5P1	$31,314.00	$57,266.00	$45,044.00	$24,892.00	$2,811.00	-$18,783.00	MiniMin
R5-36	R5P1	$100,329.00	$130,969.00	$120,236.00	$100,815.00	$79,561.00	$57,739.00	MiniMin
R5-37	R5P1	$52,451.00	$78,884.00	$66,364.00	$45,807.00	$23,357.00	$1,729.00	MiniMin
R5-38	R5P1	$74,380.00	$108,092.00	$94,546.00	$72,263.00	$48,121.00	$24,608.00	MiniMin
R5-39	R5P1	$65,022.00	$89,963.00	$77,822.00	$57,348.00	$34,912.00	$13,311.00	MiniMin
R5-40	R5P2	$43,326.00	$42,964.00	$27,968.00	$6,748.00	-$15,178.00	-$35,847.00	Zero
R5-41	R5P2	$38,831.00	$38,552.00	$23,981.00	$2,973.00	-$18,733.00	-$39,255.00	Zero
R5-42	R5P2	$23,385.00	$24,213.00	$9,122.00	-$12,419.00	-$34,284.00	-$55,517.00	MiniMin
R5-43	R5P2	$13,586.00	$12,885.00	-$1,128.00	-$22,160.00	-$43,599.00	-$64,251.00	Zero
R5-44	R5P2	$101.00	-$623.00	-$14,288.00	-$35,332.00	-$56,652.00	-$77,220.00	Zero
R5-45	R5P2	-$5,649.00	-$3,936.00	-$18,441.00	-$38,870.00	-$59,414.00	-$79,454.00	MiniMin
R5-46	R5P2	$1,803.00	$1,062.00	-$11,984.00	-$32,545.00	-$53,965.00	-$74,504.00	Zero
R5-47	R5P2	$10,336.00	$9,941.00	-$3,039.00	-$24,764.00	-$47,002.00	-$68,640.00	Zero
R5-48	R5P3	-$8,718.00	-$7,405.00	-$17,534.00	-$39,574.00	-$61,900.00	-$83,263.00	MiniMin
R5-49	R5P3	-$1,824.00	$3,440.00	-$8,955.00	-$31,765.00	-$55,351.00	-$77,804.00	MiniMin
R5-50	R5P3	-$4,228.00	$7,329.00	-$4,389.00	-$28,385.00	-$52,947.00	-$76,728.00	MiniMin
R5-51	R5P3	$21,879.00	$20,142.00	$8,075.00	-$13,985.00	-$36,525.00	-$58,146.00	Zero

TABLE B-24
WALTON COUNTY CONSTRUCTION REACHES

Construction Reach	Beginning Model Reach	Ending Model Reach
1	R1-11	R1-16
2	R3-2	R3-23
3	R4-1	R4-6
4	R5-1	R5-18
5	R5-30	R5-51

TABLE B-25
MINIMIN AND MINIMUM DESIGN ALTERNATIVES

Representative Profile	ZERO	MiniMin	Minimum	Small	Medium	Maximum
R1P1	0	10	25	50	75	100
R1P2	0	25	50	75	100	125
R2P1	0	25	50	75	100	125
R2P2	0	25	50	75	100	125
R3P1	0	25	50	75	100	125
R3P2	0	25	50	75	100	125
R4P1	0	25	50	75	100	125
R4P2	0	25	50	75	100	125
R5P1	0	25	50	75	100	125
R5P2	0	25	50	75	100	125
R5P3	0	25	50	75	100	125

8.4 THE OPTIMIZED BERM WIDTH ALTERNATIVE

A comparison of the net benefits, Table B-26, between the MiniMin and the Minimum Alternative reveals that in construction reach 1 the Minimum alternative maximizes net benefits and the MiniMin alternative maximizes net benefits in Construction reaches 2, 3, 4 and 5. Construction reach 1 is composed of profiles R1P1 and R1P2. R1P1 in the Minimum alternative has a berm width of 25 feet whereas profile R1P1 in the MiniMin alternative has a berm width of 10 feet.

TABLE B-26
WALTON COUNTY CONSTRUCTION REACHES BERM WIDTH OPTIMIZATION

Construction Reach	Beginning Model Reach	Ending Model Reach	Net Benefits Zero Berm	Net Benefits MiniMin Berm	Net Benefits Minimum Berm	Net Benefits Small Berm	Net Benefits Medium Berm	Net Benefits Maximum Berm
1	R1-11	R1-16	$435,924	$414516	$440,993	$311,341	$159,172	$13,458
2	R3-2	R3-23	$904,813	$1,742,843	$1,676,708	$1,287,383	$815,509	$26
3	R4-1	R4-6	$97,911	$166,356	$103,342	$22,924	-$117,384	-$76,562
4	R5-1	R5-18	$710,743	$868,767	$600,593	$176,833	-$208,993	-$611,285
5	R5-30	R5-51	$636,087	$932,571	$645,701	$177,435	-$313,043	-$788,554
Total NED			**$2,785,478**	**$4,125,053**	**$3,467,337**	**$1,975,916**	**$335,261**	**-$1,462,917**

Table B-27 shows the Optimized Berm Width Alternative is the minimum beach fill in construction reach one and the MiniMin beachfill in construction reaches 2 through 5. The optimized berm width alternative then is one with berm widths of 25 feet in all construction reaches as illustrated in the next table.

TABLE B-27
OPTIMIZED BERM WIDTH ALTERNATIVE

Representative Profile	Zero Berm Width	MiniMin Berm Width	Minimum Berm Width	Optimized Berm Width
R1P1	0	10	25	25
R1P2	0	25	50	25
R2P1	0	25	50	25
R2P2	0	25	50	25
R3P1	0	25	50	25
R3P2	0	25	50	25
R4P1	0	25	50	25
R4P2	0	25	50	25
R5P1	0	25	50	25
R5P2	0	25	50	25
R5P3	0	25	50	25

8.5 PHASE TWO OPTIMIZED DUNE WIDTH FORMULATION

A second round of alternatives was formulated to optimize on added dune width.

8.5.1 Optimized Dune Width Alternatives

Added dune width alternatives of 0, 10, 20, 30 and 40 feet were run with the optimized berm width alternative of 25 feet (Optimized berm template of 50 feet, 25 berm width plus 25 feet of advanced nourishment).

Table B-28 lays out the four dune width optimization alternatives.

8.5.2 Results of Dune Width Optimization

The results of the dune width optimization runs are presented in Table B-29. The maximized net benefit by model reach column identifies the added dune width alternative for each reach.

8.6 DUNE WIDTH OPTIMIZATION BY MODEL REACH

The best alternative plan based solely on an economic criterion is based on net excess benefits defines. The suggested NED Plan would be the maximized net benefits dune and berm width optimization. The optimization by model reach NED Plan describes an alternative with jagged added dune widths.

On the other hand the project must also be constructible, publicly acceptable and environmentally sustainable. Coastal engineering and constructability issues would point to a uniform smoothed and connected robust beach fill.

An additional beach fill question that arose while evaluating the results of the dune width optimization results was what would be the smallest segment of beach fill that could be constructed and yet perform adequately. Coastal engineering experience suggests that a beach fills as small as 2,000 feet would perform very poorly due to their small size.

If material is placed irregularly alongshore, i.e. gaps along the placement, then the near shore contours will be altered by the presence of the fill. Wave refraction over irregular contours will tend to cause a systematic pattern of convergence and divergence of breaking waves. Different wave heights and directions along the beach will produce areas of varying erosion and accretion. If the material is not placed over a sufficient length of beach, the material will diffuse or spread laterally to the adjacent areas and the project will perform poorly. The longer the original fill distance, the longer the material will remain in the original fill area.

Using both engineering and sound coastal engineering principles and previous experience a constructible NED Plan was formulated. That plan modified the economic NED Plan in the following attributes.

TABLE B-28
DUNE WIDTH OPTIMIZATION TEMPLATE

Sub-Reach	Model Reach	Profile	Optimized Berm Template	+00 Feet Added Dune Width	Optimized Berm Template	+10 Feet Added Dune Width	Optimized Berm Template	+20 Feet Added Dune Width	Optimized Berm Template	+30 Feet Added Dune Width	Optimized Berm Template	+40 Feet Added Dune Width
1	R1-1	R1P1	50	55	50	65	50	75	50	85	50	95
2	R1-2	R1P1	50	55	50	65	50	75	50	85	50	95
3	R1-3	R1P1	50	55	50	65	50	75	50	85	50	95
4	R1-4	R1P1	50	55	50	65	50	75	50	85	50	95
5	R1-5	R1P1	50	55	50	65	50	75	50	85	50	95
6	R1-6	R1P1	50	55	50	65	50	75	50	85	50	95
7	R1-7	R1P1	50	55	50	65	50	75	50	85	50	95
8	R1-8	R1P1	50	55	50	65	50	75	50	85	50	95
9	R1-9	R1P1	50	55	50	65	50	75	50	85	50	95
10	R1-10	R1P1	50	55	50	65	50	75	50	85	50	95
11	R1-11	R1P1	50	55	50	65	50	75	50	85	50	95
12	R1-12	R1P1	50	55	50	65	50	75	50	85	50	95
13	R1-13	R1P1	50	55	50	65	50	75	50	85	50	95
14	R1-14	R1P1	50	55	50	65	50	75	50	85	50	95
15	R1-15	R1P2	50	100	50	110	50	120	50	130	50	140
16	R1-16	R1P2	50	100	50	110	50	120	50	130	50	140
17	R1-17	R1P2	50	100	50	110	50	120	50	130	50	140
18	R1-18	R1P2	50	100	50	110	50	120	50	130	50	140
19	R1-19	R1P2	50	100	50	110	50	120	50	130	50	140
20	R1-20	R1P2	50	100	50	110	50	120	50	130	50	140
21	R1-21	R1P1	50	55	50	65	50	75	50	85	50	95
22	R1-22	R1P1	50	55	50	65	50	75	50	85	50	95
23	R1-23	R1P1	50	55	50	65	50	75	50	85	50	95
24	R1-24	R1P1	50	55	50	65	50	75	50	85	50	95
25	R2-1	R2P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
26	R2-2	R2P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
27	R2-3	R2P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
28	R2-4	R2P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
29	R2-5	R2P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
30	R2-6	R2P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
31	R2-7	R2P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

TABLE B-28 (CONTINUED)
DUNE WIDTH OPTIMIZATION TEMPLATE

Sub-Reach	Model Reach	Profile	Optimized Berm Template	+00 Feet Added Dune Width	Optimized Berm Template	+10 Feet Added Dune Width	Optimized Berm Template	+20 Feet Added Dune Width	Optimized Berm Template	+30 Feet Added Dune Width	Optimized Berm Template	+40 Feet Added Dune Width
32	R3-1	R3P1	50	75	50	85	50	95	50	105	50	115
33	R3-2	R3P1	50	75	50	85	50	95	50	105	50	115
34	R3-3	R3P1	50	75	50	85	50	95	50	105	50	115
35	R3-4	R3P2	50	45	50	55	50	65	50	75	50	85
36	R3-5	R3P2	50	45	50	55	50	65	50	75	50	85
37	R3-6	R3P2	50	45	50	55	50	65	50	75	50	85
38	R3-7	R3P2	50	45	50	55	50	65	50	75	50	85
39	R3-8	R3P1	50	75	50	85	50	95	50	105	50	115
40	R3-9	R3P1	50	75	50	85	50	95	50	105	50	115
41	R3-10	R3P1	50	75	50	85	50	95	50	105	50	115
42	R3-11	R3P1	50	75	50	85	50	95	50	105	50	115
43	R3-12	R3P1	50	75	50	85	50	95	50	105	50	115
44	R3-13	R3P1	50	75	50	85	50	95	50	105	50	115
45	R3-14	R3P1	50	75	50	85	50	95	50	105	50	115
46	R3-15	R3P1	50	75	50	85	50	95	50	105	50	115
47	R3-16	R3P1	50	75	50	85	50	95	50	105	50	115
48	R3-17	R3P1	50	75	50	85	50	95	50	105	50	115
49	R3-18	R3P1	50	75	50	85	50	95	50	105	50	115
50	R3-19	R3P1	50	75	50	85	50	95	50	105	50	115
51	R3-20	R3P1	50	75	50	85	50	95	50	105	50	115
52	R3-21	R3P1	50	75	50	85	50	95	50	105	50	115
53	R3-22	R3P1	50	75	50	85	50	95	50	105	50	115
54	R3-23	R3P1	50	75	50	85	50	95	50	105	50	115
55	R3-24	R3P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
56	R3-25	R3P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
57	R3-26	R4P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
58	R4-1	R4P1	50	50	50	60	50	70	50	80	50	90
59	R4-2	R4P1	50	50	50	60	50	70	50	80	50	90
60	R4-3	R4P2	50	85	50	95	50	105	50	115	50	125
61	R4-4	R4P2	50	85	50	95	50	105	50	115	50	125
62	R4-5	R4P1	50	50	50	60	50	70	50	80	50	90

TABLE B-28 (CONTINUED)
DUNE WIDTH OPTIMIZATION TEMPLATE

Sub-Reach	Model Reach	Profile	Optimized Berm Template	+00 Feet Added Dune Width	Optimized Berm Template	+10 Feet Added Dune Width	Optimized Berm Template	+20 Feet Added Dune Width	Optimized Berm Template	+30 Feet Added Dune Width	Optimized Berm Template	+40 Feet Added Dune Width
63	R4-6	R4P2	50	85	50	95	50	105	50	115	50	125
64	R4-7	R4P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
65	R4-8	R4P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
66	R4-9	R4P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
67	R5-1	R5P2	50	65	50	75	50	85	50	95	50	105
68	R5-2	R5P2	50	65	50	75	50	85	50	95	50	105
69	R5-3	R5P2	50	65	50	75	50	85	50	95	50	105
70	R5-4	R5P2	50	65	50	75	50	85	50	95	50	105
71	R5-5	R5P2	50	65	50	75	50	85	50	95	50	105
72	R5-6	R5P1	50	185	50	195	50	205	50	215	50	225
73	R5-7	R5P1	50	185	50	195	50	205	50	215	50	225
74	R5-8	R5P1	50	185	50	195	50	205	50	215	50	225
75	R5-9	R5P2	50	65	50	75	50	85	50	95	50	105
76	R5-10	R5P2	50	65	50	75	50	85	50	95	50	105
77	R5-11	R5P2	50	65	50	75	50	85	50	95	50	105
78	R5-12	R5P2	50	65	50	75	50	85	50	95	50	105
79	R5-13	R5P2	50	65	50	75	50	85	50	95	50	105
80	R5-14	R5P2	50	65	50	75	50	85	50	95	50	105
81	R5-15	R5P2	50	65	50	75	50	85	50	95	50	105
82	R5-16	R5P2	50	65	50	75	50	85	50	95	50	105
83	R5-17	R5P3	50	50	50	60	50	70	50	80	50	90
84	R5-18	R5P2	50	65	50	75	50	85	50	95	50	105
85	R5-19	R5P3	50	50	50	60	50	70	50	80	50	90
86	R5-20	R5P2	50	65	50	75	50	85	50	95	50	105
87	R5-21	R5P2	50	65	50	75	50	85	50	95	50	105
88	R5-22	R5P3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
89	R5-23	R5P3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
90	R5-24	R5P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
91	R5-25	R5P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
92	R5-26	R5P1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
93	R5-27	R5P3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
94	R5-28	R5P3	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1

TABLE B-28 (CONTINUED)
DUNE WIDTH OPTIMIZATION TEMPLATE

Sub-Reach	Model Reach	Profile	Optimized Berm Template	+00 Feet Added Dune Width	Optimized Berm Template	+10 Feet Added Dune Width	Optimized Berm Template	+20 Feet Added Dune Width	Optimized Berm Template	+30 Feet Added Dune Width	Optimized Berm Template	+40 Feet Added Dune Width
95	R5-29	R5P2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
96	R5-30	R5P2	50	65	50	75	50	85	50	95	50	105
97	R5-31	R5P2	50	65	50	75	50	85	50	95	50	105
98	R5-32	R5P1	50	185	50	195	50	205	50	215	50	225
99	R5-33	R5P1	50	185	50	195	50	205	50	215	50	225
100	R5-34	R5P1	50	185	50	195	50	205	50	215	50	225
101	R5-35	R5P1	50	185	50	195	50	205	50	215	50	225
102	R5-36	R5P1	50	185	50	195	50	205	50	215	50	225
103	R5-37	R5P1	50	185	50	195	50	205	50	215	50	225
104	R5-38	R5P1	50	185	50	195	50	205	50	215	50	225
105	R5-39	R5P1	50	185	50	195	50	205	50	215	50	225
106	R5-40	R5P2	50	65	50	75	50	85	50	95	50	105
107	R5-41	R5P2	50	65	50	75	50	85	50	95	50	105
108	R5-42	R5P2	50	65	50	75	50	85	50	95	50	105
109	R5-43	R5P2	50	65	50	75	50	85	50	95	50	105
110	R5-44	R5P2	50	65	50	75	50	85	50	95	50	105
111	R5-45	R5P2	50	65	50	75	50	85	50	95	50	105
112	R5-46	R5P2	50	65	50	75	50	85	50	95	50	105
113	R5-47	R5P2	50	65	50	75	50	85	50	95	50	105
114	R5-48	R5P3	50	50	50	60	50	70	50	80	50	90
115	R5-49	R5P3	50	50	50	60	50	70	50	80	50	90
116	R5-50	R5P3	50	50	50	60	50	70	50	80	50	90
117	R5-51	R5P3	50	50	50	60	50	70	50	80	50	90

TABLE B-29
DUNE WIDTH OPTIMIZATION

Model Reach	Summed Net Benefits No Added Dune Width	Summed Net Benefits 10 feet of Added Dune Width	Summed Net Benefits 20 feet of Added Dune Width	Summed Net Benefits 30 feet of Added Dune Width	Summed Net Benefits 40 feet of Added Dune Width	Profile	Constructible Added Dune Width
R1-1	-21973	-24268	-29633	-32663	-$70,656	R1P1	
R1-2	-20560	-23275	-28261	-31277	-$64,626	R1P1	
R1-3	-19452	-22450	-26062	-28842	-$59,847	R1P1	
R1-4	-20515	-21875	-26597	-29331	-$59,152	R1P1	
R1-5	-22644	-24528	-27754	-30620	-$62,686	R1P1	
R1-6	-26738	-25173	-31575	-34387	-$66,491	R1P1	
R1-7	-25776	-24932	-30447	-33119	-$64,351	R1P1	
R1-8	-27070	-26652	-31812	-34591	-$67,592	R1P1	
R1-9	-23183	-23071	-27636	-30195	-$60,899	R1P1	
R1-10	-19414	-20251	-22745	-25250	-$53,615	R1P1	
R1-11	30826	56895	68085	66491	$34,057	R1P1	10
R1-12	-24859	-21595	-29833	-32618	-$64,658	R1P1	10
R1-13	163848	164890	159465	156755	$120,973	R1P1	10
R1-14	74404	76523	72382	69860	$34,592	R1P1	10
R1-15	108037	131552	189573	212157	$204,933	R1P2	30
R1-16	108817	119998	151449	162735	$137,214	R1P2	30
R1-17	-10947	-8672	-12337	-13249	-$44,213	R1P2	
R1-18	-6686	-4787	-8185	-10136	$12,779	R1P2	
R1-19	-16464	-11762	-16353	-16455	-$44,967	R1P2	
R1-20	-18102	-14543	-17092	-16619	-$41,608	R1P2	
R1-21	-23864	-24628	-28267	-30742	-$60,704	R1P1	
R1-22	-22459	-22298	-26891	-29509	-$59,756	R1P1	
R1-23	-22482	-24929	-28360	-31250	-$65,072	R1P1	
R1-24	-18535	-19329	-25302	-28140	-$58,971	R1P1	
R2-1	-	-	-	-		R2P1	
R2-2	-	-	-	-		R2P1	
R2-3	-	-	-	-		R2P2	
R2-4	-	-	-	-		R2P1	
R2-5	-	-	-	-		R2P2	
R2-6	-	-	-	-		R2P1	
R2-7	-	-	-	-		R2P1	
R3-1	-6480	-1676	-523	-1133	-$48,529	R3P1	
R3-2	60918	88440	99635	105914	$67,319	R3P1	10
R3-3	-3637	2903	495	-467	-$39,895	R3P1	10
R3-4	-8604	-8046	-11455	-12306	-$36,443	R3P2	10
R3-5	-10952	-7497	-13443	-14081	-$40,631	R3P2	10
R3-6	-13879	-9546	-16724	-17106	-$44,795	R3P2	10

TABLE B-29 (CONTINUED)
DUNE WIDTH OPTIMIZATION

Model Reach	Summed Net Benefits No Added Dune Width	Summed Net Benefits 10 feet of Added Dune Width	Summed Net Benefits 20 feet of Added Dune Width	Summed Net Benefits 30 feet of Added Dune Width	Summed Net Benefits 40 feet of Added Dune Width	Profile	Constructible Added Dune Width
R3-7	-12437	-9368	-15972	-16624	-$44,681	R3P2	10
R3-8	6269	10978	10427	10154	-$33,177	R3P1	10
R3-9	21777	33172	32887	33918	-$7,904	R3P1	30
R3-10	54721	115738	157575	194603	$178,292	R3P1	30
R3-11	29313	44573	49252	53628	$13,442	R3P1	30
R3-12	46295	80649	104132	127568	$103,900	R3P1	30
R3-13	37990	42943	42354	41955	$656	R3P1	30
R3-14	107187	125032	125659	128119	$74,087	R3P1	30
R3-15	53578	57577	56864	56257	$11,006	R3P1	30
R3-16	42516	44866	45067	44743	$13,220	R3P1	30
R3-17	70535	75378	76840	77139	$32,760	R3P1	30
R3-18	76242	84878	86728	88165	$42,842	R3P1	30
R3-19	77587	81617	83045	82970	$38,210	R3P1	30
R3-20	239534	274140	287533	294440	$252,339	R3P1	30
R3-21	90529	112124	118304	123926	$80,356	R3P1	30
R3-22	60602	71894	70982	72274	$30,460	R3P1	30
R3-23	45841	55004	53541	54111	$17,947	R3P1	30
R3-24	-	-	-	-		R3P2	
R3-25	-	-	-	-		R3P2	
R3-26	-	-	-	-		R4P1	
R4-1	57579	60774	59376	59220	-$1,796	R4P1	10
R4-2	56114	69534	65479	66614	-$9,366	R4P1	10
R4-3	-5402	-1372	-6935	-7651	$1,532	R4P2	10
R4-4	-1736	-1313	-3208	-3895	$1,471	R4P2	10
R4-5	22248	25615	23096	22401	-$848	R4P1	10
R4-6	-405	3772	3267	2791	-$3,672	R4P2	10
R4-7	-	-	-	-		R4P2	
R4-8	-	-	-	-		R4P1	
R4-9	-	-	-	-		R4P1	
R5-1	101205	98415	95873	95109	$5,332	R5P2	10
R5-2	70355	68018	64932	63312	$5,423	R5P2	10
R5-3	37513	37398	33074	31024	$4,439	R5P2	10
R5-4	11335	10860	6833	3971	$4,502	R5P2	10
R5-5	1	3602	-1157	-3562	$1,157	R5P2	10
R5-6	140226	157419	154409	151764	-$14,183	R5P1	10
R5-7	200024	214153	209752	206797	-$9,729	R5P1	10
R5-8	86384	100229	95839	93221	-$9,455	R5P1	10

TABLE B-29 (CONTINUED)
DUNE WIDTH OPTIMIZATION

Model Reach	Summed Net Benefits No Added Dune Width	Summed Net Benefits 10 feet of Added Dune Width	Summed Net Benefits 20 feet of Added Dune Width	Summed Net Benefits 30 feet of Added Dune Width	Summed Net Benefits 40 feet of Added Dune Width	Profile	Constructible Added Dune Width
R5-9	12641	15448	8646	6694	$3,995	R5P2	10
R5-10	16735	17865	12965	11068	$3,770	R5P2	10
R5-11	22492	25100	18724	16681	$3,768	R5P2	10
R5-12	19276	19473	16094	14321	$3,182	R5P2	10
R5-13	17898	23227	15965	13943	$1,934	R5P2	10
R5-14	15842	18371	12358	10452	$3,484	R5P2	10
R5-15	22419	23919	18097	15770	$4,322	R5P2	10
R5-16	25421	31720	27972	26043	-$2,551	R5P2	10
R5-17	6949	10436	4477	3815	$2,472	R5P3	10
R5-18	24250	25944	22209	20851	$2,041	R5P2	10
R5-19	462	4253	70	647	$392	R5P3	10
R5-20	-563	825	-3538	-5666	$2,975	R5P2	10
R5-21	135	985	-3266	-5468	$3,401	R5P2	10
R5-22						R5P3	
R5-23						R5P3	
R5-24						R5P2	
R5-25						R5P2	
R5-26						R5P1	
R5-27						R5P3	
R5-28						R5P3	
R5-29						R5P2	
R5-30	31359	32542	27446	25763	-$4,716	R5P2	10
R5-31	39204	40628	34506	32596	$2,163	R5P2	10
R5-32	93797	116901	120434	119260	$77,242	R5P1	10
R5-33	70338	76230	72162	69274	$25,221	R5P1	10
R5-34	47939	51558	46369	43212	-$235	R5P1	10
R5-35	52939	56658	52726	49924	$8,037	R5P1	10
R5-36	97937	124305	126632	126125	$83,916	R5P1	10
R5-37	76094	79651	74974	71484	$28,353	R5P1	10
R5-38	97013	107768	99436	95873	$48,203	R5P1	10
R5-39	90626	91422	88855	86031	$41,575	R5P1	10
R5-40	49424	47040	44289	42296	$11,247	R5P2	10
R5-41	44150	42989	39376	37311	$6,701	R5P2	10
R5-42	28280	28539	23859	21635	-$8,858	R5P2	10
R5-43	17851	17377	13587	11494	-$17,881	R5P2	10
R5-44	3985	4253	-3	-2204	-$26,622	R5P2	10
R5-45	-1618	-1157	-5345	-7562	-$15,038	R5P2	10

TABLE B-29 (CONTINUED)
DUNE WIDTH OPTIMIZATION

Model Reach	Summed Net Benefits No Added Dune Width	Summed Net Benefits 10 feet of Added Dune Width	Summed Net Benefits 20 feet of Added Dune Width	Summed Net Benefits 30 feet of Added Dune Width	Summed Net Benefits 40 feet of Added Dune Width	Profile	Constructible Added Dune Width
R5-46	621	6642	2709	408	-$27,913	R5P2	10
R5-47	2923	17635	15037	13057	-$1,926	R5P2	10
R5-48	-4635	-3737	-7661	-8418	-$31,424	R5P3	10
R5-49	5033	4860	3240	2480	-$20,329	R5P3	10
R5-50	9987	9714	7843	7514	-$20,651	R5P3	10
R5-51	21836	23141	19461	18844	-$6,300	R5P3	10

LEGEND

CONSTRUCTION TEMPLATE 10 FEET OF ADDED DUNE WIDTH	+10
CONSTRUCTION TEMPLATE 30 FEET OF ADDED DUNE WIDTH	+30
ECONOMICALLY JUSTIFIED MODEL REACHES	

8.6.1 Constructible Dune Width Alternative

In construction reach 1, (R1-1 to R1-16), unjustified reach R1-12 was added for constructability reasons. Filling this reach ties R1-11 into the larger neighboring reach which would present a robust beach fill of about 6,000 feet. Dune widths were standardized, 10 feet of added dune width in reaches R1-11 to R1-14 and 30 feet of added dune width for reaches R1-15 and R1-16.

In construction reach 2, (R3-2 to R3-23), the 2000-foot justified segment R3-2 and R3-3 is too small of a beach fill segment and would perform too poorly to provide a robust hurricane and storm reduction project. Filling the unjustified reaches R3-4 to R3-7 would tie this smaller segment in with the larger segment Reach R3-9 through R3-23. A robust beach fill segment from R3-2 to R3-23 would be constructed. Two uniform dune widths would be constructed, 10 feet of added dune with in reaches R3-2 to R3-8 and 30 feet of added dune width in reaches R3-9 to R3-23.

In construction reach 3, (R4-1 to R4-6), the unjustified reaches R4-3 and R4-4 would be filled to provide a uniform and high performing beach fill. This would also eliminate the need for transitions that would have been required in the unjustified reaches. The predominate 10 feet of added dune width is recommended for this construction reach.

In construction reach 4, (R5-1 to R5-21), reaches R5-1 to R5-4 would receive 10 feet of added dune width based on constructability and engineering performance reasons to match the 10 feet of added dune with optimized for the remainder of this construction segment.

In construction reach 5, (R5-30 to R5-51), unjustified reaches R5-45 and R5-48 would receive full beach fill based on engineering and constructability reasons.

8.7 THE CONSTRUCTIBLE NED PLAN

In Table B-29 the constructible added dune width column identifies the constructible economic NED Plan. This plan is a robust design, it is based on economics, engineering performance characteristics, and constructability and beach fill uniformity.

Table B-30 summarizes the optimum added dune width within the five construction reaches by representative profile.

TABLE B-30
OPTIMUM ADDED DUNE WIDTH – REPRESENTATIVE PROFILE

Construction Reach	Representative Profile	Existing Dune Width	Optimum Added Dune Width	Construction Reach Length w/o transitions (feet)	Construction Reach Length w/o transitions (miles)
CR1	R1P1	55	+10		
	R1P2	100	+30		
				6,191	1.2
CR2	R3P1	76	+10 & +30		
	R3P2	45	+10		
				22,980	4.4
CR3	R4P1	50	+10		
	R4P2	85	+10		
				6,101	1.2
CR4	R5P1	185	+10		
	R5P2	65	+10		
	R5P3	50	+10		
				21,688	4.1
CR5	R5P1	185	+10		
	R5P2	65	+10		
	R5P3	50	+10		
				22,319	4.2

8.8 PERIODIC NOURISHMENT – CONSTRUCTIBLE NED PLAN

Periodic nourishment is placement of suitable material on a beach at appropriate intervals of time to maintain the design template. Periodic nourishment plans for Walton County do not include any form of retaining structures that would reduce littoral drift from reaching down-drift beaches.

Beach-*fx* examines all reaches to be nourished to determine if mobilization is warranted. The existing reach profile is compared to the design template, and a nourishment volume is determined. If the total nourishment volume for all reaches exceeds a user-defined threshold, then mobilization and nourishment take place. If nourishment is required, then nourishment time is determined based on placement rates. A start nourishment and end nourishment event for the first reach are created. At the end nourishment event, the reach profile is set to the design template, and the next reach in processing order is examined, to see if nourishment is required. The process continues until all reaches have been handled. The cost of nourishment, including mobilization and placement costs, is calculated based on nourishment volumes and user-defined cost-related parameters.

Once the NED template was determined then GENESIS runs were undertaken to determine the effect of longshore transport on the constructed project. These results were incorporated into the Beach-*fx* model and rerun then re-examined to determine renourishment quantities and cycles.

The results of the Beach-*fx* runs with GENESIS information for the NED constructible alternative revealed that the renourishment cycle would average one initial fill and four renourishments during the life of the project. That would suggest a 10-year renourishment cycle. From the 100 different realizations of alternative futures came the total project life volume of 9,613,000 cy for five nourishment cycles, the initial and four renourishments.

The initial fill is estimated to require on average 3,273,000 cy and each of the four renourishments averaging 1,585,000 cy. Renourishment summary statistics are presented in Tables B-31 and B-32. A frequency distribution of renourishment cycles obtained from one hundred possible realizations is produced in Table B-33.

8.8.1 Comparison With Other Renourishment Projects

With the determination that the renourishment cycle for this project will be a 10-year cycle, it would be prudent to compare this with any adjacent renourishment projects to insure that they will perform in concert with this project. The only adjacent Federal project is Panama City Beach, which is immediately updrift in Bay County. The average renourishment interval of 5 years was found to produce the lowest total average equivalent cost in the 1996 Panama City Beaches, Florida General Reevaluation Report (GRR). However, the Panama City Beaches, Florida Beach Erosion Control and Storm Damage Reduction Project 5-year Monitoring Report showed that the 1998/1999 constructed beach project (R-l to R- 91.5) performed above expectations. The 5-year monitoring data showed that the project had retained 85 percent of the as-built fill within the Federal project limits and suggested that the design standard had been violated only at R-84, R-85 and R-86. The post-construction monitoring supports the notion that the average beach nourishment cycle for the project is much greater than 5-years. In addition, the 2009 limited reevaluation study for Carillon Beach and Pinnacle Port updated the economics to determine whether the currently authorized yet federally un-constructed Carillon Beach and Pinnacle Port portion of the Panama City Beaches, Florida Beach Erosion Control and Storm Damage Reduction project was still economically justified. To calculate erosion, wave attack and inundation benefits the engineering-economic Monte Carlo simulation model, Beach- *fx*, which relates beach profile change to storms, coastal processes and nourishment programs was used. The average periodic nourishment for this reach was determined to be on average every 10 years based on 100 iterations in Beach-*fx*.·

TABLE B-31
NED PLAN PERIODIC NOURISHMENT SUMMARY STATISTICS
(VOLUMES IN CUBIC YARDS)

	Average	Standard Deviation
Average Total Nourishment Volume	9,613,000	3,828,971
Average Initial Construction Volume	3,273,000	1,418,378
Average Total Renourishment Volume	6,340,000	3,525,053
Average Number of Renourishment	4	
Average Renourishment Volume	1,585,000	

TABLE B-32
NED PLAN PERIODIC NOURISHMENT CONFIDENCE INTERVALS
(VOLUMES IN CUBIC YARDS)

Average Initial Construction Volume	2,639,000	
Standard Deviation	1,418,378	
95% Confidence Interval	1,534,626	2,090,620
90% Confidence Interval	1,579,321	2,045,926
Average Total Renourishment Volume	6,341,000	
Standard Deviation	3,525,053	
95% Confidence Interval	5,182,321	6,564,117
90% Confidence Interval	5,293,399	6,453,038

TABLE B-33
NOURISHMENT FREQUENCY DISTRIBUTION
100 POSSIBLE FUTURE REALIZATIONS

Number of renourishment	Number of Occurrences
0	0
1	0
2	1
3	11
4	32
5	30
6	19
7	7
8	0
9	0
10	0

8.9 SUMMARY BENEFIT ANALYSIS – CONSTRUCTIBLE NED PLAN

Table B-34 presents the benefits by reach, profile and added dune width for the NED Plan. Total project benefits are $6,375,000.

TABLE B-34
WALTON COUNTY - NATIONAL ECONOMIC DEVELOPMENT PLAN
HSDR BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits	Net Benefits
R1-1	R1P1			
R1-2	R1P1			
R1-3	R1P1			
R1-4	R1P1			
R1-5	R1P1			
R1-6	R1P1			
R1-7	R1P1			
R1-8	R1P1			
R1-9	R1P1			
R1-10	R1P1			
R1-11	R1P1	+10	$73,200	$56,895
R1-12	R1P1	+10	$6,724	-$21,595
R1-13	R1P1	+10	$224,969	$164,890
R1-14	R1P1	+10	$144,690	$76,523
R1-15	R1P2	+30	$243,959	$131,552
R1-16	R1P2	+30	$198,584	$119,998
R1-17	R1P2			
R1-18	R1P2			
R1-19	R1P2			
R1-20	R1P2			
R1-21	R1P1			
R1-22	R1P1			
R1-23	R1P1			
R1-24	R1P1			
SUBTOTALS CONSTRUCTION REACH 1			**$892,126**	**$528,263**

TABLE B-34 (CONTINUED)
WALTON COUNTY - NATIONAL ECONOMIC DEVELOPMENT PLAN
HSDR BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits	Net Benefits
R2-1	R2P1			
R2-2	R2P1			
R2-3	R2P2			
R2-4	R2P1			
R2-5	R2P2			
R2-6	R2P1			
R2-7	R2P1			
R3-1	R3P1			
R3-2	R3P1	+10	$141,423	$88,440
R3-3	R3P1	+10	$29,953	$2,903
R3-4	R3P2	+10	$5,429	-$8,046
R3-5	R3P2	+10	$7,911	-$7,497
R3-6	R3P2	+10	$7,880	-$9,546
R3-7	R3P2	+10	$12,225	-$9,368
R3-8	R3P1	+10	$48,793	$10,978
R3-9	R3P1	+30	$75,572	$33,918
R3-10	R3P1	+30	$270,209	$194,603
R3-11	R3P1	+30	$105,765	$53,628
R3-12	R3P1	+30	$209,218	$127,568
R3-13	R3P1	+30	$105,096	$41,955
R3-14	R3P1	+30	$231,799	$128,119
R3-15	R3P1	+30	$133,717	$56,257
R3-16	R3P1	+30	$103,195	$44,743
R3-17	R3P1	+30	$163,262	$77,139
R3-18	R3P1	+30	$180,787	$88,165
R3-19	R3P1	+30	$169,918	$82,970
R3-20	R3P1	+30	$396,750	$294,440
R3-21	R3P1	+30	$208,111	$123,926
R3-22	R3P1	+30	$152,143	$72,274
R3-23	R3P1	+30	$120,997	$54,111
R3-24	R3P2			
R3-25	R3P2			
R3-26	R4P1			
SUBTOTALS CONSTRUCTION REACH 2			**$2,880,154**	**$1,541,680**

TABLE B-34 (CONTINUED)
WALTON COUNTY - NATIONAL ECONOMIC DEVELOPMENT PLAN
HSDR BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits	Net Benefits
R4-1	R4P1	+10	$71,122	$60,774
R4-2	R4P1	+10	$52,477	$69,534
R4-3	R4P2	+10		-$1,372
R4-4	R4P2	+10		-$1,313
R4-5	R4P1	+10	$33,929	$25,615
R4-6	R4P2	+10	$5,415	$3,772
R4-7	R4P2			
R4-8	R4P1			
R4-9	R4P1			
SUBTOTALS CONSTRUCTION REACH 3			**$162,943**	**$157,010**
R5-1	R5P2	+10	$113,617	$98,415
R5-2	R5P2	+10	$80,091	$68,018
R5-3	R5P2	+10	$47,651	$37,398
R5-4	R5P2	+10	$19,353	$10,860
R5-5	R5P2	+10	$13,386	$3,602
R5-6	R5P1	+10	$175,371	$157,419
R5-7	R5P1	+10	$239,830	$214,153
R5-8	R5P1	+10	$126,180	$100,229
R5-9	R5P2	+10	$25,403	$15,448
R5-10	R5P2	+10	$28,271	$17,865
R5-11	R5P2	+10	$35,413	$25,100
R5-12	R5P2	+10	$28,976	$19,473
R5-13	R5P2	+10	$34,186	$23,227
R5-14	R5P2	+10	$28,753	$18,371
R5-15	R5P2	+10	$34,408	$23,919
R5-16	R5P2	+10	$42,398	$31,720
R5-17	R5P3	+10	$23,700	$10,436
R5-18	R5P2	+10	$36,055	$25,944
R5-19	R5P3	+10	$11,997	$4,253
R5-20	R5P2	+10	$10,537	$825
R5-21	R5P2	+10	$11,737	$985

TABLE B-34 (CONTINUED)
WALTON COUNTY - NATIONAL ECONOMIC DEVELOPMENT PLAN
HSDR BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits	Net Benefits
R5-22	R5P3			
R5-23	R5P3			
R5-24	R5P2			
R5-25	R5P2			
R5-26	R5P1			
R5-27	R5P3			
R5-28	R5P3			
R5-29	R5P2			
SUBTOTALS CONSTRUCTION REACH 4			**$1,167,316**	**$907,660**
R5-30	R5P2	+10	$11,702	$32,542
R5-31	R5P2	+10	$22,988	$40,628
R5-32	R5P1	+10	$87,887	$116,901
R5-33	R5P1	+10	$42,941	$76,230
R5-34	R5P1	+10	$27,691	$51,558
R5-35	R5P1	+10	$32,058	$56,658
R5-36	R5P1	+10	$104,824	$124,305
R5-37	R5P1	+10	$29,558	$79,651
R5-38	R5P1	+10	$45,484	$107,768
R5-39	R5P1	+10	$23,597	$91,422
R5-40	R5P2	+10	$11,162	$47,040
R5-41	R5P2	+10	$11,694	$42,989
R5-42	R5P2	+10	$10,664	$28,539
R5-43	R5P2	+10	$9,887	$17,377
R5-44	R5P2	+10	$9,268	$4,253
R5-45	R5P2	+10	$8,952	-$1,157
R5-46	R5P2	+10	$15,341	$6,642
R5-47	R5P2	+10	$24,513	$17,635
R5-48	R5P3	+10	$3,661	-$3,737
R5-49	R5P3	+10	$3,669	$4,860
R5-50	R5P3	+10	$3,626	$9,714
R5-51	R5P3	+10	$4,352	$124,305
SUBTOTALS CONSTRUCTION REACH 5			**$1,272,875**	**$1,076,123**
TOTALS ALL CONSTRUCTION REACHES			**$6,375,413**	**$4,210,736**

8.10 CONSTRUCTIBLE NED PLAN AND RENOURISHMENTS

Modeling with Beach-*fx* began in January 2005 using the post Hurricane Ivan surveys. Post Ivan, the very active 2005 hurricane season sent five named storms to the State of Florida. In the Gulf of Mexico, Hurricane Katrina, which made landfall in Mississippi and several other storms since then, Hurricane Dennis for example, have devastated the beaches of Northwest Florida of which Walton is no exception. These conditions have changed the morphology of the study area in significant ways since the post Hurricane Ivan surveys.

The Beach-*fx* modeling efforts have predicted an initial fill requirement of 2,639,000 cy for the NED Plan. However, surveys have shown that the erosion activity that has occurred since the post Hurricane Ivan surveys would require an equivalent NED placement of approximately 3,273,000 cy to fill the initial construction template. Renourishments will still be on a 10-year cycle and the renourishment volume is 1,585,000 for the NED plan.

The FY 2011 initial construction costs are $55,496,000 and a single renourishment FY 2011 cost is $22,517,000. Renourishment costs for each fill are lower that the FY 2011 cost due to present worthing. Total project first cost including Interest during construction for this plan is $91,459,000. The annualized cost including O&M is $4,474,000 The annualized benefits,$6,391,000 include both HSDR benefits of about $6,375,000 and recreation benefits of about $16,000. The benefit-to-cost ratio (BCR) is 1.43 to 1 which yields net benefits of about $1,917,000.

Table B-35 summarized the costs, benefits and other pertinent information on project justification for the NED Plan without recreation benefits.

TABLE B-35
SUMMARY BENEFITS NED PLAN WITHOUT RECREATION BENEFITS
WALTON COUNTY, FLORIDA – FEASIBILITY

	FY 2011 Dollars	Category
	$55,496,000	2014 Initial Construction
	$14,434,620	2024 Renourishment
	$9,635,078	2034 Renourishment
	$6,431,393	2044 Renourishment
	$4,292,941	2054 Renourishment
Total First Cost	$90,290,000	
Interest During Construction	$1,168,568	
Total Project First Cost	$91,459,000	
Average Annual First Cost	$4,349,000	
Annual O&M	$124,500	
Total Average Annual Cost	$4,474,000	
Average Annual HSDR Benefits	$6,375,000	
Total Average Annual Benefits	$6,375,000	
Benefit-to-Cost Ratio	1.42	
Net Benefits	$1,901,000	

Table B-35A summarizes the costs, benefits and other pertinent information on project justification for the NED plan with recreation benefits. There is a small amount of recreation benefits because the Future With Project is characterized by added dune width. The added dune width is gained at the expense of berm width which results in less beach to recreate on and no recreation is permitted on the dunes.

TABLE B-35A
SUMMARY BENEFITS NED PLAN
WALTON COUNTY, FLORIDA – FEASIBILITY

	FY 2011 Dollars	Category
	$55,496,000	2014 Initial Construction
	$14,434,620	2024 Renourishment
	$9,635,078	2034 Renourishment
	$6,431,393	2044 Renourishment
	$4,292,941	2054 Renourishment
Total First Cost	$90,290,000	
Interest During Construction	$1,168,568	
Total NED Project First Cost	$91,459,000	
Average Annual First Cost	$4,349,000	
Annual O&M	$124,500	
Total Average Annual NED Cost	$4,474,000	
Average Annual HSDR Benefits	$6,375,000	
Average Annual Recreation Benefits	$16,000	
Total Average Annual Benefits	$6,391,000	
Benefit-to-Cost Ratio	1.43	
Net Benefits	$1,917,000	

8.11 RECREATION BENEFITS

In order to determine the recreation benefits of the tentatively selected plan an economic value must be placed on the recreation experience at the Walton County Beaches. This value can then be applied to the increase in visitation which results from the project to determine the NED recreation benefits. For this report, unit day values (UDV's) are used to determine the economic value of recreation at Walton County Beaches. UDV's are administratively determined values which represent the National Economic Development (NED) recreation values for typical types of recreation. Guidance for their use is provided by Engineering Regulation 1105-2-100.

UDV's are determined using a point system that takes into account the following factors: recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental (esthetics) quality. A good deal of judgment is required in the assessment of point values. A group of planning professionals with knowledge of the study area made independent judgments of the UDV values which were averaged. The UDV point totals convert to a recreation value of $5.07 for the without project condition and $5.16 for the with project condition. There values were applied to the increase in visitation over the study period. The difference between the without and with project

value of recreation determines the NED and LPP recreation benefits. The complete recreation analysis can to found in the attachments to the economic appendix.

8.12 LOCALLY PREFERRED PLAN (LPP)

The PDT met with the non-Federal sponsor and presented the Constructible NED Plan. The non-Federal sponsor approved of the plan and committed to supporting that conclusion. When asked if that plan was also the non-Federal sponsor's preferred plan, the non-Federal sponsor indicated that they would like to have added to the project the unjustified reaches R1-1 to R1-10. The non-Federal sponsor has just recently constructed a similar project in those reaches. Also they would like to have reaches R1-17 to R1-24 added to the project. The beach fill will match the neighboring recommended beach fill, a 50-foot berm width and 30-feet of added dune in profile R1P2 and 10-feet of added dune width in profile R1P1. Table B-36 outlines the features of the Locally Preferred Plan.

TABLE B-36
LOCALLY PREFERRED PLAN
ADDED REACHES R1-1 TO R1-10 AND R1-17 TO R1-24

Model Reach	Summed Net Benefits No added Dune Width	Summed Net Benefits 10-ft added Dune Width	Summed Net Benefits 20-ft added Dune Width	Summed Net Benefits 30-ft added Dune Width	Summed Net Benefits 40-ft added Dune Width	Maximized Added Dune width by Sub-Reach	Profile	LPP Added Dune Width
R1-1	-$21,973	-$24,268	-$29,633	-$32,663	-$70,656	+00	R1P1	+10
R1-2	-$20,560	-$23,275	-$28,261	-$31,277	-$64,626	+00	R1P1	+10
R1-3	-$19,452	-$22,450	-$26,062	-$28,842	-$59,847	+00	R1P1	+10
R1-4	-$20,515	-$21,875	-$26,597	-$29,331	-$59,152	+00	R1P1	+10
R1-5	-$22,644	-$24,528	-$27,754	-$30,620	-$62,686	+00	R1P1	+10
R1-6	-$26,738	-$25,173	-$31,575	-$34,387	-$66,491	+10	R1P1	+10
R1-7	-$25,776	-$24,932	-$30,447	-$33,119	-$64,351	+10	R1P1	+10
R1-8	-$27,070	-$26,652	-$31,812	-$34,591	-$67,592	+10	R1P1	+10
R1-9	-$23,183	-$23,071	-$27,636	-$30,195	-$60,899	+10	R1P1	+10
R1-10	-$19,414	-$20,251	-$22,745	-$25,250	-$53,615	+00	R1P1	+10
R1-11	$30,826	$56,895	$68,085	$66,491	$34,057	+20	R1P1	+10
R1-12	-$24,859	-$21,595	-$29,833	-$32,618	-$64,658	+10	R1P1	+10
R1-13	$163,848	$164,890	$159,465	$156,755	$120,973	+10	R1P1	+10
R1-14	$74,404	$76,523	$72,382	$69,860	$34,592	+10	R1P1	+10
R1-15	$108,037	$131,552	$189,573	$212,157	$204,933	+30	R1P2	+30
R1-16	$108,817	$119,998	$151,449	$162,735	$137,214	+30	R1P2	+30
R1-17	-$10,947	-$8,672	-$12,337	-$13,249	-$44,213	+10	R1P2	+30
R1-18	-$6,686	-$4,787	-$8,185	-$10,136	$12,779	+10	R1P2	+30
R1-19	-$16,464	-$11,762	-$16,353	-$16,455	-$44,967	+10	R1P2	+30
R1-20	-$18,102	-$14,543	-$17,092	-$16,619	-$41,608	+10	R1P2	+30
R1-21	-$23,864	-$24,628	-$28,267	-$30,742	-$60,704	+00	R1P1	+10
R1-22	-$22,459	-$22,298	-$26,891	-$29,509	-$59,756	+10	R1P1	+10
R1-23	-$22,482	-$24,929	-$28,360	-$31,250	-$65,072	+00	R1P1	+10
R1-24	-$18,535	-$19,329	-$25,302	-$28,140	-$58,971	+00	R1P1	+10

TABLE B-36 CONTINUED)
LOCALLY PREFERRED PLAN
ADDED REACHES R1-1 TO R1-10 AND R1-17 TO R1-24

Model Reach	Summed Net Benefits No added Dune Width	Summed Net Benefits 10-ft added Dune Width	Summed Net Benefits 20-ft added Dune Width	Summed Net Benefits 30-ft added Dune Width	Summed Net Benefits 40-ft added Dune Width	Maximized Added Dune width by Sub-Reach	Profile	LPP Added Dune Width
R3-1	-$6,480	-$1,676	-$523	-$1,133	-$48,529	+20	R3P1	
R3-2	$60,918	$88,440	$99,635	$105,914	$67,319	+30	R3P1	+10
R3-3	-$3,637	$2,903	$495	-$467	-$39,895	+10	R3P1	+10
R3-4	-$8,604	-$8,046	-$11,455	-$12,306	-$36,443	+10	R3P2	+10
R3-5	-$10,952	-$7,497	-$13,443	-$14,081	-$40,631	+10	R3P2	+10
R3-6	-$13,879	-$9,546	-$16,724	-$17,106	-$44,795	+10	R3P2	+10
R3-7	-$12,437	-$9,368	-$15,972	-$16,624	-$44,681	+10	R3P2	+10
R3-8	$6,269	$10,978	$10,427	$10,154	-$33,177	+10	R3P1	+10
R3-9	$21,777	$33,172	$32,887	$33,918	-$7,904	+30	R3P1	+30
R3-10	$54,721	$115,738	$157,575	$194,603	$178,292	+30	R3P1	+30
R3-11	$29,313	$44,573	$49,252	$53,628	$13,442	+30	R3P1	+30
R3-12	$46,295	$80,649	$104,132	$127,568	$103,900	+30	R3P1	+30
R3-13	$37,990	$42,943	$42,354	$41,955	$656	+10	R3P1	+30
R3-14	$107,187	$125,032	$125,659	$128,119	$74,087	+30	R3P1	+30
R3-15	$53,578	$57,577	$56,864	$56,257	$11,006	+10	R3P1	+30
R3-16	$42,516	$44,866	$45,067	$44,743	$13,220	+20	R3P1	+30
R3-17	$70,535	$75,378	$76,840	$77,139	$32,760	+30	R3P1	+30
R3-18	$76,242	$84,878	$86,728	$88,165	$42,842	+30	R3P1	+30
R3-19	$77,587	$81,617	$83,045	$82,970	$38,210	+20	R3P1	+30
R3-20	$239,534	$274,140	$287,533	$294,440	$252,339	+30	R3P1	+30
R3-21	$90,529	$112,124	$118,304	$123,926	$80,356	+30	R3P1	+30
R3-22	$60,602	$71,894	$70,982	$72,274	$30,460	+30	R3P1	+30
R3-23	$45,841	$55,004	$53,541	$54,111	$17,947	+10	R3P1	+30
R4-1	$57,579	$60,774	$59,376	$59,220	-$1,796	+10	R4P1	+10
R4-2	$56,114	$69,534	$65,479	$66,614	-$9,366	+10	R4P1	+10
R4-3	-$5,402	-$1,372	-$6,935	-$7,651	$1,532	+10	R4P2	+10
R4-4	-$1,736	-$1,313	-$3,208	-$3,895	$1,471	+10	R4P2	+10
R4-5	$22,248	$25,615	$23,096	$22,401	-$848	+10	R4P1	+10
R4-6	-$405	$3,772	$3,267	$2,791	-$3,672	+10	R4P2	+10

TABLE B-36 (CONTINUED)
LOCALLY PREFERRED PLAN
ADDED REACHES R1-1 TO R1-10 AND R1-17 TO R1-24

Model Reach	Summed Net Benefits No added Dune Width	Summed Net Benefits 10-ft added Dune Width	Summed Net Benefits 20-ft added Dune Width	Summed Net Benefits 30-ft added Dune Width	Summed Net Benefits 40-ft added Dune Width	Maximized Added Dune width by Sub-Reach	Profile	LPP Added Dune Width
R5-1	$101,205	$98,415	$95,873	$95,109	$5,332	+00	R5P2	+10
R5-2	$70,355	$68,018	$64,932	$63,312	$5,423	+00	R5P2	+10
R5-3	$37,513	$37,398	$33,074	$31,024	$4,439	+00	R5P2	+10
R5-4	$11,335	$10,860	$6,833	$3,971	$4,502	+00	R5P2	+10
R5-5	$1	$3,602	-$1,157	-$3,562	$1,157	+10	R5P2	+10
R5-6	$140,226	$157,419	$154,409	$151,764	-$14,183	+10	R5P1	+10
R5-7	$200,024	$214,153	$209,752	$206,797	-$9,729	+10	R5P1	+10
R5-8	$86,384	$100,229	$95,839	$93,221	-$9,455	+10	R5P1	+10
R5-9	$12,641	$15,448	$8,646	$6,694	$3,995	+10	R5P2	+10
R5-10	$16,735	$17,865	$12,965	$11,068	$3,770	+10	R5P2	+10
R5-11	$22,492	$25,100	$18,724	$16,681	$3,768	+10	R5P2	+10
R5-12	$19,276	$19,473	$16,094	$14,321	$3,182	+10	R5P2	+10
R5-13	$17,898	$23,227	$15,965	$13,943	$1,934	+10	R5P2	+10
R5-14	$15,842	$18,371	$12,358	$10,452	$3,484	+10	R5P2	+10
R5-15	$22,419	$23,919	$18,097	$15,770	$4,322	+10	R5P2	+10
R5-16	$25,421	$31,720	$27,972	$26,043	-$2,551	+10	R5P2	+10
R5-17	$6,949	$10,436	$4,477	$3,815	$2,472	+10	R5P3	+10
R5-18	$24,250	$25,944	$22,209	$20,851	$2,041	+10	R5P2	+10
R5-19	$462	$4,253	$70	$647	$392	+10	R5P3	+10
R5-20	-$563	$825	-$3,538	-$5,666	$2,975	+10	R5P2	+10
R5-21	$135	$985	-$3,266	-$5,468	$3,401	+10	R5P2	+10
R5-30	$31,359	$32,542	$27,446	$25,763	-$4,71	+10	R5P2	+10
R5-31	$39,204	$40,628	$34,506	$32,596	$2,163	+10	R5P2	+10
R5-32	$93,797	$116,901	$120,434	$119,260	$77,242	+20	R5P1	+10
R5-33	$70,338	$76,230	$72,162	$69,274	$25,221	+10	R5P1	+10
R5-34	$47,939	$51,558	$46,369	$43,212	-$235	+10	R5P1	+10
R5-35	$52,939	$56,658	$52,726	$49,924	$8,037	+10	R5P1	+10
R5-36	$97,937	$124,305	$126,632	$126,125	$83,916	+20	R5P1	+10
R5-37	$76,094	$79,651	$74,974	$71,484	$28,353	+10	R5P1	+10
R5-38	$97,013	$107,768	$99,436	$95,873	$48,203	+10	R5P1	+10
R5-39	$90,626	$91,422	$88,855	$86,031	$41,575	+10	R5P1	+10
R5-40	$49,424	$47,040	$44,289	$42,296	$11,247	+00	R5P2	+10

TABLE B-36 (CONTINUED)
LOCALLY PREFERRED PLAN
ADDED REACHES R1-1 TO R1-10 AND R1-17 TO R1-24

Model Reach	Summed Net Benefits No added Dune Width	Summed Net Benefits 10-ft added Dune Width	Summed Net Benefits 20-ft added Dune Width	Summed Net Benefits 30-ft added Dune Width	Summed Net Benefits 40-ft added Dune Width	Maximized Added Dune width by Sub-Reach	Profile	LPP Added Dune Width
R5-41	$44,150	$42,989	$39,376	$37,311	$6,701	+00	R5P2	+10
R5-42	$28,280	$28,539	$23,859	$21,635	-$8,858	+10	R5P2	+10
R5-43	$17,851	$17,377	$13,587	$11,494	-$17,881	+00	R5P2	+10
R5-44	$3,985	$4,253	-$3	-$2,204	-$26,622	+10	R5P2	+10
R5-45	-$1,618	-$1,157	-$5,345	-$7,562	-$15,038	+10	R5P2	+10
R5-46	$621	$6,642	$2,709	$408	-$27,913	+10	R5P2	+10
R5-47	$2,923	$17,635	$15,037	$13,057	-$1,926	+10	R5P2	+10
R5-48	-$4,635	-$3,737	-$7,661	-$8,418	-$31,424	+10	R5P3	+10
R5-49	$5,033	$4,860	$3,240	$2,480	-$20,329	+00	R5P3	+10
R5-50	$9,987	$9,714	$7,843	$7,514	-$20,651	+00	R5P3	+10
R5-51	$21,836	$23,141	$19,461	$18,844	-$6,300	+10	R5P3	+10

LEGEND

CONSTRUCTION TEMPLATE 10 FEET OF ADDED DUNE WIDTH	+10
CONSTRUCTION TEMPLATE 30 FEET OF ADDED DUNE WIDTH	+30
ECONOMICALLY JUSTIFIED MODEL REACHES	

8.13 PERIODIC NOURISHMENT – LOCALLY PREFERRED PLAN

The results of the Beach-*fx* runs with GENESIS information for the Locally Preferred Plan alternative revealed that the nourishment cycle would also average five cycles, the initial fill and four renourishments suggesting a 10-year renourishment cycle.

From the 100 different realizations of alternative futures came the total project life nourishment volume of 11,024,000 cy and five nourishment cycles, the initial and four renourishments. The initial fill is estimated to require on average 3,868,000 cy and 7,157,000 cy total for the four renourishments an average 1,789,000 cy each. Renourishment summary statistics are presented in Tables B-37 and B-38. A frequency distribution of renourishment cycles obtained from one hundred possible realizations is produced in Table B-39.

TABLE B-37
LOCALLY PREFERRED PLAN PERIODIC NOURISHMENT
SUMMARY STATISTICS (VOLUMES IN CUBIC YARDS)

	Average
Average Total Nourishment Volume	11,024,000
Average Initial Construction Volume	3,868,000
Average Total Renourishment Volume	7,156,000
Average Number of Renourishments	4
Average Renourishment Volume	1,789,000

TABLE B-38
LOCALLY PREFERRED PLAN PERIODIC NOURISHMENT
CONFIDENCE INTERVALS (VOLUMES IN CUBIC YARDS)

Average Initial Construction Volume	3,152,000	
Standard Deviation	1,599,545	
95% Confidence Interval	1,913,051	2,237,091
90% Confidence Interval	1,862,647	2,287,494
Average Total Renourishment Volume	7,156,000	
Standard Deviation	4,088,020	
95% Confidence Interval	5,388,314	6,990,788
90% Confidence Interval	5,517,131	6,861,970

TABLE B-39
NOURISHMENT FREQUENCY DISTRIBUTION
100 POSSIBLE FUTURE REALIZATIONS

Number of Nourishments	Number of Occurrences
0	0
1	0
2	0
3	14
4	34
5	29
6	19
7	4
8	0
9	0
10	0

8.14 LOCALLY PREFERRED PLAN AND RENOURISHMENTS

Beach-*fx* modeling began modeling in January 2005 using the post Hurricane Ivan surveys. Post Ivan, the very active 2005 hurricane season sent five named storms to the State of Florida. In the Gulf of Mexico, Hurricane Katrina, which made landfall in Mississippi and several other storms since then, Hurricane Dennis for example, have devastated the beaches of Northwest Florida of which Walton County is no exception. These conditions have changes the morphology of the study area in significant ways.

Beach-*fx* simulation runs supplemented with the GENESIS long-term transport data suggested an average of four renourishment cycles over the 50-year project life for the LPP Plan.

8.15 SUMMARY BENEFIT ANALYSIS – LOCALLY PREFERRED PLAN

The NED and the LPP plans maintain the same placement template (see Figure B-6) but the LPP extends the coverage area to the westernmost limits of the county where the NED Plan could not justify the coverage. Table B-40 presents the LPP benefits by reach and Table B-41 summarized the costs, benefits and other pertinent information on project justification for the LPP Plan.

Modeling with Beach-*fx* began in January 2005 using the post Hurricane Ivan surveys. Post Ivan, the very active 2005 hurricane season sent five named storms to the State of Florida. In the Gulf of Mexico, Hurricane Katrina, which made landfall in Mississippi and several other storms since then, Hurricane Dennis for example, have devastated the beaches of Northwest Florida of which Walton is no exception. These conditions have changed the morphology of the study area in significant ways since the post Hurricane Ivan surveys used in Beach-*fx*.

The Beach-*fx* modeling efforts have predicted initial fill requirements of 3,152,000 cy for the Locally Preferred Plan. Recent surveys have shown that the erosion activity that has occurred since the post Hurricane Ivan surveys would require an equivalent LPP placement. If the long-term erosion rate is applied to the predicted construction timeframe of FY14, then the necessary beach fill requirements will be 3,868,000 cy. Renourishments will still be on a 10-year cycle and the renourishment volume is 1,789,000 for the LPP.

The FY2011 initial construction costs are $63,306,000 and a single renourishment FY 2011 cost is $25,300,000. Renourishment costs for each fill are lower that the FY 2011 cost due to present worthing. Total project cost including interest during construction for this plan is $103,762,000. The average annual construction cost is about $4,934,000 and annual O&M is $168,000 making total average annual costs of $5,102,000. The annualized benefits, $6,559,000, include both HSDR benefits of about $6,543,000 and recreation benefits of about $16,000. The BCR is 1.21 to 1 which yields net benefits of about $1,457,000. Tables B-40 and B-41 summarize the costs, benefits and other pertinent information on project justification for the LPP Plan.

TABLE B-40
WALTON COUNTY - LOCALLY PREFERRED PLAN
BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits
R1-1	R1P1	+10	$17,956
R1-2	R1P1	+10	$1,457
R1-3	R1P1	+10	$1,498
R1-4	R1P1	+10	$1,734
R1-5	R1P1	+10	$1,464
R1-6	R1P1	+10	$2,038
R1-7	R1P1	+10	$2,693
R1-8	R1P1	+10	$2,369
R1-9	R1P1	+10	$2,782
R1-10	R1P1	+10	$1,921
R1-11	R1P1	+10	$95,831
R1-12	R1P1	+10	$6,737
R1-13	R1P1	+10	$224,999
R1-14	R1P1	+10	$146,006
R1-15	R1P2	+30	$265,587

TABLE B-40 (CONTINUED)
WALTON COUNTY - LOCALLY PREFERRED PLAN
BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits
R1-16	R1P2	+30	$197,561
R1-17	R1P2	+30	$30,670
R1-18	R1P2	+30	$36,146
R1-19	R1P2	+30	$24,548
R1-20	R1P2	+30	$8,657
R1-21	R1P1	+10	$1,278
R1-22	R1P1	+10	$1,944
R1-23	R1P1	+10	$1,436
R1-24	R1P1	+10	$7,196
R2-1	R2P1		
R2-2	R2P1		
R2-3	R2P2		
R2-4	R2P1		
R2-5	R2P2		
R2-6	R2P1		
R2-7	R2P1		
R3-1	R3P1		
R3-2	R3P1	+10	$123,080
R3-3	R3P1	+10	$28,920
R3-4	R3P2	+10	$5,396
R3-5	R3P2	+10	$7,669
R3-6	R3P2	+10	$7,533
R3-7	R3P2	+10	$12,117
R3-8	R3P1	+10	$49,759
R3-9	R3P1	+30	$76,139
R3-10	R3P1	+30	$275,161
R3-11	R3P1	+30	$105,910
R3-12	R3P1	+30	$209,524
R3-13	R3P1	+30	$105,083
R3-14	R3P1	+30	$231,743
R3-15	R3P1	+30	$133,717
R3-16	R3P1	+30	$103,195
R3-17	R3P1	+30	$163,242
R3-18	R3P1	+30	$180,744
R3-19	R3P1	+30	$169,906

TABLE B-40 (CONTINUED)
WALTON COUNTY - LOCALLY PREFERRED PLAN
BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits
R3-20	R3P1	+30	$396,536
R3-21	R3P1	+30	$208,199
R3-22	R3P1	+30	$152,371
R3-23	R3P1	+30	$121,081
R3-24	R3P2		
R3-25	R3P2		
R3-26	R4P1		
R4-1	R4P1	+10	$69,522
R4-2	R4P1	+10	$47,773
R4-3	R4P2	+10	$0
R4-4	R4P2	+10	$0
R4-5	R4P1	+10	$32,221
R4-6	R4P2	+10	$5,415
R4-7	R4P2		
R4-8	R4P1		
R4-9	R4P1		
R5-1	R5P2	+10	$113,687
R5-2	R5P2	+10	$80,078
R5-3	R5P2	+10	$47,634
R5-4	R5P2	+10	$19,346
R5-5	R5P2	+10	$13,331
R5-6	R5P1	+10	$174,603
R5-7	R5P1	+10	$239,130
R5-8	R5P1	+10	$125,823
R5-9	R5P2	+10	$25,396
R5-10	R5P2	+10	$28,256
R5-11	R5P2	+10	$35,413
R5-12	R5P2	+10	$28,964
R5-13	R5P2	+10	$34,162
R5-14	R5P2	+10	$28,731
R5-15	R5P2	+10	$34,400
R5-16	R5P2	+10	$42,357
R5-17	R5P3	+10	$23,698
R5-18	R5P2	+10	$36,040
R5-19	R5P3	+10	$11,863

TABLE B-40 (CONTINUED)
WALTON COUNTY - LOCALLY PREFERRED PLAN
BENEFITS

Model Reach	Profile	Constructed Added Dune Width	Average Annual Benefits
R5-20	R5P2	+10	$10,526
R5-21	R5P2	+10	$11,736
R5-22	R5P3		
R5-23	R5P3		
R5-24	R5P2		
R5-25	R5P2		
R5-26	R5P1		
R5-27	R5P3		
R5-28	R5P3		
R5-29	R5P2		
R5-30	$41,615	+10	$43,455
R5-31	$54,424	+10	$51,658
R5-32	$135,413	+10	$142,628
R5-33	$89,447	+10	$103,041
R5-34	$64,991	+10	$78,275
R5-35	$68,957	+10	$82,423
R5-36	$147,407	+10	$149,050
R5-37	$98,230	+10	$107,304
R5-38	$123,595	+10	$137,893
R5-39	$108,862	+10	$120,277
R5-40	$57,539	+10	$59,113
R5-41	$54,804	+10	$54,619
R5-42	$39,019	+10	$38,823
R5-43	$26,194	+10	$26,972
R5-44	$11,719	+10	$13,051
R5-45	$8,952	+10	$6,892
R5-46	$15,328	+10	$14,643
R5-47	$24,451	+10	$26,665
R5-48	$6,763	+10	$3,169
R5-49	$23,356	+10	$15,209
R5-50	$29,212	+10	$22,015
R5-51	$41,083	+10	$32,902
Average Annual Benefits LPP			**$6,542,998**

TABLE B-41
SUMMARY BENEFITS LPP PLAN
WALTON COUNTY, FLORIDA – FEASIBILITY

	FY 2011Dollars	Category
	$63,306,000	2014 Initial Construction
	$16,218,674.68	2024 Renourishment
	$10,825,930	2034 Renourishment
	$7,226,285	2044 Renourishment
	$4,922,478	2054 Renourishment
Total NED First Cost	$102,499,000	
Interest During Construction	$1,263,422	
Total NED Project First Cost	$103,762,000	
Average Annual NED First Cost	$4,934,000	
Annual O&M	$168,000	
Total Average Annual NED Cost	$5,102,000	
Average Annual HSDR Benefits	$6,543,000	
Average Annual Recreation Benefits	$16,000	
Total Average Annual Benefits	$6,559,000	
Benefit-to-Cost Ratio	1.29	
Net Benefits	$1,457,000	

Attachment IV of this Appendix displays access points and associated parking.

8.16 SYSTEM OF ACCOUNTS

Principles and Guidelines prescribe for an evaluation of project benefits for the final array of alternatives and the selected plan according to the four accounts: National Economic Development (NED), Regional Economic Development (RED), Other Social Effects (OSE), and Environmental Quality (EQ).

The NED benefits were fully and illustratively presented throughout the economic analysis. Regional Economic Development Benefits are calculated using the Economic Impact Forecasting System (EIFS). EIFS is an regional economic impact assessment model that uses economic multipliers and a database of economic and financial statistics by county to measure the economic and financial impact to a community through various increases and/or decreases in economic activity in that community.

The evaluation of the System of Accounts is displayed in Table B-42.

TABLE B-42
SYSTEM OF ACCOUNTS

Problem Area: Walton County, Florida				
Problems ID: Damages suffered by hurricane-induced surge and wave attack; Potential future damages from storm and hurricane events.				
Item	**No Action**	**Acquisition**	**NED Plan**	**LPP Plan**
A. PLAN DESCRIPTION	No Federal Action	Buyout all row one damageable elements and land	Construct a 50-foot beach fill project in five reaches	Construct a 50-foot beach fill project in five reaches
B. IMPACT ASSESSMENT				
1. National Economic Development				
a. Beneficial Impacts				
(1) Damages Prevented	$0	$3,106,000	$6,375,000	$6,543,000
(2) Emergency Costs Avoided	$0	$0	$0	$0
(3) Recreation	$0	$0	$16,000	$16,000
(4) Total Beneficial Impacts	None.	$3,106,000	$6,391,000	$6,559,000
b. Adverse Impacts				
(1) Project Cost	$0	$3,420,000,000	$90,290,000	$102,500,000
(2) Interest During Construction	$0	$32,665,600	$1,168,000	$1, 263,000
(3) Average Annual First Cost	N/A	$193,303,000	$4,349,000	$4,934,000
(4) Annual O&M	$0		$125,000	$168,000
(5) Total Avg. Annual Costs	$0	$193,303,000	$4,474,000	$5,102,000
2. Environmental Quality (EQ)				
(1) Ecosystem Restoration	No ecosystem restoration benefits.	Significantly Increased dune habitat from added dune width	Increased habitat from added dune and berm width	Increased habitat from added dune and berm width
(2) Water Circulation	No anticipated effect on water circulation.	No anticipated effect on water circulation.	No anticipated effect on water circulation.	No anticipated effect on water circulation.
(3) Noise Level Changes	No change in noise levels	No change in noise levels	Temporary increase in noise levels during construction	Temporary increase in noise levels during construction
(4) Public Facilities	N/A	N/A	N/A	N/A
(5) Aesthetic Values	No significant change in aesthetic values	Significant increase to aesthetic improvement	Significant increase to aesthetic improvement	Significant increase to aesthetic improvement
(6) Natural Resources	No impact.	Alternative would result in restoration of coastal marsh resources.	Alternative would result in restoration of coastal marsh resources.	Alternative would result in restoration of coastal marsh resources.
(7) Biological Resources	No impact.	Biological resources would be improved versus the no-action alternative.	Biological resources would be improved versus the no-action alternative.	Biological resources would be improved versus the no-action alternative.
(8) Air Quality	Alternative would have no anticipated effect on air quality	Air emission would be de minimus	Air emission would be de minimus	Air emission would be de minimus

TABLE B-42 (CONTINUED)
SYSTEM OF ACCOUNTS

Problem Area: Walton County, Florida

Problems ID: Damages suffered by hurricane-induced surge and wave attack; Potential future damages from storm and hurricane events.

Item	No Action	Acquisition	NED Plan	LPP Plan
(9) Water Quality	No impact.	No impact.	Temporary negative impacts to water quality due to construction.	Temporary negative impacts to water quality due to construction.
(10) Public Services	Public services to community would continue to be interrupted during storm events	Public services to community would continue to be interrupted during storm events	Public services to community would continue to be interrupted during storm events	Public services to community would continue to be interrupted during storm events
(11) Cultural and Historical Preservation	No impact.	No impact.	No impact.	No impact.
(12) Total Quality of the Environment	No impact.	Environmental quality would be improved.	Environmental quality would be improved.	Environmental quality would be improved.
3. Regional Economic Development (RED)				
(1) Impact on Sales Volume	No impact.	Decrease of **$47,819,840** in sales volume.	Increase of **$171,371,800** in additional sales volume.	Increase of **$180,616,600** in additional sales volume.
(2) Impact on Income	No impact.	Decrease of **$35,723,610** in local income.	Increase of **$31,288,070** in additional local income.	Increase of **$32,975,920** in additional local income.
(3) Impact on Employment	No impact.	Decrease of **1141** jobs.	Increase of **1078** new jobs.	Increase of **1137** new jobs.
(4) Tax Changes	No impact.	Would result in loss of some local tax revenue due to acquisition of properties.	No Change	No Change
4. Other Social Effects (OSE)				
a. Beneficial Impacts				
(1) Security of Life, Health, and Safety	Continued risks to life, health and safety	Major reduction in potential loss of life of persons and property.	No appreciable difference	No appreciable difference
(2) Community Cohesion	No negative impact on community cohesion.	Community would be dispersed and/or relocated	No negative impact on community cohesion.	No negative impact on community cohesion.
(3) Tax Values	No Impact.	Ownership and land use changes would impact tax value	Increase due to enhanced property values	Increase due to enhanced property values
(4) Community Growth	No Impact.	No Impact.	No Impact.	No Impact.

TABLE B-42 (CONTINUED)
SYSTEM OF ACCOUNTS

Problem Area: Walton County, Florida

Problems ID: Damages suffered by hurricane-induced surge and wave attack; Potential future damages from storm and hurricane events.

Item	No Action	Acquisition	NED Plan	LPP Plan
(5) Property Values	No Impact.	Minor temporary negative impact to adjacent properties during acquisition phase.	Minor Positive impact to protected properties.	Minor Positive impact to protected properties.
(6) Displacement of Businesses	N/A	N/A	N/A	N/A
(7) Public Facilities	N/A	Enhances opportunities for additional public facilities for recreation	Minor improvement to recreational activities from increased beach	Minor improvement to recreational activities from increased beach
(8) Injurious Displacement of Farms	N/A	N/A	N/A	N/A
b. Preservation of loss of life	No Impact.	Some reduction in potential loss of life.	No Change	No Change
C. PLAN EVALUATION				
1. Contributions to Planning Objectives				
a. Flood, Hurricane and/or Storm Damage Reduction	No Improvement.	Total reduction in damages at project site and less stress on dune system.	Significant reduction of storm damages and loss of land	Significant reduction of storm damages and loss of land
b. Recovery of lost environmental resources	Continued loss of environmental resources.	Significant opportunity to recover environmental resources negatively impacted in past	Some Recovery of environmental resources through additional dune area for nesting birds, beach mice and turtles	Some Recovery of environmental resources through additional dune area for nesting birds, beach mice and turtles
2. Response to Planning Constraints				
a. Avoid environmental impacts and minimize induced damages	Continued loss of environmental resources.	Positive effect on environmental resources.	Positive effect on environmental resources.	Positive effect on environmental resources.
b. Institutional Acceptability	Not supported by state or local government	Not supported by state or local government	Is supported by local and state governments	Is supported by local and state governments
3. Response to Evaluation Criteria				
a. Acceptability	NO	NO	YES	YES
b. Completeness	NO	YES	YES	YES
c. Effectiveness	NO	YES	YES	YES
d. Efficiency (Cost-Effectiveness; i.e., most efficient use of Federal and Non-Federal Funds)	NO	NO	YES	NO
e. Integration	N/A	N/A	N/A	N/A
f. Reversibility	N/A	NO - land could not be resold for development	YES - project nourishment can be abandoned	YES - project nourishment can be abandoned

TABLE B-42 (CONTINUED)
SYSTEM OF ACCOUNTS

Problem Area: Walton County, Florida				
Problems ID: Damages suffered by hurricane-induced surge and wave attack; Potential future damages from storm and hurricane events.				
Item	**No Action**	**Acquisition**	**NED Plan**	**LPP Plan**
4. Stakeholder Preference Score (From MCDA weightings analysis)				
a. Summary Score	N/A	N/A	N/A	N/A
Cluster Group A	N/A	N/A	N/A	N/A
Cluster Group B	N/A	N/A	N/A	N/A
Cluster Group C	N/A	N/A	N/A	N/A
Cluster Group D	N/A	N/A	N/A	N/A
b. Stakeholder Preference	NO	NO	Stakeholder would approve.	Stakeholder Preference
D. Implementation Responsibility	No implementation responsibilities	Joint Federal/Non-Federal implementation responsibility.	Joint Federal/Non-Federal implementation responsibility.	Joint Federal/Non-Federal implementation responsibility.
E. State and other Non-Federal Coordination	No State or other Non-Federal coordination activities	Would require State or other Non-Federal coordination activities	Would require State or other Non-Federal coordination activities	Would require State or other Non-Federal coordination activities
F. Risk Evaluation				
1. Risk and Vulnerabilities				
a. Risk of Failure	N/A	Very low risk of failure	Moderate risk of failure.	Moderate risk of failure.
b. Residual Risk	Residual risk of all actions will remain substantial due to storm surge.	Residual risk of all properties purchased virtually eliminated	Residual risk of all actions will remain substantial due to storm surge.	Residual risk of all actions will remain substantial due to storm surge.
c. Reliability	N/A	This plan would provide a significant degree of reliability to properties purchased. Residents are moved out of harm's way.	This plan would provide a significant degree of reliability, would receive damage from storm events, and would require maintenance.	This plan would provide a significant degree of reliability, would receive damage from storm events, and would require maintenance.
d. Relative Sea Level Rise	Problems will be substantially exacerbated by an increasing relative rise of sea level	This Plan will be minimally impacted by an increasing relative rise of sea level over the period of analysis	This Plan will be minimally impacted by an increasing relative rise of sea level over the period of analysis	This Plan will be minimally impacted by an increasing relative rise of sea level over the period of analysis
e. Risk of Ecosystem Damage	Ecosystem damage will continue to accrue at a rate at least that of recent history with substantial negative outcomes.	Ecosystem damage will continue to accrue at a rate at least that of recent history with substantial negative outcomes.	Ecosystem damage will continue to accrue at a rate at less than that of recent history with less substantial negative outcomes.	Ecosystem damage will continue to accrue at a rate at less than that of recent history with less substantial negative outcomes.

TABLE B-42 (CONTINUED)
SYSTEM OF ACCOUNTS

Problem Area: Walton County, Florida				
Problems ID: Damages suffered by hurricane-induced surge and wave attack; Potential future damages from storm and hurricane events.				
Item	**No Action**	**Acquisition**	**NED Plan**	**LPP Plan**
f. Risk to Life and Safety	Significant threats to Life and Safety from storm surge will continue. Damages to front row structures and contents will be substantial.	Significant threats to Life and Safety from storm surge will continue. Damages to front row structures would be eliminated.	Significant threats to Life and Safety from storm surge will continue. Damages to front row structures and contents substantially reduced.	Significant threats to Life and Safety from storm surge will continue. Damages to front row structures and contents substantially reduced.
g. Risk to Mental and Physical Health	N/A	N/A	N/A	N/A
2. Recommendations and Preferences				
a. Federal Recommendation			The NED Plan is the plan that maximizes net benefits	
b. Stakeholder Preference	No clear stakeholder preference indicated, but all action plans preferred to no action plan.			The Locally Preferred Plan provides a higher level of protection over the NED Plan but is more costly. The sponsor is willing to pay 100 percent of the additional cost for this added level of protection

9.0 SELECTING A PLAN

Based on plan comparison, it is apparent that implementation of a beach fill plan will satisfy the study objectives and provide hurricane and storm damage reduction and environmental restoration along the coastline of Walton County, Florida. Further, both the NED and LPP beach fill plans were found superior to the Acquisition and No Action plans in each of the System of Accounts. Of the plans considered the non-Federal sponsor has expressed their desire to implement the LPP. Projects may deviate from the NED plan if requested by the non-Federal sponsor and approved by the Assistant Secretary of the Army for Civil Works (ASA (CW)). A waiver, that the LPP be considered for recommendation, was requested and on 7 February 2012, was approved by the ASA (CW). As such, the LPP is the Tentatively Selected Plan (TSP).

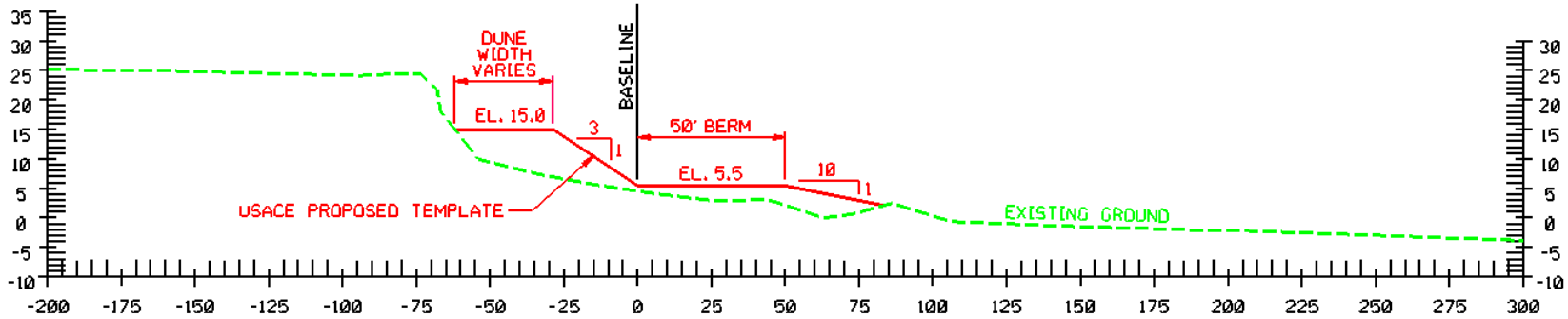
9.1 PLAN DETAILS

9.1.1 NED and TSP Plan for Construction with Renourishments

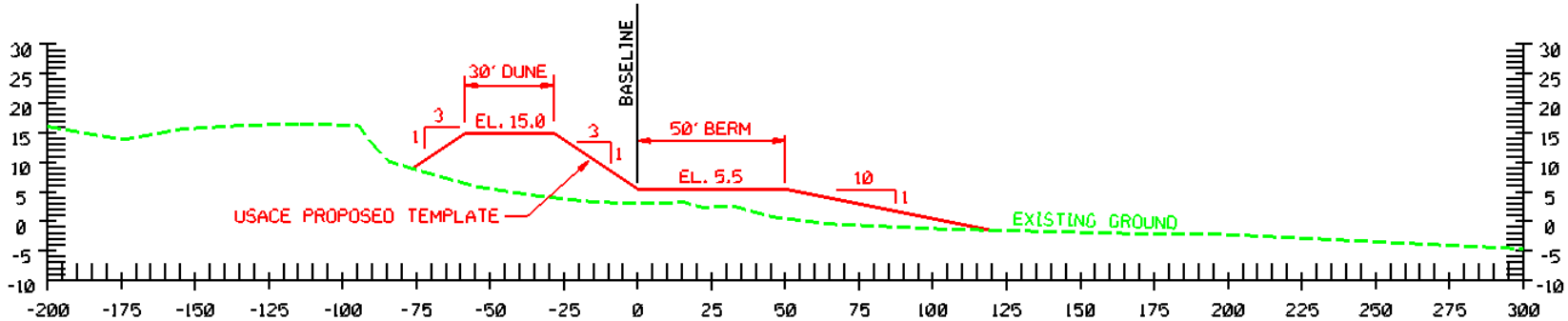
The modeling efforts have predicted initial fill requirements of 2,639,000 cy for the NED Plan and a TSP requirement of 3,152,000 cy. The two plans maintain the same placement template (see Figure B-6) but the TSP extends the coverage area to the westernmost limits of the county where the NED Plan could not justify the coverage. If this condition accounts for depletion rates to the predicted construction timeframe of FY14, then the necessary beach fill requirements will be 3,273,000 cy and 3,868,000 cy for the NED and TSP, respectively.

Renourishments will still be on a 10-year cycle and the renourishment volumes are 1,585,000 and 1,789,000 for the NED and TSP respectively. The nearness of the renourishment volumes for both plans is explained by the characteristics of the eighteen added TSP reaches on the western end of the project which is a generally accreting area. Only three of the 18 reaches are eroding while the remaining are generally accreting.

Approved and sufficient borrow sources lie offshore within the State of Florida waters.



TYPICAL SECTION "A"



TYPICAL SECTION "B"

FIGURE B-6. TYPICAL PROJECT SECTIONS TO BE CONSTRUCTED

10.0 COST SHARE

Federal cost sharing in the ratio of 65 to 35 on developed private land, 0 to 100 percent on undeveloped private lands, 50 to 50 on undeveloped public land 65 to 35 on developed public lands, is authorized when reaches are found to be constructible, environmentally sustainable and economically justified. Portions of the project which do not meet these criteria are a 100 percent non-Federal partner's expense. The NED cost share percentages are 30 percent Federal and 70 percent non-Federal. The tentatively selected plan cost share percentages are 28 Federal and 72 non-Federal. Tables B-43 and B-44 present the calculated Federal and non-Federal cost share both plans. Tables B-45 and B-45A exhibit the difference between the NED and the tentatively selected plan.

Table B-46 demonstrates if a particular reach qualifies for cost share based on adequacy of public access and parking. The analysis of adequate parking along the beaches requires either a beach capacity or peak user day point of view. Since the beach capacity is greater than the peak day visitation, the peak user day analysis is used. The most recent peak day visitation at Walton County beaches, which occurred on the past July 4th 2009 holiday, was estimated at 13,537 visits. The location of beach access points is publicly available on the World Wide Web supported by Walton County. Assumptions of the analysis are (1) the demand for public parking originates from both resident and non-residents population; (2) beach rentals on the beach that have access to the beach contribute to the supply of parking in absolute parking space terms without turnover; (3) The large county beach access and parking available at Miramar Beach and other such large day use areas, are very popular and highly attended areas. These will on peak day operate at full parking capacity; the average daily turnover rate on purely public parking is 1.5 times. Assuming 4.5 persons per vehicle each parking space accommodates 6.75 visits per day[5]. Surplus and deficits in any reach is available to be used within a quarter mile radius of the loci of the parking supply except near the large day use areas whose supply is completely used.

[5] Statistics obtained from on the ground observations in neighboring Bay County Florida and used in the Panama City Beach, Florida Hurricane and Storm Damage Feasibility Report, revised 1996

TABLE B-43

NED PLAN COST SHARE FEDERAL AND NON-FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
			65%	0%	50%	65%	65%	0%	50%	65%					
			35%	100%	50%	35%	35%	100%	50%	35%					
1	R1-1	1150	1,150	0	0	0	0	0%	0%	0%		0.0%	0.0000		
2	R1-2	1102	560	0	0	0	0	0%	0%	0%		0.0%	0.0000		
3	R1-3	1044	0	0	0	0	0	0%	0%	0%		0.0%	0.0000		
4	R1-4	1002	102	0	0	0	0	0%	0%	0%		0.0%	0.0000		
5	R1-5	1062	1,062	0	0	0	0	0%	0%	0%		0.0%	0.0000		
6	R1-6	1045	998	0	0	0	0	0%	0%	0%		0.0%	0.0000		
7	R1-7	1003	1,003	0	0	0	0	0%	0%	0%		0.0%	0.0000		
8	R1-8	1061	984	0	0	0	0	0%	0%	0%		0.0%	0.0000		
9	R1-9	1014	984	0	0	0	0	0%	0%	0%		0.0%	0.0000		
10	R1-10	959	100	0	0	0	0	0%	0%	0%	0.0012	0.0%	0.0000	100.00%	
11	R1-11	1021	955	66	0	0	94%	6%	0%	0%	0.0127	0.0%	0.0000	100.00%	Construction Reach One
12	R1-12	1057	1057	0	0	0	100%	0%	0%	0%	0.0132	65.0%	0.0086	35.00%	
13	R1-13	1040	1,040	0	0	0	100%	0%	0%	0%	0.0130	65.0%	0.0084	35.00%	
14	R1-14	1051	1,051	0	0	0	100%	0%	0%	0%	0.0131	65.0%	0.0085	35.00%	
15	R1-15	998	923	75	0	0	92%	8%	0%	0%	0.0124	60.1%	0.0075	39.89%	
16	R1-16	1025	883	142	0	0	86%	14%	0%	0%	0.0128	56.0%	0.0071	44.01%	
17	R1-17	1114	100	0	0	0	0	0%	0%	0%	0.0012	62.3%	0.0080	37.66%	
18	R1-18	1133	1,033	100	0	0	0	9%	0%	0%		0.0%	0.0000		
19	R1-19	1058	1,058	0	0	0	0	0%	0%	0%		0.0%	0.0000		
20	R1-20	961	961	0	0	0	0	0%	0%	0%		0.0%	0.0000		
21	R1-21	952	952	0	0	0	0	0%	0%	0%		0.0%	0.0000		
22	R1-22	1028	1,028	0	0	0	0	0%	0%	0%		0.0%	0.0000		
23	R1-23	1086	956	130	0	0	0	12%	0%	0%		0.0%	0.0000		
24	R1-24	1139	1139	0	0	0	0	0%	0%	0%		0.0%	0.0000		
Construction Reach One Sub Totals													0.0481		6391.2

TABLE B-43 (CONTINUED)
NED PLAN COST SHARE FEDERAL AND NON-FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
25	R2-1	495	0	0	0	0	0%	0%	0%	0%					
26	R2-2	936	0	0	0	0	0%	0%	0%	0%					
27	R2-3	2160	0	0	0	0	0%	0%	0%	0%					
28	R2-4	2066	0	0	0	0	0%	0%	0%	0%					
29	R2-5	1001	0	0	0	0	0%	0%	0%	0%					
30	R2-6	10078	0	0	0	0	0%	0%	0%	0%					
31	R2-7	1040	0	0	0	0	0%	0%	0%	0%					
32	R3-1	1147	0	0	100	0	0%	0%	9%	0%	0.0012	0.0%	0.0000	100.00%	*
33	R3-2	1037	838	199	0	0	81%	19%	0%	0%	0.0129	0.0%	0.0000	100.00%	Construction Reach Two
34	R3-3	1052	904	148	0	0	86%	14%	0%	0%	0.0131	0.0%	0.0000	100.00%	
35	R3-4	1026	914	112	0	0	89%	11%	0%	0%	0.0128	57.9%	0.0074	42.10%	
36	R3-5	1121	1,121	0	0	0	100%	0%	0%	0%	0.0140	65.0%	0.0091	35.00%	
37	R3-6	1185	1,115	70	0	0	94%	6%	0%	0%	0.0148	0.0%	0.0000	100.00%	
38	R3-7	1156	1,120	36	0	0	97%	3%	0%	0%	0.0144	0.0%	0.0000	100.00%	
39	R3-8	1103	909	194	0	0	82%	18%	0%	0%	0.0137	53.6%	0.0074	46.43%	
40	R3-9	1058	875	183	0	0	83%	17%	0%	0%	0.0132	53.8%	0.0071	46.25%	
41	R3-10	1068	1,068	0	0	0	100%	0%	0%	0%	0.0133	65.0%	0.0086	35.00%	
42	R3-11	1045	794	55	196	0	76%	5%	19%	0%	0.0130	58.8%	0.0076	41.24%	
43	R3-12	1007	824	100	83	0	82%	10%	8%	0%	0.0125	57.3%	0.0072	42.69%	
44	R3-13	1004	716	288	0	0	71%	29%	0%	0%	0.0125	46.4%	0.0058	53.65%	
45	R3-14	1345	960	385	0	0	71%	29%	0%	0%	0.0168	46.4%	0.0078	53.61%	
46	R3-15	1062	997	65	0	0	94%	6%	0%	0%	0.0132	0.0%	0.0000	100.00%	*
47	R3-16	732	732	0	0	0	100%	0%	0%	0%	0.0091	0.0%	0.0000	100.00%	*
48	R3-17	1017	758	259	0	0	75%	25%	0%	0%	0.0127	0.0%	0.0000	100.00%	
49	R3-18	1039	667	372	0	0	64%	36%	0%	0%	0.0129	0.0%	0.0000	100.00%	
50	R3-19	1036	1,036	0	0	0	100%	0%	0%	0%	0.0129	0.0%	0.0000	100.00%	
51	R3-20	1027	922	0	105	0	90%	0%	10%	0%	0.0128	63.5%	0.0081	36.53%	
52	R3-21	1029	903	126	0	0	88%	12%	0%	0%	0.0128	57.0%	0.0073	42.96%	

TABLE B-43 (CONTINUED)
NED PLAN COST SHARE FEDERAL AND NON-FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
53	R3-22	978	978	0	0	0	100%	0%	0%	0%	0.0122	65.0%	0.0079	35.00%	
54	R3-23	855	775	80	100	0	91%	9%	12%	0%	0.0107	0.0%	0.0000	100.00%	
55	R3-24	1115	0	200	100	0	0%	18%	9%	0%	0.0139	4.5%	0.0006	95.52%	
Construction Reach Two Sub Totals													0.0913		23,180.4
56	R3-25	1274	0	200	0	0	0%	16%	0%	0%	0.0159	0.0%	0.0000	100.00%	
57	R3-26	1082	0	100	0	0	0%	9%	0%	0%	0.0135	0.0%	0.0000	100.00%	
58	R4-1	1082	922	160	100	0	85%	15%	9%	0%	0.0135	0.0%	0.0000	100.00%	Construction Reach Three
59	R4-2	1126	970	156	0	0	86%	14%	0%	0%	0.0140	0.0%	0.0000	100.00%	
60	R4-3	982	0	0	982	0	0%	0%	100%	0%	0.0122	0.0%	0.0000	100.00%	
61	R4-4	942	0	0	942	0	0%	0%	100%	0%	0.0117	0.0%	0.0000	100.00%	
62	R4-5	998	786	70	142	0	79%	7%	14%	0%	0.0124	58.3%	0.0072	41.70%	
63	R4-6	971	0	0	971	0	0%	0%	100%	0%	0.0121	50.0%	0.0061	50.00%	
64	R4-7	1061	0	0		100	0%	0%	0%	9%	0.0000	0.0%	0.0000	100.00%	
Construction Reach Three Sub Totals													0.0139		6,300.8
65	R4-8	2119	0				0%	0%	0%	0%					
66	R4-9	2075	0			100	0%	0%	0%	5%	0.0000	0.0%	0.0000	100.00%	*
67	R5-1	993	993	0	100	0	100%	0%	10%	0%	0.0124	0.0%	0.0000	100.00%	Construction Reach Four
68	R5-2	1003	805	198	0	0	80%	20%	0%	0%	0.0125	52.2%	0.0065	47.83%	
69	R5-3	1039	809	230	0	0	78%	22%	0%	0%	0.0129	50.6%	0.0066	49.38%	
70	R5-4	1304	1,224	80	0	0	94%	6%	0%	0%	0.0162	61.0%	0.0099	38.99%	
71	R5-5	1009	773	236	0	0	77%	23%	0%	0%	0.0126	49.8%	0.0063	50.20%	
72	R5-6	1062	858	204	0	0	81%	19%	0%	0%	0.0132	52.5%	0.0069	47.49%	
73	R5-7	1038	1,038	0	0	0	100%	0%	0%	0%	0.0129	65.0%	0.0084	35.00%	
74	R5-8	992	992	0	0	0	100%	0%	0%	0%	0.0124	0.0%	0.0000	100.00%	
75	R5-9	1027	881	146	0	0	86%	14%	0%	0%	0.0128	55.8%	0.0071	44.25%	
76	R5-10	1011	744	129	138	0	74%	13%	14%	0%	0.0126	54.7%	0.0069	45.34%	

TABLE B-43 (CONTINUED)
NED PLAN COST SHARE FEDERAL AND NON-FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
77	R5-11	1022	1,022	0	0	0	100%	0%	0%	0%	0.0127	65.0%	0.0083	35.00%	
78	R5-12	1018	578	440	0	0	57%	43%	0%	0%	0.0127	36.9%	0.0047	63.09%	
79	R5-13	1017	965	52	0	0	95%	5%	0%	0%	0.0127	61.7%	0.0078	38.33%	
80	R5-14	1005	876	129	0	0	87%	13%	0%	0%	0.0125	56.7%	0.0071	43.34%	
81	R5-15	1011	744	267	0	0	74%	26%	0%	0%	0.0126	47.8%	0.0060	52.17%	
82	R5-16	1035.2	443	592	0	0	43%	57%	0%	0%	0.0129	27.8%	0.0036	72.17%	
83	R5-17	942.6	824	119	0	0	87%	13%	0%	0%	0.0117	56.8%	0.0067	43.21%	
84	R5-18	999.9	689	311	0	0	69%	31%	0%	0%	0.0125	44.8%	0.0056	55.22%	
85	R5-19	1010.9	719	292	0	0	71%	29%	0%	0%	0.0126	46.2%	0.0058	53.78%	
86	R5-20	1028.6	487	168	374	0	47%	16%	36%	0%	0.0128	0.0%	0.0000	100.00%	*
87	R5-21	1122	684	438	100	0	61%	39%	9%	0%	0.0140	0.0%	0.0000	100.00%	*
88	R5-22	1029.7	0		100		0%	0%	10%	0%	0.0012	0.0%	0.0000	100.00%	
Construction Reach Four Sub Totals													0.1141		21,888.4
89	R5-23	1013	0				0%	0%	0%	0%					
90	R5-24	1022	0				0%	0%	0%	0%					
91	R5-25	1054	0				0%	0%	0%	0%					
92	R5-26	884	0				0%	0%	0%	0%					
93	R5-27	1044	0				0%	0%	0%	0%					
94	R5-28	1059	0				0%	0%	0%	0%					
95	R5-29	987	0	0	100		0%	0%	10%	0%	0.0000	0.0%	0.0000	100.00%	*
96	R5-30	1022	556	466	100		54%	46%	10%	0%	0.0127	0.0%	0.0000	100.00%	Construction Reach Five
97	R5-31	1015	737	278	0		73%	27%	0%	0%	0.0126	0.0%	0.0000	100.00%	
98	R5-32	985	985	0	0		100%	0%	0%	0%	0.0123	0.0%	0.0000	100.00%	
99	R5-33	1025	854	171	0		83%	17%	0%	0%	0.0128	54.2%	0.0069	45.84%	
100	R5-34	1038	936	102	0		90%	10%	0%	0%	0.0129	58.6%	0.0076	41.39%	
101	R5-35	1002	945	57	0		94%	6%	0%	0%	0.0125	61.3%	0.0077	38.70%	
102	R5-36	944	826	118	0		87%	13%	0%	0%	0.0118	0.0%	0.0000	100.00%	

TABLE B-43

NED PLAN COST SHARE FEDERAL AND NON-FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
103	R5-37	1020	820	200	0		80%	20%	0%	0%	0.0127	0.0%	0.0000	100.00%	
104	R5-38	1094	945	149	0		86%	14%	0%	0%	0.0136	0.0%	0.0000	100.00%	
105	R5-39	1024	925	99	0		90%	10%	0%	0%	0.0128	0.0%	0.0000	100.00%	
106	R5-40	1010	848	162	0		84%	16%	0%	0%	0.0126	0.0%	0.0000	100.00%	
107	R5-41	1004	274	730	0		27%	73%	0%	0%	0.0125	0.0%	0.0000	100.00%	
108	R5-42	1023	0	1,023	0		0%	100%	0%	0%	0.0127	0.0%	0.0000	100.00%	
109	R5-43	1002	918	84	0		92%	8%	0%	0%	0.0125	0.0%	0.0000	100.00%	
110	R5-44	1001	1,001	0	0		100%	0%	0%	0%	0.0125	0.0%	0.0000	100.00%	
111	R5-45	969	969	0	0		100%	0%	0%	0%	0.0121	0.0%	0.0000	100.00%	
112	R5-46	988	682	306	0		69%	31%	0%	0%	0.0123	44.9%	0.0055	55.14%	
113	R5-47	1031	675	356	0		65%	35%	0%	0%	0.0128	42.5%	0.0055	57.45%	
114	R5-48	1026	1,026	0	0		100%	0%	0%	0%	0.0128	65.0%	0.0083	35.00%	
115	R5-49	1041	1,041	0	0		100%	0%	0%	0%	0.0130	65.0%	0.0084	35.00%	
116	R5-50	1032	862	170	0		84%	16%	0%	0%	0.0129	54.3%	0.0070	45.71%	
117	R5-51	1126	943	83	100		84%	7%	9%	0%	0.0140	58.9%	0.0083	41.12%	
Construction Reach Five Sub Totals													0.0651		22,519.2
	Reach with Transition Zone														
* Designates that all or portion of reach is in a CBRA zone (all work in CRBA zone will be 100% non-Federal funded)															
TOTAL FEDERAL COST SHARE													0.3320		
TOTAL NON FEDERAL COST SHARE													0.6680		
TOTAL CONSTRUCTED PROJECT LENGTH							80,280								80280.0

TABLE B-44

TENTATIVELY SELECTED PLAN COST SHARE FEDERAL AND NON FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
			65%	0%	50%	65%	65%	0%	50%	65%					
			35%	100%	50%	35%	35%	100%	50%	35%					
1	R1-1	1250	1,250	0	0	0	100%	0%	0%	0%	0.0127	0.0%	0.0000	100.00%	*
2	R1-2	1102	560	0	542	0	51%	0%	49%	0%	0.0112	0.0%	0.0000	100.00%	*
3	R1-3	1044	0	0	1,044	0	0%	0%	100%	0%	0.0106	0.0%	0.0000	100.00%	*
4	R1-4	1002	102	0	900	0	10%	0%	90%	0%	0.0102	0.0%	0.0000	100.00%	*
5	R1-5	1062	1,062	0	0	0	100%	0%	0%	0%	0.0108	0.0%	0.0000	100.00%	Construction Reach One
6	R1-6	1045	998	47	0	0	96%	4%	0%	0%	0.0106	0.0%	0.0000	100.00%	
7	R1-7	1003	1,003	0	0	0	100%	0%	0%	0%	0.0102	0.0%	0.0000	100.00%	
8	R1-8	1061	984	77	0	0	93%	7%	0%	0%	0.0108	0.0%	0.0000	100.00%	
9	R1-9	1014	984	30	0	0	97%	3%	0%	0%	0.0103	0.0%	0.0000	100.00%	
10	R1-10	959	761	198	0	0	79%	21%	0%	0%	0.0097	0.0%	0.0000	100.00%	
11	R1-11	1021	955	66	0	0	94%	6%	0%	0%	0.0104	0.0%	0.0000	100.00%	
12	R1-12	1057	1,057	0	0	0	100%	0%	0%	0%	0.0107	65.0%	0.0070	35.00%	
13	R1-13	1040	1,040	0	0	0	100%	0%	0%	0%	0.0106	65.0%	0.0069	35.00%	
14	R1-14	1051	1,051	0	0	0	100%	0%	0%	0%	0.0107	65.0%	0.0069	35.00%	
15	R1-15	998	923	75	0	0	92%	8%	0%	0%	0.0101	60.1%	0.0061	39.89%	
16	R1-16	1025	883	142	0	0	86%	14%	0%	0%	0.0104	56.0%	0.0058	44.01%	
17	R1-17	1114	667	447	0	0	60%	40%	0%	0%	0.0113	0.0%	0.0000	100.00%	
18	R1-18	1133	1,033	100	0	0	91%	9%	0%	0%	0.0115	0.0%	0.0000	100.00%	
19	R1-19	1058	1,058	0	0	0	100%	0%	0%	0%	0.0107	0.0%	0.0000	100.00%	
20	R1-20	961	961	0	0	0	100%	0%	0%	0%	0.0098	0.0%	0.0000	100.00%	
21	R1-21	952	952	0	0	0	100%	0%	0%	0%	0.0097	0.0%	0.0000	100.00%	
22	R1-22	1028	1,028	0	0	0	100%	0%	0%	0%	0.0104	0.0%	0.0000	100.00%	
23	R1-23	1086	956	130	0	0	88%	12%	0%	0%	0.0110	0.0%	0.0000	100.00%	
24	R1-24	1039	1039	0	0	0	100%	0%	0%	0%	0.0105	0.0%	0.0000	100.00%	
25	R2-1	495	100	0	0	0	20%	0%	0%	0%	0.0010	13.1%	0.0001	86.87%	
Construction Reach One Sub Totals													0.0327		25,202.3

TABLE B-44

TENTATIVELY SELECTED PLAN COST SHARE FEDERAL AND NON FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
26	R2-2	936	0	0	0	0	0%	0%	0%	0%					
27	R2-3	2160	0	0	0	0	0%	0%	0%	0%					
28	R2-4	2066	0	0	0	0	0%	0%	0%	0%					
29	R2-5	1001	0	0	0	0	0%	0%	0%	0%					
30	R2-6	10078	0	0	0	0	0%	0%	0%	0%					
31	R2-7	1040	0	0	0	0	0%	0%	0%	0%					
32	R3-1	1147	0	0	100	0	0%	0%	9%	0%	0.0012	0.0%	0.0000	100.00%	*
33	R3-2	1037	838	199	0	0	81%	19%	0%	0%	0.0129	0.0%	0.0000	100.00%	Construction Reach Two
34	R3-3	1052	904	148	0	0	86%	14%	0%	0%	0.0131	0.0%	0.0000	100.00%	
35	R3-4	1026	914	112	0	0	89%	11%	0%	0%	0.0128	57.9%	0.0074	42.10%	
36	R3-5	1121	1,121	0	0	0	100%	0%	0%	0%	0.0140	65.0%	0.0091	35.00%	
37	R3-6	1185	1,115	70	0	0	94%	6%	0%	0%	0.0148	0.0%	0.0000	100.00%	
38	R3-7	1156	1,120	36	0	0	97%	3%	0%	0%	0.0144	0.0%	0.0000	100.00%	
39	R3-8	1103	909	194	0	0	82%	18%	0%	0%	0.0137	53.6%	0.0074	46.43%	
40	R3-9	1058	875	183	0	0	83%	17%	0%	0%	0.0132	53.8%	0.0071	46.25%	
41	R3-10	1068	1,068	0	0	0	100%	0%	0%	0%	0.0133	65.0%	0.0086	35.00%	
42	R3-11	1045	794	55	196	0	76%	5%	19%	0%	0.0130	58.8%	0.0076	41.24%	
43	R3-12	1007	824	100	83	0	82%	10%	8%	0%	0.0125	57.3%	0.0072	42.69%	
44	R3-13	1004	716	288	0	0	71%	29%	0%	0%	0.0125	46.4%	0.0058	53.65%	
45	R3-14	1345	960	385	0	0	71%	29%	0%	0%	0.0168	46.4%	0.0078	53.61%	
46	R3-15	1062	997	65	0	0	94%	6%	0%	0%	0.0132	0.0%	0.0000	100.00%	*
47	R3-16	732	732	0	0	0	100%	0%	0%	0%	0.0091	0.0%	0.0000	100.00%	*
48	R3-17	1017	758	259	0	0	75%	25%	0%	0%	0.0127	0.0%	0.0000	100.00%	
49	R3-18	1039	667	372	0	0	64%	36%	0%	0%	0.0129	0.0%	0.0000	100.00%	
50	R3-19	1036	1,036	0	0	0	100%	0%	0%	0%	0.0129	0.0%	0.0000	100.00%	
51	R3-20	1027	922	0	105	0	90%	0%	10%	0%	0.0128	63.5%	0.0081	36.53%	
52	R3-21	1029	903	126	0	0	88%	12%	0%	0%	0.0128	57.0%	0.0073	42.96%	

TABLE B-44 (CONTINUED)

TENTATIVELY SELECTED PLAN COST SHARE FEDERAL AND NON FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
53	R3-22	978	978	0	0	0	100%	0%	0%	0%	0.0122	65.0%	0.0079	35.00%	
54	R3-23	855	775	80	100	0	91%	9%	12%	0%	0.0107	0.0%	0.0000	100.00%	
55	R3-24	1115	0	200	100	0	0%	18%	9%	0%	0.0139	4.5%	0.0006	95.52%	
Construction Reach Two Sub Totals													0.0913		23,180.4
56	R3-25	1274	0	200	0	0	0%	16%	0%	0%	0.0159	0.0%	0.0000	100.00%	
57	R3-26	1082	0	100	0	0	0%	9%	0%	0%	0.0135	0.0%	0.0000	100.00%	
58	R4-1	1082	922	160	100	0	85%	15%	9%	0%	0.0135	0.0%	0.0000	100.00%	Construction Reach Three
59	R4-2	1126	970	156	0	0	86%	14%	0%	0%	0.0140	0.0%	0.0000	100.00%	
60	R4-3	982	0	0	982	0	0%	0%	100%	0%	0.0122	0.0%	0.0000	100.00%	
61	R4-4	942	0	0	942	0	0%	0%	100%	0%	0.0117	0.0%	0.0000	100.00%	
62	R4-5	998	786	70	142	0	79%	7%	14%	0%	0.0124	58.3%	0.0072	41.70%	
63	R4-6	971	0	0	971	0	0%	0%	100%	0%	0.0121	50.0%	0.0061	50.00%	
64	R4-7	1061	0	0		100	0%	0%	0%	9%	0.0000	0.0%	0.0000	100.00%	
Construction Reach Three Sub Totals													0.0139		6,300.8
65	R4-8	2119	0				0%	0%	0%	0%					
66	R4-9	2075	0			100	0%	0%	0%	5%	0.0000	0.0%	0.0000	100.00%	*
67	R5-1	993	993	0	100	0	100%	0%	10%	0%	0.0124	0.0%	0.0000	100.00%	Construction Reach Four
68	R5-2	1003	805	198	0	0	80%	20%	0%	0%	0.0125	52.2%	0.0065	47.83%	
69	R5-3	1039	809	230	0	0	78%	22%	0%	0%	0.0129	50.6%	0.0066	49.38%	
70	R5-4	1304	1,224	80	0	0	94%	6%	0%	0%	0.0162	61.0%	0.0099	38.99%	
71	R5-5	1009	773	236	0	0	77%	23%	0%	0%	0.0126	49.8%	0.0063	50.20%	
72	R5-6	1062	858	204	0	0	81%	19%	0%	0%	0.0132	52.5%	0.0069	47.49%	
73	R5-7	1038	1,038	0	0	0	100%	0%	0%	0%	0.0129	65.0%	0.0084	35.00%	
74	R5-8	992	992	0	0	0	100%	0%	0%	0%	0.0124	0.0%	0.0000	100.00%	
75	R5-9	1027	881	146	0	0	86%	14%	0%	0%	0.0128	55.8%	0.0071	44.25%	
76	R5-10	1011	744	129	138	0	74%	13%	14%	0%	0.0126	54.7%	0.0069	45.34%	

TABLE B-44 (CONTINUED)

TENTATIVELY SELECTED PLAN COST SHARE FEDERAL AND NON FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
77	R5-11	1022	1,022	0	0	0	100%	0%	0%	0%	0.0127	65.0%	0.0083	35.00%	
78	R5-12	1018	578	440	0	0	57%	43%	0%	0%	0.0127	36.9%	0.0047	63.09%	
79	R5-13	1017	965	52	0	0	95%	5%	0%	0%	0.0127	61.7%	0.0078	38.33%	
80	R5-14	1005	876	129	0	0	87%	13%	0%	0%	0.0125	56.7%	0.0071	43.34%	
81	R5-15	1011	744	267	0	0	74%	26%	0%	0%	0.0126	47.8%	0.0060	52.17%	
82	R5-16	1035.2	443	592	0	0	43%	57%	0%	0%	0.0129	27.8%	0.0036	72.17%	
83	R5-17	942.6	824	119	0	0	87%	13%	0%	0%	0.0117	56.8%	0.0067	43.21%	
84	R5-18	999.9	689	311	0	0	69%	31%	0%	0%	0.0125	44.8%	0.0056	55.22%	
85	R5-19	1010.9	719	292	0	0	71%	29%	0%	0%	0.0126	46.2%	0.0058	53.78%	
86	R5-20	1028.6	487	168	374	0	47%	16%	36%	0%	0.0128	0.0%	0.0000	100.00%	*
87	R5-21	1122	684	438	100	0	61%	39%	9%	0%	0.0140	0.0%	0.0000	100.00%	*
88	R5-22	1029.7	0		100		0%	0%	10%	0%	0.0012	0.0%	0.0000	100.00%	
Construction Reach Four Sub Totals													0.1141		21,888.4
89	R5-23	1013	0				0%	0%	0%	0%					
90	R5-24	1022	0				0%	0%	0%	0%					
91	R5-25	1054	0				0%	0%	0%	0%					
92	R5-26	884	0				0%	0%	0%	0%					
93	R5-27	1044	0				0%	0%	0%	0%					
94	R5-28	1059	0				0%	0%	0%	0%					
95	R5-29	987	0	0	100		0%	0%	10%	0%	0.0000	0.0%	0.0000	100.00%	*
96	R5-30	1022	556	466	100		54%	46%	10%	0%	0.0127	0.0%	0.0000	100.00%	Construction Reach Five
97	R5-31	1015	737	278	0		73%	27%	0%	0%	0.0126	0.0%	0.0000	100.00%	
98	R5-32	985	985	0	0		100%	0%	0%	0%	0.0123	0.0%	0.0000	100.00%	
99	R5-33	1025	854	171	0		83%	17%	0%	0%	0.0128	54.2%	0.0069	45.84%	
100	R5-34	1038	936	102	0		90%	10%	0%	0%	0.0129	58.6%	0.0076	41.39%	
101	R5-35	1002	945	57	0		94%	6%	0%	0%	0.0125	61.3%	0.0077	38.70%	
102	R5-36	944	826	118	0		87%	13%	0%	0%	0.0118	0.0%	0.0000	100.00%	
103	R5-37	1020	820	200	0		80%	20%	0%	0%	0.0127	0.0%	0.0000	100.00%	

TABLE B-44

TENTATIVELY SELECTED PLAN COST SHARE FEDERAL AND NON FEDERAL

Reach	Model Reach	Reach Length (ft)	Developed Private	Un Developed Private	Undeveloped Public	Developed Public	Percent Developed Private	Percent Undeveloped Private	Percent Undeveloped Public	Percent Developed Public	Ratio of Reach length	Federal Participation	Federal Share	Non Federal Participation	Construction Reach Length (FEET)
104	R5-38	1094	945	149	0		86%	14%	0%	0%	0.0136	0.0%	0.0000	100.00%	
105	R5-39	1024	925	99	0		90%	10%	0%	0%	0.0128	0.0%	0.0000	100.00%	
106	R5-40	1010	848	162	0		84%	16%	0%	0%	0.0126	0.0%	0.0000	100.00%	
107	R5-41	1004	274	730	0		27%	73%	0%	0%	0.0125	0.0%	0.0000	100.00%	
108	R5-42	1023	0	1,023	0		0%	100%	0%	0%	0.0127	0.0%	0.0000	100.00%	
109	R5-43	1002	918	84	0		92%	8%	0%	0%	0.0125	0.0%	0.0000	100.00%	
110	R5-44	1001	1,001	0	0		100%	0%	0%	0%	0.0125	0.0%	0.0000	100.00%	
111	R5-45	969	969	0	0		100%	0%	0%	0%	0.0121	0.0%	0.0000	100.00%	
112	R5-46	988	682	306	0		69%	31%	0%	0%	0.0123	44.9%	0.0055	55.14%	
113	R5-47	1031	675	356	0		65%	35%	0%	0%	0.0128	42.5%	0.0055	57.45%	
114	R5-48	1026	1,026	0	0		100%	0%	0%	0%	0.0128	65.0%	0.0083	35.00%	
115	R5-49	1041	1,041	0	0		100%	0%	0%	0%	0.0130	65.0%	0.0084	35.00%	
116	R5-50	1032	862	170	0		84%	16%	0%	0%	0.0129	54.3%	0.0070	45.71%	
117	R5-51	1126	943	83	100		84%	7%	9%	0%	0.0140	58.9%	0.0083	41.12%	
Construction Reach Five Sub Totals													0.0651		22,519.2
	Reach with Transition Zone														
* Designates that all or portion of reach is in a CBRA zone (all work in CRBA zone will be 100% non-Federal funded)															
TOTAL FEDERAL COST SHARE													0.2560		
TOTAL NON FEDERAL COST SHARE													0.7440		
TOTAL CONSTRUCTED PROJECT LENGTH							98,491								98,491

TABLE 45						
NED AND TSP - COSTS AND COST SHARE						
	NED Plan ($)	Percent	TSP Plan ($)	Percent	Change ($)	Change (%)
Initial Construction Cost	$55,730,000		$63,559,000		$7,829,000	
Federal	$18,558,000	33%	$18,558,000	31%	$0	-2%
Non-Federal	$37,172,000	67%	$45,001,000	69%	$7,829,000	2%
Total Renourishment Cost	$35,729,000		$40,105,000		$4,376,000	0%
Federal	$9,290,000	26%	$9,290,000	24%	$0	-2%
Non-Federal	$26,439,000	74%	$30,495,000	76%	$4,055,000	2%
Total Construction Cost	$91,459,000		$103,664,000		$12,205,000	0%
Federal	$27,486,000	30%	$27,486,000	28%	$0	-2%
Non-Federal	$63,973,000	70%	$74,894,000	72%	$10,922,000	2%
Benefits	$6,391,000		$6,559,000		$168,000.0	
Mitigation	$0.0		$0.0		$0.0	

TABLE 45A						
NED AND TSP AVERAGE ANNUAL EQUIVALENT COSTS AND COST SHARE						
	NED Plan ($)	Percent	TSP Plan ($)	Percent	Change ($)	Change (%)
Initial Construction Cost	$2,650,000		$3,022,000		$372,000	
Federal	$882,000	33%	$882,000	31%	$0	-2.5%
Non-Federal	$1,768,000	67%	$2,140,000	69%	$372,000	2.5%
Total Renourishment Cost	$1,699,000		$1,907,000		$160,000	
Federal	$442,000	26%	$442,000	24%	$0	-2.0%
Non-Federal	$1,257,000	74%	$1,465,000	76%	$160,000	2.0%
Total Construction Cost	$4,349,000		$4,929,000		$356,000	
Federal	$1,307,000	30%	$1,307,000	28%	$0	-2.3%
Non-Federal	$3,042,000	70%	$3,559,000	72%	$356,000	2.3%
OMRR&R	$125,000		$168,000		$43,500	

Table B-46															
Parking - Access - Cost Sharing Qualifying															
Sub Reach	Model Reach	MAP ID	GIS -Database Access Name	GIS - Database Address	Large Day Use Public Areas and Access Points	Day Use Parking Spaces	Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)	Peak Day Parking Demand*	Rental Parking Spaces	Visits Rental Parking Will Support (4.5 persons per Vehicle)	Total Parking	Parking Adequate or Not Adequate	Neighboring Reaches Requisite Parking Provided From	Access Adequate or Not Adequate	Qualify for Cost Sharing Yes/No
1	R1-1					0	0	55	0	0	0	Not Adequate		Not Adequate	No ***
2	R1-2					0	0	55	22	99	99	Not Adequate		Adequate	No ***
3	R1-3	A1a	Miramar Beach Regional Access W (Parking/Access)	2375 Scenic Gulf Drive	2375 Scenic Gulf Drive	85	574	574	28	126	700	Adequate		Adequate	No ***
4	R1-4	A1b	Miramar Beach Regional Access E (Parking/Access)	2375 Scenic Gulf Drive		85	574	55	15	68	641	Adequate		Adequate	No ***
5	R1-5					0	0	55	16	72	72	Adequate		Adequate	No ***
6	R1-6					0	0	55	18	81	0	Not Adequate		Not Adequate	No ***
7	R1-7					0	0	55	0	0	0	Not Adequate		Not Adequate	No ***
8	R1-8					0	0	55	10	45	0	Not Adequate		Not Adequate	No ***
9	R1-9					0	0	55	3	14	14	Adequate	R1-10	Adequate	No ***
10	R1-10	A2	Scenic Gulf Drive Access ROW (Parking/Access)	Scenic Gulf Drive		100	675	55	33	149	824	Adequate		Adequate	No ***
11	R1-11					0	0	55	16	72	0	Not Adequate		Not Adequate	No
12	R1-12					0	0	55	31	140	140	Adequate		Adequate	Yes
13	R1-13	A3	Gerinimo Street (Access)	735 Scenic Gulf Drive	735 Scenic Gulf Drive	0	0	55	76	342	342	Adequate		Adequate	Yes
14	R1-14					0	0	55	33	149	149	Adequate		Adequate	Yes
15	R1-15	A4	Norwood Drive (Access)	132 Norwood Dirve	132 Norwood Dirve	0	0	55	77	347	347	Adequate		Adequate	Yes

Table B-46 (Continued)															
Parking - Access - Cost Sharing Qualifying															
Sub Reach	**Model Reach**	**MAP ID**	**GIS -Database Access Name**	**GIS - Database Address**	**Large Day Use Public Areas and Access Points**	**Day Use Parking Spaces**	**Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)**	**Peak Day Parking Demand***	**Rental Parking Spaces**	**Visits Rental Parking Will Support (4.5 persons per Vehicle)**	**Total Parking**	**Parking Adequate or Not Adequate**	**Neighboring Reaches Requisite Parking Provided From**	**Access Adequate or Not Adequate**	**Qualify for Cost Sharing Yes/No**
16	R1-16	A5	Open Gulf (Access)	213 Open Gulf St.	Open Gulf Street	6	41	55	103	464	504	Adequate		Adequate	Yes
17	R1-17	A6, A7	Sand Trap & Tango De Mer (Parking & Access)	253 Sand Trap Rd & End of Tango De Mer	253 Sand Trap Road	3	20	55	4	18	38	Adequate	R1-16	Adequate	No ***
18	R1-18		Acess at End of Tango De Mer	Acess at End of Tango De Mer	End of Tango De Mer	0	0	55	0	0	0	Adequate	R1-19	Adequate	No ***
19	R1-19					0	0	55	55	248	0	Not Adequate		Not Adequate	No ***
20	R1-20					0	0	55	81	365	0	Not Adequate		Not Adequate	No ***
21	R1-21					0	0	55	146	657	657	Adequate		Adequate	No ***
22	R1-22	A8	Sand Destin Day Use Area (Parking & Access)		San Destin Day Use Area	110	743	743	92	414	1,157	Adequate		Adequate	No ***
23	R1-23					0	0	55	155	698	698	Adequate		Not Adequate	No ***
24	R1-24					0	0	55	0	0	0	Adequate	R1-23	Not Adequate	No ***
25	R2-1					0	0	55	0	0	0				
26	R2-2					0	0	55	0	0	0				
27	R2-3					0	0	55	0	0	0				
28	R2-4					0	0	55	0	0	0				
29	R2-5		State Park (Parking & Access)	719 Top Sail Hill Road		0	0	55	0	0	0				
30	R2-6					0	0	55	0	0	0				
31	R2-7					0	0	55	0	0	0				
32	R3-1	A10	Stallworth Preserve North (Access)	140 Stallworth Blvd.		5	34	55	0	0	34				

Table B-46 (Continued)

Parking - Access - Cost Sharing Qualifying

Sub Reach	Model Reach	MAP ID	GIS -Database Access Name	GIS - Database Address	Large Day Use Public Areas and Access Points	Day Use Parking Spaces	Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)	Peak Day Parking Demand*	Rental Parking Spaces	Visits Rental Parking Will Support (4.5 persons per Vehicle)	Total Parking	Parking Adequate or Not Adequate	Neighboring Reaches Requisite Parking Provided From	Access Adequate or Not Adequate	Qualify for Cost Sharing Yes/No
33	R3-2	A11, A12	Beach Highland & Bullard Beach Neighborhood Access (Parking & Access)	127 & 363 Highland Avenue	127 & 363 Highland Avenue	3	20	55	0	0	20	Not Adequate		Adequate	No
34	R3-3					0	0	55	5	23	23	Not Adequate		Adequate	No
35	R3-4					5	34	55	7	32	65	Adequate		Adequate	Yes
36	R3-5	A13	Dune Allen (Parking & Access)	5753 W. Co Hwy 30A	Dune Allen 5753 W. Co Hwy 30A	75	506	506	0	0	506	Adequate		Adequate	Yes
37	R3-6	A14	West Allen (Access)	5605 Co. Hwy 30-A		0	0	55	0	0	55	Not Adequate	R3-5	Adequate	Yes
38	R3-7	A15	Palms Ave W (Parking & Access)	4850 w. Co Hwy 30A		0	0	55	0	0	0	Not Adequate		Adequate	No
39	R3-8	A16a	Palms Ave E (Parking & Access)	4850 w. Co Hwy 30A		0	0	55	12	54	54	Adequate	R3-9	Adequate	Yes
40	R3-9	A16b	Lake Causeway (Access)	5173 Co Hwy 30A	4850 & 4991 & 5605 Co Hwy 30A	15	101	55	0	0	101	Adequate		Adequate	Yes
41	R3-10	A17a, A17b	Gulf Place West and Middle (Access)		4850 w. Co Hwy 30A	5	34	55	0	0	34	Adequate	R3-9	Adequate	Yes
42	R3-11	A17c, A18	Gulf Place East & Ed Walline Regional Beach Access (Parking & Access)	4447 W Co Hwy 30A	4447 W Co Hwy 30A & Gulf Place West Access Point	55	371	55	13	59	430	Adequate		Adequate	Yes
43	R3-12	A19	Spooky lane & Shellseekers (Access and Parking)	92 South Spooky Lane & 4201 W. Co. Rd. Hwy 30-A	92 South Spooky Lane & Gulf Place East Access Point	13	88	55	0	0	88	Adequate		Adequate	Yes

Table B-46 (Continued)															
Parking - Access - Cost Sharing Qualifying															
Sub Reach	Model Reach	MAP ID	GIS -Database Access Name	GIS - Database Address	Large Day Use Public Areas and Access Points	Day Use Parking Spaces	Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)	Peak Day Parking Demand*	Rental Parking Spaces	Visits Rental Parking Will Support (4.5 persons per Vehicle)	Total Parking	Parking Adequate or Not Adequate	Neighboring Reaches Requisite Parking Provided From	Access Adequate or Not Adequate	Qualify for Cost Sharing Yes/No
44	R3-13	A20				14	95	55	16	72	167	Adequate		Adequate	Yes
45	R3-14	A21	Gulfview Heights (Parking & Access)	186 Gulfview Heights St	4201 Co. Hwy 30A & 186 Gulf View Heights Street	30	203	55	0	0	203	Adequate		Adequate	Yes
46	R3-15					0	0	55	0	0	0	Adequate	R3-14	Not Adequate	No
47	R3-16					0	0	55	0	0	0	Not Adequate		Not Adequate	No
48	R3-17					0	0	55	0	0	0	Not Adequate		Not Adequate	No
49	R3-18					0	0	55	24	108	0	Not Adequate		Not Adequate	No
50	R3-19					0	0	55	111	500	0	Not Adequate		Not Adequate	No
51	R3-20					0	0	55	23	104	104	Adequate		Adequate	Yes
52	R3-21	A22, A23	Blue Mountain and Gulf Point (Parking & Access)	2365 S Co Hwy 83 & 446 Blue Mountain Road	2365 S. Co Hwy 83 & 446, 590 and 726 Blue Mountain Road	37	250	55	0	0	250	Adequate		Adequate	Yes
53	R3-22	A24	Seagrade Road Neighborhood Access (Access)	590 Blue Mountain Road		0	0	55	0	0	0	Adequate	R3-21	Adequate	Yes
54	R3-23	A25	Blue Lake (Access)	726 Blue Mountain Road		0	0	55	0	0	0	Not Adequate		Adequate	No
55	R3-24					0	0	55	0	0	0				
56	R3-25					0	0	55	0	0	0				
57	R3-26					0	0	55	0	0	0				
58	R4-1	A26	Grayton State Park (Acess & Parking)			0	0	55	0	0	0	Not Adequate		Adequate	No
59	R4-2					0	0	55	0	0	0	Not Adequate		Not Adequate	No

Table B-46 (Continued)															
Parking - Access - Cost Sharing Qualifying															
Sub Reach	Model Reach	MAP ID	GIS -Database Access Name	GIS - Database Address	Large Day Use Public Areas and Access Points	Day Use Parking Spaces	Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)	Peak Day Parking Demand*	Rental Parking Spaces	Visits Rental Parking Will Support (4.5 persons per Vehicle)	Total Parking	Parking Adequate or Not Adequate	Neighboring Reaches Requisite Parking Provided From	Access Adequate or Not Adequate	Qualify for Cost Sharing Yes/No
60	R4-3					0	0	55	0	0	0	Not Adequate		Not Adequate	No
61	R4-4					0	0	55	0	0	0	Not Adequate	R4-5	Not Adequate	No
62	R4-5	A27	Ray's Multi-Moutain (Access)	125 Sandy Lane	125 Sandy Lane	12	81	55	0	0	81	Adequate		Adequate	Yes
63	R4-6	A28, A29	Grayton Dunes and Weston (Parking & Access)	288 Garfield St & 208 Holtz Ave	288 Garfield St. & 199 Banfill St.& 208 Holtz Avenue & 913 Main Park Road	82	554	554	0	0	554	Adequate		Adequate	Yes
64	R4-7				91 Boat Ramp Road	0	0	55	0	0	0		R4-6		
65	R4-8	A301, A30B, A30C	Grayton State Park (Acess & Parking)			0	0	55	0	0	0				
66	R4-9					0	0	55	0	0	0				
67	R5-1					0	0	55	0	0	0	Not Adequate		Not Adequate	No
68	R5-2	A31	Van Ness Butler (Parking and Access)	1931 E Co Hwy 30A	Dune Allen 5753 W. Co Hwy 30A & Water Color Park Gargae and Access	100	675	675	11	50	725	Adequate		Adequate	Yes
69	R5-3					0	0	0	0	0	0	Adequate	R5-4	Adequate	Yes
70	R5-4	A32	Seaside (Access and Parking)			60	405	55	0	0	405	Adequate		Adequate	No
71	R5-5	A33	Dogwood/Thyme (Access)	2560 E. Co Hwy 30A	2560 Co Hwy 30A	0	0	55	0	0	0	Adequate	R5-6	Adequate	Yes

Table B-46 (Continued)

Parking - Access - Cost Sharing Qualifying

Sub Reach	Model Reach	MAP ID	GIS -Database Access Name	GIS - Database Address	Large Day Use Public Areas and Access Points	Day Use Parking Spaces	Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)	Peak Day Parking Demand*	Rental Parking Spaces	Visits Rental Parking Will Support (4.5 persons per Vehicle)	Total Parking	Parking Adequate or Not Adequate	Neighboring Reaches Requisite Parking Provided From	Access Adequate or Not Adequate	Qualify for Cost Sharing Yes/No
72	R5-6	A34, A35, A36	Nightcap, Live Oak, Hickory (Access)	30A at End of Nightcap Street, 2680 E. Co Hwy 30A, 2624 E. Co Hwy 30A	2624, 2680, ~2750 and 2790 Co Hwy 30 A	32	216	55	0	0	216	Adequate		Adequate	Yes
73	R5-7	A37, A38, A39	Hollywood, Azela, Hwy 395 (Access)	2790, 2845, 2920 E. Co. Hwy 30-A	2845 and 2920 Co Hwy 30A	0	0	55	0	0	0	Adequate	R5-6	Adequate	Yes
74	R5-8	A40, A41, A42	Headland, Greenwood, Gardenia (Access)	3020 Co Hwy 30A, 30 & 118 Montgomery	3020 Co Hwy 30A	4	27	55	0	0	27	Not Adequate		Adequate	No
75	R5-9	A43, A44	Dothan and Andalusia (Access)	52 South Andalusia St and South End of Dothan Ave on Montgomery St.	52 South Andalusia St and South End of Dothan Ave on Montgomery St.	0	0	55	0	0	0	Adequate	R5-9	Adequate	Yes
76	R5-10	A45, A46, A47	Santa Clara, Santa Juan, Pelayo & Montego (Parking & Access)	3458, 3512, 3468, & 3576 E. Co Hwy 30A	3458, 3512 and 3576 E. Co Hwy 30A - San Juan & Pelaya Neighborhood G A	20	135	55	0	0	135	Adequate		Adequate	Yes
77	R5-11	A48, A49	Campbell	3694 E Co Hwy 30A		0	0	55	71	320	320	Adequate		Adequate	Yes
78	R5-12	A50	Beachwood villas (Access)	3874 E. Co Hwy 30A	3694 and 3874 E. Co Hwy 30 A - (Campbell Street)	95	641	641	50	225	866	Adequate		Adequate	Yes
79	R5-13	A51	One Seagrove (Access)		57 Seagrove Place	9	61	55	70	315	376	Adequate		Adequate	Yes
80	R5-14	A52	Sugar Cliffs (Access)			0	0	55	137	617	617	Adequate		Adequate	Yes

Table B-46 (Continued)

Parking - Access - Cost Sharing Qualifying

Sub Reach	Model Reach	MAP ID	GIS -Database Access Name	GIS - Database Address	Large Day Use Public Areas and Access Points	Day Use Parking Spaces	Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)	Peak Day Parking Demand*	Rental Parking Spaces	Visits Rental Parking Will Support (4.5 persons per Vehicle)	Total Parking	Parking Adequate or Not Adequate	Neighboring Reaches Requisite Parking Provided From	Access Adequate or Not Adequate	Qualify for Cost Sharing Yes/No
81	R5-15					0	0	55	0	0	0	Adequate	R5-14	Adequate	Yes
82	R5-16	A53	Ramsgate (Access)	679 Eastern Lake Rd	679 and 491 Eastern Lake Road	0	0	55	2	9	9	Adequate	R5-17	Adequate	Yes
83	R5-17	A54	Eastern Lake (Parking & Access)	28 Lakewood Dr		0	0	55	36	162	162	Adequate		Adequate	Yes
84	R5-18	A55	Port Property (Access)	188 San Roy Rd	188 San Roy Road	6	41	55	0	0	41	Adequate	R5-17, R5-19	Adequate	Yes
85	R5-19	A56	Sugar Dunes (Access)	11 Beachside Drive	11 Beachside Dune - Sugar Dune	16	108	55	0	0	108	Adequate		Adequate	Yes
86	R5-20					10	68	55	51	230	297	Adequate		Adequate	Yes
87	R5-21	A57	Walton Dunes (Access)	258 Beachfront Taril - Walton Dune	258 Beachfront Taril - Walton Dune - Beachside Drive & Deer Lake State Park	0	0	55	9	41	41	Adequate	R5-20, R5-22	Adequate	Yes
88	R5-22					27	182	55	0	0	182				
89	R5-23					0	0	55	0	0	0				
90	R5-24					0	0	55	0	0	0				
91	R5-25					0	0	55	0	0	0				
92	R5-26					0	0	55	0	0	0				
93	R5-27					0	0	55	0	0	0				
94	R5-28					0	0	55	0	0	0				
95	R5-29					0	0	55	0	0	0				
96	R5-30					0	0	55	0	0	0	Not Adequate		Not Adequate	No
97	R5-31					0	0	55	0	0	0	Not Adequate		Adequate	No

Table B-46 (Continued)

Parking - Access - Cost Sharing Qualifying

Sub Reach	Model Reach	MAP ID	GIS -Database Access Name	GIS - Database Address	Large Day Use Public Areas and Access Points	Day Use Parking Spaces	Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)	Peak Day Parking Demand*	Rental Parking Spaces	Visits Rental Parking Will Support (4.5 persons per Vehicle)	Total Parking	Parking Adequate or Not Adequate	Neighboring Reaches Requisite Parking Provided From	Access Adequate or Not Adequate	Qualify for Cost Sharing Yes/No
98	R5-32	A58	Gulf Lake (Access)	8040 E. Co Highway 30A	8040 E Co Hwy 30A - Gulf Lakes Neighborhood	0	0	55	0	0	0	Not Adequate		Adequate	No
99	R5-33	A59	Sea Breeze (Access)	8286 E. Co Hwy 30A	8286 E. Co. Hwy 30A - Seabreeze Neighborhood B A	0	0	55	13	59	59	Adequate		Adequate	Yes
100	R5-34		Seacrest (Access)	8520 E Co Hwy 30A	Saint Lucia Lane & Rosemary Avenue & 8520 E Co Hwy30A - Seacrest Dr.	10	68	55	4	18	86	Adequate		Adequate	Yes
101	R5-35					100	675	675	6	27	702	Adequate		Adequate	Yes
102	R5-36					0	0	55	0	0	0	Not Adequate		Not Adequate	No
103	R5-37					0	0	55	0	0	0	Not Adequate		Not Adequate	No
104	R5-38					0	0	55	0	0	0	Not Adequate		Not Adequate	No
105	R5-39					0	0	55	0	0	0	Not Adequate		Not Adequate	No
106	R5-40					0	0	55	0	0	0	Not Adequate		Not Adequate	No
107	R5-41					0	0	55	0	0	0	Not Adequate		Not Adequate	No
108	R5-42					0	0	55	13	59	0	Not Adequate		Not Adequate	No
109	R5-43					0	0	55	0	0	0	Not Adequate		Not Adequate	No
110	R5-44					0	0	55	0	0	0	Not Adequate		Not Adequate	No
111	R5-45					0	0	55	0	0	0	Not Adequate		Not Adequate	No

Table B-46 (Continued)

Parking - Access - Cost Sharing Qualifying

Sub Reach	Model Reach	MAP ID	GIS -Database Access Name	GIS - Database Address	Large Day Use Public Areas and Access Points	Day Use Parking Spaces	Visits Parking Will Support (4.5 persons per Vehicle times 1.5 Turnover Rate)	Peak Day Parking Demand*	Rental Parking Spaces	Visits Rental Parking Will Support (4.5 persons per Vehicle)	Total Parking	Parking Adequate or Not Adequate	Neighboring Reaches Requisite Parking Provided From	Access Adequate or Not Adequate	Qualify for Cost Sharing Yes/No
112	R5-46	A61	Inlet beach Neighborhood (Access)	188 Winston Lane	188 Winstor lane	105	709	709	0	0	709	Adequate		Adequate	Yes
113	R5-47	A62	Wall Street (Access)	264 South Wall Street	435 West Park Place Ave. & 264 South Wall Street	76	513	513	0	0	513	Adequate		Adequate	Yes
114	R5-48	A63A	Inlet Beach Regional Access West (Parking & Access)	438 South Orange Street Center	438 South Orange Street	67	452	452	0	0	452	Adequate		Adequate	Yes
115	R5-49	A63B	Inlet Beach Regional Access Middle & East (Parking and Access)	438 South Orange Street Center	118 West Park Place Avenue FL #20	67	452	452	0	0	452	Adequate		Adequate	Yes
116	R5-50	A64	Philips Inlet (Access)	202 South Walton Lakeshore Drive	202 South Walton Lakeshore Drive Phillips Inlet Access	15	101	55	0	0	101	Adequate		Adequate	Yes
117	R5-51					0	0	55	0	0	0	Adequate	R5-49, R5-50	Adequate	Yes
TOTALS						1,559	10,523	13537**	1,698	7,641	16,743				

* Assuming Large Public Day Use Area Parking is fully utilized and remainder of parking demand is distributed uniformly throughout the study area

** Peak Day Demand (July 4th)

*** LPP Reaches not economically justified, not eligible for cost sharing

Rental Parking disqualified - No Public Access Available

LPP Construction Reaches

11.0 RESIDUAL DAMAGES AND RISK

With a project in place to reduce hurricane and storm damage not all damages will be prevented only reduced. It is important to provide information on residual damages to demonstrate project performance and communicate that fact that the project will not eliminate all risks. Table B-47 shows the average annual remaining damages that were returned by the Beach-*fx* model has provided as output from the Beach-*fx* model runs.

TABLE B-47
AVERAGE ANNUAL RESIDUAL DAMAGES - BY REACH
TENTATIVELY SELECTED PLAN

R1-1	$1,923	CONSTRUCTION REACH ONE
R1-2	$1,612	
R1-3	$2,197	
R1-4	$348	
R1-5	$430	
R1-6	$1,081	
R1-7	$1,600	
R1-8	$789	
R1-9	$1,466	
R1-10	$2,364	
R1-11	$31,577	
R1-12	$2,881	
R1-13	$3,704	
R1-14	$2,970	
R1-15	$54,058	
R1-16	$26,066	
R1-17	$1,876	
R1-18	$3,646	
R1-19	$4,544	
R1-20	$5,960	
R1-21	$2,047	
R1-22	$2,985	
R1-23	$1,064	
R1-24	$1,176	
R3-1	$0	CONSTRUCTION REACH TWO
R3-2	$53,074	
R3-3	$5,603	
R3-4	$451	
R3-5	$10,745	
R3-6	$5,766	
R3-7	$4,874	
R3-8	$11,011	
R3-9	$7,620	
R3-10	$59,828	
R3-11	$11,647	

TABLE B-47
AVERAGE ANNUAL RESIDUAL DAMAGES - BY REACH
TENTATIVELY SELECTED PLAN

R3-12	$39,648	
R3-13	$1,827	
R3-14	$15,285	
R3-15	$1,765	
R3-16	$821	
R3-17	$1,849	
R3-18	$4,649	
R3-19	$1,037	
R3-20	$12,615	
R3-21	$13,255	
R3-22	$3,675	
R3-23	$2,625	
R4-1	$9,952	CONSTRUCTION REACH THREE
R4-2	$41,990	
R4-3	$0	
R4-4	$0	
R4-5	$67,910	
R4-6	$88,265	
R5-1	$2,764	CONSTRUCTION REACH FOUR
R5-2	$1,365	
R5-3	$15,482	
R5-4	$1,432	
R5-5	$2,229	
R5-6	$9,643	
R5-7	$8,002	
R5-8	$7,205	
R5-9	$2,619	
R5-10	$3,215	
R5-11	$7,131	
R5-12	$4,623	
R5-13	$13,263	
R5-14	$3,858	
R5-15	$3,194	
R5-16	$4,445	
R5-17	$3,143	
R5-18	$4,542	
R5-19	$10,755	
R5-20	$4,287	
R5-21	$3,366	
R5-30	$3,112	CONSTRUCTION REACH FIVE
R5-31	$2,071	
R5-32	$25,530	
R5-33	$5,711	
R5-34	$2,206	
R5-35	$4,215	

TABLE B-47
AVERAGE ANNUAL RESIDUAL DAMAGES - BY REACH
TENTATIVELY SELECTED PLAN

R5-36	$19,201	
R5-37	$1,790	
R5-38	$4,991	
R5-39	$627	
R5-40	$269	
R5-41	$909	
R5-42	$412	
R5-43	$852	
R5-44	$7,534	
R5-45	$35,862	
R5-46	$5,953	
R5-47	$9,480	
R5-48	$276	
R5-49	$8,397	
R5-50	$1,108	
R5-51	$3,716	
Total	$896,936	

12.0 SENSITIVITY ANALYSIS – WORST CASE IMPACTS OF ECONOMIC DOWNTURN (2009-2010) ON PROJECT JUSTIFICATION

12.1 BACKGROUND

The economic downturn and subsequent contraction of economic activity whose full effects were measured during the years 2009 and 2010 show strong signs that a full recovery is under way. Recovery is showing up in the majority of economic activity indicators which have enjoyed a steady upwards trend but for the unemployment rates and the very low number of housing starts. This current ongoing recovery has been termed a jobless recovery. The seasonally adjusted annual unemployment rate for the Nation was 9.6 percent in 2010, 9.3 percent in 2009 and 5.8 percent in 2008. The State of Florida unemployment rate for 2009 was 12.0 percent in December of 2010, ranking 49th of 50 states and the District of Columbia. Only California and Nevada were higher with 12.5 percent and 14.5 percent respectively. Florida's historical highest unemployment rate was recorded in March of 2010 at 12.3 percent and its lowest was 3.3 percent in May of 2006.

Our analyses are performed over a 50-year time frame horizon which assumes the expansions and contractions in the economy would be smoothed out over that time and short term phenomena like the economy is experiencing now would be mostly balanced by an expansion some time later which would generally act as a canceling if not damping force. Our Planning and Guidance directs us to assume full employment in our analyses, therefore, this sensitivity analysis is to serve as an economic check to

answer the question, what if this current condition, near the historical high rate of unemployment, were to continue throughout the period of analysis would the project still be economically justified?

Manufacturing has recorded six consecutive months of expansion and the stock market indices have returned to their pre-recession levels or just a few percentages points below. The national economy is moving from contraction to expansion. The state of the housing market across the nation is marked by large devaluations to residential and commercial properties created by large surpluses as a result of a heavily oversold market, this is true as well as in Walton County. Because of the impact on formulation of the NED and tentatively selected plan from changes in added dune width optimization and the subsequent impacts which were to occur if engineering design were likewise reformulated; this sensitivity analysis is performed to determine if the project continues to be justified. If so, then the recommendation will be to keep the formulation of the project engineering and design as is as formulated in the draft General Investigation Study in the pre 2009 -2010 economic downturn.

12.2 GENERAL

The proposed Walton County's Hurricane and Storm Damage Prevention project will provide National Economic Development (NED) benefits to the Nation in special accounts: Hurricane and Storm Damage Reduction to property, the berm and dune structure, prevention of land loss and emergency nourishment cost avoidance.

12.3 OBJECTIVE

This sensitivity analysis will estimate the impact to the justification of the proposed project using the post 2009 – 2010 inventory depreciated replacement costs and the updated near shore land values.

The near shore land value which is used to measure the land loss benefit has been significantly reduced. The near shore land value in some project reaches have declined by as much as sixty-eight percent. Depreciated replacement costs (DRC) of single family residences on the beach have remained at relatively the same as they were before the 2009 – 2010 economic downturn but have increased somewhat for multi-family residences. Investors and homeowners of structures on the beach have not panicked because of the economic downturn. Relatively few structures have been sold indicating that the belief is that values are where they should be. Most of the properties do not have year round occupancy by the owner or investor. Principally they are income producing properties that are rented or leased. The DRC for walkways and dune crossovers have increased due to the rise on construction material costs the federal discount rate has reduced to four and one-eighth percent, which is used in this sensitivity analysis. Table B-48 compares the before 2009 and 2010 near shore land values and the current estimate of near shore values as impacted by the oversold condition in the housing sector of the economy.

Project benefits are also dependent upon the prevention of emergency nourishment costs. Emergency nourishment volumes have not changed because the same historical storm sets are used in both the with and without project conditions. Fuel prices used in estimating truck haul of fill in the without project condition have held at relatively the same price level, just below three dollars per gallon used in the GI study, therefore the truck haul cost remained at 30 dollars per cubic yard.

12.4 METHODOLOGY

The total project cost estimate was just recently updated and certified by the Corps' Cost Directorate of Expertise in Walla Walla, Washington. The price level of project benefits and the total project cost estimate are adjusted to comparable price levels.

TABLE B-48
UPDATED NEAR SHORE LAND VALUES

Identifier	Reach Name	Near Shore land value pre 2009//2010 per square foot	Current Estimated Near Shore land value per square foot	Difference per square foot/ % decrease
A	Miramar Beach/Scenic Gulf Drive east to Highway 98	$70.00	$30.00	-$40.00/ - 57%
B	Scenic Gulf Drive and Highway 98 east to east side of Topsail Hill Preserve State Park and Stalworth Lake	$85.00	$32.50	-$52.50/ - 62%
C	Stalworth Lake east to Highway 393	$45.00	$16.00	-$29.00/ - 64%
D	Hwy 393 east to Watercolor	$75.00	$27.50	-$47.50/ - 63%
E	West side of Watercolor to Highway 395	$112.50	$75.00	-$37.50/ - 33%
F	Highway 395 east to Eastern Lake	$67.50	$35.00	-$32.50/ - 48%
G	East side of Eastern Lake to Rosemary Beach	$35.00	$30.00	-$5.00/ - 14%
H	West side of Rosemary Beach to convergence of Highway 30A and Highway 98	$87.50	$87.50	$0.00/ - 0%
I	Highway 30A/98 Fork east to Bay County line	$77.50	$25.00	-$52.50/ - 68%
J	The west line of Bay County through Carillon Beach	$32.50	$25.00	-$7.50/ - 23%

12.5 PREVENTION OF LAND LOST BENEFITS

Average annual erosion rates are calculated in the execution of the future without project condition. With a Hurricane and Storm Damage project properly maintained in

place, land loss to erosion is prevented and valued as a benefit. Tables B-49 and B-50 show the land lost benefit for the pre 2009 – 2010 valuations and the updated reduced current valuations.

TABLE B-49
VALUE OF LAND LOST BY REACH
PRE 2009 - 2010 NEAR SHORE LAND VALUES

Reach	Model Reach	Reach Length -ft	Representative Profile	Average Annual Erosion	Land Value per Sq. Ft.	Value of Land Loss -
1	R1-1	1149.8	R1P1	0.6808	$70.00	$54,794.87
2	R1-2	1101.6	R1P1	0.6435	$70.00	$49,621.57
3	R1-3	1043.6	R1P1	0.5137	$70.00	$37,526.81
4	R1-4	1001.8	R1P1	0.3958	$70.00	$27,755.87
5	R1-5	1061.8	R1P1	0.3077	$70.00	$22,870.11
6	R1-6	1044.6	R1P1	0.0926	$70.00	$6,771.10
7	R1-7	1002.7	R1P1	0.0063	$70.00	$442.19
8	R1-8	1061.4	R1P1	0.0156	$70.00	$1,159.05
9	R1-9	1013.6	R1P1	0.0284	$70.00	$2,015.04
10	R1-10	959.4	R1P1	0.0926	$70.00	$6,218.83
11	R1-11	1021.2	R1P1	0.1216	$70.00	$8,692.45
12	R1-12	1056.7	R1P1	0.0508	$70.00	$3,757.63
13	R1-13	1040.1	R1P2	-0.0008	$70.00	-$58.25
14	R1-14	1050.6	R1P2	-0.1008	$70.00	-$7,413.03
15	R1-15	997.9	R1P2	-0.1155	$70.00	-$8,068.02
16	R1-16	1024.7	R1P2	-0.1263	$85.00	-$11,000.67
17	R1-17	1113.6	R1P2	-0.1183	$85.00	-$11,197.80
18	R1-18	1133.1	R1P2	-0.1323	$85.00	-$12,742.28
19	R1-19	1058.4	R1P2	-0.0633	$85.00	-$5,694.72
20	R1-20	961	R1P1	0.1033	$85.00	$8,438.06
21	R1-21	952.1	R1P1	0.1122	$85.00	$9,080.18
22	R1-22	1028	R1P1	0.2459	$85.00	$21,486.74
23	R1-23	1085.9	R1P1	0.3952	$85.00	$36,477.55
24	R1-24	1038.7	R1P1	0.4652	$85.00	$41,072.28
25	R2-1	990	R2P1	0.3687	$85.00	$31,026.11
26	R2-2	935.5	R2P1	0.2417	$45.00	$10,174.97
27	R2-3	2160.3	R2P2	0.3044	$45.00	$29,591.79
28	R2-4	2065.5	R2P1	0.2417	$45.00	$22,465.41
29	R2-5	1001.3	R2P2	0.1844	$45.00	$8,308.79
30	R2-6	10078.2	R2P1	-0.5495	$45.00	-$249,208.69
31	R2-7	1040.4	R2P1	0.3869	$45.00	$18,113.88
32	R3-1	1147	R3P1	0.4031	$45.00	$20,806.01
33	R3-2	1037.4	R3P1	0.4283	$45.00	$19,994.33
34	R3-3	1051.6	R3P1	0.4316	$45.00	$20,424.18
35	R3-4	1026	R3P2	0.5535	$45.00	$25,555.10
36	R3-5	1120.7	R3P2	0.4180	$45.00	$21,080.37

TABLE B-49 (CONTINUED)
VALUE OF LAND LOST BY REACH
PRE 2009 - 2010 NEAR SHORE LAND VALUES

Reach	Model Reach	Reach Length -ft	Representative Profile	Average Annual Erosion	Land Value per Sq. Ft.	Value of Land Loss -
37	R3-6	1184.9	R3P2	0.2885	$45.00	$15,382.96
38	R3-7	1155.8	R3P2	0.0960	$45.00	$4,993.06
39	R3-8	1102.9	R3P1	-0.2985	$45.00	-$14,814.70
40	R3-9	1057.8	R3P1	-0.3588	$45.00	-$17,079.24
41	R3-10	1068.2	R3P1	-0.4446	$45.00	-$21,371.48
42	R3-11	1044.7	R3P1	-0.5076	$45.00	-$23,863.04
43	R3-12	1006.8	R3P1	-0.4978	$75.00	-$37,588.88
44	R3-13	1004	R3P1	-0.5924	$75.00	-$44,607.72
45	R3-14	1345	R3P1	-0.7700	$75.00	-$77,673.75
46	R3-15	1061.8	R3P1	-0.8489	$75.00	-$67,602.15
47	R3-16	731.7	R3P1	-0.9596	$75.00	-$52,660.45
48	R3-17	1016.6	R3P1	-1.0926	$75.00	-$83,305.29
49	R3-18	1039.4	R3P1	-1.1151	$75.00	-$86,927.62
50	R3-19	1036	R3P1	-1.0589	$75.00	-$82,276.53
51	R3-20	1026.7	R3P1	-1.0373	$75.00	-$79,874.69
52	R3-21	1029	R3P1	-1.0106	$75.00	-$77,993.06
53	R3-22	978	R3P1	-0.9243	$75.00	-$67,797.41
54	R3-23	855.4	R3P1	-0.8319	$75.00	-$53,370.54
55	R3-24	1115	R3P2	-0.5435	$75.00	-$45,450.19
56	R3-25	1274	R3P2	-0.3414	$75.00	-$32,620.77
57	R3-26	1082.2	R4P1	-0.3292	$75.00	-$26,719.52
58	R4-1	1082	R4P1	-0.6703	$75.00	-$54,394.85
59	R4-2	1125.7	R4P1	-0.5439	$75.00	-$45,920.12
60	R4-3	981.5	R4P2	0.0509	$75.00	$3,746.88
61	R4-4	942.1	R4P2	0.1131	$75.00	$7,991.36
62	R4-5	998.1	R4P1	-0.2903	$75.00	-$21,731.13
63	R4-6	971.4	R4P2	0.0925	$75.00	$6,739.09
64	R4-7	1060.9	R4P2	-0.1046	$75.00	-$8,322.76
65	R4-8	2119.2	R4P1	-0.5521	$75.00	-$87,750.77
66	R4-9	2074.7	R4P1	-0.9889	$75.00	-$153,875.31
67	R5-1	993.1	R5P2	-0.8973	$112.50	-$100,249.72
68	R5-2	1003	R5P2	-0.6237	$112.50	-$70,376.75
69	R5-3	1039.4	R5P2	-0.3263	$112.50	-$38,155.07
70	R5-4	1303.7	R5P2	-0.0772	$112.50	-$11,322.63
71	R5-5	1009.2	R5P2	0.1001	$112.50	$11,364.85
72	R5-6	1061.5	R5P1	-0.2592	$112.50	-$30,953.34
73	R5-7	1037.5	R5P1	-0.3266	$112.50	-$38,120.34
74	R5-8	991.6	R5P1	-0.4109	$67.50	-$27,502.77
75	R5-9	1026.5	R5P2	-0.2260	$67.50	-$15,659.26
76	R5-10	1010.7	R5P2	-0.2626	$67.50	-$17,915.16
77	R5-11	1022.2	R5P2	-0.2847	$67.50	-$19,643.87

TABLE B-49 (CONTINUED)
VALUE OF LAND LOST BY REACH
PRE 2009 - 2010 NEAR SHORE LAND VALUES

Reach	Model Reach	Reach Length -ft	Representative Profile	Average Annual Erosion	Land Value per Sq. Ft.	Value of Land Loss -
78	R5-12	1018	R5P2	-0.2734	$67.50	-$18,786.68
79	R5-13	1016.5	R5P2	-0.2876	$67.50	-$19,733.31
80	R5-14	1005.3	R5P2	-0.2623	$67.50	-$17,799.09
81	R5-15	1011	R5P2	-0.3549	$67.50	-$24,219.26
82	R5-16	1035.2	R5P2	-0.3543	$67.50	-$24,757.07
83	R5-17	942.6	R5P3	-0.2078	$67.50	-$13,221.38
84	R5-18	999.9	R5P2	-0.3578	$67.50	-$24,149.08
85	R5-19	1010.9	R5P3	-0.0820	$35.00	-$2,901.28
86	R5-20	1028.6	R5P2	0.0051	$35.00	$183.61
87	R5-21	1122	R5P2	-0.0141	$35.00	-$553.71
88	R5-22	1029.7	R5P3	-0.0545	$35.00	-$1,964.15
89	R5-23	1013.1	R5P3	-0.0144	$35.00	-$510.60
90	R5-24	1021.7	R5P2	-0.1929	$35.00	-$6,898.01
91	R5-25	1054.4	R5P2	-0.4140	$35.00	-$15,278.26
92	R5-26	884.4	R5P1	-0.4138	$35.00	-$12,808.77
93	R5-27	1044.2	R5P3	-0.2764	$35.00	-$10,101.59
94	R5-28	1058.5	R5P3	-0.3145	$35.00	-$11,651.44
95	R5-29	986.7	R5P2	-0.4391	$87.50	-$37,910.25
96	R5-30	1021.8	R5P2	-0.3674	$87.50	-$32,848.32
97	R5-31	1014.9	R5P2	-0.3815	$87.50	-$33,878.63
98	R5-32	984.6	R5P1	-0.7184	$87.50	-$61,891.96
99	R5-33	1025.3	R5P1	-0.6970	$87.50	-$62,530.48
100	R5-34	1037.8	R5P1	-0.5918	$87.50	-$53,739.88
101	R5-35	1002.2	R5P1	-0.6019	$87.50	-$52,782.12
102	R5-36	943.7	R5P1	-0.6839	$87.50	-$56,472.19
103	R5-37	1019.9	R5P1	-0.9037	$87.50	-$80,647.32
104	R5-38	1094.1	R5P1	-0.9874	$87.50	-$94,527.50
105	R5-39	1024.2	R5P1	-1.1019	$87.50	-$98,749.52
106	R5-40	1009.7	R5P2	-0.5617	$87.50	-$49,625.49
107	R5-41	1003.7	R5P2	-0.5106	$87.50	-$44,842.81
108	R5-42	1022.6	R5P2	-0.3367	$87.50	-$30,127.07
109	R5-43	1002.2	R5P2	-0.2136	$87.50	-$18,731.12
110	R5-44	1000.5	R5P2	-0.0640	$87.50	-$5,602.80
111	R5-45	968.6	R5P2	0.0031	$87.50	$262.73
112	R5-46	987.6	R5P2	0.0848	$87.50	$7,327.99
113	R5-47	1030.6	R5P2	0.0123	$77.50	$982.42
114	R5-48	1026.4	R5P3	0.0289	$77.50	$2,298.88
115	R5-49	1041.1	R5P3	-0.1516	$77.50	-$12,231.88
116	R5-50	1031.8	R5P3	-0.2372	$77.50	-$18,967.58
117	R5-51	1025.9	R5P3	-0.3640	$77.50	-$28,940.64

TABLE B-50
VALUE OF LAND LOST BY REACH
CURRENT UPDATED NEAR SHORE LAND VALUES

Reach	Model Reach	Reach Length -ft	Representative Profile	Average Annual Erosion	Land Value per Sq. Ft.	Value of Land Loss -
1	R1-1	1149.8	R1P1	0.6808	$30.00	$23,483.52
2	R1-2	1101.6	R1P1	0.6435	$30.00	$21,266.39
3	R1-3	1043.6	R1P1	0.5137	$30.00	$16,082.92
4	R1-4	1001.8	R1P1	0.3958	$30.00	$11,895.37
5	R1-5	1061.8	R1P1	0.3077	$30.00	$9,801.48
6	R1-6	1044.6	R1P1	0.0926	$30.00	$2,901.90
7	R1-7	1002.7	R1P1	0.0063	$30.00	$189.51
8	R1-8	1061.4	R1P1	0.0156	$30.00	$496.74
9	R1-9	1013.6	R1P1	0.0284	$30.00	$863.59
10	R1-10	959.4	R1P1	0.0926	$30.00	$2,665.21
11	R1-11	1021.2	R1P1	0.1216	$30.00	$3,725.34
12	R1-12	1056.7	R1P1	0.0508	$30.00	$1,610.41
13	R1-13	1040.1	R1P2	-0.0008	$30.00	-$24.96
14	R1-14	1050.6	R1P2	-0.1008	$30.00	-$3,177.01
15	R1-15	997.9	R1P2	-0.1155	$30.00	-$3,457.72
16	R1-16	1024.7	R1P2	-0.1263	$32.50	-$4,206.14
17	R1-17	1113.6	R1P2	-0.1183	$32.50	-$4,281.51
18	R1-18	1133.1	R1P2	-0.1323	$32.50	-$4,872.05
19	R1-19	1058.4	R1P2	-0.0633	$32.50	-$2,177.39
20	R1-20	961	R1P1	0.1033	$32.50	$3,226.32
21	R1-21	952.1	R1P1	0.1122	$32.50	$3,471.83
22	R1-22	1028	R1P1	0.2459	$32.50	$8,215.52
23	R1-23	1085.9	R1P1	0.3952	$32.50	$13,947.30
24	R1-24	1038.7	R1P1	0.4652	$32.50	$15,704.11
25	R2-1	990	R2P1	0.3687	$32.50	$11,862.92
26	R2-2	935.5	R2P1	0.2417	$16.00	$3,617.77
27	R2-3	2160.3	R2P2	0.3044	$16.00	$10,521.53
28	R2-4	2065.5	R2P1	0.2417	$16.00	$7,987.70
29	R2-5	1001.3	R2P2	0.1844	$16.00	$2,954.24
30	R2-6	10078.2	R2P1	-0.5495	$16.00	-$88,607.53
31	R2-7	1040.4	R2P1	0.3869	$16.00	$6,440.49
32	R3-1	1147	R3P1	0.4031	$16.00	$7,397.69
33	R3-2	1037.4	R3P1	0.4283	$16.00	$7,109.09
34	R3-3	1051.6	R3P1	0.4316	$16.00	$7,261.93
35	R3-4	1026	R3P2	0.5535	$16.00	$9,086.26
36	R3-5	1120.7	R3P2	0.4180	$16.00	$7,495.24
37	R3-6	1184.9	R3P2	0.2885	$16.00	$5,469.50
38	R3-7	1155.8	R3P2	0.0960	$16.00	$1,775.31
39	R3-8	1102.9	R3P1	-0.2985	$16.00	-$5,267.45
40	R3-9	1057.8	R3P1	-0.3588	$16.00	-$6,072.62
41	R3-10	1068.2	R3P1	-0.4446	$16.00	-$7,598.75

TABLE B-50 (CONTINUED)
VALUE OF LAND LOST BY REACH
CURRENT UPDATED NEAR SHORE LAND VALUES

Reach	Model Reach	Reach Length -ft	Representative Profile	Average Annual Erosion	Land Value per Sq. Ft.	Value of Land Loss -
42	R3-11	1044.7	R3P1	-0.5076	$16.00	-$8,484.64
43	R3-12	1006.8	R3P1	-0.4978	$27.50	-$13,782.59
44	R3-13	1004	R3P1	-0.5924	$27.50	-$16,356.16
45	R3-14	1345	R3P1	-0.7700	$27.50	-$28,480.38
46	R3-15	1061.8	R3P1	-0.8489	$27.50	-$24,787.46
47	R3-16	731.7	R3P1	-0.9596	$27.50	-$19,308.83
48	R3-17	1016.6	R3P1	-1.0926	$27.50	-$30,545.27
49	R3-18	1039.4	R3P1	-1.1151	$27.50	-$31,873.46
50	R3-19	1036	R3P1	-1.0589	$27.50	-$30,168.06
51	R3-20	1026.7	R3P1	-1.0373	$27.50	-$29,287.39
52	R3-21	1029	R3P1	-1.0106	$27.50	-$28,597.45
53	R3-22	978	R3P1	-0.9243	$27.50	-$24,859.05
54	R3-23	855.4	R3P1	-0.8319	$27.50	-$19,569.20
55	R3-24	1115	R3P2	-0.5435	$27.50	-$16,665.07
56	R3-25	1274	R3P2	-0.3414	$27.50	-$11,960.95
57	R3-26	1082.2	R4P1	-0.3292	$27.50	-$9,797.16
58	R4-1	1082	R4P1	-0.6703	$27.50	-$19,944.78
59	R4-2	1125.7	R4P1	-0.5439	$27.50	-$16,837.38
60	R4-3	981.5	R4P2	0.0509	$27.50	$1,373.85
61	R4-4	942.1	R4P2	0.1131	$27.50	$2,930.17
62	R4-5	998.1	R4P1	-0.2903	$27.50	-$7,968.08
63	R4-6	971.4	R4P2	0.0925	$27.50	$2,471.00
64	R4-7	1060.9	R4P2	-0.1046	$27.50	-$3,051.68
65	R4-8	2119.2	R4P1	-0.5521	$27.50	-$32,175.28
66	R4-9	2074.7	R4P1	-0.9889	$27.50	-$56,420.95
67	R5-1	993.1	R5P2	-0.8973	$75.00	-$66,833.15
68	R5-2	1003	R5P2	-0.6237	$75.00	-$46,917.83
69	R5-3	1039.4	R5P2	-0.3263	$75.00	-$25,436.72
70	R5-4	1303.7	R5P2	-0.0772	$75.00	-$7,548.42
71	R5-5	1009.2	R5P2	0.1001	$75.00	$7,576.57
72	R5-6	1061.5	R5P1	-0.2592	$75.00	-$20,635.56
73	R5-7	1037.5	R5P1	-0.3266	$75.00	-$25,413.56
74	R5-8	991.6	R5P1	-0.4109	$35.00	-$14,260.70
75	R5-9	1026.5	R5P2	-0.2260	$35.00	-$8,119.62
76	R5-10	1010.7	R5P2	-0.2626	$35.00	-$9,289.34
77	R5-11	1022.2	R5P2	-0.2847	$35.00	-$10,185.71
78	R5-12	1018	R5P2	-0.2734	$35.00	-$9,741.24
79	R5-13	1016.5	R5P2	-0.2876	$35.00	-$10,232.09
80	R5-14	1005.3	R5P2	-0.2623	$35.00	-$9,229.16
81	R5-15	1011	R5P2	-0.3549	$35.00	-$12,558.14
82	R5-16	1035.2	R5P2	-0.3543	$35.00	-$12,837.00

TABLE B-50 (CONTINUED)
VALUE OF LAND LOST BY REACH
CURRENT UPDATED NEAR SHORE LAND VALUES

Reach	Model Reach	Reach Length -ft	Representative Profile	Average Annual Erosion	Land Value per Sq. Ft.	Value of Land Loss -
83	R5-17	942.6	R5P3	-0.2078	$35.00	-$6,855.53
84	R5-18	999.9	R5P2	-0.3578	$35.00	-$12,521.75
85	R5-19	1010.9	R5P3	-0.0820	$30.00	-$2,486.81
86	R5-20	1028.6	R5P2	0.0051	$30.00	$157.38
87	R5-21	1122	R5P2	-0.0141	$30.00	-$474.61
88	R5-22	1029.7	R5P3	-0.0545	$30.00	-$1,683.56
89	R5-23	1013.1	R5P3	-0.0144	$30.00	-$437.66
90	R5-24	1021.7	R5P2	-0.1929	$30.00	-$5,912.58
91	R5-25	1054.4	R5P2	-0.4140	$30.00	-$13,095.65
92	R5-26	884.4	R5P1	-0.4138	$30.00	-$10,978.94
93	R5-27	1044.2	R5P3	-0.2764	$30.00	-$8,658.51
94	R5-28	1058.5	R5P3	-0.3145	$30.00	-$9,986.95
95	R5-29	986.7	R5P2	-0.4391	$87.50	-$37,910.25
96	R5-30	1021.8	R5P2	-0.3674	$87.50	-$32,848.32
97	R5-31	1014.9	R5P2	-0.3815	$87.50	-$33,878.63
98	R5-32	984.6	R5P1	-0.7184	$87.50	-$61,891.96
99	R5-33	1025.3	R5P1	-0.6970	$87.50	-$62,530.48
100	R5-34	1037.8	R5P1	-0.5918	$87.50	-$53,739.88
101	R5-35	1002.2	R5P1	-0.6019	$87.50	-$52,782.12
102	R5-36	943.7	R5P1	-0.6839	$87.50	-$56,472.19
103	R5-37	1019.9	R5P1	-0.9037	$87.50	-$80,647.32
104	R5-38	1094.1	R5P1	-0.9874	$87.50	-$94,527.50
105	R5-39	1024.2	R5P1	-1.1019	$87.50	-$98,749.52
106	R5-40	1009.7	R5P2	-0.5617	$87.50	-$49,625.49
107	R5-41	1003.7	R5P2	-0.5106	$87.50	-$44,842.81
108	R5-42	1022.6	R5P2	-0.3367	$87.50	-$30,127.07
109	R5-43	1002.2	R5P2	-0.2136	$87.50	-$18,731.12
110	R5-44	1000.5	R5P2	-0.0640	$87.50	-$5,602.80
111	R5-45	968.6	R5P2	0.0031	$87.50	$262.73
112	R5-46	987.6	R5P2	0.0848	$87.50	$7,327.99
113	R5-47	1030.6	R5P2	0.0123	$25.00	$316.91
114	R5-48	1026.4	R5P3	0.0289	$25.00	$741.57
115	R5-49	1041.1	R5P3	-0.1516	$25.00	-$3,945.77
116	R5-50	1031.8	R5P3	-0.2372	$25.00	-$6,118.57
117	R5-51	1025.9	R5P3	-0.3640	$25.00	-$9,335.69

12.6 DUNE WIDTH OPTIMIZATION FUTURE WITH PROJECT CONDITION

Sensitivity runs were performed on all of the dune optimization alternatives to determine if the project remains justified and indicate any the impacts upon formulation. The alternatives evaluated are added dune width on the previously optimized berm width

alternative. Early on, while evaluating additional berm width alternatives, only the results showed that justified reaches were very small and there were wide gaps of unjustified reaches. There was maybe only one somewhat contiguous reach that could have been economically justified. Then added dune width was added as a damage reducing mechanism to protect the toe of the dune which was showing evidence of erosion from wave attack. All berm widths were evaluated with a constant 20 feet of added dune width, and it was noticed that numerous more reaches were very justified so added dune width which protected the toe of the dune performed very well protecting the dunes of Walton County and gave significant protection to the project. The key to storm damage reduction in the high dune climate at Walton County was to protect the toe of the dune which helps in preventing dune sloughing. Since the majority of storm damage reduction benefits are rooted in additional dune width, those alternatives were re-evaluated for justification. The results are presented in the following tables. Added dune widths of 0, 10, 20, 30 and 40 feet were evaluated and the statistics are presented in Tables B-51 to B-56.

TABLE B-51
OPTIMIZED BERM WIDTH – NO ADDED DUNE WIDTH

Reach	Damage Reduction DW00	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW00	Summed Net Benefits DW00
R1-1	$13,790	$656	$22,628	$1,658	$2,314	$722,786	$34,369	0.067	-$32,055	
R1-2	$17,542	$834	$21,746	$760	$1,594	$690,370	$32,828	0.049	-$31,234	
R1-3	$23,522	$1,118	$16,531	$860	$1,979	$637,849	$30,330	0.065	-$28,352	
R1-4	$19,128	$910	$12,262	$947	$1,856	$652,415	$31,023	0.060	-$29,167	
R1-5	$8,308	$395	$10,066	$1,097	$1,492	$667,846	$31,757	0.047	-$30,265	
R1-6	$20,314	$966	$3,040	$1,220	$2,186	$777,559	$36,974	0.059	-$34,788	
R1-7	$33,893	$1,612	$271	$1,260	$2,871	$754,123	$35,859	0.080	-$32,988	
R1-8	$20,627	$981	$732	$1,320	$2,301	$779,792	$37,080	0.062	-$34,779	
R1-9	$38,660	$1,838	$1,125	$1,261	$3,100	$731,033	$34,761	0.089	-$31,662	
R1-10	$29,025	$1,380	$2,792	$1,128	$2,508	$639,046	$30,387	0.083	-$27,879	
R1-11	$2,111,260	$100,393	$3,707	$1,198	$101,590	$721,411	$34,304	2.961	$67,286	
R1-12	$134,057	$6,375	$1,807	$1,275	$7,650	$803,442	$38,204	0.200	-$30,555	
R1-13	$2,621,829	$124,671	-$31	$1,351	$126,052	$744,773	$35,415	3.559	$90,638	
R1-14	$2,490,545	$118,428	-$3,467	$1,641	$123,536	$810,607	$38,545	3.205	$84,991	
R1-15	$997,740	$47,444	-$4,550	$2,177	$54,171	$503,268	$23,931	2.264	$30,240	
R1-16	$1,846,130	$87,785	-$5,362	$2,224	$95,371	$539,581	$25,658	3.717	$69,713	**$312,314**
R1-17	$48,323	$2,298	-$5,465	$2,412	$10,175	$548,009	$26,058	0.390	-$15,883	
R1-18	$97,210	$4,622	-$6,187	$2,457	$13,266	$553,880	$26,338	0.504	-$13,071	
R1-19	$83,170	$3,955	-$3,233	$2,285	$9,473	$574,029	$27,296	0.347	-$17,822	
R1-20	$95,810	$4,556	$2,311	$2,005	$6,561	$137,207	$6,524	1.006	$37	
R1-21	$9,520	$453	$3,589	$1,095	$1,548	$699,267	$33,251	0.047	-$31,703	
R1-22	$34,889	$1,659	$8,653	$1,035	$2,694	$689,029	$32,764	0.082	-$30,070	
R1-23	$13,903	$661	$14,399	$1,013	$1,674	$717,604	$34,123	0.049	-$32,449	
R1-24	$142,497	$6,776	$16,204	$866	$7,641	$611,333	$29,070	0.263	-$21,428	

TABLE B-51 (CONTINUED)
OPTIMIZED BERM WIDTH – NO ADDED DUNE WIDTH

Reach	Damage Reduction DW00	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW00	Summed Net Benefits DW00
R2-1	$2,270	$0	$13,063	$598	$598	$0	$0	0.000	$0	
R2-2	$0	$0	$4,236	$0	$0	$0	$0	0.000	$0	
R2-3	$0	$0	$11,959	$0	$0	$0	$0	0.000	$0	
R2-4	$0	$0	$9,353	$0	$0	$0	$0	0.000	$0	
R2-5	$0	$0	$3,573	$0	$0	$0	$0	0.000	$0	
R2-6	$0	$0	-$83,044	$0	$83,044	$0	$0	0.000	$0	
R2-7	$0	$0	$7,141	$0	$0	$0	$0	0.000	$0	
R3-1	$199,810	$9,501	$5,891	$24,947	$34,448	$1,191,330	$56,649	0.608	-$22,201	
R3-2	$2,357,436	$112,098	$5,627	$23,658	$135,756	$1,007,056	$47,886	2.835	$87,870	
R3-3	$333,777	$15,871	$5,906	$24,046	$39,917	$947,403	$45,050	0.886	-$5,133	
R3-4	$10,947	$521	$8,487	$4,945	$5,466	$289,544	$13,768	0.397	-$8,303	
R3-5	$96,900	$4,608	$6,688	$5,603	$10,211	$380,855	$18,110	0.564	-$7,899	
R3-6	$108,389	$5,154	$4,474	$6,233	$11,387	$433,586	$20,617	0.552	-$9,230	
R3-7	$65,911	$3,134	$703	$6,395	$9,529	$433,330	$20,605	0.462	-$11,076	
R3-8	$117,844	$5,604	-$9,617	$26,457	$41,678	$1,039,621	$49,435	0.843	-$7,757	
R3-9	$596,952	$28,386	-$9,884	$25,180	$63,450	$1,046,856	$49,779	1.275	$13,670	
R3-10	$2,794,558	$132,884	-$12,203	$25,793	$170,880	$1,102,238	$52,413	3.260	$118,468	
R3-11	$860,940	$40,939	-$13,222	$25,305	$79,466	$1,066,094	$50,694	1.568	$28,772	
R3-12	$1,706,825	$81,161	-$21,956	$24,328	$127,445	$1,033,505	$49,144	2.593	$78,301	
R3-13	$1,156,401	$54,988	-$25,401	$24,456	$104,846	$1,016,554	$48,338	2.169	$56,508	
R3-14	$1,700,341	$80,853	-$44,459	$33,306	$158,618	$1,508,733	$71,742	2.211	$86,876	
R3-15	$33,003	$1,569	-$38,631	$26,434	$66,635	$1,141,150	$54,263	1.228	$12,372	
R3-16	$9,434	$449	-$30,464	$18,467	$49,380	$800,063	$38,044	1.298	$11,336	
R3-17	$161,310	$7,670	-$47,442	$25,790	$80,903	$1,153,330	$54,842	1.475	$26,061	
R3-18	$400,038	$19,022	-$49,993	$26,381	$95,396	$1,225,524	$58,275	1.637	$37,121	
R3-19	$1,513,857	$71,985	-$46,980	$26,270	$145,236	$1,163,552	$55,328	2.625	$89,908	
R3-20	$4,040,625	$192,136	-$46,022	$26,011	$264,168	$1,203,450	$57,225	4.616	$206,943	
R3-21	$1,119,176	$53,218	-$44,965	$26,018	$124,201	$1,240,216	$58,974	2.106	$65,227	
R3-22	$301,930	$14,357	-$39,078	$24,496	$77,932	$1,142,968	$54,349	1.434	$23,583	
R3-23	$276,630	$13,154	-$30,816	$21,282	$65,252	$979,392	$46,571	1.401	$18,681	**$912,297**
R3-24	$10,225	$0	-$18,581	$7,322	$0	$0	$0	0.000	$0	
R3-25	-$10,198	$0	-$13,979	$7,972	$0	$0	$0	0.000	$0	
R3-26	$0	$0	-$7,529	$0	$0	$0	$0	0.000	$0	
R4-1	$22,624	$1,076	-$22,733	$26,171	$49,980	$190,124	$9,041	5.528	$40,939	
R4-2	$82,816	$3,938	-$17,522	$26,718	$48,178	$293,418	$13,952	3.453	$34,225	$75,165
R4-3	$0	$0	$2,348	$0	$0	$142,320	$0	0.000	$0	
R4-4	$0	$0	$3,860	$0	$0	$59,895	$0	0.000	$0	
R4-5	$212,312	$10,096	-$7,878	$23,197	$41,170	$174,258	$8,286	4.969	$32,884	
R4-6	$32,526	$1,547	$2,378	$5,399	$6,946	$29,204	$1,389	5.002	$5,557	$38,441
R4-7	$0	$0	-$3,297	$5,986	$0	$0	$0	0.000	$0	
R4-8	$0	$0	-$27,507	$0	$0	$0	$0	0.000	$0	
R4-9	$0	$0	-$52,376	$0	$0	$0	$0	0.000	$0	

TABLE B-51 (CONTINUED)
OPTIMIZED BERM WIDTH – NO ADDED DUNE WIDTH

Reach	Damage Reduction DW00	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW00	Summed Net Benefits DW00
R5-1	$28,547	$1,357	-$65,843	$13,267	$80,467	$435,289	$20,698	3.888	$59,768	
R5-2	$32,644	$1,552	-$45,737	$12,035	$59,324	$380,502	$18,093	3.279	$41,231	
R5-3	$33,389	$1,588	-$23,776	$10,917	$36,281	$339,095	$16,124	2.250	$20,157	
R5-4	$28,153	$1,339	-$5,084	$12,065	$18,488	$330,158	$15,699	1.178	$2,789	
R5-5	$100,252	$4,767	$10,142	$8,641	$13,408	$260,402	$12,382	1.083	$1,026	
R5-6	$3,224,682	$153,337	-$10,350	$17,186	$180,873	$911,755	$43,355	4.172	$137,518	
R5-7	$4,372,101	$207,898	-$15,952	$17,083	$240,932	$905,590	$43,062	5.595	$197,870	
R5-8	$1,928,218	$91,689	-$10,377	$16,855	$118,921	$896,122	$42,611	2.791	$76,309	
R5-9	$49,174	$2,338	-$7,078	$10,125	$19,541	$364,118	$17,314	1.129	$2,227	
R5-10	$55,733	$2,650	-$8,738	$10,268	$21,656	$333,174	$15,843	1.367	$5,813	
R5-11	$215,229	$10,234	-$9,588	$10,496	$30,319	$368,517	$17,523	1.730	$12,795	
R5-12	$64,935	$3,088	-$9,121	$10,424	$22,633	$310,603	$14,769	1.532	$7,864	
R5-13	$130,073	$6,185	-$9,535	$10,403	$26,123	$392,444	$18,661	1.400	$7,462	
R5-14	$72,686	$3,456	-$8,691	$10,083	$22,231	$357,647	$17,006	1.307	$5,224	
R5-15	$63,395	$3,014	-$11,925	$10,730	$25,670	$371,512	$17,666	1.453	$8,004	
R5-16	$220,428	$10,482	-$11,884	$10,950	$33,316	$358,687	$17,056	1.953	$16,260	
R5-17	$26,962	$1,282	-$7,819	$2,956	$12,057	$233,169	$11,087	1.087	$969	
R5-18	$107,934	$5,132	-$11,759	$10,445	$27,336	$162,674	$7,735	3.534	$19,601	
R5-19	$147,232	$7,001	-$3,184	$3,047	$13,233	$219,156	$10,421	1.270	$2,811	
R5-20	$44,560	$2,119	$1,142	$9,036	$11,155	$271,148	$12,893	0.865	-$1,738	
R5-21	$54,067	$2,571	$202	$9,963	$12,534	$289,990	$13,789	0.909	-$1,255	**$622,705**
R5-22	$0	$0	-$1,853	$0	$0	$0	$0	0.000	$0	
R5-23	$0	$0	-$699	$0	$0	$0	$0	0.000	$0	
R5-24	$0	$0	-$4,659	$0	$0	$0	$0	0.000	$0	
R5-25	$0	$0	-$11,704	$0	$0	$0	$0	0.000	$0	
R5-26	$0	$0	-$9,313	$0	$0	$0	$0	0.000	$0	
R5-27	$0	$0	-$8,897	$0	$0	$0	$0	0.000	$0	
R5-28	$0	$0	-$10,193	$0	$0	$0	$0	0.000	$0	
R5-29	$0	$0	-$34,189	$0	$0	$0	$0	0.000	$0	
R5-30	$40,237	$1,913	-$31,024	$10,827	$43,764	$367,222	$17,462	2.506	$26,302	
R5-31	$316,946	$15,071	-$31,703	$10,722	$57,496	$385,074	$18,311	3.140	$39,185	
R5-32	$1,736,474	$82,571	-$52,553	$17,647	$152,771	$922,089	$43,846	3.484	$108,925	
R5-33	$713,989	$33,951	-$51,765	$18,446	$104,162	$933,718	$44,399	2.346	$59,763	
R5-34	$291,574	$13,865	-$41,227	$18,079	$73,170	$933,207	$44,375	1.649	$28,795	
R5-35	$426,201	$20,266	-$40,514	$17,448	$78,228	$887,506	$42,202	1.854	$36,026	
R5-36	$4,116,646	$195,751	-$45,746	$16,745	$258,241	$926,362	$44,049	5.863	$214,192	
R5-37	$313,694	$14,916	-$71,304	$19,309	$105,529	$973,843	$46,307	2.279	$59,222	
R5-38	$677,501	$32,216	-$85,107	$21,213	$138,536	$1,150,877	$54,725	2.531	$83,810	
R5-39	$133,767	$6,361	-$88,452	$20,024	$114,838	$957,806	$45,545	2.521	$69,293	
R5-40	$8,089	$385	-$47,885	$11,375	$59,645	$359,529	$17,096	3.489	$42,549	
R5-41	$23,257	$1,106	-$41,980	$11,011	$54,097	$359,413	$17,090	3.165	$37,006	
R5-42	$9,355	$445	-$28,454	$10,512	$39,411	$345,235	$16,416	2.401	$22,995	

TABLE B-51 (CONTINUED)
OPTIMIZED BERM WIDTH – NO ADDED DUNE WIDTH

Reach	Damage Reduction DW00	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW00	Summed Net Benefits DW00
R5-43	$15,851	$754	-$16,135	$9,713	$26,602	$290,822	$13,829	1.924	$12,773	
R5-44	-$5,731	-$273	-$2,976	$9,075	$11,779	$272,058	$12,937	0.910	-$1,158	
R5-45	-$25,142	-$1,196	$3,051	$8,380	$7,184	$252,172	$11,991	0.599	-$4,807	
R5-46	$183,046	$8,704	$10,715	$8,307	$17,011	$264,720	$12,588	1.351	$4,423	
R5-47	$394,981	$18,782	$1,211	$8,628	$27,410	$320,987	$15,263	1.796	$12,146	
R5-48	$3,159	$150	$334	$2,950	$3,100	$197,382	$9,386	0.330	-$6,285	
R5-49	-$7,508	-$357	-$4,633	$3,115	$7,390	$299,078	$14,221	0.520	-$6,831	
R5-50	$3,059	$145	-$6,629	$3,149	$9,923	$17,717	$842	11.779	$9,081	
R5-51	$14,052	$668	-$9,926	$3,288	$13,882	$294,107	$13,985	0.993	-$103	**$847,304**

TABLE B-52
OPTIMIZED BERM WIDTH – 10 FEET OF ADDED DUNE WIDTH

Reach	Damage Reduction DW10	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW10	Summed Net Benefits DW10
R1-1	$26,440	$1,257	$22,628	$1,659	$2,916	$1,093,581	$52,001	0.056	-$49,085	
R1-2	$49,159	$2,338	$21,746	$760	$3,097	$1,028,476	$48,905	0.063	-$45,808	
R1-3	$52,516	$2,497	$16,531	$861	$3,358	$954,802	$45,402	0.074	-$42,044	
R1-4	$17,581	$836	$12,262	$947	$1,783	$960,314	$45,664	0.039	-$43,881	
R1-5	$14,089	$670	$10,066	$1,097	$1,767	$999,252	$47,515	0.037	-$45,748	
R1-6	$34,475	$1,639	$3,040	$1,220	$2,859	$1,120,972	$53,303	0.054	-$50,444	
R1-7	$67,234	$3,197	$271	$1,260	$4,457	$1,092,591	$51,954	0.086	-$47,497	
R1-8	$34,319	$1,632	$732	$1,321	$2,953	$1,135,924	$54,014	0.055	-$51,062	
R1-9	$43,779	$2,082	$1,125	$1,261	$3,343	$1,067,820	$50,776	0.066	-$47,433	
R1-10	$29,995	$1,426	$2,792	$1,128	$2,555	$950,394	$45,192	0.057	-$42,638	
R1-11	$2,375,937	$112,978	$3,707	$1,198	$114,176	$1,046,053	$49,741	2.295	$64,435	
R1-12	$192,388	$9,148	$1,807	$1,275	$10,424	$1,141,243	$54,267	0.192	-$43,844	
R1-13	$2,893,878	$137,607	-$31	$1,351	$138,989	$1,074,718	$51,104	2.720	$87,885	
R1-14	$2,802,156	$133,245	-$3,467	$1,642	$138,354	$1,182,862	$56,246	2.460	$82,108	
R1-15	$2,594,956	$123,393	-$4,550	$2,177	$130,121	$823,993	$39,182	3.321	$90,939	
R1-16	$1,727,363	$82,138	-$5,362	$2,224	$89,723	$862,881	$41,031	2.187	$48,693	
R1-17	$80,973	$3,850	-$5,465	$2,412	$11,728	$893,116	$42,469	0.276	-$30,741	$330,215
R1-18	$139,801	$6,648	-$6,187	$2,458	$15,292	$908,943	$43,221	0.354	-$27,929	

TABLE B-52 (CONTINUED)
OPTIMIZED BERM WIDTH – 10 FEET OF ADDED DUNE WIDTH

Reach	Damage Reduction DW10	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW10	Summed Net Benefits DW10
R1-19	$102,174	$4,858	-$3,233	$2,285	$10,377	$908,084	$43,180	0.240	-$32,803	
R1-20	$115,838	$5,508	$2,311	$2,006	$7,514	$805,427	$38,299	0.196	-$30,785	
R1-21	$53,711	$2,554	$3,589	$1,095	$3,649	$1,030,529	$49,003	0.074	-$45,354	
R1-22	$63,455	$3,017	$8,653	$1,035	$4,052	$1,011,988	$48,121	0.084	-$44,069	
R1-23	$35,235	$1,675	$14,399	$1,013	$2,688	$1,074,825	$51,109	0.053	-$48,421	
R1-24	$163,796	$7,789	$16,204	$866	$8,654	$987,550	$46,959	0.184	-$38,305	
R2-1	$0	$0	$13,063	$598	$598	$0	$0	$ -	$0	
R2-2	$0	$0	$4,236	$0	$0	$0	$0	$ -	$0	
R2-3	$0	$0	$11,959	$0	$0	$0	$0	$ -	$0	
R2-4	$0	$0	$9,353	$0	$0	$0	$0	$ -	$0	
R2-5	$0	$0	$3,573	$0	$0	$0	$0	$ -	$0	
R2-6	$0	$0	-$83,044	$0	$83,044	$0	$0	$ -	$0	
R2-7	$0	$0	$7,141	$0	$0	$0	$0	$ -	$0	
R3-1	$177,922	$8,460	$5,891	$24,947	$33,408	$1,462,820	$69,559	0.480	-$36,151	
R3-2	$2,002,561	$95,224	$5,627	$23,658	$118,882	$1,242,625	$59,088	2.012	$59,794	
R3-3	$294,588	$14,008	$5,906	$24,046	$38,054	$1,181,366	$56,175	0.677	-$18,121	
R3-4	$17,007	$809	$8,487	$4,945	$5,754	$437,513	$20,804	0.277	-$15,050	
R3-5	$248,251	$11,805	$6,688	$5,603	$17,408	$553,079	$26,299	0.662	-$8,892	
R3-6	$89,741	$4,267	$4,474	$6,233	$10,501	$623,339	$29,640	0.354	-$19,140	
R3-7	$138,507	$6,586	$703	$6,395	$12,982	$627,010	$29,815	0.435	-$16,833	
R3-8	$143,276	$6,813	-$9,617	$26,457	$42,888	$1,298,951	$61,766	0.694	-$18,879	
R3-9	$617,467	$29,361	-$9,884	$25,180	$64,425	$1,292,794	$61,474	1.048	$2,952	
R3-10	$2,220,756	$105,599	-$12,203	$25,793	$143,596	$1,351,515	$64,266	2.234	$79,330	
R3-11	$761,321	$36,202	-$13,222	$25,306	$74,729	$1,307,998	$62,197	1.201	$12,532	
R3-12	$1,156,397	$54,988	-$21,956	$24,329	$101,272	$1,265,086	$60,156	1.683	$41,116	
R3-13	$1,150,851	$54,724	-$25,401	$24,457	$104,582	$1,249,851	$59,432	1.760	$45,150	
R3-14	$1,771,935	$84,257	-$44,459	$33,306	$162,022	$1,827,405	$86,895	1.865	$75,127	
R3-15	$71,684	$3,409	-$38,631	$26,435	$68,474	$1,397,560	$66,455	1.030	$2,019	
R3-16	$28,074	$1,335	-$30,464	$18,467	$50,266	$977,658	$46,489	1.081	$3,778	
R3-17	$149,792	$7,123	-$47,442	$25,790	$80,355	$1,402,687	$66,699	1.205	$13,656	
R3-18	$363,284	$17,275	-$49,993	$26,381	$93,648	$1,480,541	$70,401	1.330	$23,247	
R3-19	$1,504,492	$71,540	-$46,980	$26,271	$144,791	$1,414,296	$67,251	2.153	$77,540	
R3-20	$4,192,109	$199,339	-$46,022	$26,011	$271,372	$1,452,029	$69,045	3.930	$202,326	
R3-21	$1,095,868	$52,110	-$44,965	$26,018	$123,092	$1,487,321	$70,724	1.740	$52,369	
R3-22	$329,407	$15,664	-$39,078	$24,497	$79,239	$1,378,488	$65,548	1.209	$13,690	

TABLE B-52 (CONTINUED)
OPTIMIZED BERM WIDTH – 10 FEET OF ADDED DUNE WIDTH

Reach	Damage Reduction DW10	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW10	Summed Net Benefits DW10
R3-23	$252,654	$12,014	-$30,816	$21,282	$64,112	$1,184,704	$56,334	1.138	$7,778	$615,488
R3-24	$0	$0	-$18,581	$7,322	$25,904	$0	$0	$ -	$0	
R3-25	$0	$0	-$13,979	$7,973	$21,951	$0	$0	$ -	$0	
R3-26	$0	$0	-$7,529	$0	$7,529	$0	$0	$ -	$0	
R4-1	-$21,012	-$999	-$22,733	$26,171	$47,905	$245,679	$11,682	4.101	$36,223	
R4-2	-$122,806	-$5,840	-$17,522	$26,718	$38,400	$342,575	$16,290	2.357	$22,111	$58,334
R4-3	$0	$0	$2,348	$0	$0	$175,936	$8,366	-	-$8,366	
R4-4	$0	$0	$3,860	$0	$0	$91,479	$4,350	-	-$4,350	
R4-5	$1,077,211	$51,222	-$7,878	$23,197	$82,297	$209,879	$9,980	8.246	$72,317	
R4-6	$1,850,336	$87,985	$2,378	$5,399	$93,385	$41,227	$1,960	47.636	$91,424	$163,741
R4-7	$0	$0	-$3,297	$5,986	$9,283	$0	$0	$ -	$0	
R4-8	$0	$0	-$27,507	$0	$27,507	$0	$0	$ -	$0	
R4-9	$0	$0	-$52,376	$0	$52,376	$0	$0	$ -	$0	
R5-1	$84,950	$4,039	-$65,843	$13,267	$83,149	$713,056	$33,907	2.452	$49,242	
R5-2	$57,623	$2,740	-$45,737	$12,036	$60,512	$647,081	$30,769	1.967	$29,743	
R5-3	$376,455	$17,901	-$23,776	$10,917	$52,594	$603,128	$28,679	1.834	$23,915	
R5-4	$45,627	$2,170	-$5,084	$12,065	$19,319	$643,329	$30,591	0.632	-$11,272	
R5-5	$127,442	$6,060	$10,142	$8,641	$14,701	$492,487	$23,418	0.628	-$8,717	
R5-6	$3,312,541	$157,515	-$10,350	$17,186	$185,051	$1,257,820	$59,811	3.094	$125,240	
R5-7	$4,486,827	$213,353	-$15,952	$17,083	$246,388	$1,242,966	$59,104	4.169	$187,283	
R5-8	$2,009,656	$95,561	-$10,377	$16,855	$122,794	$1,219,582	$57,992	2.117	$64,801	
R5-9	$98,195	$4,669	-$7,078	$10,125	$21,872	$615,973	$29,290	0.747	-$7,418	
R5-10	$100,125	$4,761	-$8,738	$10,268	$23,767	$586,293	$27,879	0.853	-$4,112	
R5-11	$251,739	$11,970	-$9,588	$10,496	$32,055	$625,738	$29,754	1.077	$2,300	
R5-12	$123,463	$5,871	-$9,121	$10,424	$25,416	$564,827	$26,858	0.946	-$1,442	
R5-13	$408,697	$19,434	-$9,535	$10,403	$39,372	$647,180	$30,774	1.279	$8,598	
R5-14	$132,942	$6,322	-$8,691	$10,084	$25,096	$608,596	$28,939	0.867	-$3,843	
R5-15	$124,312	$5,911	-$11,925	$10,731	$28,566	$628,575	$29,889	0.956	-$1,323	
R5-16	$217,711	$10,352	-$11,884	$10,950	$33,187	$621,296	$29,543	1.123	$3,644	
R5-17	$70,512	$3,353	-$7,819	$2,956	$14,128	$344,141	$16,364	0.863	-$2,237	
R5-18	$135,727	$6,454	-$11,759	$10,445	$28,658	$595,140	$28,299	1.013	$359	
R5-19	$166,733	$7,928	-$3,184	$3,047	$14,160	$325,160	$15,462	0.916	-$1,302	

TABLE B-52 (CONTINUED)
OPTIMIZED BERM WIDTH – 10 FEET OF ADDED DUNE WIDTH

Reach	Damage Reduction DW10	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW10	Summed Net Benefits DW10
R5-20	$104,648	$4,976	$1,142	$9,036	$14,013	$512,478	$24,369	0.575	-$10,356	
R5-21	$81,619	$3,881	$202	$9,963	$13,844	$555,388	$26,409	0.524	-$12,565	**$430,539**
R5-22	$0	$0	-$1,853	$0	$1,853	$0	$0	$ -	$0	
R5-23	$0	$0	-$699	$0	$699	$0	$0	$ -	$0	
R5-24	$0	$0	-$4,659	$0	$4,659	$0	$0	$ -	$0	
R5-25	$0	$0	-$11,704	$0	$11,704	$0	$0	$ -	$0	
R5-26	$0	$0	-$9,313	$0	$9,313	$0	$0	$ -	$0	
R5-27	$0	$0	-$8,897	$0	$8,897	$0	$0	$ -	$0	
R5-28	$0	$0	-$10,193	$0	$10,193	$0	$0	$ -	$0	
R5-29	$0	$0	-$34,189	$0	$34,189	$0	$0	$ -	$0	
R5-30	$83,019	$3,948	-$31,024	$10,827	$45,799	$627,438	$29,835	1.535	$15,963	
R5-31	$361,948	$17,211	-$31,703	$10,722	$59,636	$643,549	$30,601	1.949	$29,034	
R5-32	$1,934,825	$92,003	-$52,553	$17,647	$162,203	$1,245,685	$59,234	2.738	$102,969	
R5-33	$806,800	$38,364	-$51,765	$18,447	$108,576	$1,268,632	$60,325	1.800	$48,251	
R5-34	$327,300	$15,563	-$41,227	$18,079	$74,869	$1,271,420	$60,457	1.238	$14,412	
R5-35	$473,196	$22,501	-$40,514	$17,448	$80,463	$1,212,663	$57,663	1.395	$22,800	
R5-36	$3,941,642	$187,429	-$45,746	$16,745	$249,920	$1,233,004	$58,631	4.263	$191,289	
R5-37	$340,379	$16,185	-$71,304	$19,309	$106,798	$1,304,941	$62,051	1.721	$44,747	
R5-38	$754,159	$35,861	-$85,107	$21,213	$142,181	$1,506,116	$71,617	1.985	$70,564	
R5-39	$142,335	$6,768	-$88,452	$20,025	$115,245	$1,299,624	$61,798	1.865	$53,447	
R5-40	$13,212	$628	-$47,885	$11,376	$59,889	$623,337	$29,640	2.021	$30,249	
R5-41	$41,435	$1,970	-$41,980	$11,011	$54,961	$620,092	$29,486	1.864	$25,475	
R5-42	$16,598	$789	-$28,454	$10,513	$39,756	$604,228	$28,732	1.384	$11,024	
R5-43	$33,357	$1,586	-$16,135	$9,713	$27,434	$538,230	$25,593	1.072	$1,841	
R5-44	$157,552	$7,492	-$2,976	$9,075	$19,543	$510,440	$24,272	0.805	-$4,729	
R5-45	$756,356	$35,966	$3,051	$8,380	$44,346	$480,652	$22,855	1.940	$21,490	
R5-46	$238,025	$11,318	$10,715	$8,307	$19,625	$490,658	$23,331	0.841	-$3,706	
R5-47	-$285,593	-$13,580	$1,211	$8,628	-$4,952	$247,219	$11,756	(0.421)	-$16,708	
R5-48	$6,644	$316	$334	$2,950	$3,266	$314,980	$14,978	0.218	-$11,711	
R5-49	$178,689	$8,497	-$4,633	$3,115	$16,244	$465,180	$22,120	0.734	-$5,875	
R5-50	$8,676	$413	-$6,629	$3,149	$10,191	$551,821	$26,240	0.388	-$16,049	
R5-51	$83,695	$3,980	-$9,926	$3,288	$17,194	$450,823	$21,437	0.802	-$4,243	$620,533

TABLE B-53
OPTIMIZED BERM WIDTH – 20 FEET OF ADDED DUNE WIDTH

Reach	Damage Reduction DW20	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW20	Summed Net Benefits DW20
R1-1	$27,980	$1,330	$22,628	$646	$1,976	$1,417,319	$67,395	0.029	-$65,419	
R1-2	$49,220	$2,340	$21,746	$760	$3,100	$1,338,060	$63,626	0.049	-$60,526	
R1-3	$53,244	$2,532	$16,531	$861	$3,392	$1,249,540	$59,417	0.057	-$56,025	
R1-4	$17,630	$838	$12,262	$947	$1,785	$1,242,814	$59,097	0.030	-$57,312	
R1-5	$14,194	$675	$10,066	$1,097	$1,772	$1,298,303	$61,736	0.029	-$59,964	
R1-6	$34,534	$1,642	$3,040	$1,220	$2,862	$1,415,470	$67,307	0.043	-$64,445	
R1-7	$67,280	$3,199	$271	$1,260	$4,459	$1,374,242	$65,347	0.068	-$60,887	
R1-8	$34,303	$1,631	$732	$1,321	$2,952	$1,433,949	$68,186	0.043	-$65,234	
R1-9	$46,163	$2,195	$1,125	$1,261	$3,457	$1,352,355	$64,306	0.054	-$60,849	
R1-10	$31,880	$1,516	$2,792	$1,128	$2,644	$1,219,726	$57,999	0.046	-$55,355	
R1-11	$2,669,471	$126,936	$3,707	$1,198	$128,134	$1,332,714	$63,372	2.022	$64,762	
R1-12	$192,771	$9,166	$1,807	$1,275	$10,442	$1,437,794	$68,369	0.153	-$57,927	
R1-13	$2,896,636	$137,738	-$31	$1,351	$139,120	$1,366,592	$64,983	2.141	$74,137	
R1-14	$2,805,319	$133,396	-$3,467	$1,642	$138,504	$1,475,949	$70,183	1.973	$68,322	
R1-15	$3,461,218	$164,584	-$4,550	$2,177	$171,312	$1,089,928	$51,827	3.305	$119,485	
R1-16	$2,191,508	$104,208	-$5,362	$2,224	$111,794	$1,133,670	$53,907	2.074	$57,887	
R1-17	$81,805	$3,890	-$5,465	$2,412	$11,767	$1,186,113	$56,401	0.209	-$44,634	**$326,666**
R1-18	$140,865	$6,698	-$6,187	$2,458	$15,342	$1,207,197	$57,403	0.267	-$42,061	
R1-19	$104,693	$4,978	-$3,233	$2,285	$10,497	$1,186,587	$56,423	0.186	-$45,926	
R1-20	$91,942	$4,372	$2,311	$2,006	$6,378	$240,270	$11,425	0.558	-$5,048	
R1-21	$53,711	$2,554	$3,589	$1,095	$3,649	$1,294,685	$61,564	0.059	-$57,914	
R1-22	$65,519	$3,115	$8,653	$1,035	$4,150	$1,298,117	$61,727	0.067	-$57,576	
R1-23	$35,259	$1,677	$14,399	$1,013	$2,690	$1,376,251	$65,442	0.041	-$62,753	
R1-24	$164,180	$7,807	$16,204	$866	$8,673	$1,276,311	$60,690	0.143	-$52,017	
R2-1	$0	$0	$13,063	$598	$598	$0	$0	$ -	$0	
R2-2	$0	$0	$4,236	$0	$0	$0	$0	$ -	$0	
R2-3	$0	$0	$11,959	$0	$0	$0	$0	$ -	$0	
R2-4	$0	$0	$9,353	$0	$0	$0	$0	$ -	$0	
R2-5	$0	$0	$3,573	$0	$0	$0	$0	$ -	$0	
R2-6	$0	$0	-$83,044	$0	$83,044	$0	$0	$ -	$0	
R2-7	$0	$0	$7,141	$0	$0	$0	$0	$ -	$0	
R3-1	$208,887	$9,933	$5,891	$24,947	$34,880	$1,763,852	$83,873	0.416	-$48,993	
R3-2	$2,409,584	$114,578	$5,627	$23,658	$138,236	$1,505,664	$71,596	1.931	$66,640	
R3-3	$349,155	$16,603	$5,906	$24,046	$40,649	$1,453,579	$69,119	0.588	-$28,470	
R3-4	$17,353	$825	$8,487	$4,945	$5,770	$711,435	$33,829	0.171	-$28,059	
R3-5	$252,656	$12,014	$6,688	$5,603	$17,617	$852,962	$40,559	0.434	-$22,942	
R3-6	$94,574	$4,497	$4,474	$6,233	$10,730	$940,961	$44,744	0.240	-$34,013	
R3-7	$140,222	$6,668	$703	$6,395	$13,063	$941,171	$44,754	0.292	-$31,691	
R3-8	$205,512	$9,772	-$9,617	$26,457	$45,847	$1,585,621	$75,398	0.608	-$29,551	
R3-9	$758,155	$36,051	-$9,884	$25,180	$71,115	$1,571,916	$74,746	0.951	-$3,631	
R3-10	$3,481,788	$165,562	-$12,203	$25,793	$203,559	$1,631,281	$77,569	2.624	$125,990	
R3-11	$993,154	$47,225	-$13,222	$25,306	$85,753	$1,586,476	$75,439	1.137	$10,314	
R3-12	$1,921,570	$91,373	-$21,956	$24,329	$137,657	$1,532,643	$72,879	1.889	$64,778	
R3-13	$1,183,206	$56,263	-$25,401	$24,457	$106,120	$1,512,571	$71,924	1.475	$34,196	
R3-14	$1,970,212	$93,686	-$44,459	$33,306	$171,451	$2,189,298	$104,103	1.647	$67,347	
R3-15	$71,684	$3,409	-$38,631	$26,435	$68,474	$1,678,647	$79,821	0.858	-$11,347	
R3-16	$28,074	$1,335	-$30,464	$18,467	$50,266	$1,172,519	$55,754	0.902	-$5,488	

TABLE B-53 (CONTINUED)
OPTIMIZED BERM WIDTH – 20 FEET OF ADDED DUNE WIDTH

Reach	Damage Reduction DW20	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW20	Summed Net Benefits DW20
R3-17	$181,481	$8,630	-$47,442	$25,790	$81,862	$1,673,978	$79,599	1.028	$2,263	
R3-18	$456,492	$21,707	-$49,993	$26,381	$98,080	$1,757,530	$83,572	1.174	$14,508	
R3-19	$1,528,670	$72,690	-$46,980	$26,271	$145,940	$1,691,568	$80,436	1.814	$65,505	
R3-20	$4,643,380	$220,797	-$46,022	$26,011	$292,830	$1,728,797	$82,206	3.562	$210,624	
R3-21	$1,400,046	$66,574	-$44,965	$26,018	$137,556	$1,765,395	$83,946	1.639	$53,610	
R3-22	$417,501	$19,853	-$39,078	$24,497	$83,428	$1,642,616	$78,108	1.068	$5,320	
R3-23	$314,983	$14,978	-$30,816	$21,282	$67,076	$1,414,807	$67,275	0.997	-$200	$525,703
R3-24	$0	$0	-$18,581	$7,322	$25,904	$0	$0	$ -	$0	
R3-25	$0	$0	-$13,979	$7,973	$21,951	$0	$0	$ -	$0	
R3-26	$0	$0	-$7,529	$0	$7,529	$0	$0	$ -	$0	
R4-1	-$11,245	-$535	-$22,733	$26,171	$48,370	$312,455	$14,858	3.256	$33,512	
R4-2	-$113,998	-$5,421	-$17,522	$26,718	$38,819	$413,011	$19,639	1.977	$19,180	$52,692
R4-3	$0	$0	$2,348	$0	$0	$213,448	$10,150	-	-$10,150	
R4-4	$0	$0	$3,860	$0	$0	$126,787	$6,029	-	-$6,029	
R4-5	$1,079,036	$51,309	-$7,878	$23,197	$82,384	$266,759	$12,685	6.495	$69,699	
R4-6	$1,850,336	$87,985	$2,378	$5,399	$93,385	$64,677	$3,075	30.365	$90,309	$160,008
R4-7	$0	$0	-$3,297	$5,986	$9,283	$0	$0	$ -	$0	
R4-8	$0	$0	-$27,507	$0	$27,507	$0	$0	$ -	$0	
R4-9	$0	$0	-$52,376	$0	$52,376	$0	$0	$ -	$0	
R5-1	$89,008	$4,232	-$65,843	$13,267	$83,342	$993,899	$47,261	1.763	$36,081	
R5-2	$58,491	$2,781	-$45,737	$12,036	$60,554	$928,665	$44,159	1.371	$16,395	
R5-3	$376,433	$17,900	-$23,776	$10,917	$52,593	$893,959	$42,509	1.237	$10,085	
R5-4	$46,797	$2,225	-$5,084	$12,065	$19,375	$1,007,036	$47,886	0.405	-$28,511	
R5-5	$130,998	$6,229	$10,142	$8,641	$14,870	$774,082	$36,808	0.404	-$21,938	
R5-6	$3,380,304	$160,737	-$10,350	$17,186	$188,273	$1,593,353	$75,766	2.485	$112,507	
R5-7	$4,528,238	$215,322	-$15,952	$17,083	$248,357	$1,571,556	$74,729	3.323	$173,628	
R5-8	$2,051,984	$97,574	-$10,377	$16,855	$124,806	$1,532,547	$72,874	1.713	$51,932	
R5-9	$99,714	$4,741	-$7,078	$10,125	$21,944	$900,572	$42,823	0.512	-$20,879	
R5-10	$104,205	$4,955	-$8,738	$10,268	$23,961	$867,429	$41,247	0.581	-$17,286	
R5-11	$237,962	$11,315	-$9,588	$10,496	$31,400	$910,575	$43,299	0.725	-$11,899	
R5-12	$125,965	$5,990	-$9,121	$10,424	$25,535	$848,683	$40,356	0.633	-$14,820	
R5-13	$411,749	$19,579	-$9,535	$10,403	$39,517	$930,104	$44,227	0.893	-$4,710	
R5-14	$135,467	$6,442	-$8,691	$10,084	$25,216	$887,775	$42,215	0.597	-$16,999	
R5-15	$125,861	$5,985	-$11,925	$10,731	$28,640	$909,784	$43,261	0.662	-$14,621	
R5-16	$251,385	$11,954	-$11,884	$10,950	$34,788	$909,322	$43,239	0.805	-$8,451	
R5-17	$71,553	$3,402	-$7,819	$2,956	$14,177	$531,333	$25,265	0.561	-$11,088	
R5-18	$119,286	$5,672	-$11,759	$10,445	$27,876	$451,732	$21,480	1.298	$6,396	
R5-19	$197,669	$9,399	-$3,184	$3,047	$15,631	$519,605	$24,708	0.633	-$9,077	
R5-20	$110,187	$5,240	$1,142	$9,036	$14,276	$798,624	$37,975	0.376	-$23,699	
R5-21	$87,636	$4,167	$202	$9,963	$14,130	$866,094	$41,184	0.343	-$27,053	**$175,992**
R5-22	$0	$0	-$1,853	$0	$1,853	$0	$0	$ -	$0	
R5-23	$0	$0	-$699	$0	$699	$0	$0	$ -	$0	
R5-24	$0	$0	-$4,659	$0	$4,659	$0	$0	$ -	$0	
R5-25	$0	$0	-$11,704	$0	$11,704	$0	$0	$ -	$0	
R5-26	$0	$0	-$9,313	$0	$9,313	$0	$0	$ -	$0	
R5-27	$0	$0	-$8,897	$0	$8,897	$0	$0	$ -	$0	
R5-28	$0	$0	-$10,193	$0	$10,193	$0	$0	$ -	$0	

TABLE B-53 (CONTINUED)
OPTIMIZED BERM WIDTH – 20 FEET OF ADDED DUNE WIDTH

Reach	Damage Reduction DW20	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW20	Summed Net Benefits DW20
R5-29	$0	$0	-$34,189	$0	$34,189	$0	$0	$ -	$0	
R5-30	$87,314	$4,152	-$31,024	$10,827	$46,003	$911,052	$43,321	1.062	$2,681	
R5-31	$362,887	$17,256	-$31,703	$10,722	$59,680	$925,122	$43,990	1.357	$15,690	
R5-32	$2,110,678	$100,365	-$52,553	$17,647	$170,565	$1,554,802	$73,932	2.307	$96,632	
R5-33	$832,606	$39,591	-$51,765	$18,447	$109,803	$1,597,136	$75,945	1.446	$33,857	
R5-34	$336,523	$16,002	-$41,227	$18,079	$75,308	$1,604,235	$76,283	0.987	-$975	
R5-35	$490,293	$23,314	-$40,514	$17,448	$81,276	$1,534,699	$72,976	1.114	$8,300	
R5-36	$4,167,716	$198,179	-$45,746	$16,745	$260,670	$1,534,802	$72,981	3.572	$187,688	
R5-37	$348,726	$16,582	-$71,304	$19,309	$107,195	$1,632,304	$77,618	1.381	$29,577	
R5-38	$777,585	$36,975	-$85,107	$21,213	$143,295	$1,858,566	$88,377	1.621	$54,918	
R5-39	$145,910	$6,938	-$88,452	$20,025	$115,415	$1,623,051	$77,178	1.495	$38,237	
R5-40	$13,244	$630	-$47,885	$11,376	$59,890	$903,780	$42,976	1.394	$16,915	
R5-41	$41,483	$1,973	-$41,980	$11,011	$54,964	$896,665	$42,637	1.289	$12,326	
R5-42	$16,613	$790	-$28,454	$10,513	$39,756	$887,569	$42,205	0.942	-$2,448	
R5-43	$33,370	$1,587	-$16,135	$9,713	$27,435	$816,019	$38,802	0.707	-$11,368	
R5-44	$157,552	$7,492	-$2,976	$9,075	$19,543	$786,707	$37,409	0.522	-$17,866	
R5-45	$756,356	$35,966	$3,051	$8,380	$44,346	$748,279	$35,581	1.246	$8,764	
R5-46	$259,633	$12,346	$10,715	$8,307	$20,653	$764,609	$36,358	0.568	-$15,705	
R5-47	$453,840	$21,581	$1,211	$8,628	$30,209	$852,338	$40,530	0.745	-$10,321	
R5-48	$7,293	$347	$334	$2,950	$3,297	$512,971	$24,392	0.135	-$21,095	
R5-49	$178,689	$8,497	-$4,633	$3,115	$16,244	$686,751	$32,656	0.497	-$16,411	
R5-50	$7,867	$374	-$6,629	$3,149	$10,152	$775,706	$36,886	0.275	-$26,733	
R5-51	$84,237	$4,006	-$9,926	$3,288	$17,220	$675,405	$32,116	0.536	-$14,897	**$367,768**

TABLE B-54
OPTIMIZED BERM WIDTH – 30 FEET OF ADDED DUNE WIDTH

Reach	Damage Reduction DW30	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW30	Summed Net Benefits DW30
R1-1	$11,501	$547	$22,628	$646	$1,193	$1,522,275	$72,386	0.016	-$71,193	
R1-2	$10,254	$488	$21,746	$760	$1,247	$1,440,805	$68,512	0.018	-$67,264	
R1-3	$17,004	$809	$16,531	$861	$1,669	$1,346,456	$64,025	0.026	-$62,356	
R1-4	$17,593	$837	$12,262	$947	$1,783	$1,333,467	$63,408	0.028	-$61,624	
R1-5	$7,189	$342	$10,066	$1,097	$1,439	$1,391,941	$66,188	0.022	-$64,749	
R1-6	$16,490	$784	$3,040	$1,220	$2,004	$1,498,667	$71,263	0.028	-$69,259	
R1-7	$26,440	$1,257	$271	$1,260	$2,517	$1,450,241	$68,960	0.037	-$66,443	
R1-8	$18,457	$878	$732	$1,321	$2,198	$1,515,263	$72,052	0.031	-$69,854	
R1-9	$35,807	$1,703	$1,125	$1,261	$2,964	$1,431,202	$68,055	0.044	-$65,091	
R1-10	$22,931	$1,090	$2,792	$1,128	$2,219	$1,297,438	$61,694	0.036	-$59,476	
R1-11	$2,659,517	$126,463	$3,707	$1,198	$127,660	$1,417,532	$67,405	1.894	$60,255	
R1-12	$123,289	$5,863	$1,807	$1,275	$7,138	$1,524,599	$72,496	0.098	-$65,358	
R1-13	$2,834,338	$134,776	-$31	$1,351	$136,157	$1,451,695	$69,030	1.972	$67,128	
R1-14	$2,798,976	$133,094	-$3,467	$1,642	$138,203	$1,545,167	$73,474	1.881	$64,729	
R1-15	$3,838,772	$182,537	-$4,550	$2,177	$189,265	$1,151,418	$54,751	3.457	$134,514	
R1-16	$2,294,935	$109,126	-$5,362	$2,224	$116,712	$1,201,735	$57,144	2.042	$59,568	
R1-17	$40,409	$1,921	-$5,465	$2,412	$9,799	$1,263,497	$60,081	0.163	-$50,282	**$320,836**
R1-18	$84,027	$3,996	-$6,187	$2,458	$12,640	$1,284,458	$61,077	0.207	-$48,437	
R1-19	$71,581	$3,404	-$3,233	$2,285	$8,923	$1,257,326	$59,787	0.149	-$50,865	
R1-20	$79,631	$3,787	$2,311	$2,006	$5,792	$1,122,553	$53,378	0.109	-$47,586	
R1-21	$963	$46	$3,589	$1,095	$1,141	$1,359,991	$64,669	0.018	-$63,528	
R1-22	$28,072	$1,335	$8,653	$1,035	$2,370	$1,383,721	$65,797	0.036	-$63,427	
R1-23	$8,969	$426	$14,399	$1,013	$1,439	$1,461,055	$69,475	0.021	-$68,035	
R1-24	$135,454	$6,441	$16,204	$866	$7,307	$1,369,576	$65,125	0.112	-$57,818	
R2-1	$0	$0	$13,063	$598	$598	$0	$0	$ -	$0	
R2-2	$0	$0	$4,236	$0	$0	$0	$0	$ -	$0	
R2-3	$0	$0	$11,959	$0	$0	$0	$0	$ -	$0	
R2-4	$0	$0	$9,353	$0	$0	$0	$0	$ -	$0	
R2-5	$0	$0	$3,573	$0	$0	$0	$0	$ -	$0	
R2-6	$0	$0	-$83,044	$0	$83,044	$0	$0	$ -	$0	
R2-7	$0	$0	$7,141	$0	$0	$0	$0	$ -	$0	
R3-1	$210,031	$9,987	$5,891	$24,947	$34,934	$1,812,616	$86,192	0.405	-$51,257	
R3-2	$2,549,759	$121,244	$5,627	$23,658	$144,902	$1,569,252	$74,619	1.942	$70,282	
R3-3	$343,083	$16,314	$5,906	$24,046	$40,360	$1,525,766	$72,552	0.556	-$32,192	
R3-4	$9,270	$441	$8,487	$4,945	$5,386	$833,654	$39,641	0.136	-$34,255	

TABLE B-54 (CONTINUED)
OPTIMIZED BERM WIDTH – 30 FEET OF ADDED DUNE WIDTH

Reach	Damage Reduction DW30	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW30	Summed Net Benefits DW30
R3-5	$55,342	$2,632	$6,688	$5,603	$8,235	$984,495	$46,814	0.176	-$38,579	
R3-6	$62,337	$2,964	$4,474	$6,233	$9,198	$1,076,646	$51,196	0.180	-$41,998	
R3-7	$46,542	$2,213	$703	$6,395	$8,609	$1,067,547	$50,763	0.170	-$42,154	
R3-8	$169,099	$8,041	-$9,617	$26,457	$44,116	$1,654,181	$78,658	0.561	-$34,542	
R3-9	$719,242	$34,201	-$9,884	$25,180	$69,265	$1,636,120	$77,799	0.890	-$8,534	
R3-10	$4,296,347	$204,296	-$12,203	$25,793	$242,292	$1,691,388	$80,427	3.013	$161,865	
R3-11	$1,049,678	$49,913	-$13,222	$25,306	$88,441	$1,641,532	$78,056	1.133	$10,384	
R3-12	$2,430,196	$115,558	-$21,956	$24,329	$161,843	$1,586,018	$75,417	2.146	$86,426	
R3-13	$1,171,493	$55,706	-$25,401	$24,457	$105,564	$1,564,251	$74,382	1.419	$31,182	
R3-14	$1,790,465	$85,138	-$44,459	$33,306	$162,903	$2,246,256	$106,812	1.525	$56,092	
R3-15	$25,013	$1,189	-$38,631	$26,435	$66,255	$1,727,551	$82,147	0.807	-$15,892	
R3-16	$5,706	$271	-$30,464	$18,467	$49,203	$1,200,159	$57,069	0.862	-$7,866	
R3-17	$174,047	$8,276	-$47,442	$25,790	$81,508	$1,709,505	$81,289	1.003	$220	
R3-18	$436,849	$20,773	-$49,993	$26,381	$97,146	$1,794,370	$85,324	1.139	$11,822	
R3-19	$1,527,392	$72,629	-$46,980	$26,271	$145,880	$1,729,073	$82,219	1.774	$63,661	
R3-20	$4,800,326	$228,260	-$46,022	$26,011	$300,293	$1,763,809	$83,871	3.580	$216,422	
R3-21	$1,420,738	$67,558	-$44,965	$26,018	$138,540	$1,801,358	$85,656	1.617	$52,884	
R3-22	$420,524	$19,996	-$39,078	$24,497	$83,571	$1,677,869	$79,784	1.047	$3,787	
R3-23	$304,369	$14,473	-$30,816	$21,282	$66,571	$1,451,311	$69,011	0.965	-$2,440	$506,573
R3-24	$0	$0	-$18,581	$7,322	$25,904	$0	$0	$ -	$0	
R3-25	$0	$0	-$13,979	$7,973	$21,951	$0	$0	$ -	$0	
R3-26	$0	$0	-$7,529	$0	$7,529	$0	$0	$ -	$0	
R4-1			-$22,733	$26,171	$48,904					
R4-2	-$130,192	-$6,191	-$17,522	$26,718	$38,049	$440,125	$20,928	1.818	$17,121	
R4-3	$0	$0	$2,348	$0	$0	$239,742	$11,400	-	-$11,400	$5,721
R4-4	$0	$0	$3,860	$0	$0	$150,944	$7,178	-	-$7,178	
R4-5	-$18,332	-$872	-$7,878	$23,197	$30,203	$299,381	$14,236	2.122	$15,967	
R4-6	-$24,942	-$1,186	$2,378	$5,399	$4,213	$93,950	$4,467	0.943	-$254	$15,713
R4-7	$0	$0	-$3,297	$5,986	$9,283	$0	$0	$ -	$0	
R4-8	$0	$0	-$27,507	$0	$27,507	$0	$0	$ -	$0	
R4-9	$0	$0	-$52,376	$0	$52,376	$0	$0	$ -	$0	
R5-1	$65,042	$3,093	-$65,843	$13,267	$82,202	$1,110,458	$52,803	1.557	$29,399	
R5-2	$30,922	$1,470	-$45,737	$12,036	$59,243	$1,056,960	$50,260	1.179	$8,983	
R5-3	$22,336	$1,062	-$23,776	$10,917	$35,756	$1,036,890	$49,305	0.725	-$13,549	
R5-4	$26,425	$1,257	-$5,084	$12,065	$18,406	$1,196,625	$56,901	0.323	-$38,495	

TABLE B-54 (CONTINUED)
OPTIMIZED BERM WIDTH – 30 FEET OF ADDED DUNE WIDTH

Reach	Damage Reduction DW30	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW30	Summed Net Benefits DW30
R5-5	$96,490	$4,588	$10,142	$8,641	$13,229	$927,103	$44,085	0.300	-$30,855	
R5-6	$3,335,466	$158,605	-$10,350	$17,186	$186,141	$1,689,746	$80,349	2.317	$105,792	
R5-7	$4,458,437	$212,003	-$15,952	$17,083	$245,038	$1,666,685	$79,253	3.092	$165,785	
R5-8	$2,016,728	$95,897	-$10,377	$16,855	$123,130	$1,621,908	$77,123	1.597	$46,007	
R5-9	$40,116	$1,908	-$7,078	$10,125	$19,110	$1,043,589	$49,624	0.385	-$30,514	
R5-10	$48,751	$2,318	-$8,738	$10,268	$21,324	$1,008,641	$47,962	0.445	-$26,638	
R5-11	$154,743	$7,358	-$9,588	$10,496	$27,443	$1,051,715	$50,010	0.549	-$22,567	
R5-12	$52,644	$2,503	-$9,121	$10,424	$22,049	$989,626	$47,058	0.469	-$25,009	
R5-13	$122,049	$5,804	-$9,535	$10,403	$25,742	$1,070,559	$50,906	0.506	-$25,165	
R5-14	$60,975	$2,899	-$8,691	$10,084	$21,674	$1,027,806	$48,873	0.443	-$27,199	
R5-15	$51,966	$2,471	-$11,925	$10,731	$25,126	$1,046,479	$49,761	0.505	-$24,635	
R5-16	$228,916	$10,885	-$11,884	$10,950	$33,720	$1,050,669	$49,960	0.675	-$16,241	
R5-17	$19,614	$933	-$7,819	$2,956	$11,707	$671,888	$31,949	0.366	-$20,241	
R5-18	$114,969	$5,467	-$11,759	$10,445	$27,671	$1,010,005	$48,027	0.576	-$20,356	
R5-19	$164,885	$7,840	-$3,184	$3,047	$14,072	$672,742	$31,990	0.440	-$17,917	
R5-20	$55,043	$2,617	$1,142	$9,036	$11,654	$951,767	$45,257	0.257	-$33,604	
R5-21	$47,328	$2,250	$202	$9,963	$12,214	$1,032,518	$49,097	0.249	-$36,883	**$16,584**
R5-22	$0	$0	-$1,853	$0	$1,853	$0	$0	$ -	$0	
R5-23	$0	$0	-$699	$0	$699	$0	$0	$ -	$0	
R5-24	$0	$0	-$4,659	$0	$4,659	$0	$0	$ -	$0	
R5-25	$0	$0	-$11,704	$0	$11,704	$0	$0	$ -	$0	
R5-26	$0	$0	-$9,313	$0	$9,313	$0	$0	$ -	$0	
R5-27	$0	$0	-$8,897	$0	$8,897	$0	$0	$ -	$0	
R5-28	$0	$0	-$10,193	$0	$10,193	$0	$0	$ -	$0	
R5-29	$0	$0	-$34,189	$0	$34,189	$0	$0	$ -	$0	
R5-30	$50,301	$2,392	-$31,024	$10,827	$44,243	$1,050,897	$49,971	0.885	-$5,728	
R5-31	$307,935	$14,643	-$31,703	$10,722	$57,067	$1,063,438	$50,568	1.129	$6,500	
R5-32	$1,969,176	$93,636	-$52,553	$17,647	$163,836	$1,641,498	$78,055	2.099	$85,781	
R5-33	$748,613	$35,597	-$51,765	$18,447	$105,809	$1,681,725	$79,968	1.323	$25,841	
R5-34	$302,561	$14,387	-$41,227	$18,079	$73,693	$1,690,822	$80,400	0.917	-$6,708	
R5-35	$442,419	$21,037	-$40,514	$17,448	$78,999	$1,620,643	$77,063	1.025	$1,936	
R5-36	$4,158,831	$197,757	-$45,746	$16,745	$260,247	$1,615,725	$76,829	3.387	$183,418	
R5-37	$320,099	$15,221	-$71,304	$19,309	$105,834	$1,711,560	$81,386	1.300	$24,447	
R5-38	$699,372	$33,256	-$85,107	$21,213	$139,576	$1,946,362	$92,551	1.508	$47,025	
R5-39	$137,642	$6,545	-$88,452	$20,025	$115,022	$1,703,368	$80,997	1.420	$34,025	

TABLE B-54 (CONTINUED)
OPTIMIZED BERM WIDTH – 30 FEET OF ADDED DUNE WIDTH

Reach	Damage Reduction DW30	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW30	Summed Net Benefits DW30
R5-40	$7,160	$340	-$47,885	$11,376	$59,601	$1,033,144	$49,127	1.213	$10,474	
R5-41	$18,545	$882	-$41,980	$11,011	$53,873	$1,028,757	$48,918	1.101	$4,954	
R5-42	$6,844	$325	-$28,454	$10,513	$39,292	$1,026,267	$48,800	0.805	-$9,508	
R5-43	$11,178	$532	-$16,135	$9,713	$26,380	$956,378	$45,477	0.580	-$19,097	
R5-44	-$5,731	-$273	-$2,976	$9,075	$11,779	$931,602	$44,299	0.266	-$32,520	
R5-45	-$20,906	-$994	$3,051	$8,380	$7,386	$889,630	$42,303	0.175	-$34,917	
R5-46	$162,751	$7,739	$10,715	$8,307	$16,046	$910,725	$43,306	0.371	-$27,260	
R5-47	$386,800	$18,393	$1,211	$8,628	$27,021	$620,858	$29,522	0.915	-$2,502	
R5-48	$2,886	$137	$334	$2,950	$3,087	$666,610	$31,698	0.097	-$28,611	
R5-49	-$7,508	-$357	-$4,633	$3,115	$7,391	$817,214	$38,859	0.190	-$31,469	
R5-50	-$1,637	-$78	-$6,629	$3,149	$9,700	$892,448	$42,437	0.229	-$32,736	
R5-51	$15,569	$740	-$9,926	$3,288	$13,954	$810,140	$38,523	0.362	-$24,569	**$168,779**

TABLE B-55
OPTIMIZED BERM WIDTH – 40 FEET OF ADDED DUNE WIDTH

Reach	Damage Reduction DW40	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW40	Summed Net Benefits DW40
R1-1	$23,090	$1,098	$22,628	$1,658	$2,756	$2,060,250	$97,967	0.028	-$95,211	
R1-2	$18,067	$859	$21,746	$760	$1,619	$1,955,573	$92,989	0.017	-$91,371	
R1-3	$28,093	$1,336	$16,531	$860	$2,196	$1,834,152	$87,216	0.025	-$85,020	
R1-4	$20,442	$972	$12,262	$947	$1,919	$1,804,627	$85,812	0.022	-$83,893	
R1-5	$9,138	$435	$10,066	$1,097	$1,531	$1,893,254	$90,026	0.017	-$88,495	
R1-6	$22,998	$1,094	$3,040	$1,220	$2,314	$1,999,827	$95,094	0.024	-$92,780	
R1-7	$33,643	$1,600	$271	$1,260	$2,860	$1,935,231	$92,022	0.031	-$89,163	
R1-8	$21,576	$1,026	$732	$1,320	$2,346	$2,026,988	$96,385	0.024	-$94,039	
R1-9	$43,850	$2,085	$1,125	$1,261	$3,346	$1,918,321	$91,218	0.037	-$87,872	
R1-10	$34,650	$1,648	$2,792	$1,128	$2,776	$1,754,866	$83,446	0.033	-$80,670	
R1-11	$2,738,287	$130,208	$3,707	$1,198	$131,406	$1,902,011	$90,443	1.453	$40,963	
R1-12	$137,166	$6,522	$1,807	$1,275	$7,797	$2,027,074	$96,389	0.081	-$88,592	
R1-13	$2,820,802	$134,132	-$31	$1,351	$135,514	$1,946,909	$92,577	1.464	$42,936	
R1-14	$2,800,613	$133,172	-$3,467	$1,641	$138,280	$2,058,601	$97,889	1.413	$40,392	
R1-15	$4,062,754	$193,188	-$4,550	$2,177	$199,916	$1,552,831	$73,839	2.707	$126,077	

TABLE B-55 (CONTINUED)
OPTIMIZED BERM WIDTH – 40 FEET OF ADDED DUNE WIDTH

Reach	Damage Reduction DW40	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW40	Summed Net Benefits DW40
R1-16	$2,254,822	$107,219	-$5,362	$2,224	$114,804	$1,610,772	$76,594	1.499	$38,211	
R1-17	$48,473	$2,305	-$5,465	$2,412	$10,182	$1,705,260	$81,087	0.126	-$70,905	**$199,987**
R1-18	$108,630	$5,165	-$6,187	$2,457	$13,810	$1,735,040	$82,503	0.167	-$68,693	
R1-19	$93,405	$4,442	-$3,233	$2,285	$9,960	$1,677,852	$79,784	0.125	-$69,823	
R1-20	$109,855	$5,224	$2,311	$2,005	$7,229	$1,503,201	$71,479	0.101	-$64,250	
R1-21	$9,520	$453	$3,589	$1,095	$1,548	$1,817,549	$86,426	0.018	-$84,879	
R1-22	$43,736	$2,080	$8,653	$1,035	$3,114	$1,863,693	$88,620	0.035	-$85,506	
R1-23	$14,130	$672	$14,399	$1,013	$1,685	$1,969,959	$93,673	0.018	-$91,989	
R1-24	$140,276	$6,670	$16,204	$866	$7,536	$1,845,218	$87,742	0.086	-$80,206	
R2-1	$2,412	$0	$13,063	$598	$598	$0	$0	$ -	$0	
R2-2	$0	$0	$4,236	$0	$0	$0	$0	$ -	$0	
R2-3	$0	$0	$11,959	$0	$0	$0	$0	$ -	$0	
R2-4	$0	$0	$9,353	$0	$0	$0	$0	$ -	$0	
R2-5	$0	$0	$3,573	$0	$0	$0	$0	$ -	$0	
R2-6	$0	$0	-$83,044	$0	$83,044	$0	$0	$ -	$0	
R2-7	$0	$0	$7,141	$0	$0	$0	$0	$ -	$0	
R3-1	$221,465	$10,531	$5,891	$24,947	$35,478	$2,384,526	$113,387	0.313	-$77,909	
R3-2	$2,685,250	$127,686	$5,627	$23,658	$151,344	$2,071,302	$98,492	1.537	$52,852	
R3-3	$366,723	$17,438	$5,906	$24,046	$41,484	$2,023,980	$96,242	0.431	-$54,758	
R3-4	$10,968	$522	$8,487	$4,945	$5,466	$1,189,013	$56,539	0.097	-$51,072	
R3-5	$107,028	$5,089	$6,688	$5,603	$10,692	$1,375,035	$65,384	0.164	-$54,692	
R3-6	$115,225	$5,479	$4,474	$6,233	$11,712	$1,493,451	$71,015	0.165	-$59,303	
R3-7	$67,927	$3,230	$703	$6,395	$9,625	$1,479,887	$70,370	0.137	-$60,745	
R3-8	$216,008	$10,271	-$9,617	$26,457	$46,346	$2,192,530	$104,257	0.445	-$57,911	
R3-9	$779,707	$37,076	-$9,884	$25,180	$72,140	$2,152,736	$102,365	0.705	-$30,225	
R3-10	$4,878,109	$231,959	-$12,203	$25,793	$269,955	$2,216,023	$105,374	2.562	$164,581	
R3-11	$1,140,404	$54,227	-$13,222	$25,305	$92,754	$2,157,173	$102,576	0.904	-$9,821	
R3-12	$2,797,284	$133,014	-$21,956	$24,328	$179,298	$2,088,249	$99,298	1.806	$80,000	
R3-13	$1,185,068	$56,351	-$25,401	$24,456	$106,209	$2,069,751	$98,419	1.079	$7,790	
R3-14	$1,888,815	$89,815	-$44,459	$33,306	$167,580	$2,934,560	$139,541	1.201	$28,039	
R3-15	$33,043	$1,571	-$38,631	$26,434	$66,637	$2,267,701	$107,831	0.618	-$41,195	
R3-16	$9,434	$449	-$30,464	$18,467	$49,380	$1,573,874	$74,839	0.660	-$25,459	
R3-17	$189,742	$9,022	-$47,442	$25,790	$82,255	$2,233,793	$106,219	0.774	-$23,965	
R3-18	$479,216	$22,787	-$49,993	$26,381	$99,161	$2,329,256	$110,758	0.895	-$11,598	
R3-19	$1,540,627	$73,258	-$46,980	$26,270	$146,509	$2,260,325	$107,481	1.363	$39,028	

TABLE B-55 (CONTINUED)
OPTIMIZED BERM WIDTH – 40 FEET OF ADDED DUNE WIDTH

Reach	Damage Reduction DW40	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW40	Summed Net Benefits DW40
R3-20	$4,913,751	$233,654	-$46,022	$26,011	$305,686	$2,287,769	$108,786	2.810	$196,901	
R3-21	$1,539,747	$73,217	-$44,965	$26,018	$144,199	$2,326,458	$110,625	1.303	$33,574	
R3-22	$448,633	$21,333	-$39,078	$24,496	$84,908	$2,172,493	$103,304	0.822	-$18,396	
R3-23	$325,922	$15,498	-$30,816	$21,282	$67,596	$1,880,715	$89,430	0.756	-$21,834	$81,788
R3-24	$4,940	$235	-$18,581	$7,322	$26,138	$0	$0	$ -	$0	
R3-25	-$10,198	-$485	-$13,979	$7,972	$21,466	$0	$0	$ -	$0	
R3-26	$0	$0	-$7,529	$0	$7,529	$0	$0	$ -	$0	
R4-1	$38,627	$1,837	-$22,733	$26,171	$50,741	$478,569	$22,756	2.230	$27,984	
R4-2	$145,281	$6,908	-$17,522	$26,718	$51,148	$568,518	$27,034	1.892	$24,114	$52,099
R4-3	$0	$0	$2,348	$0	$0	$328,547	$15,623	-	-$15,623	
R4-4	$0	$0	$3,860	$0	$0	$233,262	$11,092	-	-$11,092	
R4-5	$216,661	$10,302	-$7,878	$23,197	$41,377	$397,997	$18,925	2.186	$22,452	
R4-6	$32,526	$1,547	$2,378	$5,399	$6,946	$171,987	$8,178	0.849	-$1,232	$21,219
R4-7	$0	$0	-$3,297	$5,986	$9,283	$0	$0	$ -	$0	
R4-8	$0	$0	-$27,507	$0	$27,507	$0	$0	$ -	$0	
R4-9	$0	$0	-$52,376	$0	$52,376	$0	$0	$ -	$0	
R5-1	$74,649	$3,550	-$65,843	$13,267	$82,659	$1,549,637	$73,687	1.122	$8,972	
R5-2	$37,561	$1,786	-$45,737	$12,035	$59,558	$1,490,537	$70,877	0.840	-$11,318	
R5-3	$34,275	$1,630	-$23,776	$10,917	$36,323	$1,473,678	$70,075	0.518	-$33,752	
R5-4	$32,992	$1,569	-$5,084	$12,065	$18,718	$1,734,708	$82,487	0.227	-$63,769	
R5-5	$104,462	$4,967	$10,142	$8,641	$13,608	$1,338,038	$63,625	0.214	-$50,017	
R5-6	$3,345,811	$159,097	-$10,350	$17,186	$186,633	$2,260,344	$107,482	1.736	$79,151	
R5-7	$4,471,976	$212,647	-$15,952	$17,083	$245,681	$2,228,398	$105,963	2.319	$139,719	
R5-8	$2,022,516	$96,173	-$10,377	$16,855	$123,405	$2,157,998	$102,615	1.203	$20,790	
R5-9	$50,121	$2,383	-$7,078	$10,125	$19,586	$1,471,028	$69,949	0.280	-$50,363	
R5-10	$63,281	$3,009	-$8,738	$10,268	$22,015	$1,432,063	$68,096	0.323	-$46,081	
R5-11	$169,837	$8,076	-$9,588	$10,496	$28,160	$1,481,172	$70,431	0.400	-$42,271	
R5-12	$71,415	$3,396	-$9,121	$10,424	$22,941	$1,418,258	$67,440	0.340	-$44,498	
R5-13	$128,840	$6,126	-$9,535	$10,403	$26,064	$1,498,215	$71,242	0.366	-$45,177	
R5-14	$78,276	$3,722	-$8,691	$10,083	$22,496	$1,450,069	$68,952	0.326	-$46,456	
R5-15	$65,173	$3,099	-$11,925	$10,730	$25,754	$1,473,184	$70,051	0.368	-$44,297	
R5-16	$232,425	$11,052	-$11,884	$10,950	$33,886	$1,486,229	$70,672	0.479	-$36,785	
R5-17	$35,252	$1,676	-$7,819	$2,956	$12,451	$989,022	$47,029	0.265	-$34,578	
R5-18	$136,495	$6,490	-$11,759	$10,445	$28,694	$1,429,088	$67,955	0.422	-$39,260	
R5-19	$283,773	$13,494	-$3,184	$3,047	$19,725	$1,007,426	$47,904	0.412	-$28,179	

TABLE B-55 (CONTINUED)
OPTIMIZED BERM WIDTH – 40 FEET OF ADDED DUNE WIDTH

Reach	Damage Reduction DW40	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost (Planned Nourishment Plus Crossover Work)	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits DW40	Summed Net Benefits DW40
R5-20	$72,339	$3,440	$1,142	$9,036	$12,476	$1,369,629	$65,127	0.192	-$52,651	
R5-21	$64,889	$3,086	$202	$9,963	$13,049	$1,488,267	$70,769	0.184	-$57,720	**-$478,541**
R5-22	$0	$0	-$1,853	$0	$1,853	$0	$0	$ -	$0	
R5-23	$0	$0	-$699	$0	$699	$0	$0	$ -	$0	
R5-24	$0	$0	-$4,659	$0	$4,659	$0	$0	$ -	$0	
R5-25	$0	$0	-$11,704	$0	$11,704	$0	$0	$ -	$0	
R5-26	$0	$0	-$9,313	$0	$9,313	$0	$0	$ -	$0	
R5-27	$0	$0	-$8,897	$0	$8,897	$0	$0	$ -	$0	
R5-28	$0	$0	-$10,193	$0	$10,193	$0	$0	$ -	$0	
R5-29	$0	$0	-$34,189	$0	$34,189	$0	$0	$ -	$0	
R5-30	$64,882	$3,085	-$31,024	$10,827	$44,936	$1,476,885	$70,227	0.640	-$25,291	
R5-31	$314,708	$14,965	-$31,703	$10,722	$57,389	$1,487,399	$70,727	0.811	-$13,338	
R5-32	$1,994,943	$94,862	-$52,553	$17,647	$165,061	$2,181,877	$103,750	1.591	$61,311	
R5-33	$767,311	$36,486	-$51,765	$18,446	$106,698	$2,245,575	$106,779	0.999	-$82	
R5-34	$308,874	$14,687	-$41,227	$18,079	$73,993	$2,260,091	$107,470	0.688	-$33,477	
R5-35	$457,837	$21,771	-$40,514	$17,448	$79,732	$2,166,464	$103,017	0.774	-$23,285	
R5-36	$4,289,689	$203,979	-$45,746	$16,745	$266,470	$2,131,470	$101,354	2.629	$165,116	
R5-37	$325,896	$15,497	-$71,304	$19,309	$106,109	$2,274,156	$108,138	0.981	-$2,029	
R5-38	$713,775	$33,941	-$85,107	$21,213	$140,261	$2,543,815	$120,961	1.160	$19,300	
R5-39	$139,349	$6,626	-$88,452	$20,024	$115,103	$2,271,087	$107,992	1.066	$7,111	
R5-40	$8,036	$382	-$47,885	$11,375	$59,643	$1,458,882	$69,371	0.860	-$9,729	
R5-41	$22,721	$1,080	-$41,980	$11,011	$54,071	$1,449,635	$68,932	0.784	-$14,860	
R5-42	$9,035	$430	-$28,454	$10,512	$39,396	$1,449,324	$68,917	0.572	-$29,521	
R5-43	$15,449	$735	-$16,135	$9,713	$26,583	$1,365,501	$64,931	0.409	-$38,348	
R5-44	-$5,731	-$273	-$2,976	$9,075	$11,779	$1,336,670	$63,560	0.185	-$51,781	
R5-45	-$25,142	-$1,196	$3,051	$8,380	$7,184	$1,279,403	$60,837	0.118	-$53,652	
R5-46	$179,383	$8,530	$10,715	$8,307	$16,837	$1,306,232	$62,113	0.271	-$45,276	
R5-47	$409,155	$19,456	$1,211	$8,628	$28,084	$985,240	$46,849	0.599	-$18,765	
R5-48	$3,643	$173	$334	$2,950	$3,123	$1,003,688	$47,726	0.065	-$44,603	
R5-49	-$7,508	-$357	-$4,633	$3,115	$7,390	$1,179,714	$56,097	0.132	-$48,706	
R5-50	$4,719	$224	-$6,629	$3,149	$10,002	$1,262,758	$60,045	0.167	-$50,043	
R5-51	$16,436	$782	-$9,926	$3,288	$13,995	$1,165,307	$55,411	0.253	-$41,416	**-$291,366**

12.7 FORMULATION OF CONSTRUCTION REACHES

The added dune width alternatives were formulated to first bracket the NED plan and secondly to assist in building an optimized project. The same optimization procedure is applied at this point by comparing net benefits among the alternatives. In the next step benefits from the optimized alternatives are summed and project benefits are combined with the project's construction costs to calculate the project benefit-to-cost ratio.

Table B-56 collects and displays the net benefits alternatives with various added dune width and the optimized berm width identified in the Main Report. Each reach is evaluated to select which alternative maximized net benefits for that reach.

TABLE B-56

MAXIMIZED DUNE WIDTH BY CONSTRUCTION REACH

Reach	ZERO ADDED DUNE WIDTH Net Benefits DW00 -1	10 FEET ADDED DUNE WIDTH Net Benefits DW10 -2	20 FEET ADDED DUNE WIDTH Net Benefits DW20 -3	30 FEET ADDED DUNE WIDTH Net Benefits DW30 -4	40 FEET ADDED DUNE WIDTH Net Benefits DW40 -5	ADDED DUNE WIDTH Maximized Net Benefits by Model Reach MAX-1,2,3,4	Total Benefits -7 + -8	Average Annual Damage Reduction & Land Loss Benefits -7	Average Annual With Project Emergency Nourishment Cost Avoidance -8	Construction Reach
R1-1	-$32,055	-$49,085	-$65,419	-$71,193	-$95,211	+00	$3,972	$2,314	$1,658	
R1-2	-$31,234	-$45,808	-$60,526	-$67,264	-$91,371	+00	$2,353	$1,594	$760	
R1-3	-$28,352	-$42,044	-$56,025	-$62,356	-$85,020	+00	$2,839	$1,979	$860	
R1-4	-$29,167	-$43,881	-$57,312	-$61,624	-$83,893	+00	$2,803	$1,856	$947	
R1-5	-$30,265	-$45,748	-$59,964	-$64,749	-$88,495	+00	$2,589	$1,492	$1,097	
R1-6	-$34,788	-$50,444	-$64,445	-$69,259	-$92,780	+00	$3,406	$2,186	$1,220	
R1-7	-$32,988	-$47,497	-$60,887	-$66,443	-$89,163	+00	$4,131	$2,871	$1,260	
R1-8	-$34,779	-$51,062	-$65,234	-$69,854	-$94,039	+00	$3,622	$2,301	$1,320	
R1-9	-$31,662	-$47,433	-$60,849	-$65,091	-$87,872	+00	$4,361	$3,100	$1,261	
R1-10	-$27,879	-$42,638	-$55,355	-$59,476	-$80,670	+00	$3,636	$2,508	$1,128	
R1-11	$67,286	$64,435	$64,762	$60,255	$40,963	+00	$102,788	$101,590	$1,198	Construction Reach One
R1-12	-$30,555	-$43,844	-$57,927	-$65,358	-$88,592	+00	$8,925	$7,650	$1,275	
R1-13	$90,638	$87,885	$74,137	$67,128	$42,936	+00	$127,403	$126,052	$1,351	
R1-14	$84,991	$82,108	$68,322	$64,729	$40,392	+00	$125,178	$123,536	$1,641	
R1-15	$30,240	$90,939	$119,485	$134,514	$126,077	+30	$191,443	$189,265	$2,177	
R1-16	$69,713	$48,693	$57,887	$59,568	$38,211	+00	$97,594	$95,371	$2,224	
R1-17	-$15,883	-$30,741	-$44,634	-$50,282	-$70,905	+00	$12,587	$10,175	$2,412	
R1-18	-$13,071	-$27,929	-$42,061	-$48,437	-$68,693	+00	$15,724	$13,266	$2,457	
R1-19	-$17,822	-$32,803	-$45,926	-$50,865	-$69,823	+00	$11,759	$9,473	$2,285	
R1-20	$37	-$30,785	-$5,048	-$47,586	-$64,250	+00	$8,567	$6,561	$2,005	
R1-21	-$31,703	-$45,354	-$57,914	-$63,528	-$84,879	+00	$2,643	$1,548	$1,095	
R1-22	-$30,070	-$44,069	-$57,576	-$63,427	-$85,506	+00	$3,729	$2,694	$1,035	
R1-23	-$32,449	-$48,421	-$62,753	-$68,035	-$91,989	+00	$2,687	$1,674	$1,013	
R1-24	-$21,428	-$38,305	-$52,017	-$57,818	-$80,206	+00	$8,507	$7,641	$866	
R2-1	$0	$0	$0	$0	$0	+00	$1,195	$598	$598	
R2-2	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R2-3	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R2-4	$0	$0	$0	$0	$0	+00	$0	$0	$0	

TABLE B-56 (CONTINUED)

MAXIMIZED DUNE WIDTH BY CONSTRUCTION REACH

Reach	ZERO ADDED DUNE WIDTH Net Benefits DW00 -1	10 FEET ADDED DUNE WIDTH Net Benefits DW10 -2	20 FEET ADDED DUNE WIDTH Net Benefits DW20 -3	30 FEET ADDED DUNE WIDTH Net Benefits DW30 -4	40 FEET ADDED DUNE WIDTH Net Benefits DW40 -5	ADDED DUNE WIDTH Maximized Net Benefits by Model Reach MAX-1,2,3,4	Total Benefits -7 + -8	Average Annual Damage Reduction & Land Loss Benefits -7	Average Annual With Project Emergency Nourishment Cost Avoidance -8	Construction Reach
R2-5	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R2-6	$0	$0	$0	$0	$0	+00	$83,044	$83,044	$0	
R2-7	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R3-1	-$22,201	-$36,151	-$48,993	-$51,257	-$77,909	+00	$59,395	$34,448	$24,947	
R3-2	$87,870	$59,794	$66,640	$70,282	$52,852	+00	$159,414	$135,756	$23,658	Construction Reach Two
R3-3	-$5,133	-$18,121	-$28,470	-$32,192	-$54,758	+00	$63,963	$39,917	$24,046	
R3-4	-$8,303	-$15,050	-$28,059	-$34,255	-$51,072	+00	$10,410	$5,466	$4,945	
R3-5	-$7,899	-$8,892	-$22,942	-$38,579	-$54,692	+00	$15,813	$10,211	$5,603	
R3-6	-$9,230	-$19,140	-$34,013	-$41,998	-$59,303	+00	$17,620	$11,387	$6,233	
R3-7	-$11,076	-$16,833	-$31,691	-$42,154	-$60,745	+00	$15,925	$9,529	$6,395	
R3-8	-$7,757	-$18,879	-$29,551	-$34,542	-$57,911	+00	$68,135	$41,678	$26,457	
R3-9	$13,670	$2,952	-$3,631	-$8,534	-$30,225	+00	$88,629	$63,450	$25,180	
R3-10	$118,468	$79,330	$125,990	$161,865	$164,581	+40	$295,748	$269,955	$25,793	
R3-11	$28,772	$12,532	$10,314	$10,384	-$9,821	+00	$104,771	$79,466	$25,305	
R3-12	$78,301	$41,116	$64,778	$86,426	$80,000	+30	$186,171	$161,843	$24,328	
R3-13	$56,508	$45,150	$34,196	$31,182	$7,790	+00	$129,302	$104,846	$24,456	
R3-14	$86,876	$75,127	$67,347	$56,092	$28,039	+00	$191,923	$158,618	$33,306	
R3-15	$12,372	$2,019	-$11,347	-$15,892	-$41,195	+00	$93,069	$66,635	$26,434	
R3-16	$11,336	$3,778	-$5,488	-$7,866	-$25,459	+00	$67,847	$49,380	$18,467	
R3-17	$26,061	$13,656	$2,263	$220	-$23,965	+00	$106,692	$80,903	$25,790	
R3-18	$37,121	$23,247	$14,508	$11,822	-$11,598	+00	$121,776	$95,396	$26,381	
R3-19	$89,908	$77,540	$65,505	$63,661	$39,028	+00	$171,506	$145,236	$26,270	
R3-20	$206,943	$202,326	$210,624	$216,422	$196,901	+30	$326,304	$300,293	$26,011	
R3-21	$65,227	$52,369	$53,610	$52,884	$33,574	+00	$150,218	$124,201	$26,018	
R3-22	$23,583	$13,690	$5,320	$3,787	-$18,396	+00	$102,428	$77,932	$24,496	
R3-23	$18,681	$7,778	-$200	-$2,440	-$21,834	+00	$86,534	$65,252	$21,282	
R3-24	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R3-25	$0	$0	$0	$0	$0	+00	$0	$0	$0	

TABLE B-56 (CONTINUED)

MAXIMIZED DUNE WIDTH BY CONSTRUCTION REACH

Reach	ZERO ADDED DUNE WIDTH Net Benefits DW00 -1	10 FEET ADDED DUNE WIDTH Net Benefits DW10 -2	20 FEET ADDED DUNE WIDTH Net Benefits DW20 -3	30 FEET ADDED DUNE WIDTH Net Benefits DW30 -4	40 FEET ADDED DUNE WIDTH Net Benefits DW40 -5	ADDED DUNE WIDTH Maximized Net Benefits by Model Reach MAX-1,2,3,4	Total Benefits -7 + -8	Average Annual Damage Reduction & Land Loss Benefits -7	Average Annual With Project Emergency Nourishment Cost Avoidance -8	Construction Reach
R3-26	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R4-1	$40,939	$36,223	$33,512	$0	$27,984	+00	$76,151	$49,980	$26,171	Construction Reach Three
R4-2	$34,225	$22,111	$19,180	$17,121	$24,114	+00	$74,896	$48,178	$26,718	
R4-3	$0	-$8,366	-$10,150	-$11,400	-$15,623	+00	$0	$0	$0	
R4-4	$0	-$4,350	-$6,029	-$7,178	-$11,092	+00	$0	$0	$0	
R4-5	$32,884	$72,317	$69,699	$15,967	$22,452	+10	$105,494	$82,297	$23,197	
R4-6	$5,557	$91,424	$90,309	-$254	-$1,232	+10	$98,784	$93,385	$5,399	
R4-7	$0	$0	$0	$0	$0	+00	$5,986	$0	$5,986	
R4-8	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R4-9	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R5-1	$59,768	$49,242	$36,081	$29,399	$8,972	+00	$93,733	$80,467	$13,267	Construction Reach Four
R5-2	$41,231	$29,743	$16,395	$8,983	-$11,318	+00	$71,360	$59,324	$12,035	
R5-3	$20,157	$23,915	$10,085	-$13,549	-$33,752	+10	$63,512	$52,594	$10,917	
R5-4	$2,789	-$11,272	-$28,511	-$38,495	-$63,769	+00	$30,553	$18,488	$12,065	
R5-5	$1,026	-$8,717	-$21,938	-$30,855	-$50,017	+00	$22,049	$13,408	$8,641	
R5-6	$137,518	$125,240	$112,507	$105,792	$79,151	+00	$198,059	$180,873	$17,186	
R5-7	$197,870	$187,283	$173,628	$165,785	$139,719	+00	$258,015	$240,932	$17,083	
R5-8	$76,309	$64,801	$51,932	$46,007	$20,790	+00	$135,776	$118,921	$16,855	
R5-9	$2,227	-$7,418	-$20,879	-$30,514	-$50,363	+00	$29,665	$19,541	$10,125	
R5-10	$5,813	-$4,112	-$17,286	-$26,638	-$46,081	+00	$31,924	$21,656	$10,268	
R5-11	$12,795	$2,300	-$11,899	-$22,567	-$42,271	+00	$40,815	$30,319	$10,496	
R5-12	$7,864	-$1,442	-$14,820	-$25,009	-$44,498	+00	$33,057	$22,633	$10,424	
R5-13	$7,462	$8,598	-$4,710	-$25,165	-$45,177	+10	$49,775	$39,372	$10,403	
R5-14	$5,224	-$3,843	-$16,999	-$27,199	-$46,456	+00	$32,314	$22,231	$10,083	
R5-15	$8,004	-$1,323	-$14,621	-$24,635	-$44,297	+00	$36,400	$25,670	$10,730	
R5-16	$16,260	$3,644	-$8,451	-$16,241	-$36,785	+00	$44,266	$33,316	$10,950	
R5-17	$969	-$2,237	-$11,088	-$20,241	-$34,578	+00	$15,013	$12,057	$2,956	
R5-18	$19,601	$359	$6,396	-$20,356	-$39,260	+00	$37,781	$27,336	$10,445	

TABLE B-56 (CONTINUED)

MAXIMIZED DUNE WIDTH BY CONSTRUCTION REACH

Reach	ZERO ADDED DUNE WIDTH Net Benefits DW00 -1	10 FEET ADDED DUNE WIDTH Net Benefits DW10 -2	20 FEET ADDED DUNE WIDTH Net Benefits DW20 -3	30 FEET ADDED DUNE WIDTH Net Benefits DW30 -4	40 FEET ADDED DUNE WIDTH Net Benefits DW40 -5	ADDED DUNE WIDTH Maximized Net Benefits by Model Reach MAX-1,2,3,4	Total Benefits -7 + -8	Average Annual Damage Reduction & Land Loss Benefits -7	Average Annual With Project Emergency Nourishment Cost Avoidance -8	Construction Reach
R5-19	$2,811	-$1,302	-$9,077	-$17,917	-$28,179	+00	$16,280	$13,233	$3,047	
R5-20	-$1,738	-$10,356	-$23,699	-$33,604	-$52,651	+00	$20,191	$11,155	$9,036	
R5-21	-$1,255	-$12,565	-$27,053	-$36,883	-$57,720	+00	$22,497	$12,534	$9,963	
R5-22	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R5-23	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R5-24	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R5-25	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R5-26	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R5-27	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R5-28	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R5-29	$0	$0	$0	$0	$0	+00	$0	$0	$0	
R5-30	$26,302	$15,963	$2,681	-$5,728	-$25,291	+00	$54,591	$43,764	$10,827	Construction Reach Five
R5-31	$39,185	$29,034	$15,690	$6,500	-$13,338	+00	$68,218	$57,496	$10,722	
R5-32	$108,925	$102,969	$96,632	$85,781	$61,311	+00	$170,418	$152,771	$17,647	
R5-33	$59,763	$48,251	$33,857	$25,841	-$82	+00	$122,609	$104,162	$18,446	
R5-34	$28,795	$14,412	-$975	-$6,708	-$33,477	+00	$91,249	$73,170	$18,079	
R5-35	$36,026	$22,800	$8,300	$1,936	-$23,285	+00	$95,676	$78,228	$17,448	
R5-36	$214,192	$191,289	$187,688	$183,418	$165,116	+00	$274,986	$258,241	$16,745	
R5-37	$59,222	$44,747	$29,577	$24,447	-$2,029	+00	$124,838	$105,529	$19,309	
R5-38	$83,810	$70,564	$54,918	$47,025	$19,300	+00	$159,748	$138,536	$21,213	
R5-39	$69,293	$53,447	$38,237	$34,025	$7,111	+00	$134,862	$114,838	$20,024	
R5-40	$42,549	$30,249	$16,915	$10,474	-$9,729	+00	$71,021	$59,645	$11,375	
R5-41	$37,006	$25,475	$12,326	$4,954	-$14,860	+00	$65,108	$54,097	$11,011	
R5-42	$22,995	$11,024	-$2,448	-$9,508	-$29,521	+00	$49,924	$39,411	$10,512	
R5-43	$12,773	$1,841	-$11,368	-$19,097	-$38,348	+00	$36,314	$26,602	$9,713	
R5-44	-$1,158	-$4,729	-$17,866	-$32,520	-$51,781	+00	$20,853	$11,779	$9,075	
R5-45	-$4,807	$21,490	$8,764	-$34,917	-$53,652	+10	$52,726	$44,346	$8,380	
R5-46	$4,423	-$3,706	-$15,705	-$27,260	-$45,276	+00	$25,317	$17,011	$8,307	

TABLE B-56 (CONTINUED)

MAXIMIZED DUNE WIDTH BY CONSTRUCTION REACH

Reach	ZERO ADDED DUNE WIDTH Net Benefits DW00 -1	10 FEET ADDED DUNE WIDTH Net Benefits DW10 -2	20 FEET ADDED DUNE WIDTH Net Benefits DW20 -3	30 FEET ADDED DUNE WIDTH Net Benefits DW30 -4	40 FEET ADDED DUNE WIDTH Net Benefits DW40 -5	ADDED DUNE WIDTH Maximized Net Benefits by Model Reach MAX-1,2,3,4	Total Benefits -7 + -8	Average Annual Damage Reduction & Land Loss Benefits -7	Average Annual With Project Emergency Nourishment Cost Avoidance -8	Construction Reach
R5-47	$12,146	-$16,708	-$10,321	-$2,502	-$18,765	+00	$36,038	$27,410	$8,628	
R5-48	-$6,285	-$11,711	-$21,095	-$28,611	-$44,603	+00	$6,050	$3,100	$2,950	
R5-49	-$6,831	-$5,875	-$16,411	-$31,469	-$48,706	+10	$19,359	$16,244	$3,115	
R5-50	$9,081	-$16,049	-$26,733	-$32,736	-$50,043	+00	$13,072	$9,923	$3,149	
R5-51	-$103	-$4,243	-$14,897	-$24,569	-$41,416	+00	$17,170	$13,882	$3,288	

12.8 GEOMORPHIC OPTIMIZATION

The economic optimization of added dune width suggests construction of disparate added dune widths within the construction reaches. A final optimization needs to be applied using geomorphic and engineering construction limitations to recommend a robust beach fill design. Long contiguous same sized beach fill perturbations perform best according to observed and established geomorphic science. Each construction reach must be evaluated and adjusted to yield that robustness.

The reformulated construction reaches based on maximized benefits and geomorphic considerations is presented in Table B-57.

TABLE B-57
MAXIMIZED DUNE WIDTH BY CONSTRUCTION REACH

Reach	ZERO ADDED DUNE WIDTH Net Benefits DW00 -1	10 FEET ADDED DUNE WIDTH Net Benefits DW10 -2	20 FEET ADDED DUNE WIDTH Net Benefits DW20 -3	30 FEET ADDED DUNE WIDTH Net Benefits DW30 -4	40 FEET ADDED DUNE WIDTH Net Benefits DW40 -5	ADDED DUNE WIDTH Maximized Net Benefits by Model Reach MAX-1,2,3,4	Total Benefits - 7 + -8	Average Annual Damage Reduction & Land Loss Benefits - 7	Average Annual With Project Emergency Nourishment Cost Avoidance - 8	Construction Reach	NED Benefits - per Construction Reach	LPP Benefits - per Construction Reach
R1-1	-$32,055	-$49,085	-$65,419	-$71,193	-$95,211	+00	$3,972	$2,314	$1,658			
R1-2	-$31,234	-$45,808	-$60,526	-$67,264	-$91,371	+00	$2,353	$1,594	$760			
R1-3	-$28,352	-$42,044	-$56,025	-$62,356	-$85,020	+00	$2,839	$1,979	$860			
R1-4	-$29,167	-$43,881	-$57,312	-$61,624	-$83,893	+00	$2,803	$1,856	$947			
R1-5	-$30,265	-$45,748	-$59,964	-$64,749	-$88,495	+00	$2,589	$1,492	$1,097			
R1-6	-$34,788	-$50,444	-$64,445	-$69,259	-$92,780	+00	$3,406	$2,186	$1,220			
R1-7	-$32,988	-$47,497	-$60,887	-$66,443	-$89,163	+00	$4,131	$2,871	$1,260			
R1-8	-$34,779	-$51,062	-$65,234	-$69,854	-$94,039	+00	$3,622	$2,301	$1,320			
R1-9	-$31,662	-$47,433	-$60,849	-$65,091	-$87,872	+00	$4,361	$3,100	$1,261			
R1-10	-$27,879	-$42,638	-$55,355	-$59,476	-$80,670	+00	$3,636	$2,508	$1,128			
R1-11	$67,286	$64,435	$64,762	$60,255	$40,963	+00	$102,788	$101,590	$1,198	NED Construction Reach One		
R1-12	-$30,555	-$43,844	-$57,927	-$65,358	-$88,592	+00	$8,925	$7,650	$1,275			
R1-13	$90,638	$87,885	$74,137	$67,128	$42,936	+00	$127,403	$126,052	$1,351			
R1-14	$84,991	$82,108	$68,322	$64,729	$40,392	+00	$125,178	$123,536	$1,641			
R1-15	$30,240	$90,939	$119,485	$134,514	$126,077	+00	$56,348	$54,171	$2,177			
R1-16	$69,713	$48,693	$57,887	$59,568	$38,211	+00	$97,594	$95,371	$2,224		$518,236	
R1-17	-$15,883	-$30,741	-$44,634	-$50,282	-$70,905	+00	$12,587	$10,175	$2,412			
R1-18	-$13,071	-$27,929	-$42,061	-$48,437	-$68,693	+00	$15,724	$13,266	$2,457			
R1-19	-$17,822	-$32,803	-$45,926	-$50,865	-$69,823	+00	$11,759	$9,473	$2,285			
R1-20	$37	-$30,785	-$5,048	-$47,586	-$64,250	+00	$8,567	$6,561	$2,005			
R1-21	-$31,703	-$45,354	-$57,914	-$63,528	-$84,879	+00	$2,643	$1,548	$1,095			
R1-22	-$30,070	-$44,069	-$57,576	-$63,427	-$85,506	+00	$3,729	$2,694	$1,035			
R1-23	-$32,449	-$48,421	-$62,753	-$68,035	-$91,989	+00	$2,687	$1,674	$1,013			
R1-24	-$21,428	-$38,305	-$52,017	-$57,818	-$80,206	+00	$8,507	$7,641	$866			$619,345

TABLE B-57 (CONTINUED)
MAXIMIZED DUNE WIDTH BY CONSTRUCTION REACH

Reach	ZERO ADDED DUNE WIDTH Net Benefits DW00 -1	10 FEET ADDED DUNE WIDTH Net Benefits DW10 -2	20 FEET ADDED DUNE WIDTH Net Benefits DW20 -3	30 FEET ADDED DUNE WIDTH Net Benefits DW30 -4	40 FEET ADDED DUNE WIDTH Net Benefits DW40 -5	ADDED DUNE WIDTH Maximized Net Benefits by Model Reach MAX-1,2,3,4	Total Benefits - 7 + -8	Average Annual Damage Reduction & Land Loss Benefits - 7	Average Annual With Project Emergency Nourishment Cost Avoidance - 8	Construction Reach	NED Benefits - per Construction Reach	LPP Benefits - per Construction Reach
R2-1	$0	$0	$0	$0	$0	+00	$1,195	$598	$598			
R2-2	$0	$0	$0	$0	$0	+00	$0	$0	$0			
R2-3	$0	$0	$0	$0	$0	+00	$0	$0	$0			
R2-4	$0	$0	$0	$0	$0	+00	$0	$0	$0			
R2-5	$0	$0	$0	$0	$0	+00	$0	$0	$0			
R2-6	$0	$0	$0	$0	$0	+00	$83,044	$83,044	$0			
R2-7	$0	$0	$0	$0	$0	+00	$0	$0	$0			
R3-1	-$22,201	-$36,151	-$48,993	-$51,257	-$77,909	+00	$59,395	$34,448	$24,947			
R3-2	$87,870	$59,794	$66,640	$70,282	$52,852	+00	$159,414	$135,756	$23,658	Construction Reach Two		
R3-3	-$5,133	-$18,121	-$28,470	-$32,192	-$54,758	+00	$63,963	$39,917	$24,046			
R3-4	-$8,303	-$15,050	-$28,059	-$34,255	-$51,072	+00	$10,410	$5,466	$4,945			
R3-5	-$7,899	-$8,892	-$22,942	-$38,579	-$54,692	+00	$15,813	$10,211	$5,603			
R3-6	-$9,230	-$19,140	-$34,013	-$41,998	-$59,303	+00	$17,620	$11,387	$6,233			
R3-7	-$11,076	-$16,833	-$31,691	-$42,154	-$60,745	+00	$15,925	$9,529	$6,395			
R3-8	-$7,757	-$18,879	-$29,551	-$34,542	-$57,911	+00	$68,135	$41,678	$26,457			
R3-9	$13,670	$2,952	-$3,631	-$8,534	-$30,225	+00	$88,629	$63,450	$25,180			
R3-10	$118,468	$79,330	$125,990	$161,865	$164,581	+00	$196,673	$170,880	$25,793			
R3-11	$28,772	$12,532	$10,314	$10,384	-$9,821	+00	$104,771	$79,466	$25,305			
R3-12	$78,301	$41,116	$64,778	$86,426	$80,000	+00	$151,774	$127,445	$24,328			
R3-13	$56,508	$45,150	$34,196	$31,182	$7,790	+00	$129,302	$104,846	$24,456			
R3-14	$86,876	$75,127	$67,347	$56,092	$28,039	+00	$191,923	$158,618	$33,306			
R3-15	$12,372	$2,019	-$11,347	-$15,892	-$41,195	+00	$93,069	$66,635	$26,434			
R3-16	$11,336	$3,778	-$5,488	-$7,866	-$25,459	+00	$67,847	$49,380	$18,467			
R3-17	$26,061	$13,656	$2,263	$220	-$23,965	+00	$106,692	$80,903	$25,790		$2,404,605	$2,404,605

TABLE B-57 (CONTINUED)
MAXIMIZED DUNE WIDTH BY CONSTRUCTION REACH

Reach	ZERO ADDED DUNE WIDTH Net Benefits DW00 -1	10 FEET ADDED DUNE WIDTH Net Benefits DW10 -2	20 FEET ADDED DUNE WIDTH Net Benefits DW20 -3	30 FEET ADDED DUNE WIDTH Net Benefits DW30 -4	40 FEET ADDED DUNE WIDTH Net Benefits DW40 -5	ADDED DUNE WIDTH Maximized Net Benefits by Model Reach MAX-1,2,3,4	Total Benefits - 7 + -8	Average Annual Damage Reduction & Land Loss Benefits - 7	Average Annual With Project Emergency Nourishment Cost Avoidance - 8	Construction Reach	NED Benefits - per Construction Reach	LPP Benefits - per Construction Reach
R3-18	$37,121	$23,247	$14,508	$11,822	-$11,598	+00	$121,776	$95,396	$26,381			
R3-19	$89,908	$77,540	$65,505	$63,661	$39,028	+00	$171,506	$145,236	$26,270			
R3-20	$206,943	$202,326	$210,624	$216,422	$196,901	+00	$290,179	$264,168	$26,011			
R3-21	$65,227	$52,369	$53,610	$52,884	$33,574	+00	$150,218	$124,201	$26,018			
R3-22	$23,583	$13,690	$5,320	$3,787	-$18,396	+00	$102,428	$77,932	$24,496			
R3-23	$18,681	$7,778	-$200	-$2,440	-$21,834	+00	$86,534	$65,252	$21,282			
R3-24	$0	$0	$0	$0	$0	+00	$0	$0	$0			
R3-25	$0	$0	$0	$0	$0	+00	$0	$0	$0			
R3-26	$0	$0	$0	$0	$0	+00	$0	$0	$0			

TABLE B-57 (CONTINUED)
MAXIMIZED DUNE WIDTH BY CONSTRUCTION REACH

Reach	ZERO ADDED DUNE WIDTH Net Benefits DW00 -1	10 FEET ADDED DUNE WIDTH Net Benefits DW10 -2	20 FEET ADDED DUNE WIDTH Net Benefits DW20 -3	30 FEET ADDED DUNE WIDTH Net Benefits DW30 -4	40 FEET ADDED DUNE WIDTH Net Benefits DW40 -5	ADDED DUNE WIDTH Maximized Net Benefits by Model Reach MAX-1,2,3,4	Total Benefits - 7 + -8	Average Annual Damage Reduction & Land Loss Benefits - 7	Average Annual With Project Emergency Nourishment Cost Avoidance - 8	Construction Reach	NED Benefits - per Construction Reach	LPP Benefits - per Construction Reach
R4-1	$40,939	$36,223	$33,512	$0	$27,984	+10	$74,076	$47,905	$26,171	Construction Reach Three		
R4-2	$34,225	$22,111	$19,180	$17,121	$24,114	+10	$65,119	$38,400	$26,718			
R4-3	$0	-$8,366	-$10,150	-$11,400	-$15,623	+10	$0	$0	$0			
R4-4	$0	-$4,350	-$6,029	-$7,178	-$11,092	+10	$0	$0	$0			
R4-5	$32,884	$72,317	$69,699	$15,967	$22,452	+10	$105,494	$82,297	$23,197			
R4-6	$5,557	$91,424	$90,309	-$254	-$1,232	+10	$98,784	$93,385	$5,399		$343,473	$261,987
R4-7	$0	$0	$0	$0	$0	+00	$5,986	$0	$5,986			
R4-8	$0	$0	$0	$0	$0	+00	$0	$0	$0			
R4-9	$0	$0	$0	$0	$0	+00	$0	$0	$0			
R5-1	$59,768	$49,242	$36,081	$29,399	$8,972	+10	$96,415	$83,149	$13,267	Construction Reach Four		
R5-2	$41,231	$29,743	$16,395	$8,983	-$11,318	+10	$72,548	$60,512	$12,035			
R5-3	$20,157	$23,915	$10,085	-$13,549	-$33,752	+10	$63,512	$52,594	$10,917			
R5-4	$2,789	-$11,272	-$28,511	-$38,495	-$63,769	+10	$31,384	$19,319	$12,065			
R5-5	$1,026	-$8,717	-$21,938	-$30,855	-$50,017	+10	$23,342	$14,701	$8,641			
R5-6	$137,518	$125,240	$112,507	$105,792	$79,151	+10	$202,237	$185,051	$17,186			
R5-7	$197,870	$187,283	$173,628	$165,785	$139,719	+10	$263,471	$246,388	$17,083			
R5-8	$76,309	$64,801	$51,932	$46,007	$20,790	+10	$139,649	$122,794	$16,855			
R5-9	$2,227	-$7,418	-$20,879	-$30,514	-$50,363	+10	$31,997	$21,872	$10,125			
R5-10	$5,813	-$4,112	-$17,286	-$26,638	-$46,081	+10	$34,035	$23,767	$10,268			
R5-11	$12,795	$2,300	-$11,899	-$22,567	-$42,271	+10	$42,551	$32,055	$10,496			
R5-12	$7,864	-$1,442	-$14,820	-$25,009	-$44,498	+10	$35,840	$25,416	$10,424			
R5-13	$7,462	$8,598	-$4,710	-$25,165	-$45,177	+10	$49,775	$39,372	$10,403			
R5-14	$5,224	-$3,843	-$16,999	-$27,199	-$46,456	+10	$35,179	$25,096	$10,083			
R5-15	$8,004	-$1,323	-$14,621	-$24,635	-$44,297	+10	$39,297	$28,566	$10,730		$1,325,619	$1,325,619

TABLE B-57 (CONTINUED)
MAXIMIZED DUNE WIDTH BY CONSTRUCTION REACH

Reach	ZERO ADDED DUNE WIDTH Net Benefits DW00 -1	10 FEET ADDED DUNE WIDTH Net Benefits DW10 -2	20 FEET ADDED DUNE WIDTH Net Benefits DW20 -3	30 FEET ADDED DUNE WIDTH Net Benefits DW30 -4	40 FEET ADDED DUNE WIDTH Net Benefits DW40 -5	ADDED DUNE WIDTH Maximized Net Benefits by Model Reach MAX-1,2,3,4	Total Benefits - 7 + -8	Average Annual Damage Reduction & Land Loss Benefits - 7	Average Annual With Project Emergency Nourishment Cost Avoidance - 8	Construction Reach	NED Benefits - per Construction Reach	LPP Benefits - per Construction Reach
R5-16	$16,260	$3,644	-$8,451	-$16,241	-$36,785	+10	$44,137	$33,187	$10,950			
R5-17	$969	-$2,237	-$11,088	-$20,241	-$34,578	+10	$17,084	$14,128	$2,956			
R5-18	$19,601	$359	$6,396	-$20,356	-$39,260	+10	$39,103	$28,658	$10,445			
R5-19	$2,811	-$1,302	-$9,077	-$17,917	-$28,179	+10	$17,207	$14,160	$3,047			
R5-20	-$1,738	-$10,356	-$23,699	-$33,604	-$52,651	+10	$23,049	$14,013	$9,036			
R5-21	-$1,255	-$12,565	-$27,053	-$36,883	-$57,720	+10	$23,807	$13,844	$9,963			
R5-22	**$0**	**$0**	**$0**	**$0**	**$0**	**+00**	**$0**	**$0**	**$0**			
R5-23	**$0**	**$0**	**$0**	**$0**	**$0**	**+00**	**$0**	**$0**	**$0**			
R5-24	**$0**	**$0**	**$0**	**$0**	**$0**	**+00**	**$0**	**$0**	**$0**			
R5-25	**$0**	**$0**	**$0**	**$0**	**$0**	**+00**	**$0**	**$0**	**$0**			
R5-26	**$0**	**$0**	**$0**	**$0**	**$0**	**+00**	**$0**	**$0**	**$0**			
R5-27	**$0**	**$0**	**$0**	**$0**	**$0**	**+00**	**$0**	**$0**	**$0**			
R5-28	**$0**	**$0**	**$0**	**$0**	**$0**	**+00**	**$0**	**$0**	**$0**			
R5-29	**$0**	**$0**	**$0**	**$0**	**$0**	**+00**	**$0**	**$0**	**$0**			
R5-30	**$26,302**	**$15,963**	**$2,681**	**-$5,728**	**-$25,291**	**+10**	**$56,625**	**$45,799**	**$10,827**	**Construction Reach Five**		
R5-31	**$39,185**	**$29,034**	**$15,690**	**$6,500**	**-$13,338**	**+10**	**$70,358**	**$59,636**	**$10,722**			
R5-32	**$108,925**	**$102,969**	**$96,632**	**$85,781**	**$61,311**	**+10**	**$179,849**	**$162,203**	**$17,647**			
R5-33	**$59,763**	**$48,251**	**$33,857**	**$25,841**	**-$82**	**+10**	**$127,022**	**$108,576**	**$18,446**			
R5-34	**$28,795**	**$14,412**	**-$975**	**-$6,708**	**-$33,477**	**+10**	**$92,948**	**$74,869**	**$18,079**			
R5-35	**$36,026**	**$22,800**	**$8,300**	**$1,936**	**-$23,285**	**+10**	**$97,911**	**$80,463**	**$17,448**			
R5-36	**$214,192**	**$191,289**	**$187,688**	**$183,418**	**$165,116**	**+10**	**$266,664**	**$249,920**	**$16,745**			
R5-37	**$59,222**	**$44,747**	**$29,577**	**$24,447**	**-$2,029**	**+10**	**$126,107**	**$106,798**	**$19,309**			
R5-38	**$83,810**	**$70,564**	**$54,918**	**$47,025**	**$19,300**	**+10**	**$163,394**	**$142,181**	**$21,213**			
R5-39	**$69,293**	**$53,447**	**$38,237**	**$34,025**	**$7,111**	**+10**	**$135,270**	**$115,245**	**$20,024**		**$1,713,147**	**$1,713,147**

TABLE B-57 (CONTINUED)
MAXIMIZED DUNE WIDTH BY CONSTRUCTION REACH

Reach	ZERO ADDED DUNE WIDTH Net Benefits DW00 -1	10 FEET ADDED DUNE WIDTH Net Benefits DW10 -2	20 FEET ADDED DUNE WIDTH Net Benefits DW20 -3	30 FEET ADDED DUNE WIDTH Net Benefits DW30 -4	40 FEET ADDED DUNE WIDTH Net Benefits DW40 -5	ADDED DUNE WIDTH Maximized Net Benefits by Model Reach MAX-1,2,3,4	Total Benefits - 7 + -8	Average Annual Damage Reduction & Land Loss Benefits - 7	Average Annual With Project Emergency Nourishment Cost Avoidance - 8	Construction Reach	NED Benefits - per Construction Reach	LPP Benefits - per Construction Reach
R5-40	**$42,549**	**$30,249**	**$16,915**	**$10,474**	**-$9,729**	**+10**	**$71,264**	**$59,889**	**$11,375**			
R5-41	**$37,006**	**$25,475**	**$12,326**	**$4,954**	**-$14,860**	**+10**	**$65,972**	**$54,961**	**$11,011**			
R5-42	**$22,995**	**$11,024**	**-$2,448**	**-$9,508**	**-$29,521**	**+10**	**$50,268**	**$39,756**	**$10,512**			
R5-43	**$12,773**	**$1,841**	**-$11,368**	**-$19,097**	**-$38,348**	**+10**	**$37,147**	**$27,434**	**$9,713**			
R5-44	**-$1,158**	**-$4,729**	**-$17,866**	**-$32,520**	**-$51,781**	**+10**	**$28,618**	**$19,543**	**$9,075**			
R5-45	**-$4,807**	**$21,490**	**$8,764**	**-$34,917**	**-$53,652**	**+10**	**$52,726**	**$44,346**	**$8,380**			
R5-46	**$4,423**	**-$3,706**	**-$15,705**	**-$27,260**	**-$45,276**	**+10**	**$27,932**	**$19,625**	**$8,307**			
R5-47	**$12,146**	**-$16,708**	**-$10,321**	**-$2,502**	**-$18,765**	**+10**	**$3,676**	**-$4,952**	**$8,628**			
R5-48	**-$6,285**	**-$11,711**	**-$21,095**	**-$28,611**	**-$44,603**	**+10**	**$6,216**	**$3,266**	**$2,950**			
R5-49	**-$6,831**	**-$5,875**	**-$16,411**	**-$31,469**	**-$48,706**	**+10**	**$19,359**	**$16,244**	**$3,115**			
R5-50	**$9,081**	**-$16,049**	**-$26,733**	**-$32,736**	**-$50,043**	**+10**	**$13,339**	**$10,191**	**$3,149**			
R5-51	**-$103**	**-$4,243**	**-$14,897**	**-$24,569**	**-$41,416**	**+10**	**$20,482**	**$17,194**	**$3,288**			
									Total Project Benefits NED / LPP		**$6,305,080**	**$6,324,703**

12.9 UPDATED ECONOMIC JUSTIFICATION OF NED AND LPP PLANS

Two final runs were made to determine if the NED and the LPP plans as formulated are still justified when considering the changed cost estimate, adjustments to the structure inventory and near shore land values. If the NED and the LPP plans continue to be justified then the recommendation will be to keep the formulation and the tentatively selected plan as is, realizing that the current economic down turn and its impacts are a temporary phenomena which will not remain at these levels for the 50-year period of analysis.

Tables B-58 and B-59 show that HSDR benefits are $5,704,945 for the NED plan and $5,833,482 for the LPP plan.

TABLE B-58
NED PLAN UPDATED BENEFITS BY CONSTRUCTION REACH

Reach	Damage Reduction NED	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost -Planned Nourishment Plus Crossover Work	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits NED	NED Summed Benefits	Profile
R1-1	$9,620	$457	$23,484	$1,658	$2,116	$53,151	$2,527	0.837	-$412		R1P1
R1-2	$8,387	$399	$21,266	$760	$1,158	$44,293	$2,106	0.550	-$948		R1P1
R1-3	$14,359	$683	$16,083	$860	$1,543	$17,717	$842	1.832	$701		R1P1
R1-4	$8,307	$395	$11,895	$947	$1,342	$44,293	$2,106	0.637	-$764		R1P1
R1-5	$6,086	$289	$9,801	$1,097	$1,386	$8,859	$421	3.291	$965		R1P1
R1-6	$12,885	$613	$2,902	$1,220	$1,833	$79,727	$3,791	0.483	-$1,958		R1P1
R1-7	$25,236	$1,200	$190	$1,260	$2,460	$62,010	$2,949	0.834	-$489		R1P1
R1-8	$14,769	$702	$497	$1,320	$2,023	$53,151	$2,527	0.800	-$505		R1P1
R1-9	$30,853	$1,467	$864	$1,261	$2,728	$44,293	$2,106	1.295	$622		R1P1
R1-10	$23,201	$1,103	$2,665	$1,128	$2,231	$8,859	$421	5.297	$1,810		R1P1
R1-11	$2,415,519	$114,860	$3,725	$1,198	$116,058	$2,219,920	$105,559	1.099	$10,499	CONSTRUCTION REACH ONE	R1P1
R1-12	$137,766	$6,551	$1,610	$1,275	$7,826	$2,097,534	$99,740	0.078	-$91,914		R1P1
R1-13	$3,203,676	$152,338	-$25	$1,351	$153,713	$1,942,066	$92,347	1.665	$61,366		R1P1
R1-14	$3,085,015	$146,696	-$3,177	$1,641	$151,514	$2,097,129	$99,721	1.519	$51,793		R1P1
R1-15	$3,964,781	$188,529	-$3,458	$2,177	$194,164	$2,359,005	$112,173	1.731	$81,991		R1P2
R1-16	$2,554,768	$121,482	-$4,206	$2,224	$127,912	$1,310,098	$62,296	2.053	$65,615	$ 807,937	R1P2
R1-17	$31,014	$1,475	-$4,282	$2,412	$8,169	$53,151	$2,527	3.232	$5,641		R1P2
R1-18	$77,316	$3,676	-$4,872	$2,457	$11,006	$44,293	$2,106	5.226	$8,900		R1P2
R1-19	$56,388	$2,681	-$2,177	$2,285	$7,144	$97,444	$4,634	1.542	$2,510		R1P2
R1-20	$61,402	$2,920	$3,226	$2,005	$4,925	$70,868	$3,370	1.462	$1,555		R1P2
R1-21	$9,166	$436	$3,472	$1,095	$1,531	$26,576	$1,264	1.211	$267		R1P1
R1-22	$17,545	$834	$8,216	$1,035	$1,869	$44,293	$2,106	0.887	-$237		R1P1

TABLE B-58 (CONTINUED)
NED PLAN UPDATED BENEFITS BY CONSTRUCTION REACH

Reach	Damage Reduction NED	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost -Planned Nourishment Plus Crossover Work	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits NED	NED Summed Benefits	Profile
R1-23	$7,600	$361	$13,947	$1,013	$1,374	$17,717	$842	1.631	$532		R1P1
R1-24	$22,024	$1,047	$15,704	$866	$1,913	$0	$0	$ -	$1,913		R1P1
R2-1	$0	$0	$11,863	$0	$0	$0	$0	$ -	$0		R2P1
R2-2	$0	$0	$3,618	$0	$0	$0	$0	$ -	$0		R2P1
R2-3	$0	$0	$10,522	$0	$0	$0	$0	$ -	$0		R2P2
R2-4	$0	$0	$7,988	$0	$0	$0	$0	$ -	$0		R2P1
R2-5	$0	$0	$2,954	$0	$0	$0	$0	$ -	$0		R2P2
R2-6	$0	$0	-$88,608	$0	$0	$0	$0	$ -	$0		R2P1
R2-7	$0	$0	$6,440	$0	$0	$0	$0	$ -	$0		R2P1
R3-1	-$97,784	-$4,650	$7,398	$24,947	$20,297	$0	$0	$ -	$20,297		R3P1
R3-2	$2,485,270	$118,177	$7,109	$23,658	$141,835	$1,126,056	$53,545	2.649	$88,290	CONSTRUCTION REACH TWO	R3P1
R3-3	$319,955	$15,214	$7,262	$24,046	$39,260	$1,124,852	$53,488	0.734	-$14,228		R3P1
R3-4	$11,415	$543	$9,086	$4,945	$5,488	$418,842	$19,916	0.276	-$14,429		R3P2
R3-5	$98,291	$4,674	$7,495	$5,603	$10,277	$501,307	$23,838	0.431	-$13,561		R3P2
R3-6	$121,728	$5,788	$5,469	$6,233	$12,021	$519,290	$24,693	0.487	-$12,671		R3P2
R3-7	$65,939	$3,135	$1,775	$6,395	$9,531	$479,041	$22,779	0.418	-$13,248		R3P2
R3-8	$138,425	$6,582	-$5,267	$26,457	$38,307	$2,500,452	$118,899	0.322	-$80,592		R3P1
R3-9	$761,061	$36,189	-$6,073	$25,180	$67,442	$2,696,168	$128,205	0.526	-$60,764		R3P1
R3-10	$5,150,797	$244,925	-$7,599	$25,793	$278,317	$2,436,378	$115,852	2.402	$162,465		R3P1
R3-11	$1,171,549	$55,708	-$8,485	$25,305	$89,498	$2,187,485	$104,017	0.860	-$14,519		R3P1
R3-12	$3,044,179	$144,754	-$14,284	$24,328	$183,366	$2,024,457	$96,265	1.905	$87,101		R3P1
R3-13	$1,493,055	$70,996	-$16,951	$24,456	$112,404	$1,961,846	$93,288	1.205	$19,116		R3P1
R3-14	$1,994,340	$94,833	-$29,516	$33,306	$157,655	$2,762,244	$131,347	1.200	$26,307		R3P1

TABLE B-58 (CONTINUED)
NED PLAN UPDATED BENEFITS BY CONSTRUCTION REACH

Reach	Damage Reduction NED	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost -Planned Nourishment Plus Crossover Work	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits NED	NED Summed Benefits	Profile
R3-15	$33,043	$1,571	-$25,689	$26,434	$53,694	$2,131,967	$101,377	0.530	-$47,683		R3P1
R3-16	$9,434	$449	-$20,011	$18,467	$38,927	$1,484,287	$70,579	0.552	-$31,653		R3P1
R3-17	$189,234	$8,998	-$31,656	$25,790	$66,444	$2,125,876	$101,088	0.657	-$34,643		R3P1
R3-18	$478,323	$22,745	-$33,032	$26,381	$82,158	$2,259,579	$107,445	0.765	-$25,287		R3P1
R3-19	$1,678,176	$79,799	-$31,265	$26,270	$137,334	$2,280,429	$108,437	1.266	$28,898		R3P1
R3-20	$5,327,669	$253,336	-$30,352	$26,011	$309,699	$2,507,067	$119,214	2.598	$190,486		R3P1
R3-21	$1,512,469	$71,919	-$29,637	$26,018	$127,575	$2,884,265	$137,150	0.930	-$9,575		R3P1
R3-22	$433,629	$20,619	-$25,763	$24,496	$70,879	$3,169,557	$150,716	0.470	-$79,837		R3P1
R3-23	$328,938	$15,641	-$20,281	$21,282	$57,204	$1,779,034	$84,595	0.676	-$27,391	$ 2,089,314	R3P1
R3-24	$10,281	$0	-$17,271	$7,322	$0	$0	$0	$ -	$0		R3P2
R3-25	-$10,198	$0	-$12,396	$7,972	$0	$0	$0	$ -	$0		R3P2
R3-26	$0	$0	-$10,153	$0	$0	$0	$0	$ -	$0		R4P1
R4-1	$16,652	$792	-$20,670	$26,171	$47,633	$197,031	$9,369	5.084	$38,264	CONSTRUCTION REACH THREE	R4P1
R4-2	$79,725	$3,791	-$17,450	$26,718	$47,959	$317,117	$15,079	3.180	$32,880		R4P1
R4-3	$0	$0	$1,424	$0	$0	$174,722	$0	$ -	$0		R4P2
R4-4	$0	$0	$3,037	$0	$0	$91,574	$0	$ -	$0		R4P2
R4-5	$241,255	$11,472	-$8,258	$23,197	$42,927	$201,632	$9,588	4.477	$33,339		R4P1
R4-6	$35,284	$1,678	$2,561	$5,399	$7,077	$35,480	$1,687	4.195	$5,390	$ 145,596	R4P2
R4-7	$0	$0	-$3,163	$5,986	$0	$0	$0	$ -	$0		R4P2
R4-8	$0	$0	-$33,345	$0	$0	$0	$0	$ -	$0		R4P1
R4-9	$0	$0	-$58,473	$0	$0	$0	$0	$ -	$0		R4P1
R5-1	$50,054	$2,380	-$66,833	$13,267	$82,480	$1,750,822	$83,253	0.991	-$773	CONSTRUCTION REACH FOUR	R5P2
R5-2	$34,073	$1,620	-$46,918	$12,035	$60,573	$1,395,810	$66,372	0.913	-$5,799		R5P2

TABLE B-58 (CONTINUED)
NED PLAN UPDATED BENEFITS BY CONSTRUCTION REACH

Reach	Damage Reduction NED	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost -Planned Nourishment Plus Crossover Work	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits NED	NED Summed Benefits	Profile
R5-3	$33,924	$1,613	-$25,437	$10,917	$37,967	$1,015,440	$48,285	0.786	-$10,318		R5P2
R5-4	$29,812	$1,418	-$7,548	$12,065	$21,031	$881,157	$41,900	0.502	-$20,869		R5P2
R5-5	$105,362	$5,010	$7,577	$8,641	$13,651	$590,797	$28,093	0.486	-$14,442		R5P2
R5-6	$3,602,197	$171,288	-$20,636	$17,186	$209,110	$1,326,375	$63,070	3.315	$146,039		R5P1
R5-7	$4,865,320	$231,351	-$25,414	$17,083	$273,847	$1,300,624	$61,846	4.428	$212,001		R5P1
R5-8	$2,179,789	$103,651	-$14,261	$16,855	$134,767	$1,269,820	$60,381	2.232	$74,386		R5P1
R5-9	$48,619	$2,312	-$8,120	$10,125	$20,556	$670,787	$31,897	0.644	-$11,340		R5P2
R5-10	$54,486	$2,591	-$9,289	$10,268	$22,148	$641,153	$30,487	0.726	-$8,339		R5P2
R5-11	$218,207	$10,376	-$10,186	$10,496	$31,058	$680,573	$32,362	0.960	-$1,304		R5P2
R5-12	$67,097	$3,191	-$9,741	$10,424	$23,356	$618,727	$29,421	0.794	-$6,065		R5P2
R5-13	$138,895	$6,605	-$10,232	$10,403	$27,240	$700,896	$33,328	0.817	-$6,089		R5P2
R5-14	$72,992	$3,471	-$9,229	$10,083	$22,783	$663,490	$31,550	0.722	-$8,766		R5P2
R5-15	$63,158	$3,003	-$12,558	$10,730	$26,292	$692,853	$32,946	0.798	-$6,654		R5P2
R5-16	$223,961	$10,650	-$12,837	$10,950	$34,437	$721,798	$34,322	1.003	$115		R5P2
R5-17	$29,325	$1,394	-$6,856	$2,956	$11,206	$454,596	$21,616	0.518	-$10,411		R5P3
R5-18	$110,804	$5,269	-$12,522	$10,445	$28,236	$934,693	$44,446	0.635	-$16,210		R5P2
R5-19	$216,156	$10,278	-$2,487	$3,047	$15,812	$810,062	$38,519	0.411	-$22,707		R5P3
R5-20	$53,301	$2,535	$157	$9,036	$11,571	$1,485,337	$70,629	0.164	-$59,058		R5P2
R5-21	$52,645	$2,503	-$475	$9,963	$12,941	$471,610	$22,426	0.577	-$9,484	$ 1,121,062	R5P2
R5-22	$0	$0	-$1,684	$0	$0	$0	$0	$ -	$0		R5P3
R5-23	$0	$0	-$438	$0	$0	$0	$0	$ -	$0		R5P3
R5-24	$0	$0	-$5,913	$0	$0	$0	$0	$ -	$0		R5P2
R5-25	$0	$0	-$13,096	$0	$0	$0	$0	$ -	$0		R5P2
R5-26	$0	$0	-$10,979	$0	$0	$0	$0	$ -	$0		R5P1
R5-27	$0	$0	-$8,659	$0	$0	$0	$0	$ -	$0		R5P3

TABLE B-58 (CONTINUED)
NED PLAN UPDATED BENEFITS BY CONSTRUCTION REACH

Reach	Damage Reduction NED	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost -Planned Nourishment Plus Crossover Work	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits NED	NED Summed Benefits	Profile
R5-28	$0	$0	-$9,987	$0	$0	$0	$0	$ -	$0		R5P3
R5-29	$0	$0	-$37,910	$0	$0	$0	$0	$ -	$0		R5P2
R5-30	$47,602	$2,264	-$32,848	$10,827	$45,938	$1,604,072	$76,275	0.602	-$30,337	CONSTRUCTION REACH FIVE	R5P2
R5-31	$345,353	$16,422	-$33,879	$10,722	$61,022	$1,359,284	$64,635	0.944	-$3,613		R5P2
R5-32	$1,933,757	$91,952	-$61,892	$17,647	$171,491	$1,709,931	$81,309	2.109	$90,182		R5P1
R5-33	$751,701	$35,744	-$62,530	$18,446	$116,721	$1,519,045	$72,232	1.616	$44,489		R5P1
R5-34	$307,967	$14,644	-$53,740	$18,079	$86,463	$1,393,904	$66,281	1.304	$20,181		R5P1
R5-35	$445,780	$21,197	-$52,782	$17,448	$91,427	$1,287,290	$61,212	1.494	$30,215		R5P1
R5-36	$4,569,570	$217,288	-$56,472	$16,745	$290,504	$1,289,036	$61,295	4.739	$229,209		R5P1
R5-37	$325,474	$15,477	-$80,647	$19,309	$115,433	$1,364,144	$64,866	1.780	$50,566		R5P1
R5-38	$711,049	$33,811	-$94,528	$21,213	$149,551	$1,567,523	$74,537	2.006	$75,014		R5P1
R5-39	$139,002	$6,610	-$98,750	$20,024	$125,384	$1,355,066	$64,435	1.946	$60,949		R5P1
R5-40	$8,174	$389	-$49,625	$11,375	$61,390	$676,365	$32,162	1.909	$29,228		R5P2
R5-41	$23,301	$1,108	-$44,843	$11,011	$56,962	$671,353	$31,923	1.784	$25,038		R5P2
R5-42	$9,385	$446	-$30,127	$10,512	$41,086	$657,037	$31,243	1.315	$9,843		R5P2
R5-43	$15,873	$755	-$18,731	$9,713	$29,199	$590,384	$28,073	1.040	$1,125		R5P2
R5-44	-$5,731	-$273	-$5,603	$9,075	$14,405	$565,175	$26,875	0.536	-$12,470		R5P2
R5-45	-$25,142	-$1,196	$263	$8,380	$7,184	$537,137	$25,541	0.281	-$18,357		R5P2
R5-46	$181,668	$8,639	$7,328	$8,307	$16,945	$565,047	$26,869	0.631	-$9,923		R5P2
R5-47	$390,378	$18,563	$317	$8,628	$27,191	$686,496	$32,644	0.833	-$5,453		R5P2
R5-48	$3,752	$178	$742	$2,950	$3,129	$473,867	$22,533	0.139	-$19,404		R5P3
R5-49	-$7,508	-$357	-$3,946	$3,115	$6,703	$782,524	$37,210	0.180	-$30,506		R5P3
R5-50	$6,151	$292	-$6,119	$3,149	$9,560	$1,169,915	$55,631	0.172	-$46,071		R5P3
R5-51	$15,225	$724	-$9,336	$3,288	$13,348	$340,821	$16,206	0.824	-$2,858	$ 1,541,035	R5P3
NED SUMMED BENEFITS---------->										$5,704,945	

TABLE B-59
LPP PLAN UPDATED BENEFITS BY CONSTRUCTION REACH

Reach	Damage Reduction LPP	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost -Planned Nourishment Plus Crossover Work	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits LPP	LPP Summed Benefits	Profile
R1-1	$13,149	$625	$23,484	$1,658	$2,284	$959,993	$45,649	0.050	-$43,365	CONSTRUCTION REACH ONE	R1P1
R1-2	$17,556	$835	$21,266	$760	$1,594	$902,116	$42,896	0.037	-$41,302		R1P1
R1-3	$23,567	$1,121	$16,083	$860	$1,981	$834,489	$39,681	0.050	-$37,700		R1P1
R1-4	$19,327	$919	$11,895	$947	$1,866	$842,705	$40,071	0.047	-$38,206		R1P1
R1-5	$8,704	$414	$9,801	$1,097	$1,511	$872,093	$41,469	0.036	-$39,958		R1P1
R1-6	$20,390	$970	$2,902	$1,220	$2,190	$987,277	$46,946	0.047	-$44,756		R1P1
R1-7	$33,916	$1,613	$190	$1,260	$2,872	$960,262	$45,661	0.063	-$42,789		R1P1
R1-8	$20,689	$984	$497	$1,320	$2,304	$996,894	$47,403	0.049	-$45,099		R1P1
R1-9	$37,640	$1,790	$864	$1,261	$3,051	$936,399	$44,527	0.069	-$41,476		R1P1
R1-10	$27,897	$1,327	$2,665	$1,128	$2,455	$829,503	$39,444	0.062	-$36,989		R1P1
R1-11	$3,040,594	$144,583	$3,725	$1,198	$145,781	$919,706	$43,733	3.333	$102,048		R1P1
R1-12	$137,993	$6,562	$1,610	$1,275	$7,837	$1,009,498	$48,003	0.163	-$40,166		R1P1
R1-13	$3,212,573	$152,761	-$25	$1,351	$154,137	$944,689	$44,921	3.431	$109,216		R1P1
R1-14	$3,137,802	$149,206	-$3,177	$1,641	$154,024	$1,035,520	$49,240	3.128	$104,784		R1P1
R1-15	$4,822,253	$229,303	-$3,458	$2,177	$234,938	$721,578	$34,312	6.847	$200,626		R1P2
R1-16	$2,728,699	$129,752	-$4,206	$2,224	$136,182	$761,163	$36,194	3.763	$99,988		R1P2
R1-17	$49,610	$2,359	-$4,282	$2,412	$9,053	$785,242	$37,339	0.242	-$28,286		R1P2
R1-18	$117,512	$5,588	-$4,872	$2,457	$12,917	$797,897	$37,941	0.340	-$25,024		R1P2
R1-19	$91,895	$4,370	-$2,177	$2,285	$8,832	$803,973	$38,230	0.231	-$29,397		R1P2
R1-20	$71,126	$3,382	$3,226	$2,005	$5,388	$711,085	$33,813	0.159	-$28,425		R1P2
R1-21	$9,520	$453	$3,472	$1,095	$1,548	$901,612	$42,873	0.036	-$41,325		R1P1
R1-22	$34,341	$1,633	$8,216	$1,035	$2,668	$887,741	$42,213	0.063	-$39,545		R1P1

TABLE B-59 (CONTINUED)
LPP PLAN UPDATED BENEFITS BY CONSTRUCTION REACH

Reach	Damage Reduction LPP	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost -Planned Nourishment Plus Crossover Work	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits LPP	LPP Summed Benefits	Profile
R1-23	$13,768	$655	$13,947	$1,013	$1,667	$939,091	$44,655	0.037	-$42,987		R1P1
R1-24	$161,596	$7,684	$15,704	$866	$8,550	$869,858	$41,363	0.207	-$32,813	$ 905,628	R1P1
R2-1	$0	$0	$0	$0	$0	$0	$0	0	$0		R2P1
R2-2	$0	$0	$0	$0	$0	$0	$0	0	$0		R2P1
R2-3	$0	$0	$0	$0	$0	$0	$0	0	$0		R2P2
R2-4	$0	$0	$0	$0	$0	$0	$0	0	$0		R2P1
R2-5	$0	$0	$0	$0	$0	$0	$0	0	$0		R2P2
R2-6	$0	$0	$0	$0	$0	$0	$0	0	$0		R2P1
R2-7	$0	$0	$0	$0	$0	$0	$0	0	$0		R2P1
R3-1	-$59,050	-$2,808	$7,398	$24,947	$22,139	$1,277,161	$60,730	0.365	-$38,591		R3P1
R3-2	$2,384,316	$113,377	$7,109	$23,658	$137,034	$1,092,091	$51,930	2.639	$85,104	CONSTRUCTION REACH TWO	R3P1
R3-3	$296,817	$14,114	$7,262	$24,046	$38,160	$1,039,846	$49,446	0.772	-$11,286		R3P1
R3-4	$10,856	$516	$9,086	$4,945	$5,461	$383,597	$18,240	0.299	-$12,779		R3P2
R3-5	$93,019	$4,423	$7,495	$5,603	$10,026	$492,286	$23,409	0.428	-$13,383		R3P2
R3-6	$122,608	$5,830	$5,469	$6,233	$12,063	$555,796	$26,429	0.456	-$14,365		R3P2
R3-7	$63,720	$3,030	$1,775	$6,395	$9,425	$555,580	$26,418	0.357	-$16,993		R3P2
R3-8	$159,817	$7,599	-$5,267	$26,457	$39,324	$1,137,770	$54,102	0.727	-$14,778		R3P1
R3-9	$774,468	$36,827	-$6,073	$25,180	$68,079	$1,138,093	$54,117	1.258	$13,962		R3P1
R3-10	$5,585,285	$265,586	-$7,599	$25,793	$298,978	$1,191,546	$56,659	5.277	$242,318		R3P1
R3-11	$1,202,340	$57,172	-$8,485	$25,305	$90,963	$1,150,204	$54,693	1.663	$36,269		R3P1
R3-12	$3,280,288	$155,981	-$14,284	$24,328	$194,593	$1,112,806	$52,915	3.677	$141,678		R3P1
R3-13	$1,492,409	$70,966	-$16,951	$24,456	$112,373	$1,093,836	$52,013	2.160	$60,360		R3P1

TABLE B-59 (CONTINUED)
LPP PLAN UPDATED BENEFITS BY CONSTRUCTION REACH

Reach	Damage Reduction LPP	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost -Planned Nourishment Plus Crossover Work	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits LPP	LPP Summed Benefits	Profile
R3-14	$1,993,234	$94,780	-$29,516	$33,306	$157,602	$1,609,707	$76,543	2.059	$81,059		R3P1
R3-15	$33,043	$1,571	-$25,689	$26,434	$53,694	$1,221,427	$58,080	0.924	-$4,386		R3P1
R3-16	$9,434	$449	-$20,011	$18,467	$38,927	$853,193	$40,570	0.959	-$1,644		R3P1
R3-17	$188,572	$8,967	-$31,656	$25,790	$66,413	$1,224,753	$58,238	1.140	$8,174		R3P1
R3-18	$476,567	$22,661	-$33,032	$26,381	$82,075	$1,297,156	$61,681	1.331	$20,394		R3P1
R3-19	$1,676,841	$79,735	-$31,265	$26,270	$137,271	$1,234,871	$58,719	2.338	$78,552		R3P1
R3-20	$5,393,166	$256,450	-$30,352	$26,011	$312,813	$1,274,585	$60,608	5.161	$252,206		R3P1
R3-21	$1,511,988	$71,897	-$29,637	$26,018	$127,552	$1,311,034	$62,341	2.046	$65,211		R3P1
R3-22	$436,987	$20,779	-$25,763	$24,496	$71,039	$1,213,908	$57,723	1.231	$13,316		R3P1
R3-23	$329,306	$15,659	-$20,281	$21,282	$57,222	$1,043,882	$49,638	1.153	$7,584	$ 2,121,086	R3P1
R3-24	$0	$0	$0	$0	$0	$0	$0	$ -	$0	CONSTRUCTION REACH THREE	R3P2
R3-25	$0	$0	$0	$0	$0	$0	$0	$ -	$0		R3P2
R3-26	$0	$0	$0	$0	$0	$0	$0	$ -	$0		R4P1
R4-1	-$28,753	-$1,367	-$20,670	$26,171	$45,474	$217,520	$10,343	4.396	$35,131		R4P1
R4-2	-$66,325	-$3,154	-$17,450	$26,718	$41,014	$315,625	$15,008	2.733	$26,006		R4P1
R4-3	$0	$0	$1,424	$0	$0	$166,991	$7,941	-	-$7,941		R4P2
R4-4	$0	$0	$3,037	$0	$0	$83,142	$3,953	-	-$3,953		R4P2
R4-5	$296,627	$14,105	-$8,258	$23,197	$45,560	$188,599	$8,968	5.080	$36,592		R4P1
R4-6	$93,818	$4,461	$2,561	$5,399	$9,860	$37,068	$1,763	5.594	$8,098	$ 141,908	R4P2
R4-7	$0	$0	$0	$0	$0	$0	$0	$ -	$0		R4P2
R4-8	$0	$0	$0	$0	$0	$0	$0	$ -	$0		R4P1
R4-9	$0	$0	$0	$0	$0	$0	$0	$ -	$0		R4P1

TABLE B-59 (CONTINUED)
LPP PLAN UPDATED BENEFITS BY CONSTRUCTION REACH

Reach	Damage Reduction LPP	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost -Planned Nourishment Plus Crossover Work	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits LPP	LPP Summed Benefits	Profile
R5-1	$50,088	$2,382	-$66,833	$13,267	$82,481	$622,597	$29,605	2.786	$52,876	CONSTRUCTION REACH FOUR	R5P2
R5-2	$33,465	$1,591	-$46,918	$12,035	$60,545	$566,239	$26,925	2.249	$33,619		R5P2
R5-3	$33,823	$1,608	-$25,437	$10,917	$37,962	$530,213	$25,212	1.506	$12,750		R5P2
R5-4	$29,982	$1,426	-$7,548	$12,065	$21,039	$562,980	$26,770	0.786	-$5,731		R5P2
R5-5	$108,820	$5,174	$7,577	$8,641	$13,815	$436,065	$20,735	0.666	-$6,920		R5P2
R5-6	$3,638,134	$172,997	-$20,636	$17,186	$210,819	$1,108,799	$52,725	3.998	$158,094		R5P1
R5-7	$4,901,507	$233,072	-$25,414	$17,083	$275,568	$1,095,852	$52,109	5.288	$223,459		R5P1
R5-8	$2,206,097	$104,902	-$14,261	$16,855	$136,018	$1,076,607	$51,194	2.657	$84,824		R5P1
R5-9	$48,622	$2,312	-$8,120	$10,125	$20,556	$548,236	$26,069	0.789	-$5,513		R5P2
R5-10	$54,465	$2,590	-$9,289	$10,268	$22,147	$517,816	$24,623	0.899	-$2,475		R5P2
R5-11	$222,152	$10,564	-$10,186	$10,496	$31,245	$555,609	$26,420	1.183	$4,826		R5P2
R5-12	$67,076	$3,190	-$9,741	$10,424	$23,355	$495,694	$23,571	0.991	-$216		R5P2
R5-13	$141,831	$6,744	-$10,232	$10,403	$27,379	$577,709	$27,471	0.997	-$91		R5P2
R5-14	$72,962	$3,469	-$9,229	$10,083	$22,782	$540,668	$25,709	0.886	-$2,927		R5P2
R5-15	$63,142	$3,002	-$12,558	$10,730	$26,291	$556,942	$26,483	0.993	-$192		R5P2
R5-16	$240,746	$11,448	-$12,837	$10,950	$35,235	$548,322	$26,073	1.351	$9,162		R5P2
R5-17	$29,445	$1,400	-$6,856	$2,956	$11,211	$311,306	$14,803	0.757	-$3,591		R5P3
R5-18	$111,682	$5,311	-$12,522	$10,445	$28,277	$524,388	$24,935	1.134	$3,342		R5P2
R5-19	$213,591	$10,156	-$2,487	$3,047	$15,690	$293,626	$13,962	1.124	$1,728		R5P3
R5-20	$50,575	$2,405	$157	$9,036	$11,441	$452,349	$21,510	0.532	-$10,068		R5P2
R5-21	$52,584	$2,500	-$475	$9,963	$12,938	$488,609	$23,234	0.557	-$10,296	$ 1,126,797	R5P2
R5-22	$0	$0	$0	$0	$0	$0	$0	$ -	$0		R5P3

TABLE B-59 (CONTINUED)
LPP PLAN UPDATED BENEFITS BY CONSTRUCTION REACH

Reach	Damage Reduction LPP	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost -Planned Nourishment Plus Crossover Work	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits LPP	LPP Summed Benefits	Profile
R5-23	$0	$0	$0	$0	$0	$0	$0	$ -	$0		R5P3
R5-24	$0	$0	$0	$0	$0	$0	$0	$ -	$0		R5P2
R5-25	$0	$0	$0	$0	$0	$0	$0	$ -	$0		R5P2
R5-26	$0	$0	$0	$0	$0	$0	$0	$ -	$0		R5P1
R5-27	$0	$0	$0	$0	$0	$0	$0	$ -	$0		R5P3
R5-28	$0	$0	$0	$0	$0	$0	$0	$ -	$0		R5P3
R5-29	$0	$0	$0	$0	$0	$0	$0	$ -	$0		R5P2
R5-30	$44,493	$2,116	-$32,848	$10,827	$45,790	$554,812	$26,382	1.736	$19,409	CONSTRUCTION REACH FIVE	R5P2
R5-31	$345,328	$16,421	-$33,879	$10,722	$61,021	$571,129	$27,158	2.247	$33,863		R5P2
R5-32	$2,022,512	$96,172	-$61,892	$17,647	$175,711	$1,097,078	$52,167	3.368	$123,544		R5P1
R5-33	$748,163	$35,576	-$62,530	$18,446	$116,553	$1,114,803	$53,010	2.199	$63,543		R5P1
R5-34	$307,009	$14,599	-$53,740	$18,079	$86,417	$1,118,372	$53,180	1.625	$33,238		R5P1
R5-35	$444,499	$21,136	-$52,782	$17,448	$91,366	$1,064,885	$50,636	1.804	$40,730		R5P1
R5-36	$4,660,489	$221,611	-$56,472	$16,745	$294,828	$1,091,714	$51,912	5.679	$242,916		R5P1
R5-37	$323,556	$15,385	-$80,647	$19,309	$115,341	$1,146,445	$54,515	2.116	$60,827		R5P1
R5-38	$704,787	$33,513	-$94,528	$21,213	$149,253	$1,334,296	$63,447	2.352	$85,806		R5P1
R5-39	$138,667	$6,594	-$98,750	$20,024	$125,368	$1,136,118	$54,024	2.321	$71,344		R5P1
R5-40	$8,174	$389	-$49,625	$11,375	$61,390	$544,407	$25,887	2.371	$35,503		R5P2
R5-41	$23,301	$1,108	-$44,843	$11,011	$56,962	$543,856	$25,861	2.203	$31,101		R5P2
R5-42	$9,385	$446	-$30,127	$10,512	$41,086	$532,308	$25,312	1.623	$15,774		R5P2
R5-43	$15,871	$755	-$18,731	$9,713	$29,198	$472,514	$22,468	1.300	$6,730		R5P2
R5-44	-$5,731	-$273	-$5,603	$9,075	$14,405	$449,433	$21,371	0.674	-$6,966		R5P2

TABLE B-59 (CONTINUED)
LPP PLAN UPDATED BENEFITS BY CONSTRUCTION REACH

Reach	Damage Reduction LPP	Average Annual Damage Reduction	Average Annual Erosion Benefits	Average Annual Emergency Nourishment Cost Avoidance	Average Annual Benefits	Additional Cost -Planned Nourishment Plus Crossover Work	Average Annual Cost	Benefit-to-Cost Ratio	Net Benefits LPP	LPP Summed Benefits	Profile
R5-45	-$25,142	-$1,196	$263	$8,380	$7,184	$423,472	$20,136	0.357	-$12,952		R5P2
R5-46	$195,538	$9,298	$7,328	$8,307	$17,605	$434,469	$20,659	0.852	-$3,055		R5P2
R5-47	$432,393	$20,561	$317	$8,628	$29,189	$224,561	$10,678	2.734	$18,511		R5P2
R5-48	$3,828	$182	$742	$2,950	$3,132	$279,061	$13,270	0.236	-$10,137		R5P3
R5-49	-$7,508	-$357	-$3,946	$3,115	$6,703	$407,677	$19,385	0.346	-$12,682		R5P3
R5-50	$6,144	$292	-$6,119	$3,149	$9,559	$483,178	$22,976	0.416	-$13,416		R5P3
										$ 1,538,063	
LPP SUMMED BENEFITS--------->										$5,833,482	

12.10 CONSTRUCTION COSTS

The following tables display the FY 2011 construction costs for the NED and the LPP plans from the total project cost summary.

TABLE B-60
NED CONSTRUCTION COSTS

	NED	Initial Nourishment ($K)	Renourishment ($K)
Account		(2014)	(2024, 2034, 2044, 2054)
01	Lands & Damages	695	
17	Initial Beach Nourishment	53,737	21,366
22	Environmental	194	93
30	Planning Engineering &Design	1,611	635
31	Construction Management	1,087	423
	Total NED Cost	**57,324**	**27,763**

TABLE B-61
LPP CONSTRUCTION COSTS

	LPP	Initial Nourishment ($K)	Renourishment ($K)
Account		(2014)	(2024, 2034, 2044, 2054)
01	Lands & Damages	695	
17	Initial Beach Nourishment	61,427	29,613
22	Environmental	194	115
30	Planning Engineering &Design	1,837	876
31	Construction Management	1,241	591
	Total LPP Cost	**65,394**	**31,195**

Table B-62 shows the economic justification for the NED and LPP plans from the Draft Final Report compared to the results of this sensitivity. The average annual benefits for the NED plan reduce by $670,000, the benefit-to-cost ratio drops from 1.43 to 1.28 and net benefits decrease from $1,919,000 to $1,247,000. The average annual benefits for the LPP plan reduce by $710,000, the benefit-to-cost ratio falls from 1.29 to 1.15 and the net benefits decrease from $1,457,000 to $747,000.

TABLE B-62
SUMMARY BENEFITS COMPARISONS – FEASIBILITY AND SENSITIVITY

	NED - Feasibility	NED - Sensitivity
Total First Cost	$90,290,000	$90,290,000
Interest During Construction	$1,168,568	$1,168,568
Total Project First Cost	$91,459,000	$91,459,000
Average Annual First Cost	$4,349,000	$4,349,000
Annual O&M	$124,500	$124,500
Total Average Annual Cost	$4,474,000	$4,474,000
Average Annual HSDR Benefits	$6,375,000	$5,705,000
Average Annual Recreation Benefits	$16,000	$16,000
Total Average Annual Benefits	$6,391,000	$5,721,000
Benefit-to-Cost Ratio	1.43	1.28
Net Benefits	$1,917,000	$1,247,000
	LPP - Feasibility	LPP - Sensitivity
Total First Cost	$102,499,000	$102,499,000
Interest During Construction	$1,263,422	$1,263,422
Total Project First Cost	$103,762,000	$103,762,000
Average Annual First Cost	$4,934,000	$4,934,000
Annual O&M	$168,000	$168,000
Total Average Annual Cost	$5,102,000	$5,102,000
Average Annual HSDR Benefits	$6,543,000	$5,833,000
Average Annual Recreation Benefits	$16,000	$16,000
Total Average Annual Benefits	$6,559,000	$5,849,000
Benefit-to-Cost Ratio	1.29	1.15
Net Benefits	$1,457,000	$747,000

12.11 CONCLUSION

The NED plan and the LPP (the tentatively selected plan) remain justified even considering the effects of the economic downturn throughout the full period of analysis. Therefore the formulation in the feasibility study should remain and go forward for recommendation.

ATTACHMENT I

RECREATION ANALYSIS

BACKGROUND

Walton County Beaches are ranked among the top 20 destinations in the world by Frommers.

FROMMERS TOP 20 DESTINATIONS 2010
Florida Panhandle Beaches, United States

”Northwest Florida contains some of the most diverse recreation choices along Florida's drastically under-appreciated Gulf coast, and some of the best options for visitors seeking an affordable family vacation. From Destin to the west, where you can hire fishing or sailing charter, to the smattering of National Seashores as you move east, there's really something for everyone. Seaside's planned community is so "perfect" it was the setting for the *Truman Show*, yet you'll also find old-school Florida towns with funky shops, tiny hotels, pristine beaches, and the perfect cottage to rent. ("Stunning beaches, nature trails, great restaurants, and a cozy, yet quirky, sense of community." -- Lesley Abravanel, author *Frommer's Florida)*

SOURCE:
http://www.frommers.com/trip_ideas/arts_and_culture/article.cfm?ideaID=ARTCULTURE&articleID=6469&t=Frommer%27s%20Top%20Destinations%202010

RECREATIONAL FACILITIES

Recreation at Walton County Beaches occurs along the entire length of the beach which extends for the 26 miles. In addition to the beach, there are a variety of recreation facilities.

STATE PARKS

There are three State Parks in the Walton County Study area. They feature great diversity and natural beauty.

Grayton Beach State Park

Grayton Beach State Park is located south of U.S. Hwy 98 approximately halfway between Panama City Beach and Destin. Grayton Beach State Park offers a wide variety of activities for the visitor. Along with the beaches, there are two trails in the 2,228-acre coastal park. There are also 35 campsites with camping and cabin rentals with an additional 22 campsites to be provided in a renovation project that also includes a new ranger station and enhanced ADA accessibility and boardwalks.

Topsail Hill Preserve State Park

Topsail Hill Preserve State Park features one of the most diverse natural eco-systems in the state, with wet prairies, scrub, pine flatwoods, marshes and cypress domes. The park has more than three miles of beaches and five dune lakes. The lakes total more than 170 acres within the 1,637 acre park. In addition to the beaches, this recreation area provides opportunities for bicycling, camping, fishing, nature trails, picnicking, scuba, and swimming. The park has a 2.5 mile long maritime nature trail which traverses ancient dunes and scrub communities. The park has RV accommodations, with 156 sites and 16 rental cabins. Topsail Hill Preserve State Park is located in Santa Rosa Beach about 10 miles east of Destin, FL.

Deer Lake State Park

The Deer Lake State Park on County Hwy 30A, just west of Watersound, offers park goers a look at intact ancient sand dunes and vast ecosystems. The park has an area of approximately 2,000 acres, the majority of which lies on the north side of the park across County Hwy 30A. A walking trail approximately one mile long is located in the wooded area in the northern portion of the park. The recreation area has recently completed a remodeling project on the walkway to the beach providing ADA accessibility.

RECREATION BENEFITS

In order to determine the recreation benefits of the tentatively selected plan an economic value must be placed on the recreation experience at the Walton County Beaches. This value can then be applied to the increase in visitation which results from the project to determine the NED recreation benefits. For this report, general unit day values (UDV's) are used to determine the economic value of recreation at Walton County Beaches. UDV's are administratively determined values which represent the National Economic Development (NED) recreation values for typical types of recreation. Guidance for their use is provided by Engineering Regulation 1105-2-100.

UDV's are determined using a point system that takes into account the following factors: recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental (esthetics) quality. A good deal of judgment is required in the assessment of point values. A group of planning professionals with knowledge of the study area made independent judgments of the UDV values which were averaged. The UDV point totals convert to a recreation value of $5.07 for the without project condition and $5.16 for the with project condition. There values were applied to the increase in visitation over the study period. The difference between the without and with project value of recreation determines the NED and LPP recreation benefits. The source of the value of recreation is obtained from Economic Guidance Memorandum, 10-03, Unit Day Values for Recreation, Fiscal Year 2010.

The complete recreation analysis can to found in the attachments to the economic appendix.

Current Visitation

The Walton County Beaches area had 2,300,000 beach visitors in 2004. This estimate is based on data provided by the Beaches of South Walton. In 2009 the peak day estimate was July 4th 2009 weekend when an estimated 13,537 visits occurred. The Peak recreation season is from 15 May thru 8 September each year (a total of 15 weeks). Recreational visitation reaches a peak four times during the year. These times are Spring Break, Memorial Day, Independence Day, and Labor Day.

TABLE B-1-1
2004 BEACH VISITATION SUMMARY

According to 2004 Census		
Month	Average Monthly Visitation	Average Daily Visitation
January	34000	1097
February	34000	1172
March	50000	1613
Peak Day	Spring Break	10830
April	40000	1333
May	300000	9677
Peak Day	Memorial Day	13537
June	520000	17333
July	540000	17419
Peak Day	4th of July	13537
August	520000	16774
September	160000	5333
Peak Day	Labor Day	13537
October	34000	1097
November	34000	1133
December	34000	1097
Yearly Total	2,300,000	

SOURCE: Beaches of Walton County

PARKING

Lack of parking may constitute a restriction on public access and use. Therefore, eligibility for Federal participation is precluded in areas where there is a lack of sufficient parking facilities provided for the general public (including nonresident users) reasonably near and accessible to the project beaches according to the Engineering Regulation 1105-2-100.

Access

According to the Engineering Regulation 1105-2-100, reasonable access is approximately every one-half mile or less. Provision of reasonable public access rights-of-way, consistent with attendance used in benefit evaluation is a condition of Corps participation.

Capacity Constraints

The actual capacity of the beach is limited by several types of constraints. These include public access to the beach, availability of parking, and the size of the beach area. Thus the unconstrained visitation forecast must be limited by these capacity

considerations. There are a total of 73 access points along the beach. There are over 10,000 public and private parking spaces within the beach. Assuming an average of 4.5 persons per automobile and a turnover rate of 1.5 cars per parking space per day, these 10,000 spaces will support visitation of over 67,000 persons per day.

TABLE B-1-2
ACCESS POINTS AND PARKING

Construction Reach	Model Reach	Access Points	Parking Spaces	Visits Parking Will Support
1	R1-3	2375 Scenic Gulf Drive	170	1,148
1	R1-12	735 Scenic Gulf Drive	0	0
1	R1-14	132 Norwood Drive	0	0
1	R1-15	Open Gulf Street	0	0
1	R1-16	~ 90 Beach Drive	6	41
1	R1-17	253 Sand Trap Road	3	20
1	R1-18	End of Tango De Mer	0	0
1	R1-22	San Destin Day Use Area	110	743
1	R2-1	719 Top Sail Hill Road	0	0
2	R3-4	363 Highland Avenue	5	34
2	R3-4	127 Highland Avenue	0	0
2	R3-5	Dune Allen 5753 W. Co Hwy 30A	75	506
2	R3-9	5605 Co Hwy 30A	0	0
2	R3-9	5173 Co Hwy 30A	15	101
2	R3-9	4991 W. Co Hwy 30A	0	0
2	R3-10	4850 W. Co Hwy 30A	5	34
2	R3-11	Gulf Place West Access Point	13	88
2	R3-12	Gulf Place Middle Access Point	13	88
2	R3-13	Gulf Place East Access Point	14	95
2	R3-11	4447 W Co Hwy 30A	42	284
2	R3-13	92 South Spooky Lane	0	0
2	R3-14	4201 Co. Hwy 30A	0	0
2	R3-14	186 Gulf View Heights Street	30	203
2	R3-21	2365 S. Co Hwy 83	22	149
2	R3-21	446 Blue Mountain Road	5	34
2	R3-21	590 Blue Mountain Road	5	34
2	R3-21	726 Blue Mountain Road	5	34
3	R4-5	125 Sandy Lane	12	81
3	R4-6	288 Garfield St.	41	277
3	R4-6	199 Banfill Street	41	277

TABLE B-1-2
ACCESS POINTS AND PARKING

Construction Reach	Model Reach	Access Points	Parking Spaces	Visits Parking Will Support
3	R4-6	208 Holtz Avenue	0	0
3	R4-7	91 Boat Ramp Road	0	0
3	R4-6	913 Main Park Road	0	0
4	R5-2	Water Color Park Garage and Access	100	675
4	R5-3	1931 E. Co Hwy 30A Van Ness Butler Beach Access	101	682
4	R5-5	2560 Co Hwy 30A	0	0
4	R5-6	2624 Co Hwy 30A	2	14
4	R5-6	2680 Co Hwy 30A	0	0
4	R5-6	~ 2750 Co Hwy 30A	0	0
4	R5-6	2790 Co Hwy 30A	30	203
4	R5-7	2845 Co Hwy 30A	0	0
4	R5-7	2920 Co Hwy 30A	0	0
4	R5-8	3020 Co Hwy 30A	4	27
4	R5-9	118 Montgomery Street	0	0
4	R5-9	52 S Andalusia St	0	0
4	R5-9	South end of Dothan Avenue on Montgomery Street	0	0
4	R5-10	3458 E. Co Hwy 30A - San Juan Neighborhood B A	20	135
4	R5-10	3512 E. Co. Hwy 30A	0	0
4	R5-10	3576 E. Co Hwy 30A - Pelaya Neighborhood B A	0	0
4	R5-12	3694 E. Co Hwy 30 A - Campbell Street Neighborhood	75	506
4	R5-12	3874 E. Co Hwy 30A	20	135
4	R5-13	57 Seagrove Place	9	61
4	R5-18	679 Eastern Lake Road	6	41
4	R5-18	491 Eastern Lake Road #33 - Eastern Lake N B A	0	0
4	R5-18	188 San Roy Road - neighborhood come out to helio	0	0
4	R5-19	11 Beachside Dune - Sugar Dune	16	108
4	R5-20	258 Beachfront Trail - Walton Dune	10	68
4	R5-22	308 Beachfront Trail	10	68
4	R5-22	Beachside Drive	16	108
5	R5-22	Deer Lake State Park	1	7
5	R5-32	8040 E. Co Hwy 30A - Gulf Lakes Neighborhood B A	0	0
5	R5-34	8286 E. Co. Hwy 30A - Seabreeze Neighborhood B A	10	68

TABLE B-1-2
ACCESS POINTS AND PARKING

Construction Reach	Model Reach	Access Points	Parking Spaces	Visits Parking Will Support
5	R5-35	Saint Lucia Lane	100	675
5	R5-35	Rosemary Avenue	0	0
5	R5-35	8520 E. Co Hwy 30A - Seacrest Drive Neighborhood B A	0	0
5	R5-46	East Water Street	50	338
5	R5-46	East Water Street	50	338
5	R5-46	188 Winston Lane Beach Access	5	34
5	R5-47	264 South Wall Street - Wall Street Neighborhood	9	61
5	R5-47	435 West Park Place Ave.	67	452
5	R5-48	139 South Orange Street	67	452
5	R5-49	118 West Park Place Avenue FL #20	67	452
5	R5-50	202 South Walton Lakeshore Drive Phillips Inlet Access	15	101
TOTALS		73 Access Points	1,492	10,071

BEACH AREA AND CAPACITY

Beach area acts as a constraint on the number of visitors that will visit the Walton County Beaches during peak days. Measurements of the beach were taken using 2007 aerial photographs. These measurements indicated that there were over 14.6 million square feet of beach. In this report, it is assumed that visitors will each require 100 square feet of beach per day. Because some visitors spend only part of the day at the beach, a turnover rate of 1.5 visitors per 100 square feet of beach is used as an adjustment. Thus, in 2004, the Walton County beaches were capable of supporting 219,967 visitors per day. Beach area and visitation capacity for 2004 are displayed in Table B-1-3.

TABLE B-1-3
WALTON COUNTY BEACHES BEACH AREA AND VISITATION CAPACITY YEAR 2010

Sub-Reach	Beach Area 2010 (sq. ft.)	2010 Beach Visitation Capacity
1	144,647	2,170
2	193,884	2,908
3	118,450	1,777
4	143,759	2,156
5	151,095	2,266
6	81,688	1,225
7	144,038	2,161
8	150,241	2,254
9	98,015	1,470
10	142,423	2,136
11	102,325	1,535
12	138,375	2,076
13	108,430	1,626
14	145,981	2,190
15	132,471	1,987
16	118,250	1,774
17	120,825	1,812
18	186,678	2,800
19	99,066	1,486
20	117,002	1,755
21	117,680	1,765
22	126,239	1,894
23	146,109	2,192
24	138,097	2,071
25	-	-
26	-	-
27	-	-
28	-	-
29	-	-
30	-	-
31	-	-
32	196,081	2,941
33	94,405	1,416
34	104,320	1,565
35	106,244	1,594
36	148,886	2,233
37	169,797	2,547
38	160,194	2,403
39	123,744	1,856
40	129,262	1,939
41	111,145	1,667
42	132,414	1,986
43	139,742	2,096
44	105,268	1,579
45	168,190	2,523

TABLE B-1-3
WALTON COUNTY BEACHES BEACH AREA AND VISITATION CAPACITY YEAR 2010

Sub-Reach	Beach Area 2010 (sq. ft.)	2010 Beach Visitation Capacity
46	181,141	2,717
47	119,447	1,792
48	144,862	2,173
49	162,923	2,444
50	146,073	2,191
51	151,948	2,279
52	176,213	2,643
53	160,927	2,414
54	133,953	2,009
55	-	-
56	-	-
57	-	-
58	152,398	2,286
59	147,409	2,211
60	147,225	2,208
61	141,315	2,120
62	153,307	2,300
63	204,820	3,072
64	-	-
65	-	-
66	-	-
67	159,837	2,398
68	139,515	2,093
69	151,024	2,265
70	235,318	3,530
71	180,143	2,702
72	197,863	2,968
73	192,040	2,881
74	152,606	2,289
75	171,220	2,568
76	169,494	2,542
77	177,249	2,659
78	197,338	2,960
79	187,086	2,806
80	159,641	2,395
81	181,271	2,719
82	186,231	2,793
83	164,059	2,461
84	198,929	2,984
85	172,004	2,580
86	178,565	2,678
87	220,361	3,305
88	-	-
89	-	-
90	-	-

TABLE B-1-3
WALTON COUNTY BEACHES BEACH AREA AND VISITATION CAPACITY YEAR 2010

Sub-Reach	Beach Area 2010 (sq. ft.)	2010 Beach Visitation Capacity
91	-	-
92	-	-
93	-	-
94	-	-
95	-	-
96	173,143	2,597
97	169,589	2,544
98	163,392	2,451
99	178,913	2,684
100	180,108	2,702
101	165,461	2,482
102	153,915	2,309
103	163,946	2,459
104	173,029	2,595
105	181,690	2,725
106	177,504	2,663
107	157,027	2,355
108	149,656	2,245
109	141,009	2,115
110	136,468	2,047
111	123,157	1,847
112	131,154	1,967
113	140,728	2,111
114	137,897	2,068
115	157,622	2,364
116	174,941	2,624
117	182,917	2,744
TOTALS	14,664,482	219,967

WITHOUT AND WITH PROJECT VALUES

In order to determine the recreation benefits of the tentatively selected plan an economic value must be placed on the recreation experience at the Walton County Beaches. This value can then be applied to the increase in visitation which results from the project to determine the NED recreation benefits. For this report, unit day values (UDV's) are used to determine the economic value of recreation at Walton County Beaches. UDV's are administratively determined values which represent the National Economic Development (NED) recreation values for typical types of recreation. They should not be confused with regional economic impact values, which are not appropriate measures of economic benefits for use in a study of this type. UDV's were originally set by the U.S. Water Resources Council based on studies of recreation value. Guidance for their use is provided by Engineering Regulation 1105-2-100.

Point System

UDV's are determined using a point system that takes into account the following factors: recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental (esthetics) quality. A good deal of judgment is required in the assessment of point values. A group of planning professionals with knowledge of the study area made independent judgments of the UDV values. These values varied somewhat within categories, but were remarkably similar over all. They were averaged for the use in this study.

Recreation Experience. Under the without project condition, Walton County Beaches has several general recreation activities including swimming, boating, picnicking, and sunbathing, providing a recreation experience equivalent to 10 points out of 30.

Availability of Opportunity. Availability of opportunity is considered high because there are several similar beaches within 30 minutes to one hour driving time. Because of the large number of competing recreation opportunities, this category was limited to 3 points out of a total of 18.

Carrying Capacity. The carrying capacity of the facilities is considered adequate to conduct recreation during peak demand days, although facilities can certainly be strained at those times. This equates to 7 points out of a total of 14. Note that carrying capacity in the future with project condition is characterized by added dune width. The added dune width is gained at the expense of berm width resulting in less beach in which to recreate.

Accessibility. The project is considered very accessible, with high quality roads to the site and 73 access points within the site. This equates to 15 points out of a total of 18.

Environment. The area has exceptional esthetic value due to the beautiful white sand and clear, warm water of the Gulf of Mexico. Some reduction was made in this category due to the close proximity of commercial development. A rating of 13 out of a total of 16 points was awarded. Under the width project condition, it was felt that the additional 50 foot beach width would result in a slight increase esthetic value during peak days, so one additional point was awarded, for a total of 14 points.

The UDV point totals convert to a recreation value of $5.07 for the without project condition and $5.16 for the with project condition per Economics Guidance Memorandum, 10-03, Unit Day Values for Recreation, Fiscal Year 2010.

TABLE B-1-4
WALTON COUNTY BEACHES WITHOUT AND WITH PROJECT UNIT DAY VALUES

Criteria	W/O Project Points	W/ Project Points
Recreation Experience	10	10
Availability of Opportunity	3	3
Carrying Capacity	8	7
Accessibility	15	15

TABLE B-1-4 WALTON COUNTY BEACHES WITHOUT AND WITH PROJECT UNIT DAY VALUES		
Criteria	W/O Project Points	W/ Project Points
Environment (Esthetics)	13	14
Total Points	49	49
General Recreation Value	$5.07	$5.16

Future Visitation

Visitation to the Walton County Beach study area has increased rapidly, and this trend is expected to continue as the population of the tributary area increases. For this study, and unconstrained visitation growth forecast was developed for both annual visitation and peak day visitation by applying three percent annual historic increases in visitation. The unconstrained forecast identifies the maximum potential recreation demand for the study area. Limiting factor such as availability of parking and beach area are not considered under this unconstrained forecast.

TABLE B-1-5
WALTON COUNTY BEACHES PROJECTED UNCONSTRAINED VISITATION
2004-2063

Year	Unconstrained Total Annual Visitation	Unconstrained Peak Day Visitation Per Day
2004	2,300,000	13,537
2010	2,746,320	16,164
2014	3,091,008	18,193
2020	3,690,825	21,723
2030	4,960,160	29,194
2040	6,666,040	39,234
2050	8,958,601	52,727
2060	12,039,610	70,861
2063	13,156,007	77,432

Erosion and Accretion

Because the beach is eroding in some areas and accreting in others, total beach area will vary over time in the without project condition.

TABLE B-1-6 WITHOUT PROJECT CONDITION - BEACH AREA STATION (2010 - 2063)								
Sub-Reach	Model Reach	2010 (sq. ft)	2020 (sq. ft.)	2030 (sq. ft)	2040 (sq. ft)	2050 (sq. ft)	2060 (sq. ft)	2063 (sq. ft)
1	R1-1	144,647	144,654	144,660	144,667	144,674	144,681	144,688
2	R1-2	193,884	193,890	193,896	193,903	193,909	193,916	193,922
3	R1-3	118,450	118,455	118,460	118,466	118,471	118,476	118,481
4	R1-4	143,759	143,763	143,767	143,771	143,775	143,779	143,783

TABLE B-1-6 WITHOUT PROJECT CONDITION - BEACH AREA STATION (2010 - 2063)								
Sub-Reach	Model Reach	2010 (sq. ft)	2020 (sq. ft.)	2030 (sq. ft)	2040 (sq. ft)	2050 (sq. ft)	2060 (sq. ft)	2063 (sq. ft)
5	R1-5	151,095	151,098	151,101	151,104	151,107	151,110	151,114
6	R1-6	81,688	81,689	81,690	81,691	81,692	81,693	81,694
7	R1-7	144,038	144,038	144,038	144,038	144,038	144,038	144,038
8	R1-8	150,241	150,241	150,242	150,242	150,242	150,242	150,242
9	R1-9	98,015	98,015	98,016	98,016	98,016	98,017	98,017
10	R1-10	142,423	142,424	142,425	142,426	142,427	142,428	142,429
11	R1-11	102,325	102,326	102,327	102,328	102,329	102,331	102,332
12	R1-12	138,375	138,376	138,376	138,377	138,377	138,378	138,378
13	R1-13	108,430	108,430	108,430	108,430	108,430	108,430	108,430
14	R1-14	145,981	145,980	145,979	145,978	145,977	145,976	145,975
15	R1-15	132,471	132,470	132,469	132,467	132,466	132,465	132,464
16	R1-16	118,250	118,249	118,247	118,246	118,245	118,244	118,242
17	R1-17	120,825	120,824	120,823	120,822	120,821	120,819	120,818
18	R1-18	186,678	186,677	186,675	186,674	186,673	186,671	186,670
19	R1-19	99,066	99,065	99,065	99,064	99,064	99,063	99,062
20	R1-20	117,002	117,003	117,004	117,005	117,006	117,007	117,008
21	R1-21	117,680	117,681	117,682	117,683	117,684	117,686	117,687
22	R1-22	126,239	126,242	126,244	126,247	126,249	126,251	126,254
23	R1-23	146,109	146,113	146,117	146,121	146,125	146,129	146,133
24	R1-24	138,097	138,101	138,106	138,111	138,115	138,120	138,124
25	R2-1	-	-	-	-	-	-	-
26	R2-2	-	-	-	-	-	-	-
27	R2-3	-	-	-	-	-	-	-
28	R2-4	-	-	-	-	-	-	-
29	R2-5	-	-	-	-	-	-	-
30	R2-6	-	-	-	-	-	-	-
31	R2-7	-	-	-	-	-	-	-
32	R3-1	196,081	196,085	196,089	196,093	196,097	196,101	196,105
33	R3-2	94,405	94,409	94,413	94,418	94,422	94,426	94,430
34	R3-3	104,320	104,324	104,329	104,333	104,337	104,342	104,346
35	R3-4	106,244	106,249	106,255	106,261	106,266	106,272	106,277
36	R3-5	148,886	148,890	148,895	148,899	148,903	148,907	148,911
37	R3-6	169,797	169,800	169,803	169,806	169,809	169,811	169,814
38	R3-7	160,194	160,195	160,196	160,197	160,198	160,199	160,200
39	R3-8	123,744	123,741	123,739	123,736	123,733	123,730	123,727
40	R3-9	129,262	129,258	129,255	129,251	129,248	129,244	129,241
41	R3-10	111,145	111,140	111,136	111,132	111,127	111,123	111,118
42	R3-11	132,414	132,409	132,404	132,399	132,394	132,389	132,384
43	R3-12	139,742	139,737	139,732	139,727	139,722	139,717	139,712
44	R3-13	105,268	105,262	105,256	105,250	105,244	105,238	105,232
45	R3-14	168,190	168,182	168,175	168,167	168,159	168,151	168,144
46	R3-15	181,141	181,132	181,124	181,115	181,107	181,098	181,090
47	R3-16	119,447	119,438	119,428	119,418	119,409	119,399	119,390
48	R3-17	144,862	144,851	144,840	144,829	144,819	144,808	144,797

TABLE B-1-6 WITHOUT PROJECT CONDITION - BEACH AREA STATION (2010 - 2063)								
Sub-Reach	Model Reach	2010 (sq. ft)	2020 (sq. ft.)	2030 (sq. ft)	2040 (sq. ft)	2050 (sq. ft)	2060 (sq. ft)	2063 (sq. ft)
49	R3-18	162,923	162,911	162,900	162,889	162,878	162,867	162,856
50	R3-19	146,073	146,062	146,052	146,041	146,030	146,020	146,009
51	R3-20	151,948	151,938	151,928	151,917	151,907	151,897	151,886
52	R3-21	176,213	176,203	176,193	176,183	176,173	176,163	176,153
53	R3-22	160,927	160,918	160,909	160,899	160,890	160,881	160,872
54	R3-23	133,953	133,945	133,937	133,928	133,920	133,912	133,903
55	R3-24	-	-	-	-	-	-	-
56	R3-25	-	-	-	-	-	-	-
57	R3-26	-	-	-	-	-	-	-
58	R4-1	152,398	152,391	152,384	152,378	152,371	152,364	152,357
59	R4-2	147,409	147,403	147,398	147,392	147,387	147,382	147,376
60	R4-3	147,225	147,226	147,226	147,227	147,227	147,228	147,228
61	R4-4	141,315	141,316	141,318	141,319	141,320	141,321	141,322
62	R4-5	153,307	153,304	153,301	153,299	153,296	153,293	153,290
63	R4-6	204,820	204,821	204,822	204,823	204,824	204,825	204,826
64	R4-7	-	-	-	-	-	-	-
65	R4-8	-	-	-	-	-	-	-
66	R4-9	-	-	-	-	-	-	-
67	R5-1	159,837	159,828	159,819	159,810	159,801	159,792	159,783
68	R5-2	139,515	139,509	139,503	139,497	139,490	139,484	139,478
69	R5-3	151,024	151,021	151,017	151,014	151,011	151,008	151,004
70	R5-4	235,318	235,317	235,316	235,315	235,315	235,314	235,313
71	R5-5	180,143	180,144	180,145	180,146	180,147	180,148	180,149
72	R5-6	197,863	197,860	197,858	197,855	197,852	197,850	197,847
73	R5-7	192,040	192,037	192,034	192,030	192,027	192,024	192,021
74	R5-8	152,606	152,602	152,598	152,594	152,590	152,585	152,581
75	R5-9	171,220	171,217	171,215	171,213	171,210	171,208	171,206
76	R5-10	169,494	169,491	169,488	169,486	169,483	169,480	169,478
77	R5-11	177,249	177,246	177,243	177,240	177,237	177,234	177,232
78	R5-12	197,338	197,336	197,333	197,330	197,328	197,325	197,322
79	R5-13	187,086	187,083	187,080	187,077	187,074	187,072	187,069
80	R5-14	159,641	159,638	159,636	159,633	159,630	159,628	159,625
81	R5-15	181,271	181,268	181,264	181,261	181,257	181,253	181,250
82	R5-16	186,231	186,228	186,224	186,221	186,217	186,214	186,210
83	R5-17	164,059	164,057	164,055	164,053	164,051	164,049	164,046
84	R5-18	198,929	198,925	198,922	198,918	198,915	198,911	198,908
85	R5-19	172,004	172,004	172,003	172,002	172,001	172,000	171,999
86	R5-20	178,565	178,565	178,565	178,565	178,565	178,565	178,565
87	R5-21	220,361	220,361	220,360	220,360	220,360	220,360	220,360
88	R5-22	-	-	-	-	-	-	-
89	R5-23	-	-	-	-	-	-	-
90	R5-24	-	-	-	-	-	-	-
91	R5-25	-	-	-	-	-	-	-
92	R5-26	-	-	-	-	-	-	-

TABLE B-1-6 WITHOUT PROJECT CONDITION - BEACH AREA STATION (2010 - 2063)								
Sub-Reach	Model Reach	2010 (sq. ft)	2020 (sq. ft.)	2030 (sq. ft)	2040 (sq. ft)	2050 (sq. ft)	2060 (sq. ft)	2063 (sq. ft)
93	R5-27	-	-	-	-	-	-	-
94	R5-28	-	-	-	-	-	-	-
95	R5-29	-	-	-	-	-	-	-
96	R5-30	173,143	173,139	173,136	173,132	173,128	173,125	173,121
97	R5-31	169,589	169,585	169,581	169,577	169,573	169,570	169,566
98	R5-32	163,392	163,385	163,378	163,371	163,363	163,356	163,349
99	R5-33	178,913	178,906	178,899	178,892	178,885	178,878	178,871
100	R5-34	180,108	180,102	180,097	180,091	180,085	180,079	180,073
101	R5-35	165,461	165,455	165,449	165,443	165,437	165,431	165,425
102	R5-36	153,915	153,909	153,902	153,895	153,888	153,881	153,874
103	R5-37	163,946	163,937	163,928	163,919	163,910	163,901	163,892
104	R5-38	173,029	173,019	173,009	172,999	172,989	172,980	172,970
105	R5-39	181,690	181,679	181,668	181,657	181,646	181,635	181,624
106	R5-40	177,504	177,498	177,492	177,487	177,481	177,475	177,470
107	R5-41	157,027	157,022	157,017	157,012	157,007	157,002	156,997
108	R5-42	149,656	149,653	149,650	149,646	149,643	149,640	149,636
109	R5-43	141,009	141,007	141,005	141,002	141,000	140,998	140,996
110	R5-44	136,468	136,467	136,467	136,466	136,465	136,465	136,464
111	R5-45	123,157	123,158	123,158	123,158	123,158	123,158	123,158
112	R5-46	131,154	131,154	131,155	131,156	131,157	131,158	131,159
113	R5-47	140,728	140,729	140,729	140,729	140,729	140,729	140,729
114	R5-48	137,897	137,897	137,898	137,898	137,898	137,898	137,899
115	R5-49	157,622	157,621	157,619	157,618	157,616	157,615	157,613
116	R5-50	174,941	174,939	174,936	174,934	174,931	174,929	174,927
117	R5-51	182,917	182,913	182,910	182,906	182,902	182,899	182,895
TOTALS		14,664,482	14,664,257	14,664,033	14,663,808	14,663,583	14,663,358	14,663,133

Visitation Constraints

Because beach visitation can be affected not only by demand, but also by access constraints, parking constraints, and beach area, all factors are considered in determining actual visitation. Note that parking is a critical constraint when using a beach capacity methodology. The peak user day methodology will be employed to determine the adequacy of parking for the project.

TABLE B-1-7 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2010							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2010 Beach Capacity	Daily Visits For 2010	Daily Value @ $5.07	Critical Constraint
1	R1-1	0	0	2,170	0	$0	Parking
2	R1-2	22	99	2,908	99	$502	Parking
3	R1-3	198	1,274	1,777	1,274	$6,457	Parking

TABLE B-1-7 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2010							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2010 Beach Capacity	Daily Visits For 2010	Daily Value @ $5.07	Critical Constraint
4	R1-4	15	68	2,156	68	$342	Parking
5	R1-5	16	72	2,266	72	$365	Parking
6	R1-6	18	81	1,225	81	$411	Parking
7	R1-7	0	0	2,161	0	$0	Parking
8	R1-8	10	45	2,254	45	$228	Parking
9	R1-9	3	14	1,470	14	$68	Parking
10	R1-10	33	149	2,136	149	$753	Parking
11	R1-11	16	72	1,535	72	$365	Parking

TABLE B-1-7 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2010							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2010 Beach Capacity	Daily Visits For 2010	Daily Value @ $5.07	Critical Constraint
12	R1-12	31	140	2,076	140	$707	Parking
13	R1-13	76	342	1,626	342	$1,734	Parking
14	R1-14	33	149	2,190	149	$753	Parking
15	R1-15	77	347	1,987	347	$1,757	Parking
16	R1-16	109	504	1,774	504	$2,555	Parking
17	R1-17	7	38	1,812	38	$194	Parking
18	R1-18	0	0	2,800	0	$0	Parking
19	R1-19	55	248	1,486	248	$1,255	Parking
20	R1-20	81	365	1,755	365	$1,848	Parking
21	R1-21	146	657	1,765	657	$3,331	Parking
22	R1-22	202	1,157	1,894	1,157	$5,863	Parking
23	R1-23	155	698	2,192	698	$3,536	Parking
24	R1-24	0	0	2,071	0	$0	Parking
25	R2-1	0	0	-	0	$0	Parking
26	R2-2	0	0	-	0	$0	Parking
27	R2-3	0	0	-	0	$0	Parking
28	R2-4	0	0	-	0	$0	Parking
29	R2-5	0	0	-	0	$0	Parking
30	R2-6	0	0	-	0	$0	Parking
31	R2-7	0	0	-	0	$0	Parking
32	R3-1	0	0	2,941	0	$0	Parking
33	R3-2	0	0	1,416	0	$0	Parking
34	R3-3	5	23	1,565	23	$114	Parking
35	R3-4	12	65	1,594	65	$331	Parking
36	R3-5	75	506	2,233	506	$2,567	Parking
37	R3-6	0	0	2,547	0	$0	Parking
38	R3-7	0	0	2,403	0	$0	Parking
39	R3-8	12	54	1,856	54	$274	Parking
40	R3-9	15	101	1,939	101	$513	Parking
41	R3-10	5	34	1,667	34	$171	Parking
42	R3-11	68	430	1,986	430	$2,179	Parking

TABLE B-1-7 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2010							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2010 Beach Capacity	Daily Visits For 2010	Daily Value @ $5.07	Critical Constraint
43	R3-12	13	88	2,096	88	$445	Parking
44	R3-13	30	167	1,579	167	$844	Parking
45	R3-14	30	203	2,523	203	$1,027	Parking
46	R3-15	0	0	2,717	0	$0	Parking
47	R3-16	0	0	1,792	0	$0	Parking
48	R3-17	0	0	2,173	0	$0	Parking
49	R3-18	24	108	2,444	108	$548	Parking
50	R3-19	111	500	2,191	500	$2,532	Parking
51	R3-20	23	104	2,279	104	$525	Parking
52	R3-21	37	250	2,643	250	$1,266	Parking
53	R3-22	0	0	2,414	0	$0	Parking
54	R3-23	0	0	2,009	0	$0	Parking
55	R3-24	0	0	-	0	$0	Parking

TABLE B-1-7 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2010							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2010 Beach Capacity	Daily Visits For 2010	Daily Value @ $5.07	Critical Constraint
56	R3-25	0	0	-	0	$0	Parking
57	R3-26	0	0	-	0	$0	Parking
58	R4-1	0	0	2,286	0	$0	Parking
59	R4-2	0	0	2,211	0	$0	Parking
60	R4-3	0	0	2,208	0	$0	Parking
61	R4-4	0	0	2,120	0	$0	Parking
62	R4-5	12	81	2,300	81	$411	Parking
63	R4-6	82	554	3,072	554	$2,806	Parking
64	R4-7	0	0	-	0	$0	Parking
65	R4-8	0	0	-	0	$0	Parking
66	R4-9	0	0	-	0	$0	Parking
67	R5-1	0	0	2,398	0	$0	Parking
68	R5-2	111	725	2,093	725	$3,673	Parking
69	R5-3	101	682	2,265	682	$3,456	Parking
70	R5-4	0	0	3,530	0	$0	Parking
71	R5-5	0	0	2,702	0	$0	Parking
72	R5-6	32	216	2,968	216	$1,095	Parking
73	R5-7	0	0	2,881	0	$0	Parking
74	R5-8	4	27	2,289	27	$137	Parking
75	R5-9	0	0	2,568	0	$0	Parking
76	R5-10	20	135	2,542	135	$684	Parking
77	R5-11	71	320	2,659	320	$1,620	Parking
78	R5-12	145	866	2,960	866	$4,392	Parking
79	R5-13	79	376	2,806	376	$1,905	Parking
80	R5-14	137	617	2,395	617	$3,126	Parking
81	R5-15	0	0	2,719	0	$0	Parking

TABLE B-1-7 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2010							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2010 Beach Capacity	Daily Visits For 2010	Daily Value @ $5.07	Critical Constraint
82	R5-16	2	9	2,793	9	$46	Parking
83	R5-17	36	162	2,461	162	$821	Parking
84	R5-18	6	41	2,984	41	$205	Parking
85	R5-19	16	108	2,580	108	$548	Parking
86	R5-20	61	297	2,678	297	$1,506	Parking
87	R5-21	9	41	3,305	41	$205	Parking
88	R5-22	27	182	-	182	$924	Parking
89	R5-23	0	0	-	0	$0	Parking
90	R5-24	0	0	-	0	$0	Parking
91	R5-25	0	0	-	0	$0	Parking
92	R5-26	0	0	-	0	$0	Parking
93	R5-27	0	0	-	0	$0	Parking
94	R5-28	0	0	-	0	$0	Parking
95	R5-29	0	0	-	0	$0	Parking
96	R5-30	0	0	2,597	0	$0	Parking
97	R5-31	0	0	2,544	0	$0	Parking
98	R5-32	0	0	2,451	0	$0	Parking
99	R5-33	13	59	2,684	59	$297	Parking

TABLE B-1-7 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2010							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2010 Beach Capacity	Daily Visits For 2010	Daily Value @ $5.07	Critical Constraint
100	R5-34	14	86	2,702	86	$433	Parking
101	R5-35	106	702	2,482	702	$3,559	Parking
102	R5-36	0	0	2,309	0	$0	Parking
103	R5-37	0	0	2,459	0	$0	Parking
104	R5-38	0	0	2,595	0	$0	Parking
105	R5-39	0	0	2,725	0	$0	Parking
106	R5-40	0	0	2,663	0	$0	Parking
107	R5-41	0	0	2,355	0	$0	Parking
108	R5-42	13	59	2,245	59	$297	Parking
109	R5-43	0	0	2,115	0	$0	Parking
110	R5-44	0	0	2,047	0	$0	Parking
111	R5-45	0	0	1,847	0	$0	Parking
112	R5-46	105	709	1,967	709	$3,593	Parking
113	R5-47	76	513	2,111	513	$2,601	Parking
114	R5-48	67	452	2,068	452	$2,293	Parking
115	R5-49	67	452	2,364	452	$2,293	Parking
116	R5-50	15	101	2,624	101	$513	Parking
117	R5-51	0	0	2,744	0	$0	Parking
TOTAL		3,190	17,712	219,967	17,712	$89,800	

2020

TABLE B-1-8 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2020							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2020 Beach Capacity	Daily Visits For 2020	Daily Value @ $5.07	Critical Constraint
1	R1-1	0	0	2,170	0	$0	Parking
2	R1-2	22	99	2,908	99	$502	Parking
3	R1-3	198	1,274	1,777	1,274	$6,457	Parking
4	R1-4	15	68	2,156	68	$342	Parking
5	R1-5	16	72	2,266	72	$365	Parking
6	R1-6	18	81	1,225	81	$411	Parking
7	R1-7	0	0	2,161	0	$0	Parking
8	R1-8	10	45	2,254	45	$228	Parking
9	R1-9	3	14	1,470	14	$68	Parking
10	R1-10	33	149	2,136	149	$753	Parking
11	R1-11	16	72	1,535	72	$365	Parking
12	R1-12	31	140	2,076	140	$707	Parking
13	R1-13	76	342	1,626	342	$1,734	Parking
14	R1-14	33	149	2,190	149	$753	Parking
15	R1-15	77	347	1,987	347	$1,757	Parking
16	R1-16	109	504	1,774	504	$2,555	Parking
17	R1-17	7	38	1,812	38	$194	Parking
18	R1-18	0	0	2,800	0	$0	Parking
19	R1-19	55	248	1,486	248	$1,255	Parking
20	R1-20	81	365	1,755	365	$1,848	Parking
21	R1-21	146	657	1,765	657	$3,331	Parking
22	R1-22	202	1,157	1,894	1,157	$5,863	Parking
23	R1-23	155	698	2,192	698	$3,536	Parking
24	R1-24	0	0	2,072	0	$0	Parking
25	R2-1	0	0	-	0	$0	Parking
26	R2-2	0	0	-	0	$0	Parking
27	R2-3	0	0	-	0	$0	Parking
28	R2-4	0	0	-	0	$0	Parking
29	R2-5	0	0	-	0	$0	Parking
30	R2-6	0	0	-	0	$0	Parking
31	R2-7	0	0	-	0	$0	Parking
32	R3-1	0	0	2,941	0	$0	Parking
33	R3-2	0	0	1,416	0	$0	Parking
34	R3-3	5	23	1,565	23	$114	Parking
35	R3-4	12	65	1,594	65	$331	Parking
36	R3-5	75	506	2,233	506	$2,567	Parking
37	R3-6	0	0	2,547	0	$0	Parking
38	R3-7	0	0	2,403	0	$0	Parking
39	R3-8	12	54	1,856	54	$274	Parking
40	R3-9	15	101	1,939	101	$513	Parking
41	R3-10	5	34	1,667	34	$171	Parking

TABLE B-1-8 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2020							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2020 Beach Capacity	Daily Visits For 2020	Daily Value @ $5.07	Critical Constraint
42	R3-11	68	430	1,986	430	$2,179	Parking
43	R3-12	13	88	2,096	88	$445	Parking
44	R3-13	30	167	1,579	167	$844	Parking
45	R3-14	30	203	2,523	203	$1,027	Parking
46	R3-15	0	0	2,717	0	$0	Parking
47	R3-16	0	0	1,792	0	$0	Parking
48	R3-17	0	0	2,173	0	$0	Parking
49	R3-18	24	108	2,444	108	$548	Parking
50	R3-19	111	500	2,191	500	$2,532	Parking
51	R3-20	23	104	2,279	104	$525	Parking
52	R3-21	37	250	2,643	250	$1,266	Parking
53	R3-22	0	0	2,414	0	$0	Parking
54	R3-23	0	0	2,009	0	$0	Parking
55	R3-24	0	0	-	0	$0	Parking
56	R3-25	0	0	-	0	$0	Parking
57	R3-26	0	0	-	0	$0	Parking
58	R4-1	0	0	2,286	0	$0	Parking
59	R4-2	0	0	2,211	0	$0	Parking
60	R4-3	0	0	2,208	0	$0	Parking
61	R4-4	0	0	2,120	0	$0	Parking
62	R4-5	12	81	2,300	81	$411	Parking
63	R4-6	82	554	3,072	554	$2,806	Parking
64	R4-7	0	0	-	0	$0	Parking
65	R4-8	0	0	-	0	$0	Parking
66	R4-9	0	0	-	0	$0	Parking
67	R5-1	0	0	2,397	0	$0	Parking
68	R5-2	111	725	2,093	725	$3,673	Parking
69	R5-3	101	682	2,265	682	$3,456	Parking
70	R5-4	0	0	3,530	0	$0	Parking
71	R5-5	0	0	2,702	0	$0	Parking
72	R5-6	32	216	2,968	216	$1,095	Parking
73	R5-7	0	0	2,881	0	$0	Parking
74	R5-8	4	27	2,289	27	$137	Parking
75	R5-9	0	0	2,568	0	$0	Parking
76	R5-10	20	135	2,542	135	$684	Parking
77	R5-11	71	320	2,659	320	$1,620	Parking
78	R5-12	145	866	2,960	866	$4,392	Parking
79	R5-13	79	376	2,806	376	$1,905	Parking
80	R5-14	137	617	2,395	617	$3,126	Parking
81	R5-15	0	0	2,719	0	$0	Parking
82	R5-16	2	9	2,793	9	$46	Parking
83	R5-17	36	162	2,461	162	$821	Parking
84	R5-18	6	41	2,984	41	$205	Parking

TABLE B-1-8 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2020							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2020 Beach Capacity	Daily Visits For 2020	Daily Value @ $5.07	Critical Constraint
85	R5-19	16	108	2,580	108	$548	Parking
86	R5-20	61	297	2,678	297	$1,506	Parking
87	R5-21	9	41	3,305	41	$205	Parking
88	R5-22	27	182	-	182	$924	Parking
89	R5-23	0	0	-	0	$0	Parking
90	R5-24	0	0	-	0	$0	Parking
91	R5-25	0	0	-	0	$0	Parking
92	R5-26	0	0	-	0	$0	Parking
93	R5-27	0	0	-	0	$0	Parking
94	R5-28	0	0	-	0	$0	Parking
95	R5-29	0	0	-	0	$0	Parking
96	R5-30	0	0	2,597	0	$0	Parking
97	R5-31	0	0	2,544	0	$0	Parking
98	R5-32	0	0	2,451	0	$0	Parking
99	R5-33	13	59	2,684	59	$297	Parking
100	R5-34	14	86	2,702	86	$433	Parking
101	R5-35	106	702	2,482	702	$3,559	Parking
102	R5-36	0	0	2,309	0	$0	Parking
103	R5-37	0	0	2,459	0	$0	Parking
104	R5-38	0	0	2,595	0	$0	Parking
105	R5-39	0	0	2,725	0	$0	Parking
106	R5-40	0	0	2,662	0	$0	Parking
107	R5-41	0	0	2,355	0	$0	Parking
108	R5-42	13	59	2,245	59	$297	Parking
109	R5-43	0	0	2,115	0	$0	Parking
110	R5-44	0	0	2,047	0	$0	Parking
111	R5-45	0	0	1,847	0	$0	Parking
112	R5-46	105	709	1,967	709	$3,593	Parking
113	R5-47	76	513	2,111	513	$2,601	Parking
114	R5-48	67	452	2,068	452	$2,293	Parking
115	R5-49	67	452	2,364	452	$2,293	Parking
116	R5-50	15	101	2,624	101	$513	Parking
117	R5-51	0	0	2,744	0	$0	Parking
TOTAL		3,190	17,712	219,964	17,712	$89,800	

2030

TABLE B-1-9 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2030

Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2030 Beach Capacity	Daily Visits For 2030	Daily Value @ $5.07	Critical Constraint
1	R1-1	0	0	2,170	0	$0	Parking
2	R1-2	22	99	2,908	99	$502	Parking
3	R1-3	198	1,274	1,777	1,274	$6,457	Parking
4	R1-4	15	68	2,157	68	$342	Parking
5	R1-5	16	72	2,267	72	$365	Parking
6	R1-6	18	81	1,225	81	$411	Parking
7	R1-7	0	0	2,161	0	$0	Parking
8	R1-8	10	45	2,254	45	$228	Parking
9	R1-9	3	14	1,470	14	$68	Parking
10	R1-10	33	149	2,136	149	$753	Parking
11	R1-11	16	72	1,535	72	$365	Parking
12	R1-12	31	140	2,076	140	$707	Parking
13	R1-13	76	342	1,626	342	$1,734	Parking
14	R1-14	33	149	2,190	149	$753	Parking
15	R1-15	77	347	1,987	347	$1,757	Parking
16	R1-16	109	504	1,774	504	$2,555	Parking
17	R1-17	7	38	1,812	38	$194	Parking
18	R1-18	0	0	2,800	0	$0	Parking
19	R1-19	55	248	1,486	248	$1,255	Parking
20	R1-20	81	365	1,755	365	$1,848	Parking
21	R1-21	146	657	1,765	657	$3,331	Parking
22	R1-22	202	1,157	1,894	1,157	$5,863	Parking
23	R1-23	155	698	2,192	698	$3,536	Parking
24	R1-24	0	0	2,072	0	$0	Parking
25	R2-1	0	0	-	0	$0	Parking
26	R2-2	0	0	-	0	$0	Parking
27	R2-3	0	0	-	0	$0	Parking
28	R2-4	0	0	-	0	$0	Parking
29	R2-5	0	0	-	0	$0	Parking
30	R2-6	0	0	-	0	$0	Parking
31	R2-7	0	0	-	0	$0	Parking
32	R3-1	0	0	2,941	0	$0	Parking
33	R3-2	0	0	1,416	0	$0	Parking
34	R3-3	5	23	1,565	23	$114	Parking
35	R3-4	12	65	1,594	65	$331	Parking
36	R3-5	75	506	2,233	506	$2,567	Parking
37	R3-6	0	0	2,547	0	$0	Parking
38	R3-7	0	0	2,403	0	$0	Parking
39	R3-8	12	54	1,856	54	$274	Parking
40	R3-9	15	101	1,939	101	$513	Parking
41	R3-10	5	34	1,667	34	$171	Parking
42	R3-11	68	430	1,986	430	$2,179	Parking
43	R3-12	13	88	2,096	88	$445	Parking
44	R3-13	30	167	1,579	167	$844	Parking
45	R3-14	30	203	2,523	203	$1,027	Parking

TABLE B-1-9 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2030							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2030 Beach Capacity	Daily Visits For 2030	Daily Value @ $5.07	Critical Constraint
46	R3-15	0	0	2,717	0	$0	Parking
47	R3-16	0	0	1,791	0	$0	Parking
48	R3-17	0	0	2,173	0	$0	Parking
49	R3-18	24	108	2,444	108	$548	Parking
50	R3-19	111	500	2,191	500	$2,532	Parking
51	R3-20	23	104	2,279	104	$525	Parking
52	R3-21	37	250	2,643	250	$1,266	Parking
53	R3-22	0	0	2,414	0	$0	Parking
54	R3-23	0	0	2,009	0	$0	Parking
55	R3-24	0	0	-	0	$0	Parking
56	R3-25	0	0	-	0	$0	Parking
57	R3-26	0	0	-	0	$0	Parking
58	R4-1	0	0	2,286	0	$0	Parking
59	R4-2	0	0	2,211	0	$0	Parking
60	R4-3	0	0	2,208	0	$0	Parking
61	R4-4	0	0	2,120	0	$0	Parking
62	R4-5	12	81	2,300	81	$411	Parking
63	R4-6	82	554	3,072	554	$2,806	Parking
64	R4-7	0	0	-	0	$0	Parking
65	R4-8	0	0	-	0	$0	Parking
66	R4-9	0	0	-	0	$0	Parking
67	R5-1	0	0	2,397	0	$0	Parking
68	R5-2	111	725	2,093	725	$3,673	Parking
69	R5-3	101	682	2,265	682	$3,456	Parking
70	R5-4	0	0	3,530	0	$0	Parking
71	R5-5	0	0	2,702	0	$0	Parking
72	R5-6	32	216	2,968	216	$1,095	Parking
73	R5-7	0	0	2,881	0	$0	Parking
74	R5-8	4	27	2,289	27	$137	Parking
75	R5-9	0	0	2,568	0	$0	Parking
76	R5-10	20	135	2,542	135	$684	Parking
77	R5-11	71	320	2,659	320	$1,620	Parking
78	R5-12	145	866	2,960	866	$4,392	Parking
79	R5-13	79	376	2,806	376	$1,905	Parking
80	R5-14	137	617	2,395	617	$3,126	Parking
81	R5-15	0	0	2,719	0	$0	Parking
82	R5-16	2	9	2,793	9	$46	Parking
83	R5-17	36	162	2,461	162	$821	Parking
84	R5-18	6	41	2,984	41	$205	Parking
85	R5-19	16	108	2,580	108	$548	Parking
86	R5-20	61	297	2,678	297	$1,506	Parking
87	R5-21	9	41	3,305	41	$205	Parking
88	R5-22	27	182	-	182	$924	Parking

TABLE B-1-9 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2030							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2030 Beach Capacity	Daily Visits For 2030	Daily Value @ $5.07	Critical Constraint
89	R5-23	0	0	-	0	$0	Parking
90	R5-24	0	0	-	0	$0	Parking
91	R5-25	0	0	-	0	$0	Parking
92	R5-26	0	0	-	0	$0	Parking
93	R5-27	0	0	-	0	$0	Parking
94	R5-28	0	0	-	0	$0	Parking
95	R5-29	0	0	-	0	$0	Parking
96	R5-30	0	0	2,597	0	$0	Parking
97	R5-31	0	0	2,544	0	$0	Parking
98	R5-32	0	0	2,451	0	$0	Parking
99	R5-33	13	59	2,683	59	$297	Parking
100	R5-34	14	86	2,701	86	$433	Parking
101	R5-35	106	702	2,482	702	$3,559	Parking
102	R5-36	0	0	2,309	0	$0	Parking
103	R5-37	0	0	2,459	0	$0	Parking
104	R5-38	0	0	2,595	0	$0	Parking
105	R5-39	0	0	2,725	0	$0	Parking
106	R5-40	0	0	2,662	0	$0	Parking
107	R5-41	0	0	2,355	0	$0	Parking
108	R5-42	13	59	2,245	59	$297	Parking
109	R5-43	0	0	2,115	0	$0	Parking
110	R5-44	0	0	2,047	0	$0	Parking
111	R5-45	0	0	1,847	0	$0	Parking
112	R5-46	105	709	1,967	709	$3,593	Parking
113	R5-47	76	513	2,111	513	$2,601	Parking
114	R5-48	67	452	2,068	452	$2,293	Parking
115	R5-49	67	452	2,364	452	$2,293	Parking
116	R5-50	15	101	2,624	101	$513	Parking
117	R5-51	0	0	2,744	0	$0	Parking
TOTAL		3,190	17,712	219,960	17,712	$89,800	

2040

TABLE B-1-10 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2040							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2040 Beach Capacity	Daily Visits For 2040	Daily Value @ $5.07	Critical Constraint
1	R1-1	0	0	2,170	0	$0	Parking
2	R1-2	0	0	2,909	0	$0	Parking
3	R1-3	170	1,148	1,777	1,148	$5,818	Parking

TABLE B-1-10 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2040							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2040 Beach Capacity	Daily Visits For 2040	Daily Value @ $5.07	Critical Constraint
4	R1-4	0	0	2,157	0	$0	Parking
5	R1-5	0	0	2,267	0	$0	Parking
6	R1-6	0	0	1,225	0	$0	Parking
7	R1-7	0	0	2,161	0	$0	Parking
8	R1-8	0	0	2,254	0	$0	Parking
9	R1-9	0	0	1,470	0	$0	Parking
10	R1-10	0	0	2,136	0	$0	Parking
11	R1-11	0	0	1,535	0	$0	Parking
12	R1-12	0	0	2,076	0	$0	Parking
13	R1-13	0	0	1,626	0	$0	Parking
14	R1-14	0	0	2,190	0	$0	Parking
15	R1-15	0	0	1,987	0	$0	Parking
16	R1-16	6	41	1,774	41	$205	Parking
17	R1-17	3	20	1,812	20	$103	Parking
18	R1-18	0	0	2,800	0	$0	Parking
19	R1-19	0	0	1,486	0	$0	Parking
20	R1-20	0	0	1,755	0	$0	Parking
21	R1-21	0	0	1,765	0	$0	Parking
22	R1-22	110	743	1,894	743	$3,764	Parking
23	R1-23	0	0	2,192	0	$0	Parking
24	R1-24	0	0	2,072	0	$0	Parking
25	R2-1	0	0	-	0	$0	Parking
26	R2-2	0	0	-	0	$0	Parking
27	R2-3	0	0	-	0	$0	Parking
28	R2-4	0	0	-	0	$0	Parking
29	R2-5	0	0	-	0	$0	Parking
30	R2-6	0	0	-	0	$0	Parking
31	R2-7	0	0	-	0	$0	Parking
32	R3-1	0	0	2,941	0	$0	Parking
33	R3-2	0	0	1,416	0	$0	Parking
34	R3-3	0	0	1,565	0	$0	Parking
35	R3-4	5	34	1,594	34	$171	Parking
36	R3-5	75	506	2,233	506	$2,567	Parking
37	R3-6	0	0	2,547	0	$0	Parking
38	R3-7	0	0	2,403	0	$0	Parking
39	R3-8	0	0	1,856	0	$0	Parking
40	R3-9	15	101	1,939	101	$513	Parking
41	R3-10	5	34	1,667	34	$171	Parking
42	R3-11	55	371	1,986	371	$1,882	Parking
43	R3-12	13	88	2,096	88	$445	Parking
44	R3-13	14	95	1,579	95	$479	Parking
45	R3-14	30	203	2,523	203	$1,027	Parking
46	R3-15	0	0	2,717	0	$0	Parking

TABLE B-1-10 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2040							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2040 Beach Capacity	Daily Visits For 2040	Daily Value @ $5.07	Critical Constraint
47	R3-16	0	0	1,791	0	$0	Parking
48	R3-17	0	0	2,172	0	$0	Parking
49	R3-18	0	0	2,443	0	$0	Parking
50	R3-19	0	0	2,191	0	$0	Parking
51	R3-20	0	0	2,279	0	$0	Parking
52	R3-21	37	250	2,643	250	$1,266	Parking
53	R3-22	0	0	2,413	0	$0	Parking
54	R3-23	0	0	2,009	0	$0	Parking
55	R3-24	0	0	-	0	$0	Parking
56	R3-25	0	0	-	0	$0	Parking
57	R3-26	0	0	-	0	$0	Parking
58	R4-1	0	0	2,286	0	$0	Parking
59	R4-2	0	0	2,211	0	$0	Parking
60	R4-3	0	0	2,208	0	$0	Parking
61	R4-4	0	0	2,120	0	$0	Parking
62	R4-5	12	81	2,299	81	$411	Parking
63	R4-6	82	554	3,072	554	$2,806	Parking
64	R4-7	0	0	-	0	$0	Parking
65	R4-8	0	0	-	0	$0	Parking
66	R4-9	0	0	-	0	$0	Parking
67	R5-1	0	0	2,397	0	$0	Parking
68	R5-2	100	675	2,092	675	$3,422	Parking
69	R5-3	101	682	2,265	682	$3,456	Parking
70	R5-4	0	0	3,530	0	$0	Parking
71	R5-5	0	0	2,702	0	$0	Parking
72	R5-6	32	216	2,968	216	$1,095	Parking
73	R5-7	0	0	2,880	0	$0	Parking
74	R5-8	4	27	2,289	27	$137	Parking
75	R5-9	0	0	2,568	0	$0	Parking
76	R5-10	20	135	2,542	135	$684	Parking
77	R5-11	0	0	2,659	0	$0	Parking
78	R5-12	95	641	2,960	641	$3,251	Parking
79	R5-13	9	61	2,806	61	$308	Parking
80	R5-14	0	0	2,394	0	$0	Parking
81	R5-15	0	0	2,719	0	$0	Parking
82	R5-16	0	0	2,793	0	$0	Parking
83	R5-17	0	0	2,461	0	$0	Parking
84	R5-18	6	41	2,984	41	$205	Parking
85	R5-19	16	108	2,580	108	$548	Parking
86	R5-20	10	68	2,678	68	$342	Parking
87	R5-21	0	0	3,305	0	$0	Parking
88	R5-22	27	182	-	182	$924	Parking
89	R5-23	0	0	-	0	$0	Parking

TABLE B-1-10 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2040							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2040 Beach Capacity	Daily Visits For 2040	Daily Value @ $5.07	Critical Constraint
90	R5-24	0	0	-	0	$0	Parking
91	R5-25	0	0	-	0	$0	Parking
92	R5-26	0	0	-	0	$0	Parking
93	R5-27	0	0	-	0	$0	Parking
94	R5-28	0	0	-	0	$0	Parking
95	R5-29	0	0	-	0	$0	Parking
96	R5-30	0	0	2,597	0	$0	Parking
97	R5-31	0	0	2,544	0	$0	Parking
98	R5-32	0	0	2,451	0	$0	Parking
99	R5-33	0	0	2,683	0	$0	Parking
100	R5-34	10	68	2,701	68	$342	Parking
101	R5-35	100	675	2,482	675	$3,422	Parking
102	R5-36	0	0	2,308	0	$0	Parking
103	R5-37	0	0	2,459	0	$0	Parking
104	R5-38	0	0	2,595	0	$0	Parking
105	R5-39	0	0	2,725	0	$0	Parking
106	R5-40	0	0	2,662	0	$0	Parking
107	R5-41	0	0	2,355	0	$0	Parking
108	R5-42	0	0	2,245	0	$0	Parking
109	R5-43	0	0	2,115	0	$0	Parking
110	R5-44	0	0	2,047	0	$0	Parking
111	R5-45	0	0	1,847	0	$0	Parking
112	R5-46	105	709	1,967	709	$3,593	Parking
113	R5-47	76	513	2,111	513	$2,601	Parking
114	R5-48	67	452	2,068	452	$2,293	Parking
115	R5-49	67	452	2,364	452	$2,293	Parking
116	R5-50	15	101	2,624	101	$513	Parking
117	R5-51	0	0	2,744	0	$0	Parking
TOTAL		3,190	17,712	219,957	10,071	$51,060	

2050

TABLE B-1-11 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2050							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2050 Beach Capacity	Daily Visits For 2050	Daily Value @ $5.07	Critical Constraint
1	R1-1	0	0	2,170	0	$0	Parking
2	R1-2	22	99	2,909	99	$502	Parking
3	R1-3	198	1,274	1,777	1,274	$6,457	Parking
4	R1-4	15	68	2,157	68	$342	Parking

TABLE B-1-11 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2050							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2050 Beach Capacity	Daily Visits For 2050	Daily Value @ $5.07	Critical Constraint
5	R1-5	16	72	2,267	72	$365	Parking
6	R1-6	18	81	1,225	81	$411	Parking
7	R1-7	0	0	2,161	0	$0	Parking
8	R1-8	10	45	2,254	45	$228	Parking
9	R1-9	3	14	1,470	14	$68	Parking
10	R1-10	33	149	2,136	149	$753	Parking
11	R1-11	16	72	1,535	72	$365	Parking
12	R1-12	31	140	2,076	140	$707	Parking
13	R1-13	76	342	1,626	342	$1,734	Parking
14	R1-14	33	149	2,190	149	$753	Parking
15	R1-15	77	347	1,987	347	$1,757	Parking
16	R1-16	109	504	1,774	504	$2,555	Parking
17	R1-17	7	38	1,812	38	$194	Parking
18	R1-18	0	0	2,800	0	$0	Parking
19	R1-19	55	248	1,486	248	$1,255	Parking
20	R1-20	81	365	1,755	365	$1,848	Parking
21	R1-21	146	657	1,765	657	$3,331	Parking
22	R1-22	202	1,157	1,894	1,157	$5,863	Parking
23	R1-23	155	698	2,192	698	$3,536	Parking
24	R1-24	0	0	2,072	0	$0	Parking
25	R2-1	0	0	-	0	$0	Parking
26	R2-2	0	0	-	0	$0	Parking
27	R2-3	0	0	-	0	$0	Parking
28	R2-4	0	0	-	0	$0	Parking
29	R2-5	0	0	-	0	$0	Parking
30	R2-6	0	0	-	0	$0	Parking
31	R2-7	0	0	-	0	$0	Parking
32	R3-1	0	0	2,941	0	$0	Parking
33	R3-2	0	0	1,416	0	$0	Parking
34	R3-3	5	23	1,565	23	$114	Parking
35	R3-4	12	65	1,594	65	$331	Parking
36	R3-5	75	506	2,234	506	$2,567	Parking
37	R3-6	0	0	2,547	0	$0	Parking
38	R3-7	0	0	2,403	0	$0	Parking
39	R3-8	12	54	1,856	54	$274	Parking
40	R3-9	15	101	1,939	101	$513	Parking
41	R3-10	5	34	1,667	34	$171	Parking
42	R3-11	68	430	1,986	430	$2,179	Parking
43	R3-12	13	88	2,096	88	$445	Parking
44	R3-13	30	167	1,579	167	$844	Parking
45	R3-14	30	203	2,522	203	$1,027	Parking
46	R3-15	0	0	2,717	0	$0	Parking
47	R3-16	0	0	1,791	0	$0	Parking

TABLE B-1-11 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2050							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2050 Beach Capacity	Daily Visits For 2050	Daily Value @ $5.07	Critical Constraint
48	R3-17	0	0	2,172	0	$0	Parking
49	R3-18	24	108	2,443	108	$548	Parking
50	R3-19	111	500	2,190	500	$2,532	Parking
51	R3-20	23	104	2,279	104	$525	Parking
52	R3-21	37	250	2,643	250	$1,266	Parking
53	R3-22	0	0	2,413	0	$0	Parking
54	R3-23	0	0	2,009	0	$0	Parking
55	R3-24	0	0	-	0	$0	Parking
56	R3-25	0	0	-	0	$0	Parking
57	R3-26	0	0	-	0	$0	Parking
58	R4-1	0	0	2,286	0	$0	Parking
59	R4-2	0	0	2,211	0	$0	Parking
60	R4-3	0	0	2,208	0	$0	Parking
61	R4-4	0	0	2,120	0	$0	Parking
62	R4-5	12	81	2,299	81	$411	Parking
63	R4-6	82	554	3,072	554	$2,806	Parking
64	R4-7	0	0	-	0	$0	Parking
65	R4-8	0	0	-	0	$0	Parking
66	R4-9	0	0	-	0	$0	Parking
67	R5-1	0	0	2,397	0	$0	Parking
68	R5-2	111	725	2,092	725	$3,673	Parking
69	R5-3	101	682	2,265	682	$3,456	Parking
70	R5-4	0	0	3,530	0	$0	Parking
71	R5-5	0	0	2,702	0	$0	Parking
72	R5-6	32	216	2,968	216	$1,095	Parking
73	R5-7	0	0	2,880	0	$0	Parking
74	R5-8	4	27	2,289	27	$137	Parking
75	R5-9	0	0	2,568	0	$0	Parking
76	R5-10	20	135	2,542	135	$684	Parking
77	R5-11	71	320	2,659	320	$1,620	Parking
78	R5-12	145	866	2,960	866	$4,392	Parking
79	R5-13	79	376	2,806	376	$1,905	Parking
80	R5-14	137	617	2,394	617	$3,126	Parking
81	R5-15	0	0	2,719	0	$0	Parking
82	R5-16	2	9	2,793	9	$46	Parking
83	R5-17	36	162	2,461	162	$821	Parking
84	R5-18	6	41	2,984	41	$205	Parking
85	R5-19	16	108	2,580	108	$548	Parking
86	R5-20	61	297	2,678	297	$1,506	Parking
87	R5-21	9	41	3,305	41	$205	Parking
88	R5-22	27	182	-	182	$924	Parking
89	R5-23	0	0	-	0	$0	Parking
90	R5-24	0	0	-	0	$0	Parking

TABLE B-1-11 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2050							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2050 Beach Capacity	Daily Visits For 2050	Daily Value @ $5.07	Critical Constraint
91	R5-25	0	0	-	0	$0	Parking
92	R5-26	0	0	-	0	$0	Parking
93	R5-27	0	0	-	0	$0	Parking
94	R5-28	0	0	-	0	$0	Parking
95	R5-29	0	0	-	0	$0	Parking
96	R5-30	0	0	2,597	0	$0	Parking
97	R5-31	0	0	2,544	0	$0	Parking
98	R5-32	0	0	2,450	0	$0	Parking
99	R5-33	13	59	2,683	59	$297	Parking
100	R5-34	14	86	2,701	86	$433	Parking
101	R5-35	106	702	2,482	702	$3,559	Parking
102	R5-36	0	0	2,308	0	$0	Parking
103	R5-37	0	0	2,459	0	$0	Parking
104	R5-38	0	0	2,595	0	$0	Parking
105	R5-39	0	0	2,725	0	$0	Parking
106	R5-40	0	0	2,662	0	$0	Parking
107	R5-41	0	0	2,355	0	$0	Parking
108	R5-42	13	59	2,245	59	$297	Parking
109	R5-43	0	0	2,115	0	$0	Parking
110	R5-44	0	0	2,047	0	$0	Parking
111	R5-45	0	0	1,847	0	$0	Parking
112	R5-46	105	709	1,967	709	$3,593	Parking
113	R5-47	76	513	2,111	513	$2,601	Parking
114	R5-48	67	452	2,068	452	$2,293	Parking
115	R5-49	67	452	2,364	452	$2,293	Parking
116	R5-50	15	101	2,624	101	$513	Parking
117	R5-51	0	0	2,744	0	$0	Parking
TOTAL		3,190	17,712	219,954	17,712	$89,800	

2060

TABLE B-1-12 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2060							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2060 Beach Capacity	Daily Visits For 2060	Daily Value @ $5.07	Critical Constraint
1	R1-1	0	0	2,170	0	$0	Parking
2	R1-2	22	99	2,909	99	$502	Parking
3	R1-3	198	1,274	1,777	1,274	$6,457	Parking
4	R1-4	15	68	2,157	68	$342	Parking
5	R1-5	16	72	2,267	72	$365	Parking

TABLE B-1-12 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2060							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2060 Beach Capacity	Daily Visits For 2060	Daily Value @ $5.07	Critical Constraint
6	R1-6	18	81	1,225	81	$411	Parking
7	R1-7	0	0	2,161	0	$0	Parking
8	R1-8	10	45	2,254	45	$228	Parking
9	R1-9	3	14	1,470	14	$68	Parking
10	R1-10	33	149	2,136	149	$753	Parking
11	R1-11	16	72	1,535	72	$365	Parking
12	R1-12	31	140	2,076	140	$707	Parking
13	R1-13	76	342	1,626	342	$1,734	Parking
14	R1-14	33	149	2,190	149	$753	Parking
15	R1-15	77	347	1,987	347	$1,757	Parking
16	R1-16	109	504	1,774	504	$2,555	Parking
17	R1-17	7	38	1,812	38	$194	Parking
18	R1-18	0	0	2,800	0	$0	Parking
19	R1-19	55	248	1,486	248	$1,255	Parking
20	R1-20	81	365	1,755	365	$1,848	Parking
21	R1-21	146	657	1,765	657	$3,331	Parking
22	R1-22	202	1,157	1,894	1,157	$5,863	Parking
23	R1-23	155	698	2,192	698	$3,536	Parking
24	R1-24	0	0	2,072	0	$0	Parking
25	R2-1	0	0	-	0	$0	Parking
26	R2-2	0	0	-	0	$0	Parking
27	R2-3	0	0	-	0	$0	Parking
28	R2-4	0	0	-	0	$0	Parking
29	R2-5	0	0	-	0	$0	Parking
30	R2-6	0	0	-	0	$0	Parking
31	R2-7	0	0	-	0	$0	Parking
32	R3-1	0	0	2,942	0	$0	Parking
33	R3-2	0	0	1,416	0	$0	Parking
34	R3-3	5	23	1,565	23	$114	Parking
35	R3-4	12	65	1,594	65	$331	Parking
36	R3-5	75	506	2,234	506	$2,567	Parking
37	R3-6	0	0	2,547	0	$0	Parking
38	R3-7	0	0	2,403	0	$0	Parking
39	R3-8	12	54	1,856	54	$274	Parking
40	R3-9	15	101	1,939	101	$513	Parking
41	R3-10	5	34	1,667	34	$171	Parking
42	R3-11	68	430	1,986	430	$2,179	Parking
43	R3-12	13	88	2,096	88	$445	Parking
44	R3-13	30	167	1,579	167	$844	Parking
45	R3-14	30	203	2,522	203	$1,027	Parking
46	R3-15	0	0	2,716	0	$0	Parking
47	R3-16	0	0	1,791	0	$0	Parking
48	R3-17	0	0	2,172	0	$0	Parking

TABLE B-1-12 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2060							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2060 Beach Capacity	Daily Visits For 2060	Daily Value @ $5.07	Critical Constraint
49	R3-18	24	108	2,443	108	$548	Parking
50	R3-19	111	500	2,190	500	$2,532	Parking
51	R3-20	23	104	2,278	104	$525	Parking
52	R3-21	37	250	2,642	250	$1,266	Parking
53	R3-22	0	0	2,413	0	$0	Parking
54	R3-23	0	0	2,009	0	$0	Parking
55	R3-24	0	0	-	0	$0	Parking
56	R3-25	0	0	-	0	$0	Parking
57	R3-26	0	0	-	0	$0	Parking
58	R4-1	0	0	2,285	0	$0	Parking
59	R4-2	0	0	2,211	0	$0	Parking
60	R4-3	0	0	2,208	0	$0	Parking
61	R4-4	0	0	2,120	0	$0	Parking
62	R4-5	12	81	2,299	81	$411	Parking
63	R4-6	82	554	3,072	554	$2,806	Parking
64	R4-7	0	0	-	0	$0	Parking
65	R4-8	0	0	-	0	$0	Parking
66	R4-9	0	0	-	0	$0	Parking
67	R5-1	0	0	2,397	0	$0	Parking
68	R5-2	111	725	2,092	725	$3,673	Parking
69	R5-3	101	682	2,265	682	$3,456	Parking
70	R5-4	0	0	3,530	0	$0	Parking
71	R5-5	0	0	2,702	0	$0	Parking
72	R5-6	32	216	2,968	216	$1,095	Parking
73	R5-7	0	0	2,880	0	$0	Parking
74	R5-8	4	27	2,289	27	$137	Parking
75	R5-9	0	0	2,568	0	$0	Parking
76	R5-10	20	135	2,542	135	$684	Parking
77	R5-11	71	320	2,659	320	$1,620	Parking
78	R5-12	145	866	2,960	866	$4,392	Parking
79	R5-13	79	376	2,806	376	$1,905	Parking
80	R5-14	137	617	2,394	617	$3,126	Parking
81	R5-15	0	0	2,719	0	$0	Parking
82	R5-16	2	9	2,793	9	$46	Parking
83	R5-17	36	162	2,461	162	$821	Parking
84	R5-18	6	41	2,984	41	$205	Parking
85	R5-19	16	108	2,580	108	$548	Parking
86	R5-20	61	297	2,678	297	$1,506	Parking
87	R5-21	9	41	3,305	41	$205	Parking
88	R5-22	27	182	-	182	$924	Parking
89	R5-23	0	0	-	0	$0	Parking
90	R5-24	0	0	-	0	$0	Parking
91	R5-25	0	0	-	0	$0	Parking

TABLE B-1-12 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2060							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2060 Beach Capacity	Daily Visits For 2060	Daily Value @ $5.07	Critical Constraint
92	R5-26	0	0	-	0	$0	Parking
93	R5-27	0	0	-	0	$0	Parking
94	R5-28	0	0	-	0	$0	Parking
95	R5-29	0	0	-	0	$0	Parking
96	R5-30	0	0	2,597	0	$0	Parking
97	R5-31	0	0	2,544	0	$0	Parking
98	R5-32	0	0	2,450	0	$0	Parking
99	R5-33	13	59	2,683	59	$297	Parking
100	R5-34	14	86	2,701	86	$433	Parking
101	R5-35	106	702	2,481	702	$3,559	Parking
102	R5-36	0	0	2,308	0	$0	Parking
103	R5-37	0	0	2,459	0	$0	Parking
104	R5-38	0	0	2,595	0	$0	Parking
105	R5-39	0	0	2,725	0	$0	Parking
106	R5-40	0	0	2,662	0	$0	Parking
107	R5-41	0	0	2,355	0	$0	Parking
108	R5-42	13	59	2,245	59	$297	Parking
109	R5-43	0	0	2,115	0	$0	Parking
110	R5-44	0	0	2,047	0	$0	Parking
111	R5-45	0	0	1,847	0	$0	Parking
112	R5-46	105	709	1,967	709	$3,593	Parking
113	R5-47	76	513	2,111	513	$2,601	Parking
114	R5-48	67	452	2,068	452	$2,293	Parking
115	R5-49	67	452	2,364	452	$2,293	Parking
116	R5-50	15	101	2,624	101	$513	Parking
117	R5-51	0	0	2,743	0	$0	Parking
TOTAL		3,190	17,712	219,950	17,712	$89,800	

2063

TABLE B-1-13 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2063							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2063 Beach Capacity	Daily Visits For 2063	Daily Value @ $5.07	Critical Constraint
1	R1-1	0	0	2,170	0	$0	Parking
2	R1-2	22	99	2,909	99	$502	Parking
3	R1-3	198	1,274	1,777	1,274	$6,457	Parking
4	R1-4	15	68	2,157	68	$342	Parking
5	R1-5	16	72	2,267	72	$365	Parking
6	R1-6	18	81	1,225	81	$411	Parking

TABLE B-1-13 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2063							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2063 Beach Capacity	Daily Visits For 2063	Daily Value @ $5.07	Critical Constraint
7	R1-7	0	0	2,161	0	$0	Parking
8	R1-8	10	45	2,254	45	$228	Parking
9	R1-9	3	14	1,470	14	$68	Parking
10	R1-10	33	149	2,136	149	$753	Parking
11	R1-11	16	72	1,535	72	$365	Parking
12	R1-12	31	140	2,076	140	$707	Parking
13	R1-13	76	342	1,626	342	$1,734	Parking
14	R1-14	33	149	2,190	149	$753	Parking
15	R1-15	77	347	1,987	347	$1,757	Parking
16	R1-16	109	504	1,774	504	$2,555	Parking
17	R1-17	7	38	1,812	38	$194	Parking
18	R1-18	0	0	2,800	0	$0	Parking
19	R1-19	55	248	1,486	248	$1,255	Parking
20	R1-20	81	365	1,755	365	$1,848	Parking
21	R1-21	146	657	1,765	657	$3,331	Parking
22	R1-22	202	1,157	1,894	1,157	$5,863	Parking
23	R1-23	155	698	2,192	698	$3,536	Parking
24	R1-24	0	0	2,072	0	$0	Parking
25	R2-1	0	0	-	0	$0	Parking
26	R2-2	0	0	-	0	$0	Parking
27	R2-3	0	0	-	0	$0	Parking
28	R2-4	0	0	-	0	$0	Parking
29	R2-5	0	0	-	0	$0	Parking
30	R2-6	0	0	-	0	$0	Parking
31	R2-7	0	0	-	0	$0	Parking
32	R3-1	0	0	2,942	0	$0	Parking
33	R3-2	0	0	1,416	0	$0	Parking
34	R3-3	5	23	1,565	23	$114	Parking
35	R3-4	12	65	1,594	65	$331	Parking
36	R3-5	75	506	2,234	506	$2,567	Parking
37	R3-6	0	0	2,547	0	$0	Parking
38	R3-7	0	0	2,403	0	$0	Parking
39	R3-8	12	54	1,856	54	$274	Parking
40	R3-9	15	101	1,939	101	$513	Parking
41	R3-10	5	34	1,667	34	$171	Parking
42	R3-11	68	430	1,986	430	$2,179	Parking
43	R3-12	13	88	2,096	88	$445	Parking
44	R3-13	30	167	1,578	167	$844	Parking
45	R3-14	30	203	2,522	203	$1,027	Parking
46	R3-15	0	0	2,716	0	$0	Parking
47	R3-16	0	0	1,791	0	$0	Parking
48	R3-17	0	0	2,172	0	$0	Parking
49	R3-18	24	108	2,443	108	$548	Parking

TABLE B-1-13 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2063							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2063 Beach Capacity	Daily Visits For 2063	Daily Value @ $5.07	Critical Constraint
50	R3-19	111	500	2,190	500	$2,532	Parking
51	R3-20	23	104	2,278	104	$525	Parking
52	R3-21	37	250	2,642	250	$1,266	Parking
53	R3-22	0	0	2,413	0	$0	Parking
54	R3-23	0	0	2,009	0	$0	Parking
55	R3-24	0	0	-	0	$0	Parking
56	R3-25	0	0	-	0	$0	Parking
57	R3-26	0	0	-	0	$0	Parking
58	R4-1	0	0	2,285	0	$0	Parking
59	R4-2	0	0	2,211	0	$0	Parking
60	R4-3	0	0	2,208	0	$0	Parking
61	R4-4	0	0	2,120	0	$0	Parking
62	R4-5	12	81	2,299	81	$411	Parking
63	R4-6	82	554	3,072	554	$2,806	Parking
64	R4-7	0	0	-	0	$0	Parking
65	R4-8	0	0	-	0	$0	Parking
66	R4-9	0	0	-	0	$0	Parking
67	R5-1	0	0	2,397	0	$0	Parking
68	R5-2	111	725	2,092	725	$3,673	Parking
69	R5-3	101	682	2,265	682	$3,456	Parking
70	R5-4	0	0	3,530	0	$0	Parking
71	R5-5	0	0	2,702	0	$0	Parking
72	R5-6	32	216	2,968	216	$1,095	Parking
73	R5-7	0	0	2,880	0	$0	Parking
74	R5-8	4	27	2,289	27	$137	Parking
75	R5-9	0	0	2,568	0	$0	Parking
76	R5-10	20	135	2,542	135	$684	Parking
77	R5-11	71	320	2,658	320	$1,620	Parking
78	R5-12	145	866	2,960	866	$4,392	Parking
79	R5-13	79	376	2,806	376	$1,905	Parking
80	R5-14	137	617	2,394	617	$3,126	Parking
81	R5-15	0	0	2,719	0	$0	Parking
82	R5-16	2	9	2,793	9	$46	Parking
83	R5-17	36	162	2,461	162	$821	Parking
84	R5-18	6	41	2,984	41	$205	Parking
85	R5-19	16	108	2,580	108	$548	Parking
86	R5-20	61	297	2,678	297	$1,506	Parking
87	R5-21	9	41	3,305	41	$205	Parking
88	R5-22	27	182	-	182	$924	Parking
89	R5-23	0	0	-	0	$0	Parking
90	R5-24	0	0	-	0	$0	Parking
91	R5-25	0	0	-	0	$0	Parking
92	R5-26	0	0	-	0	$0	Parking

TABLE B-1-13 HISTORIC PEAK DAY CONSTRAINED VISITATION CAPACITY - 2063							
Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	2063 Beach Capacity	Daily Visits For 2063	Daily Value @ $5.07	Critical Constraint
93	R5-27	0	0	-	0	$0	Parking
94	R5-28	0	0	-	0	$0	Parking
95	R5-29	0	0	-	0	$0	Parking
96	R5-30	0	0	2,597	0	$0	Parking
97	R5-31	0	0	2,543	0	$0	Parking
98	R5-32	0	0	2,450	0	$0	Parking
99	R5-33	13	59	2,683	59	$297	Parking
100	R5-34	14	86	2,701	86	$433	Parking
101	R5-35	106	702	2,481	702	$3,559	Parking
102	R5-36	0	0	2,308	0	$0	Parking
103	R5-37	0	0	2,458	0	$0	Parking
104	R5-38	0	0	2,595	0	$0	Parking
105	R5-39	0	0	2,724	0	$0	Parking
106	R5-40	0	0	2,662	0	$0	Parking
107	R5-41	0	0	2,355	0	$0	Parking
108	R5-42	13	59	2,245	59	$297	Parking
109	R5-43	0	0	2,115	0	$0	Parking
110	R5-44	0	0	2,047	0	$0	Parking
111	R5-45	0	0	1,847	0	$0	Parking
112	R5-46	105	709	1,967	709	$3,593	Parking
113	R5-47	76	513	2,111	513	$2,601	Parking
114	R5-48	67	452	2,068	452	$2,293	Parking
115	R5-49	67	452	2,364	452	$2,293	Parking
116	R5-50	15	101	2,624	101	$513	Parking
117	R5-51	0	0	2,743	0	$0	Parking
TOTAL		3,190	17,712	219,947	17,712	$89,800	

Table B-1-14 presents a summary data for visitation capacity by year for the without project condition.

TABLE B-1-14
WITHOUT PROJECT CONDITION SUMMARY VISITATION CAPACITY BY YEAR

Year	Maximum Peak Day Visits	Daily Parking Capacity	Daily Beach Capacity	Daily Constrained Visits		Daily Parking Capacity
2010	16,164	17,712	219,967	17,712		17,712
2020	18,193	17,712	219,964	17,712		17,712
2030	21,723	17,712	219,960	17,712		17,712

2040	29,194	17,712	219,957	17,712		17,712
2050	39,234	17,712	219,954	17,712		17,712
2060	52,727	17,712	219,950	17,712		17,712
2063	70,861	17,712	219,947	17,712		17,712

Table B-1-15 presents a summary of peak day recreation value by reach and year for the without project condition.

TABLE B-1-15
WITHOUT PROJECT PEAK DAY VISITATION VALUE BY REACH AND YEAR

Sub-Reach	Model Reach	2020	2030	2040	2050	2060	2063
1	R1-1	$0	$0	$0	$0	$0	$0
2	R1-2	$502	$502	$502	$502	$502	$502
3	R1-3	$6,457	$6,457	$6,457	$6,457	$6,457	$6,457
4	R1-4	$342	$342	$342	$342	$342	$342
5	R1-5	$365	$365	$365	$365	$365	$365
6	R1-6	$411	$411	$411	$411	$411	$411
7	R1-7	$0	$0	$0	$0	$0	$0
8	R1-8	$228	$228	$228	$228	$228	$228
9	R1-9	$68	$68	$68	$68	$68	$68
10	R1-10	$753	$753	$753	$753	$753	$753
11	R1-11	$365	$365	$365	$365	$365	$365
12	R1-12	$707	$707	$707	$707	$707	$707
13	R1-13	$1,734	$1,734	$1,734	$1,734	$1,734	$1,734
14	R1-14	$753	$753	$753	$753	$753	$753
15	R1-15	$1,757	$1,757	$1,757	$1,757	$1,757	$1,757
16	R1-16	$2,555	$2,555	$2,555	$2,555	$2,555	$2,555
17	R1-17	$194	$194	$194	$194	$194	$194
18	R1-18	$0	$0	$0	$0	$0	$0
19	R1-19	$1,255	$1,255	$1,255	$1,255	$1,255	$1,255
20	R1-20	$1,848	$1,848	$1,848	$1,848	$1,848	$1,848
21	R1-21	$3,331	$3,331	$3,331	$3,331	$3,331	$3,331
22	R1-22	$5,863	$5,863	$5,863	$5,863	$5,863	$5,863
23	R1-23	$3,536	$3,536	$3,536	$3,536	$3,536	$3,536
24	R1-24	$0	$0	$0	$0	$0	$0
25	R2-1	$0	$0	$0	$0	$0	$0
26	R2-2	$0	$0	$0	$0	$0	$0
27	R2-3	$0	$0	$0	$0	$0	$0
28	R2-4	$0	$0	$0	$0	$0	$0
29	R2-5	$0	$0	$0	$0	$0	$0
30	R2-6	$0	$0	$0	$0	$0	$0
31	R2-7	$0	$0	$0	$0	$0	$0
32	R3-1	$0	$0	$0	$0	$0	$0
33	R3-2	$0	$0	$0	$0	$0	$0
34	R3-3	$114	$114	$114	$114	$114	$114
35	R3-4	$331	$331	$331	$331	$331	$331
36	R3-5	$2,567	$2,567	$2,567	$2,567	$2,567	$2,567
37	R3-6	$0	$0	$0	$0	$0	$0
38	R3-7	$0	$0	$0	$0	$0	$0
39	R3-8	$274	$274	$274	$274	$274	$274
40	R3-9	$513	$513	$513	$513	$513	$513
41	R3-10	$171	$171	$171	$171	$171	$171

TABLE B-1-15
WITHOUT PROJECT PEAK DAY VISITATION VALUE BY REACH AND YEAR

Sub-Reach	Model Reach	2020	2030	2040	2050	2060	2063
42	R3-11	$2,179	$2,179	$2,179	$2,179	$2,179	$2,179
43	R3-12	$445	$445	$445	$445	$445	$445
44	R3-13	$844	$844	$844	$844	$844	$844
45	R3-14	$1,027	$1,027	$1,027	$1,027	$1,027	$1,027
46	R3-15	$0	$0	$0	$0	$0	$0
47	R3-16	$0	$0	$0	$0	$0	$0
48	R3-17	$0	$0	$0	$0	$0	$0
49	R3-18	$548	$548	$548	$548	$548	$548
50	R3-19	$2,532	$2,532	$2,532	$2,532	$2,532	$2,532
51	R3-20	$525	$525	$525	$525	$525	$525
52	R3-21	$1,266	$1,266	$1,266	$1,266	$1,266	$1,266
53	R3-22	$0	$0	$0	$0	$0	$0
54	R3-23	$0	$0	$0	$0	$0	$0
55	R3-24	$0	$0	$0	$0	$0	$0
56	R3-25	$0	$0	$0	$0	$0	$0
57	R3-26	$0	$0	$0	$0	$0	$0
58	R4-1	$0	$0	$0	$0	$0	$0
59	R4-2	$0	$0	$0	$0	$0	$0
60	R4-3	$0	$0	$0	$0	$0	$0
61	R4-4	$0	$0	$0	$0	$0	$0
62	R4-5	$411	$411	$411	$411	$411	$411
63	R4-6	$2,806	$2,806	$2,806	$2,806	$2,806	$2,806
64	R4-7	$0	$0	$0	$0	$0	$0
65	R4-8	$0	$0	$0	$0	$0	$0
66	R4-9	$0	$0	$0	$0	$0	$0
67	R5-1	$0	$0	$0	$0	$0	$0
68	R5-2	$3,673	$3,673	$3,673	$3,673	$3,673	$3,673
69	R5-3	$3,456	$3,456	$3,456	$3,456	$3,456	$3,456
70	R5-4	$0	$0	$0	$0	$0	$0
71	R5-5	$0	$0	$0	$0	$0	$0
72	R5-6	$1,095	$1,095	$1,095	$1,095	$1,095	$1,095
73	R5-7	$0	$0	$0	$0	$0	$0
74	R5-8	$137	$137	$137	$137	$137	$137
75	R5-9	$0	$0	$0	$0	$0	$0
76	R5-10	$684	$684	$684	$684	$684	$684
77	R5-11	$1,620	$1,620	$1,620	$1,620	$1,620	$1,620
78	R5-12	$4,392	$4,392	$4,392	$4,392	$4,392	$4,392
79	R5-13	$1,905	$1,905	$1,905	$1,905	$1,905	$1,905
80	R5-14	$3,126	$3,126	$3,126	$3,126	$3,126	$3,126
81	R5-15	$0	$0	$0	$0	$0	$0
82	R5-16	$46	$46	$46	$46	$46	$46
83	R5-17	$821	$821	$821	$821	$821	$821
84	R5-18	$205	$205	$205	$205	$205	$205
85	R5-19	$548	$548	$548	$548	$548	$548

TABLE B-1-15
WITHOUT PROJECT PEAK DAY VISITATION VALUE BY REACH AND YEAR

Sub-Reach	Model Reach	2020	2030	2040	2050	2060	2063
86	R5-20	$1,506	$1,506	$1,506	$1,506	$1,506	$1,506
87	R5-21	$205	$205	$205	$205	$205	$205
88	R5-22	$924	$924	$924	$924	$924	$924
89	R5-23	$0	$0	$0	$0	$0	$0
90	R5-24	$0	$0	$0	$0	$0	$0
91	R5-25	$0	$0	$0	$0	$0	$0
92	R5-26	$0	$0	$0	$0	$0	$0
93	R5-27	$0	$0	$0	$0	$0	$0
94	R5-28	$0	$0	$0	$0	$0	$0
95	R5-29	$0	$0	$0	$0	$0	$0
96	R5-30	$0	$0	$0	$0	$0	$0
97	R5-31	$0	$0	$0	$0	$0	$0
98	R5-32	$0	$0	$0	$0	$0	$0
99	R5-33	$297	$297	$297	$297	$297	$297
100	R5-34	$433	$433	$433	$433	$433	$433
101	R5-35	$3,559	$3,559	$3,559	$3,559	$3,559	$3,559
102	R5-36	$0	$0	$0	$0	$0	$0
103	R5-37	$0	$0	$0	$0	$0	$0
104	R5-38	$0	$0	$0	$0	$0	$0
105	R5-39	$0	$0	$0	$0	$0	$0
106	R5-40	$0	$0	$0	$0	$0	$0
107	R5-41	$0	$0	$0	$0	$0	$0
108	R5-42	$297	$297	$297	$297	$297	$297
109	R5-43	$0	$0	$0	$0	$0	$0
110	R5-44	$0	$0	$0	$0	$0	$0
111	R5-45	$0	$0	$0	$0	$0	$0
112	R5-46	$3,593	$3,593	$3,593	$3,593	$3,593	$3,593
113	R5-47	$2,601	$2,601	$2,601	$2,601	$2,601	$2,601
114	R5-48	$2,293	$2,293	$2,293	$2,293	$2,293	$2,293
115	R5-49	$2,293	$2,293	$2,293	$2,293	$2,293	$2,293
116	R5-50	$513	$513	$513	$513	$513	$513
117	R5-51	$0	$0	$0	$0	$0	$0
TOTAL		$89,800	$89,800	$89,800	$89,800	$89,800	$89,800

TENTATIVELY SELECTED PLAN

Only one alternative, the tentatively selected plan, is evaluated under the with project condition.

TABLE B-1-16
WITH PROJECT PEAK DAY VISITATION CAPACITY AND VALUE - 2010

Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	With Project Beach Capacity	Daily Visits With Project	Daily Value @ $5.16	Critical Constraint
1	R1-1	0	0	2,170	0	$0	Parking
2	R1-2	22	99	2,908	99	$511	Parking
3	R1-3	198	1,274	1,777	1,274	$6,571	Parking
4	R1-4	15	68	2,156	68	$348	Parking
5	R1-5	16	72	2,266	72	$372	Parking
6	R1-6	18	81	1,225	81	$418	Parking
7	R1-7	0	0	2,161	0	$0	Parking
8	R1-8	10	45	2,254	45	$232	Parking
9	R1-9	3	14	1,470	14	$70	Parking
10	R1-10	33	149	2,136	149	$766	Parking
11	R1-11	16	72	1,535	72	$372	Parking
12	R1-12	31	140	2,076	140	$720	Parking
13	R1-13	76	342	1,626	342	$1,765	Parking
14	R1-14	33	149	2,190	149	$766	Parking
15	R1-15	77	347	1,987	347	$1,788	Parking
16	R1-16	109	504	1,774	504	$2,601	Parking
17	R1-17	7	38	1,812	38	$197	Parking
18	R1-18	0	0	2,800	0	$0	Parking
19	R1-19	55	248	1,486	248	$1,277	Parking
20	R1-20	81	365	1,755	365	$1,881	Parking
21	R1-21	146	657	1,765	657	$3,390	Parking
22	R1-22	202	1,157	1,894	1,157	$5,968	Parking
23	R1-23	155	698	2,192	698	$3,599	Parking
24	R1-24	0	0	2,071	0	$0	Parking
25	R2-1	0	0	-	0	$0	Parking
26	R2-2	0	0	-	0	$0	Parking
27	R2-3	0	0	-	0	$0	Parking
28	R2-4	0	0	-	0	$0	Parking
29	R2-5	0	0	-	0	$0	Parking
30	R2-6	0	0	-	0	$0	Parking
31	R2-7	0	0	-	0	$0	Parking
32	R3-1	0	0	2,941	0	$0	Parking
33	R3-2	0	0	1,416	0	$0	Parking
34	R3-3	5	23	1,565	23	$116	Parking
35	R3-4	12	65	1,594	65	$337	Parking
36	R3-5	75	506	2,233	506	$2,612	Parking
37	R3-6	0	0	2,547	0	$0	Parking
38	R3-7	0	0	2,403	0	$0	Parking
39	R3-8	12	54	1,856	54	$279	Parking
40	R3-9	15	101	1,939	101	$522	Parking
41	R3-10	5	34	1,667	34	$174	Parking
42	R3-11	68	430	1,986	430	$2,218	Parking
43	R3-12	13	88	2,096	88	$453	Parking

TABLE B-1-16
WITH PROJECT PEAK DAY VISITATION CAPACITY AND VALUE - 2010

Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	With Project Beach Capacity	Daily Visits With Project	Daily Value @ $5.16	Critical Constraint
44	R3-13	30	167	1,579	167	$859	Parking
45	R3-14	30	203	2,523	203	$1,045	Parking
46	R3-15	0	0	2,717	0	$0	Parking
47	R3-16	0	0	1,792	0	$0	Parking
48	R3-17	0	0	2,173	0	$0	Parking
49	R3-18	24	108	2,444	108	$557	Parking
50	R3-19	111	500	2,191	500	$2,577	Parking
51	R3-20	23	104	2,279	104	$534	Parking
52	R3-21	37	250	2,643	250	$1,289	Parking
53	R3-22	0	0	2,414	0	$0	Parking
54	R3-23	0	0	2,009	0	$0	Parking
55	R3-24	0	0	-	0	$0	Parking
56	R3-25	0	0	-	0	$0	Parking
57	R3-26	0	0	-	0	$0	Parking
58	R4-1	0	0	2,286	0	$0	Parking
59	R4-2	0	0	2,211	0	$0	Parking
60	R4-3	0	0	2,208	0	$0	Parking
61	R4-4	0	0	2,120	0	$0	Parking
62	R4-5	12	81	2,300	81	$418	Parking
63	R4-6	82	554	3,072	554	$2,856	Parking
64	R4-7	0	0	-	0	$0	Parking
65	R4-8	0	0	-	0	$0	Parking
66	R4-9	0	0	-	0	$0	Parking
67	R5-1	0	0	2,398	0	$0	Parking
68	R5-2	111	725	2,093	725	$3,738	Parking
69	R5-3	101	682	2,265	682	$3,518	Parking
70	R5-4	0	0	3,530	0	$0	Parking
71	R5-5	0	0	2,702	0	$0	Parking
72	R5-6	32	216	2,968	216	$1,115	Parking
73	R5-7	0	0	2,881	0	$0	Parking
74	R5-8	4	27	2,289	27	$139	Parking
75	R5-9	0	0	2,568	0	$0	Parking
76	R5-10	20	135	2,542	135	$697	Parking
77	R5-11	71	320	2,659	320	$1,649	Parking
78	R5-12	145	866	2,960	866	$4,470	Parking
79	R5-13	79	376	2,806	376	$1,939	Parking
80	R5-14	137	617	2,395	617	$3,181	Parking
81	R5-15	0	0	2,719	0	$0	Parking
82	R5-16	2	9	2,793	9	$46	Parking
83	R5-17	36	162	2,461	162	$836	Parking
84	R5-18	6	41	2,984	41	$209	Parking
85	R5-19	16	108	2,580	108	$557	Parking
86	R5-20	61	297	2,678	297	$1,533	Parking

TABLE B-1-16
WITH PROJECT PEAK DAY VISITATION CAPACITY AND VALUE - 2010

Sub-Reach	Model Reach	Parking Spaces	Daily Parking Capacity	With Project Beach Capacity	Daily Visits With Project	Daily Value @ $5.16	Critical Constraint
87	R5-21	9	41	3,305	41	$209	Parking
88	R5-22	27	182	-	182	$940	Parking
89	R5-23	0	0	-	0	$0	Parking
90	R5-24	0	0	-	0	$0	Parking
91	R5-25	0	0	-	0	$0	Parking
92	R5-26	0	0	-	0	$0	Parking
93	R5-27	0	0	-	0	$0	Parking
94	R5-28	0	0	-	0	$0	Parking
95	R5-29	0	0	-	0	$0	Parking
96	R5-30	0	0	2,597	0	$0	Parking
97	R5-31	0	0	2,544	0	$0	Parking
98	R5-32	0	0	2,451	0	$0	Parking
99	R5-33	13	59	2,684	59	$302	Parking
100	R5-34	14	86	2,702	86	$441	Parking
101	R5-35	106	702	2,482	702	$3,622	Parking
102	R5-36	0	0	2,309	0	$0	Parking
103	R5-37	0	0	2,459	0	$0	Parking
104	R5-38	0	0	2,595	0	$0	Parking
105	R5-39	0	0	2,725	0	$0	Parking
106	R5-40	0	0	2,663	0	$0	Parking
107	R5-41	0	0	2,355	0	$0	Parking
108	R5-42	13	59	2,245	59	$302	Parking
109	R5-43	0	0	2,115	0	$0	Parking
110	R5-44	0	0	2,047	0	$0	Parking
111	R5-45	0	0	1,847	0	$0	Parking
112	R5-46	105	709	1,967	709	$3,657	Parking
113	R5-47	76	513	2,111	513	$2,647	Parking
114	R5-48	67	452	2,068	452	$2,334	Parking
115	R5-49	67	452	2,364	452	$2,334	Parking
116	R5-50	15	101	2,624	101	$522	Parking
117	R5-51	0	0	2,744	0	$0	Parking
TOTAL		3,190	17,712	219,967	17,712	$91,394	

Benefit Evaluation

The net increase in visitation between the without and with project conditions is the basis for determining recreation benefits for the tentatively selected plan. Information related to net increases in peak day recreation is provided in Table B-1-17.

TABLE B-1-17
NET INCREASE IN PEAK DAY VISITATION TENTATIVELY SELECTED PLAN

Year	Without Project Peak Day Visits	With Project Peak Day Visits	Net Peak Day Increased
2010	17,712	17,712	0
2020	17,712	17,712	0
2030	17,712	17,712	0
2040	17,712	17,712	0
2050	17,712	17,712	0
2060	17,712	17,712	0
2063	17,712	17,712	0

Assuming a project life of 50 years and an interest rate of four and three-eights percent, average annual benefits for recreation total approximately $15,800. Average annual recreation value information is presented by reach in Table B-1-18 These benefits are included as incidental benefits in the total benefit accounting, but they are not included in the formulation of the project with respect to size and scope.

TABLE B-1-18 AVERAGE ANNUAL PEAK DAY RECREATION BENEFITS BY REACH				
Sub-Reach	W/O Project Peak Day Benefits	W/ Project Peak Day Benefits	Incremental Peak Day Benefits	Total Annual Benefits
1	$0	$0	$0	$0
2	$502	$511	$9	$89
3	$6,457	$6,571	$115	$1,146
4	$342	$348	$6	$61
5	$365	$372	$6	$65
6	$411	$418	$7	$73
7	$0	$0	$0	$0
8	$228	$232	$4	$40
9	$68	$70	$1	$12
10	$753	$766	$13	$134
11	$365	$372	$6	$65
12	$707	$720	$13	$126
13	$1,734	$1,765	$31	$308
14	$753	$766	$13	$134
15	$1,757	$1,788	$31	$312
16	$2,555	$2,601	$45	$454
17	$194	$197	$3	$34
18	$0	$0	$0	$0
19	$1,255	$1,277	$22	$223
20	$1,848	$1,881	$33	$328
21	$3,331	$3,390	$59	$591
22	$5,863	$5,968	$104	$1,041
23	$3,536	$3,599	$63	$628
24	$0	$0	$0	$0
25	-	-	-	-
26	-	-	-	-
27	-	-	-	-
28	-	-	-	-
29	-	-	-	-
30	-	-	-	-
31	-	-	-	-
32	$0	$0	$0	$0
33	$0	$0	$0	$0
34	$114	$116	$2	$20
35	$331	$337	$6	$59
36	$2,567	$2,612	$46	$456
37	$0	$0	$0	$0
38	$0	$0	$0	$0
39	$274	$279	$5	$49
40	$513	$522	$9	$91
41	$171	$174	$3	$30
42	$2,179	$2,218	$39	$387
43	$445	$453	$8	$79
44	$844	$859	$15	$150

TABLE B-1-18 AVERAGE ANNUAL PEAK DAY RECREATION BENEFITS BY REACH				
Sub-Reach	W/O Project Peak Day Benefits	W/ Project Peak Day Benefits	Incremental Peak Day Benefits	Total Annual Benefits
45	$1,027	$1,045	$18	$182
46	$0	$0	$0	$0
47	$0	$0	$0	$0
48	$0	$0	$0	$0
49	$548	$557	$10	$97
50	$2,532	$2,577	$45	$450
51	$525	$534	$9	$93
52	$1,266	$1,289	$22	$225
53	$0	$0	$0	$0
54	$0	$0	$0	$0
55	-	-	-	-
56	-	-	-	-
57	-	-	-	-
58	$0	$0	$0	$0
59	$0	$0	$0	$0
60	$0	$0	$0	$0
61	$0	$0	$0	$0
62	$411	$418	$7	$73
63	$2,806	$2,856	$50	$498
64	-	-	-	-
65	-	-	-	-
66	-	-	-	-
67	$0	$0	$0	$0
68	$3,673	$3,738	$65	$652
69	$3,456	$3,518	$61	$614
70	$0	$0	$0	$0
71	$0	$0	$0	$0
72	$1,095	$1,115	$19	$194
73	$0	$0	$0	$0
74	$137	$139	$2	$24
75	$0	$0	$0	$0
76	$684	$697	$12	$122
77	$1,620	$1,649	$29	$288
78	$4,392	$4,470	$78	$780
79	$1,905	$1,939	$34	$338
80	$3,126	$3,181	$55	$555
81	$0	$0	$0	$0
82	$46	$46	$1	$8
83	$821	$836	$15	$146
84	$205	$209	$4	$36
85	$548	$557	$10	$97
86	$1,506	$1,533	$27	$267
87	$205	$209	$4	$36
88	-	-	-	-

TABLE B-1-18 AVERAGE ANNUAL PEAK DAY RECREATION BENEFITS BY REACH				
Sub-Reach	W/O Project Peak Day Benefits	W/ Project Peak Day Benefits	Incremental Peak Day Benefits	Total Annual Benefits
89	-	-	-	-
90	-	-	-	-
91	-	-	-	-
92	-	-	-	-
93	-	-	-	-
94	-	-	-	-
95	-	-	-	-
96	$0	$0	$0	$0
97	$0	$0	$0	$0
98	$0	$0	$0	$0
99	$297	$302	$5	$53
100	$433	$441	$8	$77
101	$3,559	$3,622	$63	$632
102	$0	$0	$0	$0
103	$0	$0	$0	$0
104	$0	$0	$0	$0
105	$0	$0	$0	$0
106	$0	$0	$0	$0
107	$0	$0	$0	$0
108	$297	$302	$5	$53
109	$0	$0	$0	$0
110	$0	$0	$0	$0
111	$0	$0	$0	$0
112	$3,593	$3,657	$64	$638
113	$2,601	$2,647	$46	$462
114	$2,293	$2,334	$41	$407
115	$2,293	$2,334	$41	$407
116	$513	$522	$9	$91
117	$0	$0	$0	$0
TOTALS	$88,876	$90,454	$1,578	$15,777

- Non-Benefiting Reaches

APPENDIX C

REAL ESTATE PLAN

WALTON COUNTY, FLORIDA
HURRICANE AND STORM DAMAGE REDUCTION
GENERAL INVESTIGATIONS STUDY

APPENDIX C – REAL ESTATE PLAN

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WALTON COUNTY, FLORIDA
HURRICANE AND STORM DAMAGE REDUCTION
GENERAL INVESTIGATIONS STUDY

APPENDIX C – REAL ESTATE PLAN

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WALTON COUNTY, FLORIDA
HURRICANE AND STORM DAMAGE REDUCTION

GENERAL INVESTIGATIONS STUDY
ALTERNATIVE FORMULATION BRIEFING DOCUMENTATION

APPENDIX C – REAL ESTATE PLAN

1. PURPOSE OF THE REAL ESTATE PLAN

This Real Estate Plan (REP) identifies the real estate requirements for the proposed construction of the various project components for a Federal shore protection project in Walton County, Florida. These real estate requirements are based on a project need to reduce the damaging effects of hurricanes and severe storms to real property along the coast and stabilize or restore the shoreline by eliminating long-term erosion. This REP is tentative in nature for planning purposes only and both the final real property acquisition lines and estimates of value are subject to change even after approval of this report. The REP is written to support the Walton County Hurricane and Storm Damage Reduction Project General Investigations Study and is written to the same level of detail as the Feasibility Report. The author of this report has inspected the project area. The non-Federal sponsor is the Walton County Board of Commissioners, represented by the Director of Beach Management for the Walton County Tourist Development Council (TDC).

2. PROJECT AUTHORIZATION

This study was authorized both within the United States Senate and the U.S. House of Representatives. In the Senate, the Committee on Environment and Public Works adopted a committee resolution (unnumbered) on July 25, 2002, which reads as follows:

> *"Resolved by the Committee on Environment and Public Works of the United States Senate, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and related improvements in Walton County, Florida, in the interest of protecting and restoring the environmental resources on and behind the beach, including the feasibility of providing shoreline and erosion protection and related improvements consistent with the unique characteristics of the existing beach sand, and with consideration of the need to develop a comprehensive body of knowledge, information, and data on coastal area changes and processes as well as impacts from Federally constructed projects in the vicinity of Walton County, Florida.*

In the House, the Committee on Transportation and Infrastructure adopted a resolution, Docket 2690, dated July 24, 2002, which reads as follows:

"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and environmental restoration and protection in the vicinity of Walton County, Florida..

3. PROJECT LOCATION AND DESCRIPTION

The project location is located in Walton County, Florida along the coast of the Gulf of Mexico in the northwest Florida panhandle. Walton County is situated approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. Walton County beaches extend from Destin, Florida in Okaloosa County, on the west, to Philips Inlet in Bay County, Florida on the east. A vicinity map of Walton County, Florida project limits is shown below as Figure C-1.

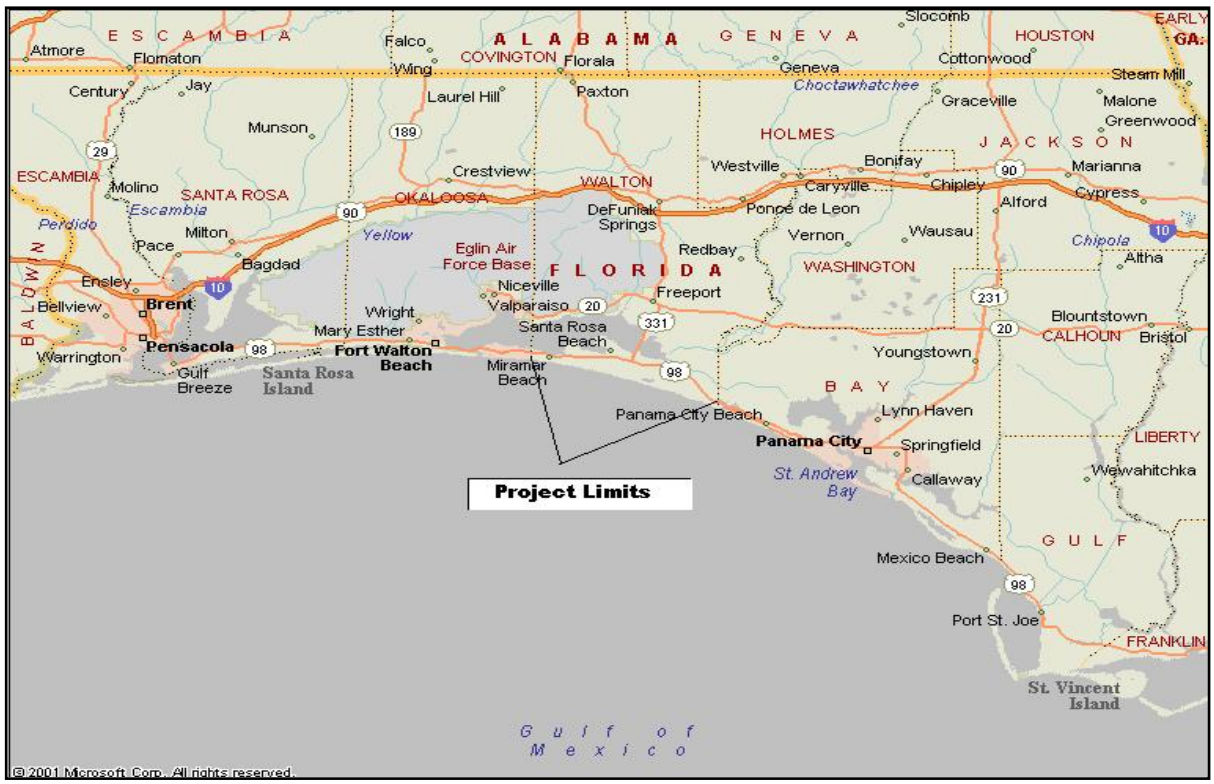


Figure C-1. Walton County, Florida Vicinity Map

In April of 2003, Taylor Engineering, Inc. of Jacksonville, Florida conducted a Beach Management Feasibility Study for Walton County, Florida. The results of this coastal processes analysis indicate that the beaches of Walton County have the natural ability to recover from storm events given sufficient time; however, successive storms from 1995 to 1998 have severely eroded the beach and hindered natural recovery process by transporting large volumes of sediment out of the littoral system both onshore and offshore. Furthermore, this study found that the beaches of Walton County have eroded

an average of seven feet per year from 1993 to 2003. The beach width, beach elevation, and dune heights and widths have become critically eroded to the point that the beach no longer provides protection to upland structures from the ravages of hurricane driven surges. Without beach restoration, it is estimated that 85 percent of the upland structures will be damaged by a Category 2 or 3 hurricane.

Walton County, Florida encompasses 26 miles of shoreline which includes six miles of State parks. A coastal peninsula extending west from the mainland characterizes the western two-thirds of the coastline, and a mainland beach characterizes the eastern third. Choctawhatchee Bay lies north of the peninsula. Behind the dune system, upland drainage feeds several freshwater lakes that intermittently breach the dune system at seven different intervals throughout the project (See Table C-6). These lake outfalls discharge directly into the Gulf of Mexico. Primary dune elevations range from 11.5 to 44.5 feet North American Vertical Datum 88 (NAVD88) and average 25.5 feet National Geodetic Vertical Datum (NGVD).

An array of plans has been formulated and considered for this project. This REP will focus on the Locally Preferred Plan (LPP) which provides for shore protection measures in the interest of reducing hurricane and storm damages within the aforementioned project location. The LPP varies slightly from the proposed National Economic Development (NED) Plan by extending the berm and dune system horizontally which envelops a diminutive amount of additional coastline within reaches R1-1 – R1-10 and R1-17 – R2-1. In concept, the project will consist of the construction and maintenance of a berm and dune system that will tie into the existing dunes and vegetation line. The LPP is a beach-fill plan with a 30-foot wide dune at elevation 15 feet NGVD, fronted by a 50-foot wide berm at elevation 5.5 feet NGVD. A typical cross section is shown in Exhibit “A”. The project begins in Reach R1-1 and runs eastwardly approximately 137,280 feet or 26 miles to Reach R5-51. Due to breaches in the construction limits caused by dune lake outfalls and State park preserves, the actual dune and berm system constructed will be approximately 77,944 feet in length. The frequency of maintenance is estimated to be every 10 years or four cycles during the 50-year project life. The constructed berm will serve two primary purposes: as a stockpile of sand on the beach to serve as sacrificial material to reduce the erosion of the high ground beach during storm events and to provide storm damage protection to beachfront structures by moving the point of erosion seaward.

4. DESCRIPTION OF LANDS, EASEMENTS, RIGHTS-OF-WAY AND RELOCATIONS, AND DISPOSAL/BORROW AREAS (LERRDS)

The requirements for lands, easements, rights-of-way, relocations, and disposal/borrow areas (LERRDs) include the right to construct a dune and berm system along the shoreline of Walton County from R1-1 to R5-51. Included within these project reaches are single family residential units, multi family and condominium units, and a very limited amount of commercial properties. According to the project maps and site examinations, no dwellings will be impacted by the project. In addition, there are no

public or private piers within the existing project limits. The following subsections a – e and accompanying tables detail the LERRDs requirements for the proposed project:

a. **Lands and Easements:** Tables C-1 – C-5 depict the number of parcels which will be impacted by easement acquisition within each reach and the associated average acreage per reach. It is estimated that a total of 179.16 acres will be required in Perpetual Storm Damage Reduction Easements. All estimates are based on the average distance from the landward toe of the proposed dune to the Mean High Water Line (MHWL) which is equivalent to the engineering baseline located at 1.037 NGVD. Refer to Exhibit "A" for a typical cross section of the proposed construction limits. The MHWL normally corresponds with the Erosion Control Line (ECL) and is an estimate of where the ECL will be set. For planning purposes, an average easement width of 80 feet is projected between the MHWL and the landward toe based on typical sections. Refer to Exhibit "B" for an aerial depiction of the typical easement limits. All coordinates are founded on 2007 survey information provided by the non-Federal sponsor.

   The MHWL is used for estimate purposes for this project since an ECL has not been identified and recorded for the entire Walton County coastline; however, recordation of the ECL will be required prior to construction. An ECL does currently exist between Reaches R1-1 and R1-24 of the westernmost portion of the project area. The existing ECL coordinates commence at Northing 506,530.825 feet and Easting 1,369,639.083 feet and runs eastwardly to coordinate N 502,059.76 feet E 1,393,555.83 feet as referenced to the Florida State Plane Coordinate System, North Zone, North American Datum of 1983, 1990 Adjustment.

   As shown in Table C-1, the estimated number of impacted parcels within the proposed project is 960 of which 37 of these are deemed to be publicly-owned. Based on these calculations, 923 Perpetual Storm Damage Reduction Easements will be required on private lands and 37 Perpetual Storm Damage Reduction Easements required for publicly-held lands. All easements will be located landward of the MHWL or the ECL once the ECL is surveyed and recorded. The ECL is expected to be set by the FL Department of Environmental Protection (FDEP) during the Preconstruction, Engineering, and Design (PED) phase of the project.

   Material placed upon public lands seaward of the MHWL or proposed ECL will require a Consent of Use from the State of Florida. The Consent of Use grants the rights to place material on state-owned submerged lands in accordance with the beach nourishment plans submitted with the application for an ECL.

   Based on a ground examination, it appears that there will be no adverse impact to the upland portion of ownership. The only improvements noted in

the proposed easement area are access structures, such as walkways and dune crossovers. Damage to any existing structures is not compensable as this would be covered under the easement estate that is acquired by the non-Federal sponsor. Furthermore, this damage is not creditable unless an approved appraisal shows compensation due because of the structure damage. It should be noted that the Perpetual Beach Storm Damage Reduction Easement provided herein allows for landowners to "construct dune over walk structures in accordance with any applicable Federal, State or local laws or regulations, provided that such structures shall not violate the integrity of the dune in shape, dimension or function, and that prior approval of the plans and specifications for such structures is obtained from the Walton County Tourist Development Council acting by and through the Walton County Board of Commissioners and provided further that such structures are subordinate to the construction, operation, maintenance, repair, rehabilitation and replacement of the project."

b. **Appraisal:** The proposed shore protection project has been reviewed by Mobile District appraiser. The appraiser has determined that the value of the lands needed for easement purposes are assessed at zero based on the off-setting benefits appraisal method. The proposed project is deemed to be within the purview of EC 405-1-04, Section V, paragraph 4-44(b) which states "Hurricane protection and shore protection projects will generally be treated in a manner as to not allow credit for LERRDs when the project provides direct (off-setting) benefits such as prevention of erosion or re-establishment of beaches, i.e., those lands subject to shore erosion that are required for the project." Although credit is not allowed for LERRDs due to the off-setting benefits valuation, the administrative acquisition expenses incurred by the non-Federal sponsor are allowed for credit purposes.

After in-depth discussions with Jacksonville District and Mobile District appraisal branches, it was noted that Florida appraisal laws do not conform completely to the Federal off-setting benefits appraisal methodology. Under Florida law, off-setting benefits can be used for damages, but this method cannot be applied to the part taken. Due to the nature of this beach nourishment project and the significance of the estate being used herein, the appraised land values in terms of the part taken would be nominal. It has been recommend by Mobile District Real Estate Division that the non-Federal sponsor can issue waivers of payment to the landowners along with the easement document that would specify that the land transaction is a voluntarily made donation for the public project. The waiver can further acknowledge that the landowner is receiving a benefit from the construction of a dune and berm system that connects to the subject property and further deem this project benefit to be sufficient consideration in lieu of monetary compensation. Refer to Exhibit "I" for the appraisal waiver template.

If in fact the non-Federal sponsor chooses to make land payments for the part taken, then this would be considered a non-creditable item and is strictly the responsibility of the non-Federal sponsor. Further guidance regarding this type of appraisal situation is provided for in EC 405-1-04-4-33 and 4-43, dated 30 Dec 2003 which includes Appendix 4-F – USACE Suggested Format for Informal Value Estimates.

Near Shore / Land Loss Valuations:

The loss of land benefit is measured as the value of near shore upland. Typically, determinations of the fair market value for the land losses are based on the value of near shore upland. Near shore upland is defined as sufficiently removed from the shore to lose its significant increment of value because of its proximity to the shore, when compared to adjacent parcels that are more distant (inland) from the shore. A hurricane and storm damage reduction project that prevents the loss of land due to erosion accrues benefits to that project alternative.

In order to assist the economic benefit evaluation of near shore / land loss valuations as previously defined, USACE-SAM-RE-P estimated near shore values of parcels that were sufficiently removed from the shore to lose any direct water frontage value. This valuation estimate, dated 27 February 2007, was performed under jurisdictional exception, 2001 edition of the Uniform Standards of Professional Appraisal Practice and designed for the internal use of USACE and conforms to USACE regulations. This analysis was performed using the following criteria: 1) No Gulf frontage; 2) No view of the Gulf; 3) No access point to the Gulf as part of the vesting conveyance or deeded via subdivision right of access.

The methodology contained 2005 and 2006 sales of near shore parcels in Walton County, and in Carillon Beach subdivision in Bay County, FL (the adjoining county). Property values varied according to location, as did sales prices due to the pause in the market caused by storm activity on the Gulf in 2004/2005. As is custom in the real estate market, an event will not impact values immediately, but has a delayed effect on the market which can continue until saturation and eventual upturn. As such, the valuations contained herein are not inclined to constant/immediate fluctuations.

This estimate presented a range of values by price per square foot for near shore properties. The near shore values are as follows:

1. Miramar Beach/Scenic Gulf Drive east to the convergence of Scenic Gulf Drive and Highway 98; Value Range: $65/SF to $75/SF

2. Scenic Gulf Drive/Highway 98 Fork east to the east side of Topsail Hill Preserve State Park and Stalworth Lake; Value Range: $80/SF to $90/S.F.
3. Stalworth Lake east to Highway 393; Value Range: $40/SF to $50/SF
4. Highway 393 east to Watercolor; Value Range: $70/SF to $80/SF
5. West side of Watercolor to Highway 395; Value Range: $100/SF to $125/SF
6. Highway 395 east to Eastern Lake; Value Range: $60/SF to $75/SF
7. East side of Eastern Lake to Rosemary Beach; Value Range: $30/SF to $40/SF
8. West side of Rosemary Beach to Convergence of Highway 30A and Highway 98; Value Range: $75/SF to $100/SF
9. Highway 30A/98 Fork east to Bay County Line; Value Range: $75/SF to $80/SF
10. The west line of Bay County through Carillon Beach; Value Range: $30/SF to $35/SF; Note: Carillon Beach is an enclosed subdivision where each lot owner has deeded access to the Gulf. Therefore, Carillon sale data was not included.

Based on these valuation estimates, the economic loss of land benefit was calculated using the average of the high and low value of land lost. The value used represents a long-term value suitable for the period of evaluation.

Sensitivity Analysis: Near Shore / Land Loss Valuations (2009-2010):

In order to support the Economic Sensitivity Analysis (Economic Appendix B, Section 12.0) concerning project justification, USACE-SAM-RE-P updated near shore / land loss values which showed a significant reduction in estimated square footage value ranges. All factors used for updating this valuation remained constant. This valuation estimate, effective 8 December 2010, presented a range of values by price per square foot for near shore properties. The near shore values are as follows:

1. Miramar Beach/Scenic Gulf Drive east to the convergence of Scenic Gulf Drive and Highway 98; Value Range: $25/SF to $35/SF
2. Scenic Gulf Drive/Highway 98 Fork east to the east side of Topsail Hill Preserve State Park and Stalworth Lake; Value Range: $30/SF to $35/S.F.
3. Stalworth Lake east to Highway 393; Value Range: $12/SF to $20/SF
4. Highway 393 east to Watercolor; Value Range: $25/SF to $30/SF
5. West side of Watercolor to Highway 395; Value Range: $70/SF to $80/SF

6. Highway 395 east to Eastern Lake; Value Range: $30/SF to $40/SF
7. East side of Eastern Lake to Rosemary Beach; Value Range: $25/SF to $35/SF
8. West side of Rosemary Beach to Convergence of Highway 30A and Highway 98; Value Range: $75/SF to $100/SF
9. Highway 30A/98 Fork east to Bay County Line; Value Range: $20/SF to $30/SF
10. The west line of Bay County through Carillon Beach; Value Range: $20/SF to $30/SF; Note: Carillon Beach is an enclosed subdivision where each lot owner has deeded access to the Gulf. Therefore, Carillon sale data was not included.

For further information concerning the inclusion of these valuation estimates and its relation to the formulation of the Sensitivity Analysis, refer to Appendix B – Economic Investigations.

c. Borrow Areas: Only one offshore borrow area has been identified as a source of sand for this project. If required for future renourishment cycles, this site may be expanded further south to accommodate this need. This borrow area is located within State waters which by definition are limited to three nautical miles offshore. A more detailed discussion on the borrow area is found in the Geotechnical Analysis and in the Sand Compatibility Analysis. Permits and/or consent agreements for sand removal from borrow areas will be from appropriate State and/or Federal agencies.

d. Access: The non-Federal sponsor must meet the requirements for public access to participate in cost sharing with the Federal Government. Otherwise, the non-Federal sponsor is responsible for 100% of the project cost for that reach where no public access exists. Public access must be available every one-half mile, and parking must be within one-quarter mile. Engineer Regulation 1165-2-130 sets forth the requirements for public access. Although Walton County has approximately 50 public access points dispersed across the coastline, the County does not fully meet this access and parking requirement. The non-Federal sponsor is working toward meeting this obligation and understands that they must provide additional access points and parking areas as a pre-requisite for meeting Federal cost-share requirements. All access and parking sites should be acquired in either fee simple or perpetual easement. Acquisition of public beach access points that are necessary for compliance in cost sharing is strictly a non-Federal sponsor responsibility and is not considered a project cost. Accordingly, any cost incurred with the acquisition of public access points and parking areas is not a creditable item of cost share. The aforementioned access and parking locations are shown under Exhibit “G” attached hereto.

i. **Construction Access:** Proposed construction access to the project will be via public roads and existing rights-of-way. There are sufficient access corridors along the Walton County coastline located at the ends of public streets and at public access areas for contractors to move pipe and construction equipment onto the beach. Table C-6 lists all known publicly-owned lands within the project area that could be used for such access and Exhibit “G” provides additional mapping of these public access points that could be suitable for construction access purposes.

e. Staging Areas: All staging areas for the placement of construction equipment are expected to be within public rights-of-way, public access corridors, seaward of the ECL, and/or within acquired easement limits. If it is later determined that a temporary off-site staging area is required for project purposes, said site should be appraised by a USACE, Mobile District appraiser in order to determine a fair market value. It is also noted that once this value is determined, that the real estate estimate will be adjusted accordingly. Section 21 b. of this report provides the estate recommended for temporary staging area acquisitions.

Table C-1. Reach 1

Project Reaches	Parcels	Estimated Acreage	Project Reaches	Parcels	Estimated Acreage
R1-1 = 549'	6	1.01	**R1-13=1040'**	5	1.91
R1-2 = 920'	16	1.69	**R1-14=1054'**	9	1.93
R1-3 = 1182'	3	2.17	**R1-15=990'**	7	1.82
R1-4 = 975'	1	1.79	**R1-16=1027'**	11	1.88
R1-5 =1140'	22	2.09	**R1-17=1115'**	15	2.05
R1-6 = 1035'	37	1.9	**R1-18=1135'**	11	2.08
R1-7 = 1045'	17	1.92	**R1-19=1075'**	8	1.97
R1-8 = 1032'	31	1.89	**R1-20=960'**	9	1.76
R1-9 = 1005'	6	1.84	**R1-21=956'**	6	1.75
R1-10 = 960'	4	1.76	**R1-22=1027'**	4	1.88
R1-11 = 1025'	19	1.88	**R1-23=1087'**	4	2
R1-12 = 1057'	14	1.94	**R1-24=1040'**	8	1.91
Sub-total:		21.88	**Total:**		44.82

Table C-2. Reach 2

Project Reaches	Parcels	Estimated Acreage
R2-1=503'	4	0.92
R2-2	0	0
R2-3	0	0
R2-4	0	0
R2-5	0	0
R2-6	0	0
R2-7	0	0
Total:		0.92

Table C-3. Reach 3

Project Reaches	Parcels	Estimated Acreage	Project Reaches	Parcels	Estimated Acreage
R3-1=478'	10	0.87	**R3-14=1348'**	17	2.48
R3-2=1040'	11	1.91	**R3-15=932'**	2	1.71
R3-3=1065'	8	1.95	**R3-16=732'**	5	1.34
R3-4=1035'	11	1.9	**R3-17=1020'**	15	1.87
R3-5=1125'	12	2.07	**R3-18=1040'**	15	1.91
R3-6=1002'	17	1.84	**R3-19=1037'**	5	1.9
R3-7=1163'	21	2.13	**R3-20=1029'**	11	1.89
R3-8=1105'	3	2.03	**R3-21=1032'**	11	1.89
R3-9=1061'	14	1.95	**R3-22=978'**	12	1.79
R3-10=1072'	15	1.97	**R3-23=940'**	8	1.72
R3-11=950'	9	1.74	**R3-24=485'**	1	0.89
R3-12=1007'	15	1.85	**R3-25=0'**	0	0
R3-13=1007'	6	1.85	**R3-26=470'**	1	0.86
Sub-total:		24.06	**Total:**		44.31

Table C-4. Reach 4

Project Reaches	Parcels	Estimated Acreage
R4-1=1084'	13	1.99
R4-2=854'	16	1.57
R4-3=961'	3	1.76
R4-4=945'	2	1.73
R4-5=1000'	10	1.84
R4-6=628'	3	1.15
R4-7=479'	2	0.88
R4-8=0'	0	0
R4-9=490'	1	0.9
Total:		11.82

Table C-5. Reach 5

Project Reaches	Parcels	Estimated Acreage	Project Reaches	Parcels	Estimated Acreage
R5-1=1035'	3	1.9	**R5-26=0**	0	0
R5-2=1005'	8	1.84	**R5-27=0'**	0	0
R5-3=1040'	26	1.91	**R5-28=0'**	0	0
R5-4=1035'	12	1.9	**R5-29=496'**	2	0.91
R5-5=1007'	13	1.85	**R5-30=1068'**	15	1.96
R5-6=1064'	1	1.95	**R5-31=969'**	7	1.78
R5-7=1037'	0	0	**R5-32=985'**	14	1.81
R5-8=997'	1	0.79	**R5-33=1028'**	12	1.89
R5-9=1026'	1	0.16	**R5-34=1040'**	21	1.91
R5-10=1015'	16	1.86	**R5-35=1000'**	11	1.84
R5-11=1025'	11	1.88	**R5-36=960'**	24	1.76
R5-12=1018'	8	1.87	**R5-37=1003'**	11	1.84
R5-13=1018'	13	1.87	**R5-38=1094'**	22	2.01
R5-14=1007'	15	1.85	**R5-39=1025'**	4	1.88
R5-15=1007'	18	1.85	**R5-40=1013'**	3	1.86
R5-16=1037'	14	1.9	**R5-41=1001'**	16	1.84
R5-17=900'	13	1.65	**R5-42=1020'**	16	1.87
R5-18=916'	14	1.68	**R5-43=1001'**	12	1.84
R5-19=1010'	10	1.85	**R5-44=1000'**	6	1.84
R5-20=1030'	13	1.89	**R5-45=970'**	3	1.78
R5-21=1125'	12	2.07	**R5-46=990'**	8	1.82
R5-22=469'	2	0.86	**R5-47=1031'**	17	1.89
R5-23=0'	0	0	**R5-48=1027'**	7	1.88
R5-24=0'	0	0	**R5-49=1040'**	3	1.91
R5-25=0'	0	0	**R5-50=1035'**	20	1.9
			R5-51=1030'	7	1.89
			Total:		77.29

Table C-6. Walton County, Florida Parcel Data

Project Reaches		General Reach Description	
R1		Miramar Beach, Sandestin, and Four Mile Village	
R2		Topsail Hill Preserve State Park	
R3		Beach Highlands, Dune Allen, Santa Rosa Beach, Blue Mountain and Gulf Trace	
R4		Grayton Beach State Park, Grayton Beach	
R5		Watercolor, Seaside, Seagrove, Watersound, Seacrest, Rosemary, and Inlet Beach	
Project Sheet #	**Project Reach**	**Publicly-owned Lands w/in Project Area (Public Beach, Access & Parking Areas)**	**Total # of Impacted Parcels**
F-101	R1-1 - R1-7	1)PIDN:30-2S-21-42290-000-1200	101
		Walton County Board of Commissioners	
F-102	R1-8 - R1-16	None Identified	104
F-103	R1-17 - R2-1	1)East of PIDN:34-2S-21-42000-019-0011	53
		Walton County-owned Access Rd. (R1-17)	
		2)East of PIDN:34-2S-21-42080-007-0300	
		Walton County-owned Access Rd. (R1-19)	
F-104	R2-1 - R2-6	1)Topsail State Park (R2-2 thru R2-6)	0
		Florida Board of Trustees of the Internal Improvement Trust Fund (TIITF)/State of FL Forestry Dept. of Ag.&Con.	
		**Breach in Construction limits from R2-1 thru R3-1.*	
F-105	R2-6 - R3-1	1)Topsail State Park (R2-6 thru R3-1)(4 separate parcels)	0
F-106	R3-1 - R3-9	1)PIDN:05-3S-20-34000-001-0010	98
		Walton County-owned parcel (R3-1)	
		(Note: Above parcel marks the end of Topsail State Park and the recommencement of project construction limits.)	
		2)Beach Highlands w/ access (R3-2 thru R3-3) (no PIDN)	
		3)PIDN:04-3S-20-34110-000-0021	
		Walton County-owned parcel in R3-5 (south of Ft.Panic Rd)	
		4)PIDN:04-3S-20-34140-000-0370	
		Dune Allen Regional Beach Access & Parking Area(R3-5)	
		5)Public beach parcel (R3-5 - R3-6) (no PIDN)	
		Walton County-owned(access south of Allen Loop Drive)	
		**Breach in Construction limits in R3-6*	
		6)Public beach access parcel (R3-8) (no PIDN)	
		Walton County-owned parcel	

Table C-6 (Continued). Walton County, Florida Parcel Data

Project Reaches		General Reach Description	
F-107	R3-9 - R3-18	1)PIDN:02-3S-20-34160-000-0680	83
		Ed Walline Regional Beach Access & Parking Area(R3-11)	
		2)PIDN:11-3S-20-34000-003-0000	
		Gulfview Heights Regional Beach Access & Parking(R3-14)	
		3)PIDN:11-3S-20-34000-002-0000	
		TIITF/State of FL Public Lands (R3-12 thru R3-13)	
		**Breach in Construction limits for Draper Lake Outfall(R3-15)*	
F-108	R3-18 - R3-26	1)PIDN:12-3S-20-34000-001-0061	53
		Blue Mountain Regional Beach Access & Parking (R3-20)	
		2)Public beach access parcel w/ parking (R3-21)	
		Walton County-owned - Co. Rd.83 r/w (no PIDN)	
		3) 3 Beach Access parcels (R3-21 thru R3-23) (no PIDN)	
		Located in Blue Mountain Beach Sub. PB2-41	
		4)PIDN:07-3S-19-25000-003-0000	
		Grayton Beach State Park (R3-26)	
		TIITF/St. of FL Dept.Rec&Parks	
		**Breach in Construction limits for Big Redfish Lake Outfall (R3-24 - R3-26)*	
F-109	R3-26 - R4-8	1)PIDN:08-3S-19-25000-017-0000	42
		TIITF/DNR (Rec&Parks Div.)(Abutting SFR/Alligator Lake)	
		**Breach in Construction limits for Alligator Lake Outfall (R4-2 - R4-3)*	
		2)PIDN:08-3S-19-25000-017-0000	
		TIITF/State of FL Public Lands (R4-3 thru R4-5)	
		3)PIDN:17-3S-19-25000-017-0010	
		Walton County-owned access parcel (R4-5)	
		4)PIDN:17-3S-19-25000-016-0000	
		Grayton Dunes Regional Beach Access/Parking/Rec Area	
		TIITF/DNR (Rec&Parks Div.) (R4-5 thru R4-6)	
		5)PIDN:17-3S-19-25040-000-0091	
		Walton County-owned access parcel (R4-6)	
		6)PIDN:17-3S-19-25040-000-0010	
		Grayton Dunes Regional Beach Access/Rec Area	
		TIITF/DNR (Rec&Parks Div.) (R4-6)	
		**Breach in Construction limits due to Western Lake outfall (R4-6)*	
		7)PIDN:17-3S-19-25000-016-0020	
		Grayton Dunes Regional Beach Access/Rec Area	
		TIITF/DNR (Rec&Parks Div.) (R4-6 thru R4-7)	
		8)PIDN:16-3S-19-25000-001-0000	
		Grayton Beach State Park	
		TIITF/DNR (Rec&Parks Div.) (R4-7 thru R4-8)	
		**Breach in Construction limits due to State Park Land (R4-7 - R4-9)*	

Table C-6 (Continued). Walton County, Florida Parcel Data

Project Reaches		General Reach Description	
F-110	R4-8 - R5-7	1)Van Ness Butler, Jr. Regional Beach Access/Rec Area	53
		(No PIDN or Parcel Ownership Information Available)	
		Located in Sec.15-3S-19W	
F-111	R5-7 - R5-16	1)PIDN:23-3S-19-25100-000-00A0	79
		Santa Clara Regional Beach Access/Parking/Rec Area	
		Walton Co. Board of Commissioners (R5-10)	
		2)PIDN:24-3S-19-25120-000-0240	
		U.S. Park/Federally-owned Land (1.022 acres)	
		(Accessed via Seagrove Pl.) (R5-13) (Sec.24-3S-19)	
F-112	R5-16 - R5-25	**Breach in Construction limits due to Eastern Lake Outfall (R5-17 - R5-18)*	67
		1)PIDN:19-3S-18-16320-000-00A1(Beachfront Trail r/w)	
		Walton County-owned access r/w w/ parking located @ sw cor of Beachfront Trail & Lakewood Dr. (R5-20)	
		2)PIDN:19-3S-18-16080-000-0340	
		Walton County-owned beach parcel (R5-20 thru R5-21)	
		Public Beach Park w/ access via Beachfront Trail above	
		3)PIDN:19-3S-18-16080-000-0370	
		TIITF/DNR (Rec&Parks Div.) (R5-21 thru R5-22)	
		4)PIDN:20-3S-18-160000-001-0020	
		TIITF/Forestry Dept. of Ag&Con. (R5-22 thru R5-23)	
		**Breach in Construction limits due to Deer Lake Outfall (R5-22 - R5-29)*	
F-113	R5-25 - R5-34	None Identified	41
F-114	R5-34 - R5-43	None Identified	116
F-115	R5-43 - R5-51	1)PIDN:36-3S-18-16100-000-1890	70
		Inlet Beach Regional Beach Access/Parking/Rec Area	
		Walton County-owned beach parcel (R5-47 thru R5-48)	
		2)PIDN:36-3S-18-16100-000-1930	
		Inlet Beach Regional Beach Access/Parking/Rec Area	
		Walton County-owned beach parcel (R5-48 thru R5-49)	
		(Access provided via West Park Place Ave.)	
		Total # of Publicly-owned parcels: 37	
	Total # of Reaches: 117	**Overall Total # of Impacted Parcels:** **Total # of Privately-owned Impacted Parcels:** **Total # of Publicly-owned Impacted Parcels:**	**960** **923** **37**

5. LERRDS OWNED BY NON-FEDERAL SPONSOR

The lands, easements, and rights-of-way that are owned by the non-Federal sponsor are described in Table C-6. An approximate total of 37 parcels have been identified within the project area. This includes both County and State owned lands. Walton County owns numerous regional beach areas, street ends which will be used for access, and parking areas that can be used for staging areas during construction.

State-owned lands within the project area consist of Topsail Hill Preserve State Park, just east of Miramar Beach, Grayton Beach State Park, adjacent to Grayton Beach, and Deer Lake State Park located east of Grayton Beach State Park. In addition, there are numerous other parcels containing dune lake outfalls that are owned and managed by the Florida Board of Trustees of the Internal Improvement Trust Fund (TIITF) and the State of Florida Forestry Department of Agriculture and Conservation. For those areas where the project construction limits transition onto State-owned lands, a Consent of Use or Temporary Work Area Easement will be required from the appropriate State agency.

6. ANY EXISTING FEDERAL PROJECT THAT LIES FULLY OR PARTIALLY WITHIN THE LERRDs REQUIRED FOR THE PROJECT

There are no existing Federal projects that lie fully or partially within the LERRDs required for this project.

7. ANY FEDERALLY OWNED LAND

There is only one Federally owned parcel identified within the project area. This parcel is located in Reach 5-13. According to county land records, this parcel is vested in the United States of America and described as a U.S. Park. This parcel is exempt from State property levy and is assessed under Parcel Identification Number (PIDN): 24-3S-19-25120-000-0240 containing 1.022 acres and is located in Section 24, 3 South, 19 West. The political subdivision by which this parcel of land is being managed has yet to be identified.

8. LERRDs THAT LIES BELOW THE ORDINARY HIGH WATER MARK

Under Florida law**,** the boundary between private riparian or littoral property and the State's sovereign land is the Ordinary High Water Mark (also known as the Mean High Water Line which represents the intersection of the land with the water surface at the elevation of mean high water), which migrates over time as sand is added or removed by natural forces.

The State of Florida owns all submerged lands that lie seaward of the Ordinary High Water Mark or the Erosion Control Line (ECL) depending on whether an ECL has been established. According to Florida Statute, submerged lands are defined as: "State lands lying below the ordinary high water line of fresh waters and below the mean high water line of salt waters and any other lands defined as submerged lands in Florida Statute (F.S.) § 253.03. Florida law also requires that an ECL be fixed before a restoration project can proceed. Furthermore, the Federal Government's ability to exercise navigational servitude is not available as the determination has been made that no nexus exists between the proposed project and commercial navigation.

9. MAPS / EXHIBITS / TABLES

- **f.** Refer to Figure 1 for vicinity map of Walton County, Florida.
- **g.** Table C-1 through C-5 details the number of impacted parcels and estimated acreage required for acquisition within Reaches 1 – 5.
- **h.** Table C-6 provides a general description of each reach as well as publicly-owned lands within each reach of the overall project area.
- **i.** Table C-7 – Real Estate Cost Estimate.
- **j.** Table C-8 - Chart of Accounts.
- **k.** Refer to Exhibit "A" for typical cross sections A and B (Proposed Government Template).
- **l.** Refer to Exhibit "B" for an aerial depiction of typical easement limits.
- **m.** Refer to Exhibit "C" for overview map of Reaches 1 – 5.
- **n.** Refer to Exhibit "D" for Assessment of Non-Federal Sponsor's Real Estate Acquisition Capability.
- **o.** Refer to Exhibit "E" for Formal Risk Notification to Non-Federal Sponsor.
- **p.** Refer to Exhibit "F-1 through F-6" for photographs of various locations across the project area.
- **q.** Refer to Exhibit "G" for Master Beach Access Improvement Plan depicting access points and USACE GIS aerial maps depicting beach access/parking
- **r.** Refer to Exhibit "H" for Authorization for Entry for Construction.
- **s.** Refer to Exhibit "I" for Appraisal Waiver Template

10. ANY POSSIBLE INDUCED FLOODING

No induced flooding is expected as a result of the proposed storm damage reduction and beach erosion control project.

11. REAL ESTATE COST ESTIMATE

The following real estate cost estimate was closely coordinated between Mobile District Real Estate Division and the non-Federal sponsor. It was agreed that the non-Federal sponsor would provide a realistic cost estimate since the non-Federal sponsor will be tasked with all acquisition activities. The non-Federal sponsor estimate included the cost for acquisition of land, relocation costs, and non-Federal administrative costs. For

this particular project, the non-Federal sponsor administrative costs are those costs incurred for verifying ownership of lands, certification of those lands required for project purposes, legal opinions, title insurance, appraisals, condemnations, property analysis and/or other requirements to secure the land interests that will be necessary during the Preconstruction, Engineering and Design (PED) Phase. According to EC 405-1-04, Section V, paragraph 4-44(b), this real estate cost estimate is based on the determination that the value of project lands needed for beach restoration easement purposes are assessed at zero dollars due to the off-setting benefits appraisal methodology. The remaining expense is contained in Federal and non-Federal administrative costs associated with acquisition of approximately 960 perpetual beach restoration easements. Table C-7 is an itemized breakdown of the projected real estate costs.

Table C-7. Real Estate Cost Estimate

CATEGORY	COST
A. Lands:	
I. Lands	$0.00
II. Improvements	$0.00
III. Severance Damages	$0.00
IV. Minerals	$0.00
V. Total Lands & Damages	$0.00
B. ADMINISTRATIVE COSTS	
I. Federal Review of Non-Federal Sponsor	
1. $100.00 x 923 (private lands)	$92,300.00
2. $100.00 x 37 (public lands)	$3,700.00
3. Sub-Total:	$96,000.00
4. Contingency (25%)	$24,000.00
5. Sub-Total:	**$120,000.00**
II. Non-Federal Sponsor Acquisition Costs	
Estimates based on a total of 960 easement acquisitions	
1. ECL Survey/Mapping/Legal Descriptions	$35,000.00
2. Ownership Verification & Title Insurance (960 x $125.00)	$120,000.00
3. County Atty. Review of Title (960 x $100.00)	$96,000.00
4. Contingency for items 1-3 (25% rounded)	$63,000.00
5. Appraisal Reports (assuming 5% of landowners)	$25,000.00
6. Appraisal Waivers (assuming 95% of landowners)	$5,000.00
7. Contingency for items 5 & 6 (25% rounded)	$8,000.00
8. Condemnation/Quick-Take Process (assuming 1%)	$100,000.00
9. Miscellaneous non-Federal Sponsor Administrative Costs	$40,000.00
10. Contingency (25%)	$35,000.00
11. Sub-Total:	**$527,000.00**
III. Public Law 91-646 Relocation Costs	$0.00
IV. **Total RE Cost Estimate:**	**$647,000.00**

12. RELOCATION ASSISTANCE BENEFITS (P.L. 91-646)

Based on the proposed project construction limits/project alignment and site examinations, no persons or businesses will require relocation assistance benefits as required under Public Law 91-64, Title II.

13. MINERAL ACTIVITY

There are no known mineral activities within the scope of the proposed project.

14. ASSESSMENT OF NON-FEDERAL SPONSOR AND PROJECT SPONSOR RESPONSIBILITIES

The Walton County Board of Commissioners, represented by the Director of Beach Management for the Walton County Tourist Development Council (TDC)is the non-Federal sponsor for this proposed project. The non-Federal sponsor has the responsibility to acquire all real estate interests required for the project. The non-Federal sponsor shall accomplish all alterations and relocations of facilities, structures and improvements (if applicable) determined by the Government to be necessary for construction of the project. Furthermore, the non-Federal sponsor will have operation and maintenance responsibility for the project after construction is completed.

Title to any acquired real estate will be retained by the non-Federal sponsor and will not be conveyed to the United States of America. Prior to advertisement of any construction contracts, the non-Federal sponsor shall furnish to the Government an Authorization for Entry for Construction (See Exhibit “H” attached hereto) to all lands, easements, and rights-of-way, as necessary. The non-Federal sponsor will also furnish to the Government evidence supporting their legal authority to grant rights-of-way to such lands.

The non-Federal sponsor shall comply with applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, approved 2 January 1971, and amended by Title IV of the Surface Transportation Uniform Relocation Assistance Act of 1987, Public Law 100-17, effective 2 April 1989, in acquiring real estate interests for the proposed project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act(s).

Mobile District, Real Estate Division has officially inquired into the non-Federal sponsor’s capability to adequately acquire all necessary LERRDs. The non-Federal sponsor has documented this understanding in the Assessment of the Non-Federal Sponsor’s Real Estate Acquisition Capability and has also confirmed said real property acquisition tasks and associated estimate of costs in that letter dated 14 May 2009 attached hereto as Exhibit “D”.

The NFS is entitled to receive credits against its share of project costs for the value of lands it provides and the value of any relocation that may be required for the project. The value of the real property interests will also include the documented incidental costs of acquiring such interests, as determined by the Government, to be reasonable. Credit for sponsor owned lands that may have been acquired more than 5 years from the effective date of the Project Partnership Agreement (PPA) will not include incidental costs. Credit for real property owned by the sponsor at the effective date of the PPA will be based on the fair market value of the land at that time. For land acquired after the effective date of the PPA, credit will be based on the fair market value at time of acquisition and administrative costs will be based on actual documented costs submitted by the sponsor. For further information regarding acquisition/relocation and crediting requirements, the sponsor should review and abide by the *NFS Guide to Land Acquisition* located at http://www.sam.usace.army.mil/RE/default.htm

15. APPLICATION OF ZONING ORDINANCES

No application or enactment of zoning ordinances is proposed in lieu of, or to facilitate acquisition in connection with this project.

16. LAND ACQUISITION MILESTONES

Commencement of land acquisition hinges on a number of overall project milestones. Specifically, the projected fiscal budget appropriations, anticipated approval of the Chief's Report by the Assistant Secretary of the Army (ASA) Civil Works, and ultimately, the finalization of a Project Partnership Agreement (PPA). That being said, the non-Federal sponsor has made proposals to begin acquisition at the time of feasibility approval and prior to the final execution of PPA. The non-Federal sponsor has been notified of the risks involved as provided for in Exhibit "E" – Formal Risk Notification Letter. However, the land acquisition schedule ultimately centers on the placement and recordation of an ECL which is anticipated for the vast majority of the Walton County coastline. Due to the large number of impacted lands, a minimum of 24 to 36 months for the acquisition process is estimated for this project. It is recommended that the project be constructed in phases to mirror the acquisition timeline. The non-Federal sponsor, USACE Project Manager, and Real Estate Technical Manager will further formulate the milestone schedule upon project approval to allow adequate time to complete real estate acquisition phase in order to meet the advertisement for construction date(s).

It is critical to note some general elements that have an impact on acquisition schedules are landowner attitudes, funding concerns, manpower resources, and title issues. Depending on the nature of some title defects, significant time and efforts should be expected to impact acquisition milestones. In some cases, curative efforts may require condemnation to identify and provide legal notice to all affected landowners. Where negotiations fail and condemnation is required, the non-Federal

sponsor should use their quick-take authority in order to expedite the condemnation process and allow for possession of the property for project purposes. The non-Federal sponsor has documented in Exhibit "D" attached hereto that quick-take authority is available for this project.

17. FACILITY OR UTILITY RELOCATIONS

There are no known facilities or utility relocations within the scope of the proposed project.

18. KNOWN CONTAMINANTS

There is no known or suspected presence of Hazardous, Toxic, and Radiological Waste (HTRW) located in, on, under, or adjacent to the LERRDs required for the construction or operation and maintenance of the proposed project.

19. SUPPORT OR OPPOSITION TO THE PROJECT

Based on past meetings with the non-Federal sponsor, it appears the majority of landowners within the project area are supportive of the proposed hurricane and storm damage reduction project since this project will provide much needed protection to upland structures and real property.

However, in 2004, a small group of landowners challenged the establishment of a Walton County Erosion Control Line (applied under the Beach and Shore Preservation Act) claiming that this acquisition affected an unconstitutional taking of their property without just compensation. The importance of citing this case is to point out the possible procedural effects on real estate acquisition for this proposed project. A brief synopsis of this case is as follows:

> Save Our Beaches v. City of Destin, Walton County
> Case No. SC06-1449
> Florida Supreme Court

Walton County, along with the Florida Department of Environmental Protection, the Internal Improvement Trust Fund and the City of Destin, have appealed a decision of the First District Court of Appeal (DCA) finding that the application of Section 161.141, Florida Statutes, and the establishment and recordation of an Erosion Control Line ("ECL"), to the properties of the members of Stop the Beach Renourishment, Inc. ("STBR"), constitutes an unconstitutional taking of private property. Although the DCA decision is couched in terms an "as-applied" constitutional challenge, neither the court nor STBR established how the members of STBR are situated any differently than any other owner of beach front property in the State. The practical effect of the decision, therefore, is a determination of the facial invalidity of the statute. The decision would then apply to all existing and proposed beach renourishment projects in the State, as each project requires the establishment and recordation of an ECL. The effect of such a decision, therefore, is the requirement that the State and/or the local project sponsor acquire, through eminent domain, all riparian rights to the upland properties included within a project area prior to the issuance of a permit by the Department of Environmental Protection (the "Department").

On 29 September, 2008, the Florida Supreme Court issued an Opinion holding that the Beach and Shore Preservation Act achieves a reasonable balance between public and private interests. Further, the Act, on its face, does not unconstitutionally deprive upland owners of property rights without just compensation when the State is restoring beaches under the aforementioned Act.

After the Florida Supreme Court decision was issued, this case was further elevated to the Supreme Court of the United States (No. 08-1151), argued December 2, 2009 and decided June 17, 2010. The Certiorari affirmed the lower court's decision as stated in the following excerpt:

Florida owns in trust for the public the land permanently submerged beneath navigable waters and the foreshore. The mean high-water line is the ordinary boundary between private beachfront, or littoral property, and state-owned land. Littoral owners have, inter alia, rights to have access to the water, to use the water for certain purposes, to have an unobstructed view of the water, and to receive accretions and relictions (collectively, accretions) to the littoral property. An accretion occurs gradually and imperceptibly, while a sudden change is an avulsion. The littoral owner automatically takes title to dry land added to his property by accretion. With avulsion, however, the seaward boundary of littoral property remains what it was: the mean high-water line before the event. Thus, when an avulsion has added new land, the littoral owner has no right to subsequent accretions, because the property abutting the water belongs to the owner of the seabed (ordinarily the State).

Florida's Beach and Shore Preservation Act establishes procedures for depositing sand on eroded beaches (restoration) and maintaining the deposited sand (nourishment). When such a project is undertaken, the State entity that holds title to the seabed sets a fixed "erosion control line" to replace the fluctuating mean high-water line as the boundary between littoral and state property. Once the new line is recorded, the

common law ceases to apply. Thereafter, when accretion moves the mean high-water line seaward, the littoral property remains bounded by the permanent erosion-control line.

Respondents, the city of Destin and Walton County, sought permits to restore 6.9 miles of beach eroded by several hurricanes, adding about 75 feet of dry sand seaward of the mean high-water line (to be denominated the erosion-control line). Petitioner, a nonprofit corporation formed by owners of beachfront property bordering the project (hereinafter Members) brought an unsuccessful administrative challenge. Respondent the Florida Department of Environmental Protection approved the permits, and this suit followed. The State Court of Appeal concluded that the Department's order had eliminated the Members' littoral rights (1) to receive accretions to their property and (2) to have their property's contact with the water remain intact. Concluding that this would be an unconstitutional taking and would require an additional administrative requirement to be met, it set aside the order, remanded the proceeding, and certified to the Florida Supreme Court the question whether the Act unconstitutionally deprived the Members of littoral rights without just compensation. The State Supreme Court answered "no" and quashed the remand, concluding that the Members did not own the property supposedly taken. Petitioner sought rehearing on the ground that the Florida Supreme Court's decision effected a taking of the Members' littoral rights contrary to the Fifth and Fourteenth Amendments; rehearing was denied. ***Held: The judgment is affirmed.***

20. STATEMENT THAT NON-FEDERAL SPONSOR HAS BEEN NOTIFIED IN WRITING ABOUT THE RISKS ASSOCIATED WITH ACQUIRING LAND

The non-Federal sponsor has been notified of the risks involved upon acquiring lands required for the project prior to execution of the PPA. Should the non-Federal sponsor proceed with acquisition of lands prior to execution of the PPA, it is at the risk of not receiving credit or reimbursement for any costs incurred in the connection with the acquisition process should the PPA not be signed. There is also risk in acquiring lands either not needed for the project or not acquired in compliance with requirements for crediting purposes in accordance with 49 CFR Part 24, dated March 2, 1989.

The non-Federal sponsor has been notified via email and supplied with a formal notification of the risks involved in acquiring land for the proposed prior to the execution of the PPA and the Government's formal notice to proceed with acquisition. The non-Federal sponsor's formal acknowledgment of these risks as provided for in ER 405-1-12-31 is attached hereto as Exhibit "E".

21. ESTATES TO BE ACQUIRED

It is recommended that the non-Federal sponsor acquire the standard perpetual beach storm damage reduction easement, as is described under item a. below.

a. Perpetual Beach Storm Damage Reduction Easement:

A perpetual and assignable easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts No. ___), for use by the Project Sponsor, its representatives, agents, contractors and assigns, to construct; preserve; patrol; operate; maintain; repair; rehabilitate; and replace; a public beach, a dune system, and other erosion control and storm damage reduction measures together with appurtenances thereto, including the right to deposit sand; to accomplish any alterations of contours on said land; to construct berms and dunes; to nourish and renourish periodically; to move, store and remove equipment and supplies; to erect and remove temporary structures; and to perform any other work necessary and incident to the construction, periodic renourishment and maintenance of the Walton County Hurricane and Storm Damage Reduction Project, together with the right of public use and access; to plant vegetation on said dunes and berms; to erect, maintain and remove silt screens and snow fences; to facilitate preservation of dunes and vegetation through the limitation of access to dune areas; to trim, cut, fell, and remove from said land all trees, underbrush, debris, obstructions, and any other vegetation, structures and obstacles within the limits of the easement (except _____); (reserving, however, to the grantor(s), (his) (her) (its) (their) (heirs), successors and assigns, the right to construct dune over walk structures in accordance with any applicable Federal, State or local laws or regulations, provided that such structures shall not violate the integrity of the dune in shape, dimension or function, and that prior approval of the plans and specifications for such structures is obtained from the Florida Department of Environmental Protection (FDEP) and provided further that such structures are subordinate to the construction, operation, maintenance, repair, rehabilitation and replacement of the project; and further reserving to the grantor(s), (his) (her) (its) (their) (heirs), successors and assigns all such rights and privileges as may be used and enjoyed without interfering with or abridging the rights and easements hereby acquired; subject however to existing easements for public roads and highways, public utilities, railroads and pipelines.

b. Temporary Work Area Easement:

In the event that the non-Federal sponsor encounters difficulties with construction access and staging, it is recommended that the non-Federal sponsor acquire a temporary work area easement. Said temporary easement term should be required for 24 – 36 months in order to provide enough time for the project to be fully constructed unless it is determined later that the easement term can be minimized to reflect construction phases.

A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. _____, _____ and _____), for a period not to exceed_____, beginning with date possession of the land is granted to the Project Sponsor, for use by the Project Sponsor, its representatives, agents, and contractors as a work area, including the right to deposit backfill, move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Walton County Hurricane and Storm Damage Reduction Project, together with the right

to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

c. Consent of Use

(1) There is no estate which the sponsors acquire from the State to place material seaward of the ECL, however, the State issues a permit type document known as a "Consent of Use". This consent is issued when the initial Water Quality Certificate is approved by the Florida Department of Environmental Regulation and the ECL is approved by the Governor and Cabinet.

(2) The consent of use basically grants the rights to place sand on state-owned submerged land in accordance with the beach nourishment plans submitted with the application for an ECL. This document must be renewed with the renewal of the Water Quality Certificate.

22. NAVIGATIONAL SERVITUDE

The Federal Navigational Servitude doctrine arises from two related components: navigation power which is derived from the commerce clause of the U.S. Constitution giving Congress regulatory power over navigable waters; and navigation servitude which provides that certain private property may be taken, without compensation to the landowner, if the taking is necessary to exercise the navigation power. Private ownership of land below navigable or tidal waters is acquired and held subject to the dominant public right of navigation. This dominant public right may be exercised by Congress without giving rise to a compensable taking. The Federal Government's ability to exercise navigational servitude is not available for this project as the determination has been made that no nexus exists between the proposed project and commercial navigation.

23. CHART OF ACCOUNTS

The cost estimate for all Federal and non-Federal real estate activities necessary for implementation of the project after completion of the feasibility study for land acquisition, construction, LERRDs, and other items are codes as delineated in the Cost Work Breakdown Structure (CWBS). This real estate cost estimate is then incorporated into the Total Project Cost Summary utilizing the Microcomputer Aided Cost Engineering System (MCACES).

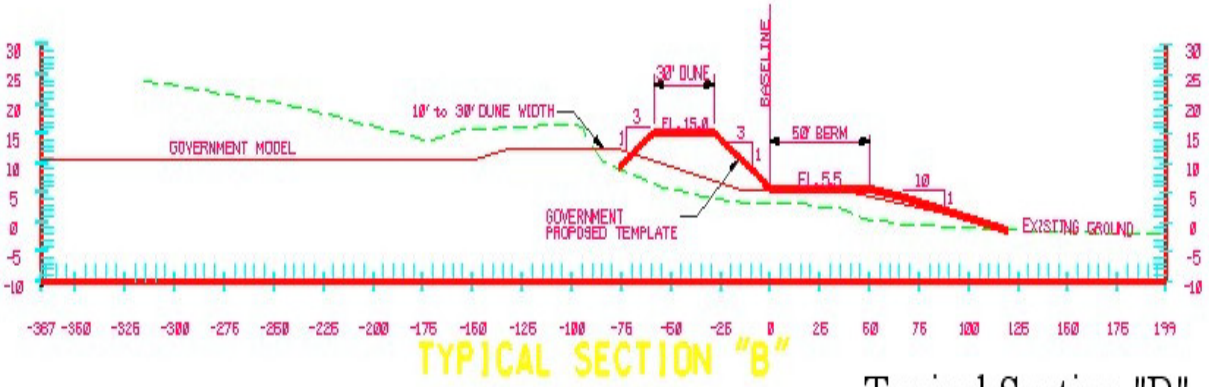
Table C-8. Chart of Accounts

Chart of Accounts				
01A	**PROJECT PLANNING**	**FEDERAL**	**NON-FEDERAL**	**TOTALS**
	Other			
	Project Partnership Agreement (OC)	$ -	$ -	$ -
01AX	Contingencies (25%)	$ -	$ -	$ -
	Subtotal	$ -	$ -	$ -
01B	**LANDS AND DAMAGES**			
01B20	Acquisition by non-Federal sponsor	$ -	$421,000.00	$421,000.00
01B40	Acq/Review of non-Federal sponsor	$96,000.00	$	$96,000.00
01BX	Contingencies (25% Rounded)	$24,000.00	$106,000.00	$130,000.00
01R	**RE PAYMENTS**	**FEDERAL**	**NON-FEDERAL**	**TOTALS**
01R1	LAND PAYMENTS	$ -	$ -	$ -
01R1A	By Government	$ -	$ -	$ -
01R1B	By non-Federal sponsor	$ -	$ -	$ -
01R1C	By Government on behalf of non-Federal sponsor	$ -	$ -	$ -
01R1D	Review of non-Federal sponsor	$ -	$ -	$ -
01RX	Contingencies (25%)	$ -	$ -	$ -
01R2	**PL 91-646 Assistance Payments**			
01R2A	By Government	$ -	$ -	$ -
01R2B	By non-Federal sponsor	$ -	$ -	$ -
01R2C	By Government on behalf of non-Federal sponsor	$ -	$ -	$ -
01R2D	Review of non-Federal sponsor	$ -	$ -	$ -
	TOTALS	**$120,000.00**	**$527,000.00**	**$647,000.00**

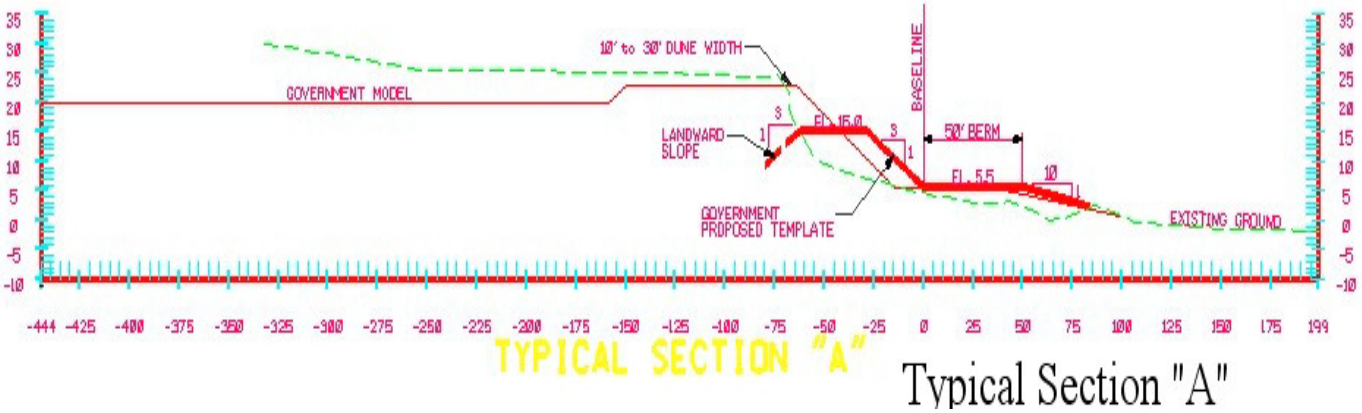
24. OTHER REAL ESTATE ISSUES

No other pertinent real estate issues have been identified for the proposed project.

EXHIBIT “A”



Typical Section "B"



Typical Section "A"

EXHIBIT "B"

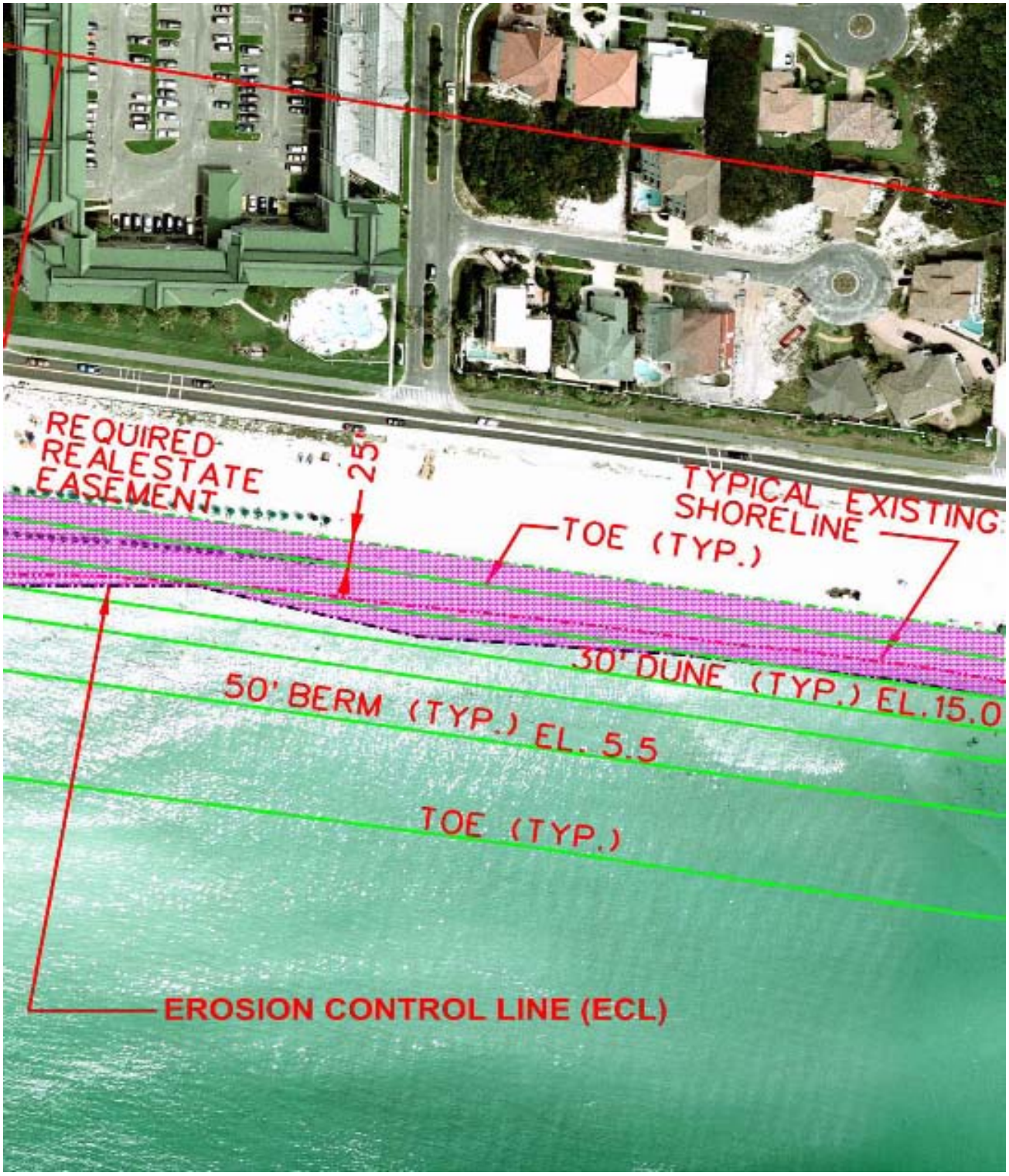

REQUIRED
REALESTATE
EASEMENT
25'
TYPICAL EXISTING
SHORELINE
TOE (TYP.)
30' DUNE (TYP.) EL.15.0
50' BERM (TYP.) EL. 5.5
TOE (TYP.)
EROSION CONTROL LINE (ECL)

EXHIBIT "C"

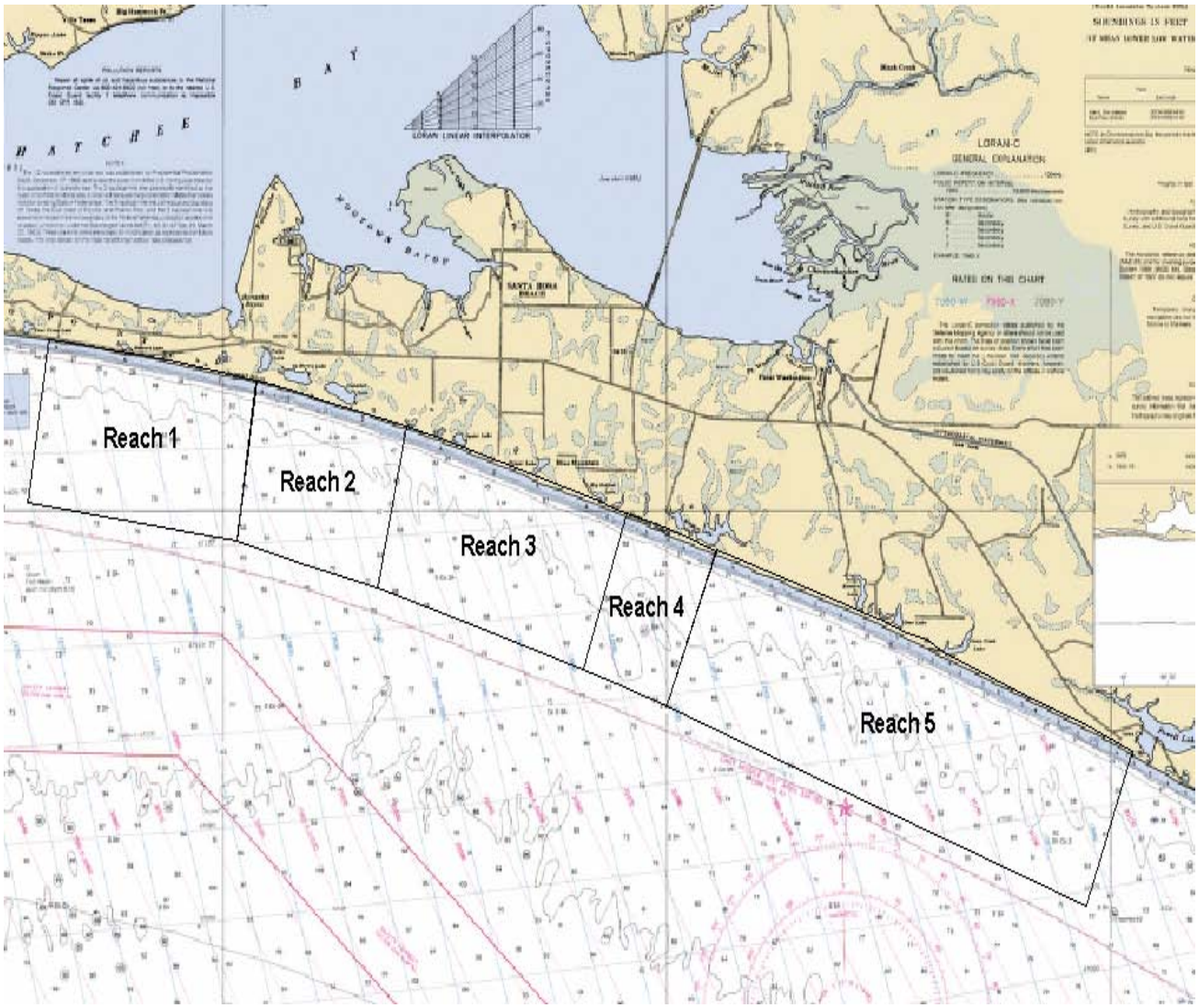


EXHIBIT "D"

WALTON COUNTY, FLORIDA
STORM DAMAGE REDUCTION AND
BEACH EROSION CONTROL PROJECT

WALTON COUNTY BOARD OF COMMISSIONERS – NON FEDERAL SPONSOR

ASSESSMENT OF NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILITY

1. **LEGAL AUTHORITY:**

    a. **Does the sponsor have legal authority to acquire and hold title to real property for project purposes? Yes**

    b. **Does the sponsor have the power of eminent domain for this project? Yes**

    c. **Does the sponsor have "quick-take" authority for this project? Yes**

    d. **Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? No**

    e. **Any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn?**
        i. **Private Property: Yes**
        ii. **State-Owned Property: No**

2. **HUMAN RESOURCE REQUIREMENTS:**

    a. **Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? No**

    b. **If the answer to 2(a) is "yes", has a reasonable plan been developed to provide such training? N/A**

    c. **Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? Yes**

    d. **Is the sponsor's projected in-house staffing level sufficient considering its other workload, if any, and the project schedule? Yes**

e. **Can the sponsor obtain contractor support, if required, in a timely fashion? Yes**

f. **Will the sponsor likely request USACE assistance in acquiring real estate? (If "yes", provide description). No, USACE will provide guidance and oversight functions only.**

3. **OTHER PROJECT VARIABLES:**

a. **Will the sponsor's staff be located within reasonable proximity to the project site? Yes**

b. **Has the sponsor approved the project/real estate schedule milestones? The project/real estate schedule milestones have not yet been explicitly defined.**

4. **OVERALL ASSESSMENT:**

a. **Has the sponsor performed satisfactorily on other USACE projects? Yes**

b. **With regard to this project, the sponsor is anticipated to be: Highly capable; Fully capable; Moderately capable; Marginally capable; Insufficiently capable. (If sponsor is believed to be insufficiently capable, please provide explanation).**

5. **COORDINATION:**

a. **Has this assessment been coordinated with the sponsor? Yes**

b. **Does the sponsor concur with this assessment? Yes**

Accepted by Non-Federal Sponsor:

Donny Mares **(Signature)**

EXECUTIVE DIRECTOR **(Title)**

WALTON COUNTY TOURIST DEVELOPMENT COUNCIL

Prepared by:

_____ **(Signature)**
RUSSELL W. BLOUNT III
PLANNING SECTION
REAL ESTATE DIVISION

Reviewed and Approved by:

_____ **(Signature)**
FREDERICK D. DAWSON
ACTING CHIEF
REAL ESTATE DIVISION
U.S. ARMY CORPS OF ENGINEERS
MOBILE DISTRICT

BEACHES OF SOUTH WALTON
Northwest Florida's Gulf Coast

May 14, 2009

Russell W. Blount III
U.S. Army Corps of Engineers
Mobile District, Real Estate Division
109 St. Joseph Street
Mobile, AL 36602

Re: Walton County, Florida's Plan regarding Real Estate Acquisition for the Walton County Hurricane and Storm Damage Reduction Project

Mr. Blount,

As you are aware, Walton County has been working with the Mobile District of the U.S Army Corps of Engineers since 2003 with the goal of identifying a federally justified Hurricane and Storm Damage Reduction Protection project for the Walton County shoreline. In this letter, Walton County is proposing how we would approach the real estate acquisition portion of the project based on previous conversations with Mobile team members.

It is our understanding that prior to the initiation of any real estate activities; Walton County will survey and record an Erosion Control Line (ECL) for the entire length of the project. Additional real estate acquisition activities will include identifying the parcels that are within the project area, identifying the ownership of those parcels, securing easements for those parcels that meet or exceed the need of the federal government to construct the federal shore protection project, and obtaining appraisal waivers and appraisal reports (an appraisal report will be required if Walton County is forced to use their quick-take authority due to failed landowner negotiations). Based on previous discussions with Mobile District Real Estate Division, they have identified roughly 960 parcels within the proposed project area. This leaves an explanation of how we would identify ownership of those parcels and securing easements as the remaining two items that we must account for costs and activities. Walton County's proposed plan for those two activities is outlined in the following two sections.

Identification of parcel ownership within the project area

Walton County is in the process of identifying the ownership of the parcels within the project area. Mike Burke, Walton County Attorney, has contacted Fidelity National Title Insurance Company, a major title insurance company in the United States, to obtain a cost estimate for their effort to identify the owners and producing a report for each parcel. The cost for this effort is estimated by Fidelity to be $125 per parcel. In addition to this cost, the County Attorney anticipates a cost of $100 per parcel to review each report from Fidelity to insure accuracy and prepare information to be included for individual easement documents. Based on these estimates, we calculate the local sponsors cost for ownership identification portion of the real estate acquisition program to be $216,000. In addition to the parcel ownership identification process, Walton County has received an estimate of $35,000 for the Erosion Control Line Survey from Morgan & Eklund a registered surveying company in the State of Florida. Assuming a 25% contingency (approximately $63,000), the cost for this activity would be estimated at approximately $314,000.

Beaches of South Walton Tourist Development Council
25777 U.S. Hwy. 331 South • Santa Rosa Beach, FL 32459
800-822-6877 • 850-267-1216 • Fax 850-267-3943
www.beachesofsouthwalton.com

ACCREDITED Destination Marketing Organization 2007-2010
Blue Wave Certified

Securing easements for parcels located within the project area

In conversations with Mobile, Walton County has expressed an interest in moving quickly to begin securing easements for the project area. Walton County has been informed of the risks in moving forward prior to the project being authorized and those risks were noted and accepted in a formal risk notification letter dated July 3, 2008. It is our intention to work closely with Mobile to insure that our easement includes the necessary language to meet or exceed the needs of the project.

The approach by Walton County in this task will be to draft an easement for review by Mobile District Real Estate Division and receive acceptance that the language is sufficient for supporting the needs of the project. Additionally, it is the intention of Walton County to include language within the easement document regarding offsetting benefits in order to alleviate the need of an appraisal for takings claims. In addition, Walton County and Mobile District will draft an appraisal waiver detailing that the easement was voluntarily provided by the landowner for the proposed project and that monetary compensation for said easement will be waived. If the need arises for an appraiser, Walton County will identify an appraiser and submit the necessary documentation to Mobile for review. The appraiser will then be tasked with assisting Walton County through the acquisition process.

Walton County staff will be responsible for formulating, mailing, and recording of easements in the Walton County, FL Clerk of Courts. Moreover, Walton County, through the Tourist Development Council, will conduct an educational campaign to assist the dissemination of information regarding the project and specifically the easement process. Walton County has notified the Mobile District Real Estate Division that the County is highly capable of implementing this acquisition project as noted in that real estate assessment letter dated July 16, 2008. The estimated cost to the non-federal sponsor for administrative duties regarding securing easements for parcels located within the project area is $40,000 plus a 25% contingency for a total administrative cost of $50,000.

Summary

It is our understanding that the current estimate for non-federal sponsor administrative costs related to this project exceeds $3,500,000 including the 25% contingency. Our estimate for the non-federal sponsor administrative cost is $527,000. Therefore, we expect a cost savings of almost $3 million on this item. Refer to the attached itemized chart for the newly proposed real estate cost estimate. We appreciate the opportunity to submit this information in regards to the Walton County, FL Hurricane and Storm Damage Reduction Project.

Sincerely,

Sonny Mares

Sonny Mares
Executive Director

REAL ESTATE COST ESTIMATE

CATEGORY	COST
A. Lands:	
I. Lands	$0.00
II. Improvements	$0.00
III. Severance Damages	$0.00
IV. Minerals	$0.00
V. Total Lands & Damages	$0.00
B. ADMINISTRATIVE COSTS	
I. Federal Review of NFS	
1. $100.00 x 923 (private lands)	$92,300.00
2. $100.00 x 37 (public lands)	$3,700.00
3. Sub-Total:	$96,000.00
4. Contingency (25%)	$24,000.00
5. Sub-Total:	**$120,000.00**
II. Non-Federal Sponsor (NFS) Acquisition Costs Estimates based on a total of 960 easement acquisitions	
1. ECL Survey/Mapping/Legal Descriptions	$35,000.00
2. Ownership Verification & Title Insurance (960 x $125.00)	$120,000.00
3. County Atty. Review of Title (960 x $100.00)	$96,000.00
4. Contingency (25%)	$63,000.00
5. Appraisal Reports (assuming 10% of landowners)	$25,000.00
6. Appraisal Waivers (assuming 90% of landowners)	$5,000.00
7. Contingency (25%)	$8,000.00
8. Condemnation/Quick-Take Process (assuming 1%)	$ 100,000.00
9. Miscellaneous NFS Administrative Costs	$40,000.00
10. Contingency (25%)	$35,000.00
11. Sub-Total:	**$527,000.00**
III. Public Law 91-646 Relocation Costs	$0.00
IV. **Total RE Cost Estimate:**	**$647,000.00**

EXHIBIT "E"

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF:

Real Estate Division
Planning Section

South Walton Tourist Development Council
Attn: Sonny Mares, Executive Director
P.O. Box 1248
Santa Rosa Beach, FL 32459

Re: Walton County, FL Storm Damage Reduction and Beach Erosion Control Project;
Formal Risk Notification to Non-Federal Sponsor

Dear Mr. Mares,

The intent of this letter is to formally advise Walton County, as potential Non-Federal Sponsor for a proposed project, of the risks associated with land acquisition prior to the execution of a Project Partnership Agreement (PPA) or prior to the Government's formal notice to proceed with acquisition. If a Non-Federal Sponsor deems it necessary to commence acquisition prior to an executed PPA for whatever reason, the Non-Federal Sponsor assumes full and sole responsibility for any and all costs, responsibility, or liability arising out of the acquisition effort.

Generally, these risks include, but may be not be limited to, the following:

(1) Congress may not appropriate funds to construct the proposed project;

(2) The proposed project may otherwise not be funded or approved for construction;

(3) A PPA mutually agreeable to the non-Federal sponsor and the Government may not be executed and implemented;

(4) The non-Federal sponsor may incur liability and expense by virtue of its ownership of contaminated lands, or interests therein, whether such liability should arise out of local, state, or Federal laws or regulations including liability arising out of CERCLA, as amended;

(5) The non-Federal sponsor may acquire interests or estates that are later determined by the Government to be inappropriate, insufficient, or otherwise not required for the project;

(6) The non-Federal sponsor may initially acquire insufficient or excessive real property acreage which may result in additional negotiations and/or benefit payments under P.L. 91-646 as well as the payment of additional fair market value to affected landowners which could

have been avoided by delaying acquisition until after PPA execution and the Government's notice to commence acquisition and performance of LERRD;

(7) The non-Federal sponsor may incur costs or expenses in connection with its decision to acquire or perform LERRD in advance of the executed PPA and the Government's notice to proceed which may not be creditable under the provisions of Public Law 99-662 or the PCA. **(Reference: ER 405-1-12 (Change 31; 1 May 98) Section 12-31. Acquisition Prior to PCA Execution.)**

Please acknowledge that the Non-Federal Sponsor for the proposed project accepts these terms and conditions.

Accepted on behalf of the Non-Federal Sponsor:

Donny Mars (Signature)

EXECUTIVE DIRECTOR (Title)

Prepared by:

Russell W. Blount III
Planning Section
Real Estate Division
U.S. Army Corps of Engineers

EXHIBIT "F-1"

Facing west at the Miramar Beach Regional Access – This public access is located on the very western end of Walton County, Florida.

EXHIBIT "F-2"

Facing east at the Miramar Beach Regional Access.

EXHIBIT "F-3"

Just south of the intersection of Highland Avenue and Bullard Road. Topsail Hill Preserve State Park is directly to the west and Dune Allen Regional Beach Access is directly to the east.

EXHIBIT "F-4"

Facing northeast at the Ed Walline Regional Beach Access corridor located near the intersection of Walton County Hwy. 393 and Walton County Hwy. 30A.

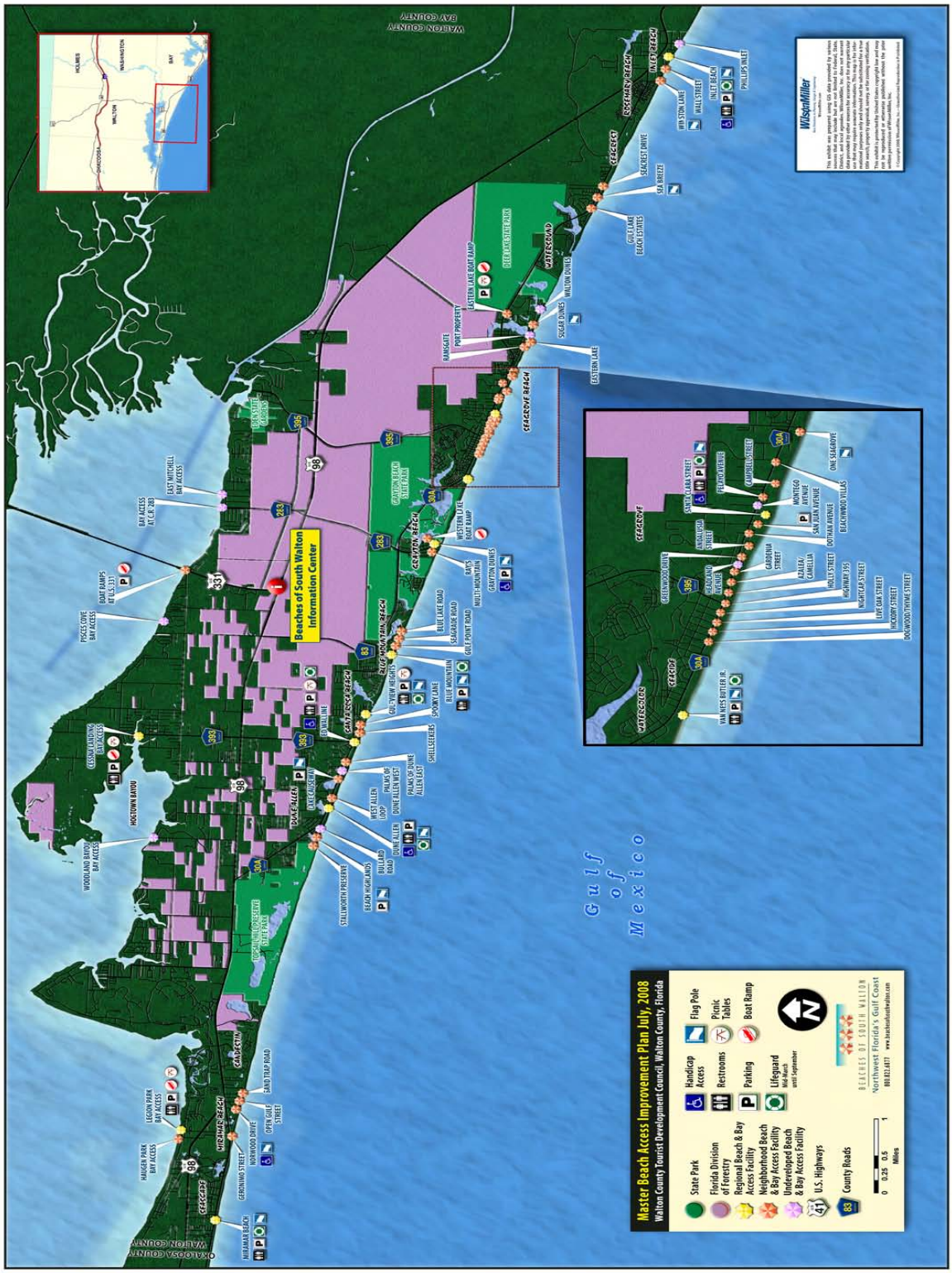
EXHIBIT "F-5"

Facing north at Blue Mountain Regional Beach Access (Note: Construction is privately funded effort to shore up private lands that were critically eroded by Hurricane Ivan.)

EXHIBIT "F-6"

Facing east at Blue Mountain Regional Beach Access located near the intersection of Walton County Hwy. 30A and State Route 83.

EXHIBIT "G"


Master Beach Access Improvement Plan July, 2008
Walton County Tourist Development Council, Walton County, Florida
State Park
Florida Division of Forestry
Regional Beach & Bay Access Facility
Neighborhood Beach & Bay Access Facility
Undeveloped Beach & Bay Access Facility
U.S. Highways
County Roads
Handicap Access
Restrooms
Parking
Lifeguard
Mid-March until September
Flag Pole
Picnic Tables
Boat Ramp
BEACHES OF SOUTH WALTON
Northwest Florida's Gulf Coast
Miles
Beaches of South Walton Information Center
Gulf of Mexico
WALTON COUNTY
BAY COUNTY
OKALOOSA COUNTY
WilsonMiller

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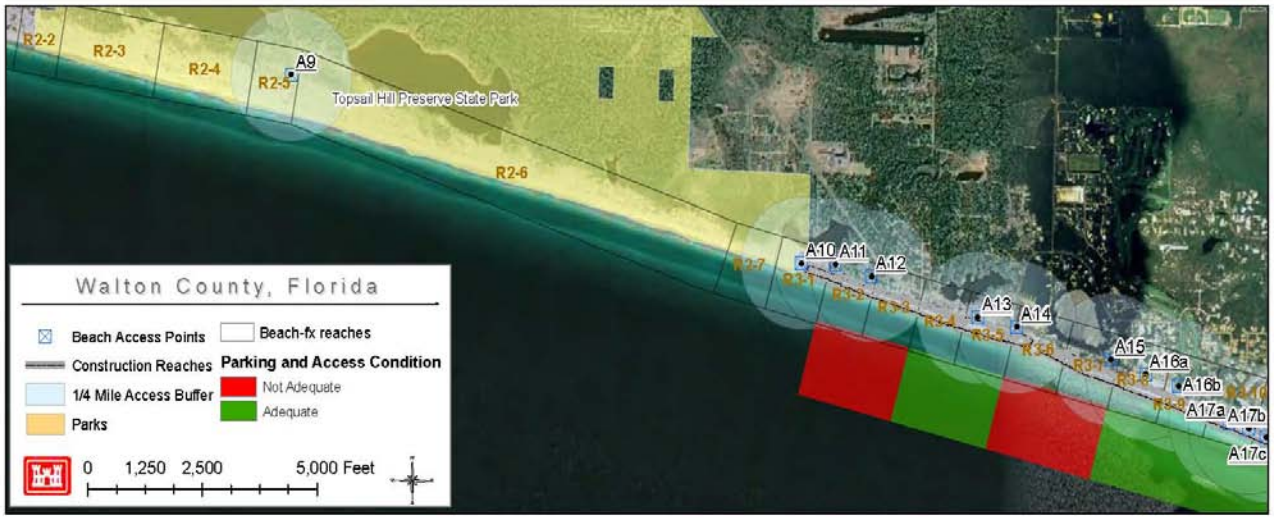
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Construction Reaches
1/4 Mile Access Buffer
Parks
Beach-fx reaches
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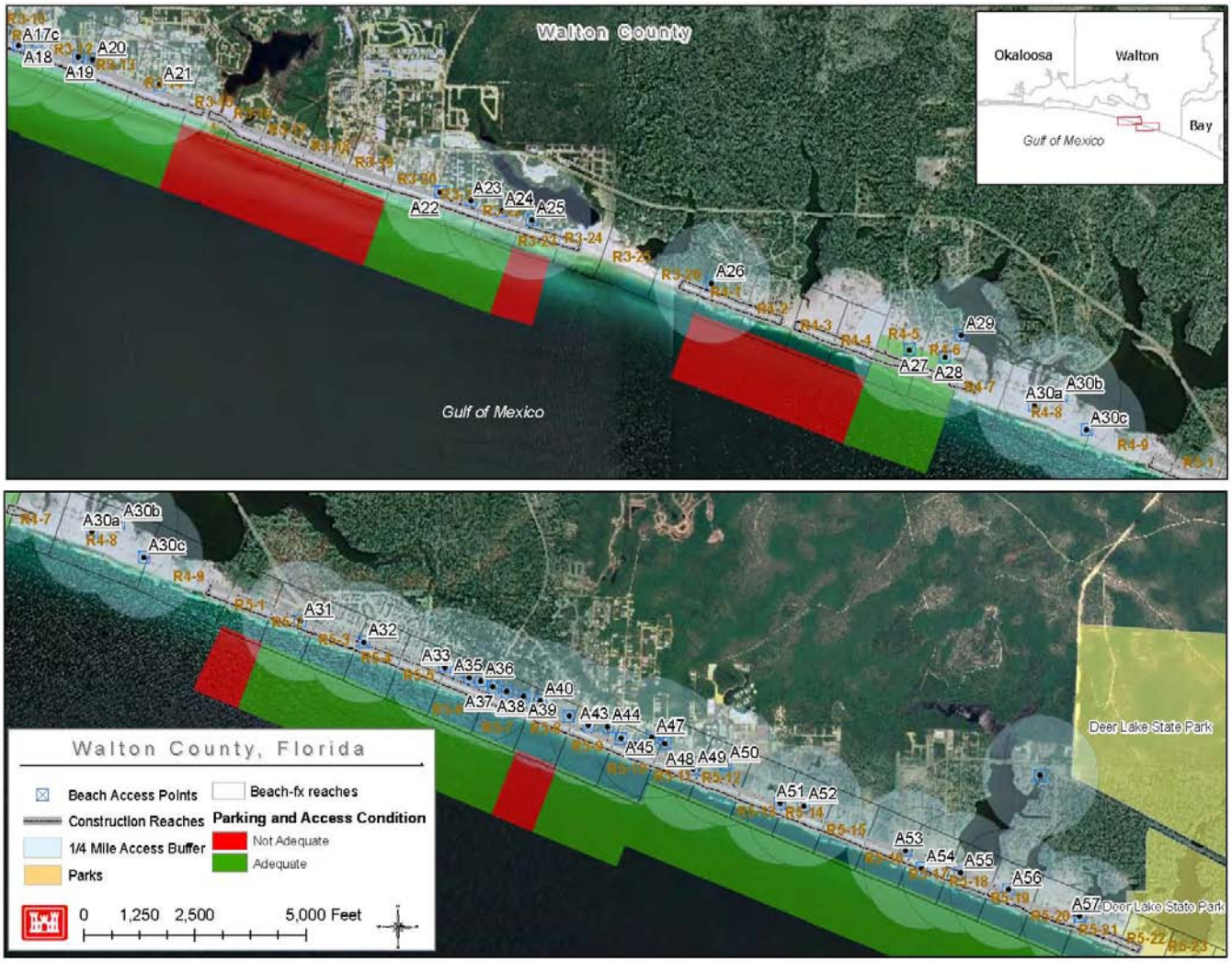
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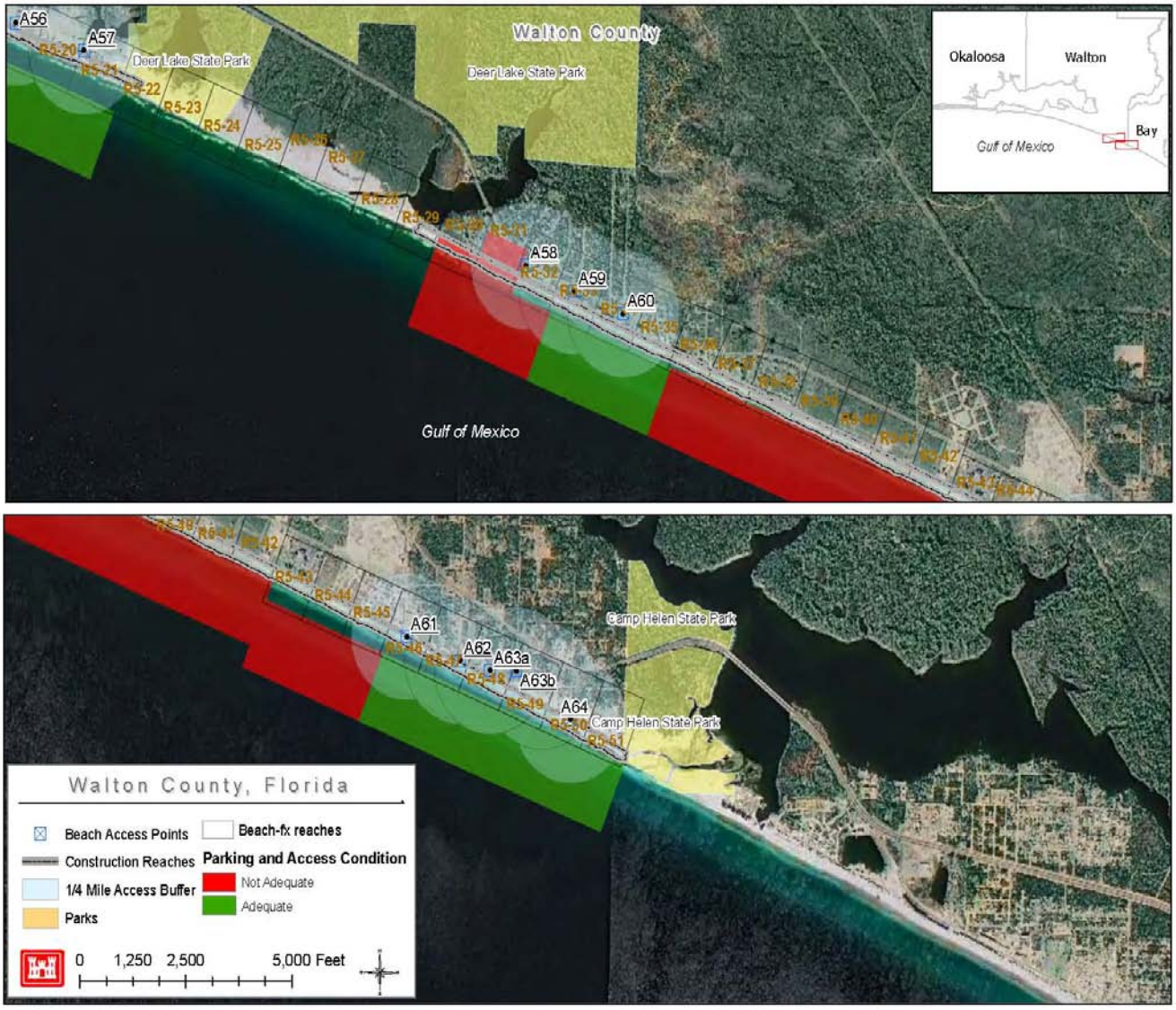
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Adequate
0 1,250 2,500 5,000 Feet

EXHIBIT "H"

AUTHORIZATION FOR ENTRY FOR CONSTRUCTION

I _____, _____ for the
(Name of accountable official) (Title)

Walton County Tourist Development Council acting by and through the Walton County Board of Commissioners, do hereby certify that the Walton County Tourist Development Council acting by and through the Walton County Board of Commissioners has acquired the real property interest required by the Department of the Army, and otherwise is vested with sufficient title and interest in lands to support construction for Walton County, FL Hurricane and Storm Damage Reduction Project. Further, I hereby authorize the Department of the Army, its agents, employees and contractors, to enter upon _____
(Identify tracts)

to construct Walton County, FL Hurricane and Storm Damage Reduction Project as set forth in the plans and specifications held in the U. S. Army Corps of Engineers', Mobile District, Mobile, AL.

WITNESS my signature as _____ for the
(Title)

Walton County Tourist Development Council acting by and through the Walton County Board of Commissioners this _____ day of _____, 20_____.

BY: _____
(Name)

_____
(Title)

ATTORNEY'S CERTIFICATE OF AUTHORITY

I,_____, _____ for the
(Name) (Title of legal officer)

Walton County Tourist Development Council acting by and through the Walton County Board of Commissioners, certify that _____ has
(Name of accountable official)

authority to grant Authorization for Entry; that said Authorization for Entry is executed by the proper duly authorized officer; and that the Authorization for Entry is in sufficient form to grant the authorization therein stated.

WITNESS my signature as _____ for the
(Title)

Walton County Tourist Development Council acting by and through the Walton County Board of Commissioners, this_____day of_____, 20_____.

BY: _____ (Name)

_____ (Title)

EXHIBIT "I"

STATE OF FLORIDA

COUNTY OF WALTON

WAIVER

We, _____ and wife, _____, donated the following described easement to the COUNTY OF WALTON, FLORIDA, a governmental entity of the State of Florida, for the purpose of implementing the Walton County, Florida Hurricane and Storm Damage Reduction Project, pursuant to__(State Code/Authority)_____:

LEGAL DESCRIPTION

The donation of the above described easement was voluntarily made. We acknowledge that we are receiving a benefit from the construction of a dune and berm system that connects to the property hereinabove described and deem this project benefit to be sufficient consideration. As such, we hereby waive our right to any monetary compensation for said easement and agree that the subject easement is worth less than _____; therefore, no appraisal is necessary.

WITNESS THE EXECUTION OF THIS INSTRUMENT, on this the ____ day of _____ 2009.

_____
Owner name

_____
Owner name

STATE OF FLORIDA

COUNTY OF WALTON

PERSONALLY CAME AND APPEARED BEFORE ME, the undersigned authority in and for said county and state the within named _____and wife, _____ _____who acknowledged to me that they signed and delivered the above instrument of writing on the date therein written as their free and voluntary act and for the uses and purposes therein contained.

GIVEN UNDER MY HAND AND OFFICIAL SEAL OF OFFICE, this the ____ day of_____ _____, 2009.

_____
NOTARY PUBLIC

My Commission Expires:

This Instrument Prepared By:

DRAFT
ENVIRONMENTAL ASSESSMENT
FOR
WALTON COUNTY, FLORIDA HURRICANE AND STORM DAMAGE REDUCTION PROJECT
WALTON COUNTY, FLORIDA

Prepared by

U.S. Army Corps of Engineers, Mobile District
Planning and Environmental Division
Environmental Resources Branch
Coastal Environment Team

April 2012

DRAFT ENVIRONMENTAL ASSESSMENT

WALTON COUNTY HURRICANE AND STORM DAMAGE REDUCTION PROJECT WALTON COUNTY, FLORIDA

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DRAFT ENVIRONMENTAL ASSESSMENT

WALTON COUNTY, FLORIDA
HURRICANE AND STORM DAMAGE REDUCTION PROJECT

1.0 INTRODUCTION

Walton County's shoreline located in Florida's Panhandle is receding; the protective dunes and high bluffs are being destroyed by hurricane and storm. The impacts of these storms to property and infrastructure are considerable and can possibly be reduced through a beach restoration and stabilization project which also includes environmental restoration opportunities associated with the beach and dune system. Behind the dune system, upland drainage feeds several freshwater lakes that intermittently breach the dune system and discharge directly into the Gulf. Primary dune elevations range from 11.5 to 44.5 feet North American Vertical Datum, 1988 (NAVD88) and average 25.5 feet National Geodetic Vertical Datum (NGVD).

During the late 1990s, the area endured several strong hurricanes resulting in extensive shoreline erosion (Taylor Engineering, Inc., 2003). In 2004 the area was affected severely by Hurricane Ivan (Sep 04) and early into the 2005 hurricane season it was impacted by Hurricanes Arlene (June 05) and Dennis (July 05).

1.1 AUTHORITY

This study was authorized both within the United States Senate and the U.S. House of Representatives. In the Senate, the Committee on Environment and Public Works adopted a committee resolution (unnumbered) on July 25, 2002, which reads as follows:

> *"Resolved by the Committee on Environment and Public Works of the United States Senate, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and related improvements in Walton County, Florida, in the interest of protecting and restoring the environmental resources on and behind the beach, including the feasibility of providing shoreline and erosion protection and related improvements consistent with the unique characteristics of the existing beach sand, and with consideration of the need to develop a comprehensive body of knowledge, information, and data on coastal area changes and processes as well as impacts from Federally constructed projects in the vicinity of Walton County, Florida.*

> In the House, the Committee on Transportation and Infrastructure adopted a resolution, Docket 2690, dated July 24, 2002, which reads as follows:

> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and environmental restoration and protection in the vicinity of Walton County, Florida.*

The Non-Federal Sponsor is the Walton County Board of Commissioners. Their central point of contact is the Director of Beach Management for the Walton County Tourist Development Council (TDC).

1.2 LOCATION OF STUDY AREA

Walton County is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet (Figure EA-1). The western two-thirds of Walton County are comprised of a coastal peninsula extending from the mainland, and the eastern third is comprised of mainland beaches. Choctawhatchee Bay lies north of the peninsula. Walton County includes 11.9 miles of state-designated critically eroding areas and three State of Florida park areas that cover approximately six miles of the 26-mile shoreline.

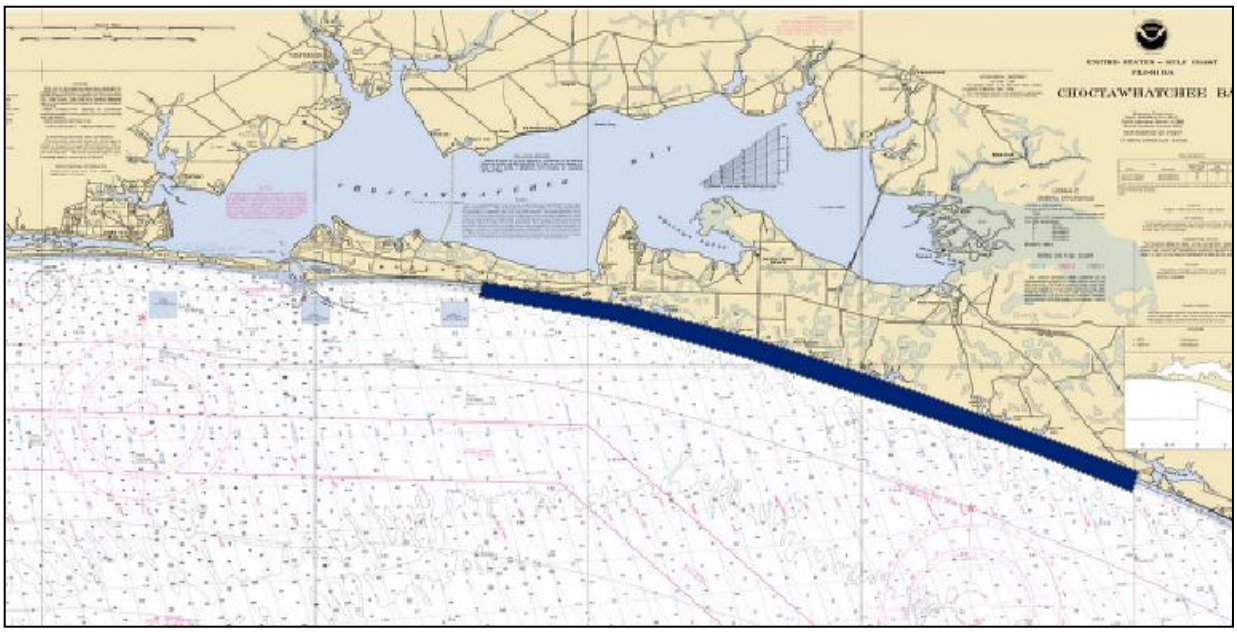

Figure EA-1. Location of Walton County Project Area

1.3 PURPOSE AND NEED

The purpose of this study is to assess the needs for hurricane and storm damage protection and opportunities for environmental restoration and protection along the Gulf Coast of Walton County, Florida. The purpose of this report is to document the environmental considerations completed to formulate a shore protection project for Walton County, Florida, which will reduce the damaging effects of hurricanes and severe storms to properties and environmental resources along the coast and stabilize or restore the shoreline by eliminating long-term erosion. The project is constructible, acceptable to the public, environmentally sustainable, and justified by an economic evaluation.

In addition to storm damage protection the proposed action provides environmental restoration opportunities. A report produced by the State of Florida following Hurricane Ivan (2004) to assess damages and recovery plan as a result of the storm, the state recommends an assisted recovery plan to implement beach and dune restoration and re-vegetation for the critical areas in Walton County. Such action would restore valuable dune and beach habitat including sea turtle nesting habitat, shorebird foraging and roosting areas, dune habitat supporting various flora and fauna and general beach ecosystem functions. Restoring a beach-dune system allows greater stability and sustainability of the coastal environment once it has become established. Restoring the beach habitat that supports a variety of associated flora and fauna contribute to the success and continual survival of several threatened or endangered species. The restoration effort will also contribute to the well-being of various other flora and fauna that naturally occur in the immediate vicinity as well as providing continued sustainability to the fragile ecosystems of the dune lakes that exists in the area. Future conditions associated with not restoring the beach and dune system would result in the continued degradation of a valuable beach ecosystem and loss of these types of habitats and associated benefits. The already damaged habitats would remain particularly vulnerable to wave and storm activity that continually threaten and prevent the re-establishment of valuable natural resources.

1.4 SCOPE

This Environmental Assessment (EA) was prepared in accordance with Engineer Regulation (ER) 200-2-2, *Procedures for Implementing the National Environmental Policy Act (NEPA)* and the Council on Environmental Quality (CEQ) *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* (40 Code of Federal Regulations (CFR) Pts. 1500-1508). The objective of the EA is to determine the magnitude of the environmental impacts of the proposed storm protection and restoration actions. If such impacts are relatively minor, a Finding of No Significant Impact (FONSI) would be issued and the Mobile District, U.S. Army Corps of Engineers (Corps) will proceed with the Federal action. If the environmental impacts are significant according to CEQ's criteria (40 CFR Section 1508.27), an Environmental Impact Statement (EIS) would be prepared before a decision is reached to implement the proposed action.

Applicable laws under which these impacts will be evaluated include the National Environmental Policy Act (NEPA), Endangered Species Act (ESA), the Clean Water Act (CWA), the Clean Air Act, the U.S. Fish and Wildlife Coordination Act (FWCA), National Historic Preservation Act, Coastal Barrier Resources Act (CBRA), Magnuson – Stevens Fishery Conservation and Management Act (MSFCMA), and Coastal Zone Management Act (CZMA).

1.5 ENVIRONMENTAL ASSUMPTIONS

The general environmental criteria for projects of this nature are identified in Federal environmental statutes, executive orders, planning guidelines, and the U.S. Army Corps of Engineers Environmental Operating Principles (EOP). It is the national policy that ecosystem restoration, particularly that which results in conservation of fish and wildlife

resources, be given equal consideration with other study purposes in the formulation and evaluation of alternative plans. The basic guidance during planning studies is to assure that care is taken to preserve and protect significant ecological and cultural resources, and to conserve natural resources. These efforts also should provide the means to maintain and restore, as applicable, the desirable qualities of the human and natural environment. Formulation of alternative plans should avoid damaging the environment to the extent practicable and contain measures to minimize or mitigate unavoidable environmental damages. Consistent with laws and policy, alternative plans formulated should avoid damaging the environment to the extent practicable and contain measures to minimize or mitigate unavoidable environmental impacts.

EOPs have been established for evaluation of water resource projects and have been implemented throughout the study process to ensure conservation, environmental preservation, and restoration is considered at the same level as economic issues. These principles are: 1) Strive to achieve environmental sustainability, 2) Consider environmental consequences, 3) Seek balance and synergy, 4) Accept responsibility, 5) Mitigate impacts, 6) Understand the environment, and 7) Respect other views. The following criteria were used to address environmental impacts during the evaluation of alternatives:

- Protection, preservation, and improvement of the existing fish and wildlife resources along with the protection and preservation of coastal and offshore habitat and water quality;
- Consideration in the project design of the least disruptive construction techniques and methods;
- Protection and preservation of endangered and/or threatened species, critical habitat, and essential fish habitat (EFH); and
- Preservation of significant historical and archeological resources through avoidance, if possible, or data recordation if destruction of the resources is necessary.

1.6 APPLICABLE ENVIRONMENTAL LAWS AND REGULATIONS

Of primary concern is compliance with the CWA. Potential water quality impacts associated with the borrowing and placement of fill material associated with beach nourishment operations must be considered. Such activities include evaluation of sediment from identified borrow sources for placement within the littoral zone throughout the study area. Sediment characteristics of concern are sediment grain size and color. Borrow sediments identified as suitable must match, as closely as possible, the sediment characteristics at the nourishment site. This information will been utilized in the preparation of the Section 404(b)(1) evaluation report and also in developing the management requirements to minimize impacts to threatened and/or endangered species under Section 7 of the Endangered Species Act.

Additional issues to be addressed include coordination with the U.S. Fish and Wildlife Service (USFWS) on six Coastal Barrier Resource System Units. The Coastal Barrier

Resources Act (CBRA) limits the expenditure of Federal funds in designated system units so that expenditure would not enhance future/further development of the area. The activities proposed within designated CBRA units will provide enhancement of fish and wildlife resources and habitats which may be allowable under CBRA. The MSFCMA identified habitats within the marine and estuarine areas of the U.S. that were essential to the management of certain specific fin and shellfish. Areas identified by the Gulf of Mexico Fishery Management Council as EFH include all the marine and estuarine areas of Walton County. Consultation with the National Marine Fisheries Service (NMFS) focused on activities to minimize impacts to EFH. Of particular concern has been avoidance or minimization of impacts or the enhancement of EFH. Coordination with the USFWS and NMFS concerning potential impacts to listed species is required and has been initiated for the tentatively selected plan. Efforts have been made to include actions that would benefit the recovery of listed species.

All Federal activities affecting any land, water use, or natural resources of the coastal zone shall be carried out in a manner which is consistent, to the maximum extent practicable, with the enforceable policies of the Florida coastal management program. In addition, water quality certification (WQC) from the State of Florida is required for all actions to be implemented. A WQC/CZC application has been submitted to the state to obtain the necessary certifications. The feasibility study of the critically eroded shoreline has been conducted and found consistent with State of Florida's beach management plan.

2.0 PROPOSED PROJECT DESCRIPTION

The Walton County upland cross section is defined by dune elevations ranging from +11.5 to +44.5 feet NAVD88 and a natural berm elevation of +5.5 feet NAVD88. The study region was divided into five study reaches based on structural development and state park areas as illustrated in Figure EA-2. The historical and 2004 beach surveys were used to develop 11 representative profiles which characterize the existing condition for the five study reaches. The representative profiles were identified based on similarity in shape of the upper beach profile (dune height and width, berm width, foreshore beach slope, and profile volume) and shape of the offshore profile. Because significant erosion occurred due to Hurricane Ivan in September 2004, the representative profiles were revised using the post-Ivan data to characterize the upper portion of the beach and to include the post-Ivan data in the submerged portion of the beach.

Modeling using a model called Beach-*fx* was used to simplify beach profiles representing a single trapezoidal dune, with a horizontal berm as shown in Figure EA-3. The submerged profile is represented by a series of points or an approximate functional representation. The beach variables which change with storms are dune width, dune height, berm width, and upland elevation. Constant values are upland elevation, dune slope, berm height, foreslope, and shape of the submerged profile. Thus in response to a given storm, the berm can be eroded or accreted; the dune height and/or width can change and translate landward or seaward.

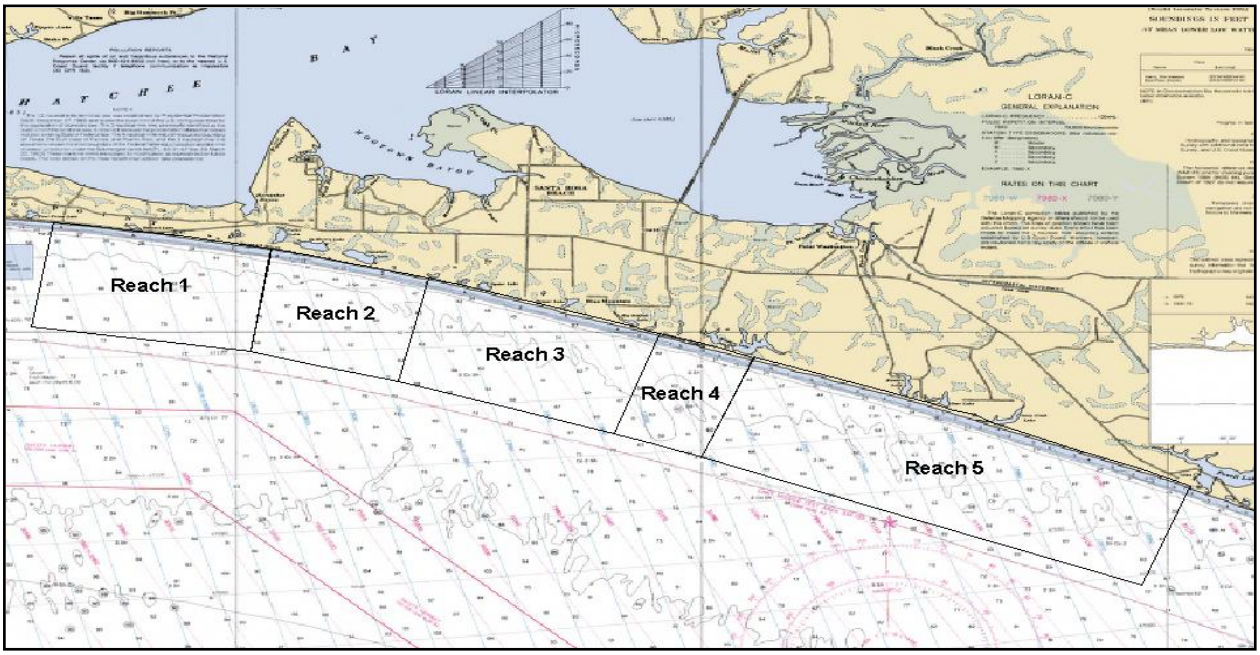

Figure EA-2. Location of the Five (5) Construction Reaches within the Project Area

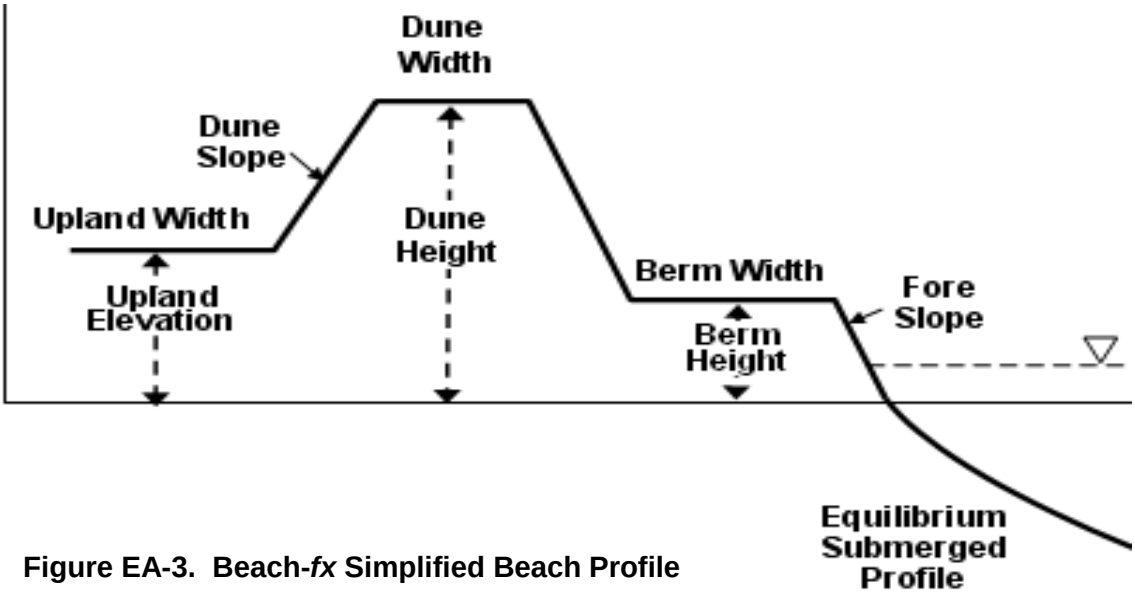

Figure EA-3. Beach-*fx* Simplified Beach Profile

Eleven simplified beach profiles were modified for various berm and dune configurations. Maximum dune and berm widths were determined based on volumes provided by the Federal Emergency Management Agency (FEMA) post-Hurricane Ivan emergency beach nourishment. Other modeling was conducted using the Storm-Induced Beach Change Model (SBEACH) to predict the response of each dune and berm configuration to the 552 storms developed for this study. Approximately 240,000 SBEACH simulations were conducted to develop the shoreline responses for the Beach-*fx* storm response database.

2.1 ALTERNATIVES

2.1.1 No Action. Walton County's shoreline is receding and its protective dunes and high bluffs are being adversely impacted by hurricane and coastal storm forces. The impacts of these storms to property and infrastructure have been considerable. Erosion is also having an impact on the environment due to decreased beach area and elevation. Such impact directly affects the availability of suitable nesting habitat required for nesting sea turtles and the areas needed by shorebirds to forage and rest. Damage to the previously established dune system destroyed much of the existing vegetation that provides stabilization. The absence of the dunes and associated vegetation eliminates much of the suitable habitat required to sustain beach mice populations and other wildlife that relies on these types of habitats for their continued survival.

Historical analysis conducted by Taylor Engineering (2003) indicates a stable or accreting shoreline in Walton County in the absence of severe storms. Their analyses looked at the Mean High Water (MHW) shoreline changes representing four time periods: the pre-Hurricane Opal intermediate-term (1973 – 1995), the post-Hurricane Opal short-term (1995 – 1998), the intermediate-term (1973 – 1998), and the long-term (1872 – 1998) periods. In summary, the MHW trends generally indicate accretion from 1872 to the early 1970's, possibly due to the effects of relocating and stabilizing East Pass in the western portion of Destin to west of Walton County. From the mid 1970's through the late 1980's, the MHW positions reveal a distinct erosional behavior attributed to Hurricane Eloise (1975), Frederic (1979), and Elena (1985). The study area did not experience any significant hurricanes until Hurricane Erin in July 1995. During this relatively quiescent hurricane period (almost 10 years), the MHW positions became accretional. Then from 1995 – 2000, the MHW position eroded throughout the entire county, most likely a result of back-to-back hurricanes (Hurricanes Opal, Earl, and Georges). During this period, overall shoreline measurements indicate an average 2.4 feet per year of erosion for Walton County resulting from storm activities. Most recent storm events occurring since 2000, notably Hurricanes Ivan, Dennis, and Katrina, indicate that this trend will continue without some form of storm damage protection measures.

Future conditions associated with not restoring the beach and dune system would result in the continued degradation of a valuable beach ecosystem and loss of these types of habitats and associated benefits. The already damaged habitats would remain particularly vulnerable to wave and storm activity that continually threaten and prevent the re-establishment of valuable natural resources. Opportunities would be lost to implement beach and dune restoration and re-vegetation for the critical areas in Walton County. Degradation of valuable dune and beach habitat including sea turtle nesting habitat, shorebird foraging and roosting areas, dune habitat that supports various flora and fauna, and general beach ecosystem functions would persist as the area continues to be vulnerable to even minor storm activity. A no-action scenario would not provide the much needed stability and sustainability that a healthy coastal environment could offer to the area.

2.1.2 Structural Measures

In addition to the fact that the use of coastal structures in this case would not be consistent with state policy for a shore-wide solution for Walton County and not considered as a permittable alternative by the state, it is believed that the use of hard structures would have a negative impact on listed species inhabiting the area.

It has been demonstrated that a loss of nesting habitat related to placement of coastal structures has had an impact on nesting sea turtles in Florida. Structures not only cause the loss of suitable nesting habitat, but can result in the disruption of coastal processes accelerating erosion and interrupting the natural shoreline migration. Because of the effects on sea turtle nesting habitat believed to be caused by coastal structures, the continued vulnerability of remaining nesting habitat to frequent or successive severe weather events, may impact ability of sea turtle populations to survive and recover. In response to periodic storms, the beach itself moves landward, construction or persistence of structures at their pre-storm locations can result in a major loss of nesting habitat. In addition, the presence of hard coastal structures may interfere with nesting turtle access to the beach, result in a change in beach profile and width (downdrift erosion, loss of sandy berms, and escarpment formation), trap hatchlings, and concentrate predatory fishes, resulting in higher probabilities of hatchling predation. The combination of habitat loss and nesting opportunities resulting from beachfront development and subsequent use of coastal structures such as seawalls, bulkheads, and groins is believed to be a threat to sea turtle survival and recovery and should be avoided were possible.

Coastal structures are known to have a similar affect on beach mouse habitat and various shorebirds known to exist along the project area. The use of seawalls, bulkheads, and groins disrupt the natural dune and beach building processes that are critical to the survival of endangered beach mouse populations and shorebirds. Because of the limited remaining habitat such structures could compromise the ability of certain populations to survive and recover. As with sea turtles, the combination of habitat loss to beachfront development and subsequent use of persistent coastal structures to stabilize the shorelines at their pre-storm locations has resulted in an increased threat to species survival and recovery. In order to preserve the survival and recovery of these species, it is recommended that the use of such coastal structures be avoided.

2.1.3 Beach Restoration Alternatives

A process was followed for initial screening of alternatives and resulted in the recommendation of a set of preliminary alternatives to further evaluate in feasibility. The design looked at both historical and current dune heights and dune widths and berm heights and berm widths over the study area as defined in each representative profile. In Reaches 1, 3, and 5 the dune height is preserved as a result of the emergency nourishment action. Because emergency nourishment is only applied to the dune, the erosion is most significant to the berm. It was then determined that the project alternatives for evaluation generally would vary the berm width in 50-, 75-, 100-, and 125-foot increments except in reach one profile one (R1P1) whose alternative berm

width was 25 feet smaller. The optimized section was found to be a 50-foot berm with a set dune height and width against the existing dune. Added dune width alternatives of 0, 10, 20 and 30 feet were run with the optimized berm width alternative of 25 feet (Optimized berm template of 50 feet, 25 berm width plus 25 feet of advanced nourishment). Table EA-1 above summarizes the optimum added dune width within the five construction reaches by representative profile. The necessary beach fill requirements have been shown to be 3,000,000 cubic yards (cy) and 3,350,000 cy. Renourishments will be on a 10-year cycle but the renourishment volumes will increase to approximately 2,000,000 cy.

Table EA-1. Optimum Added Dune Width – Representative Profile

Construction Reach	Representative Profile	Existing Dune Width	Optimum Added Dune Width
CR1	R1P1	55	+10
	R1P2	100	+30
CR2	R3P1	76	+10 & +30
	R3P2	45	+10
CR3	R4P1	50	+10
	R4P2	85	+10
CR4	R5P1	185	+10
	R5P2	65	+10
	R5P3	50	+10
CR5	R5P1	185	+10
	R5P2	65	+10
	R5P3	50	+10

2.1.4 Tentatively Selected Plan

The selected plan recommended for construction is the LPP identified in the feasibility report which consists of five of the construction reaches shown in Figure EA-2. Table EA-2 below specifies the length within each of the construction reaches. The project will be composed of a 50-foot berm width, a 25-foot berm and an additional 25 feet of advanced nourishment in all construction reaches. The project will also feature added dune width in all construction reaches of either 10 or 30 feet. The modeling efforts have predicted fill requirements of 2,400,000 cy. This plan extends the coverage area to the westernmost limits of the county where the NED Plan could not justify the coverage. The model assumes an annual erosion rate of 100,000 cy annually lost to the system, thereby creating a renourishment cycle every 10 years requiring 1,200,000 cy of placement; however, recent surveys have shown that the erosion during a period of non-storm event activity has produced an initial placement of 2,980,000 cy. If this condition can be extrapolated to the predicted construction timeframe of FY10 or FY11, then the necessary beach fill requirements will be 3,350,000 cy. Renourishments will still be on a 10-year cycle but the renourishment volumes will increase to approximately

2,000,000 cy. Approved borrow sources lie offshore within the State of Florida waters and are described below. The typical cross sections for the selected plan are illustrated in Figure EA-4. When dune construction is complete, the dune will be planted with at least three species of dune vegetation as described under Section 2.3.

Table EA-2. Walton County Construction Reaches For the Selected LPP Plan

Construction Reach	Beginning Model Reach	Ending Model Reach	Model Reach Length in Feet	Length in Miles	Construction Length with transitions	Length in Miles
1	R1-1	R1-24	25,002	4.7	26,002	4.9
2	R3-2	R3-23	22,980	4.4	23,980	4.5
3	R4-1	R4-6	6,101	1.2	7,101	1.3
4	R5-1	R5-21	21,688	4.1	22,688	4.3
5	R5-30	R5-51	22,319	4.2	23,319	4.4
Total LPP Length			**98,091**	**18.6**	**103,091**	**19.5**

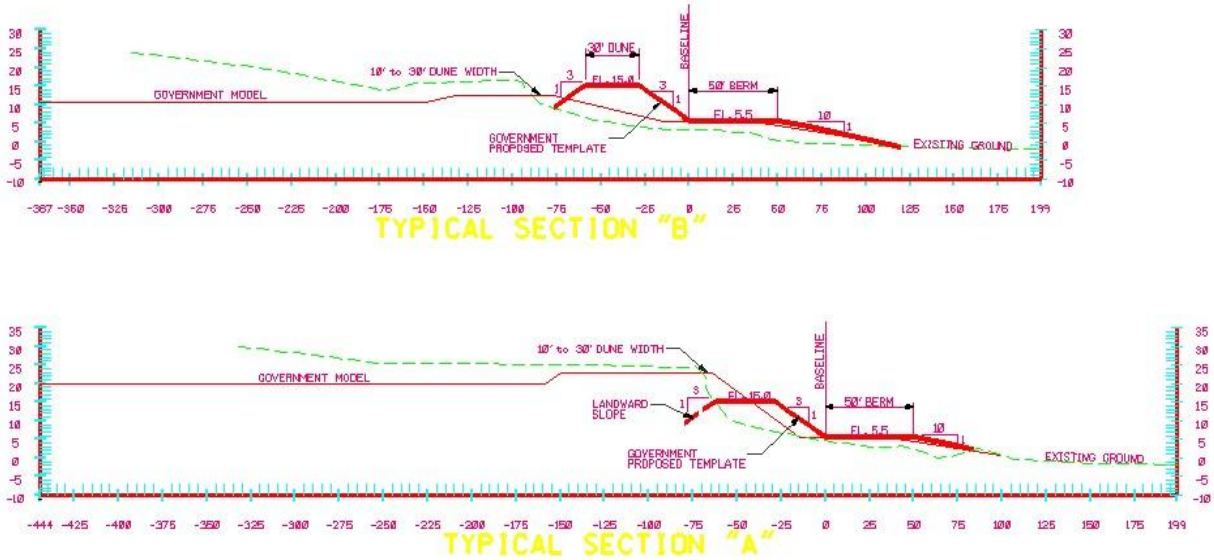

Figure EA-4. Selected Plan Typical Cross Sections to be Constructed

2.1.5 Local Plan

It should be recognized that the non-Federal sponsor proceeded with pursuing a beach restoration plan of their own. Their local project area lays the length of Walton County and composed of two separate segments. The first being a 6.9-mile reach at the western end of the county where an emergency nourishment action was conducted. The second segment is 13.5 miles continuing to the east, for a total length of 20.4 miles. The overall proposed local plan includes a berm design that on average exhibits a construction profile that has a 207-foot wide berm measured from the existing 9.5 feet NAVD contour with a10-foot wide dune crest. The proposed plan view and profiles totally encompasses the tentatively selected plan and uses the same borrow site. Subsequently, the County has already completed the process of applying for the state WQC/CZC. They have also completed coordination for threatened and endangered species as required by the Endangered Species Act (ESA), initiated coordination on EFH, completed cultural resources coordination, and prepared a draft EA. Because their initial efforts did not involve any Federal funding, the Coastal Barriers Resources Act (CBRA) did not apply. The non-Federal sponsor has requested that their efforts be considered as in-kind services toward their cost share requirement. For the Federal action, the U.S. Army Corps of Engineers, Mobile District (Corps) as the lead agency under NEPA is required to and has conducted independent environmental coordinations and consultations for the tentatively selected plan.

2.2 BORROW AREAS

Recent offshore studies to include geological and geophysical interpretation to identify a suitable offshore borrow area has been performed by Taylor Engineering, Inc. (2003) in the Walton County Destin Beach Management Feasibility Study Final Report under contract to the non-Federal sponsor, which initially concentrated on the East Pass area southwest of Destin and the eastern most end of Okaloosa County and the westernmost end of Walton County. Subsequent investigations looked at the entire coastline to assess locations with sufficient quantities for borrow development for the initial beach placement and future renourishments.

While initial prospective borrow sites appeared promising, additional geotechnical and geophysical work was conducted in these areas and further offshore and within the eastern end of Walton County to assess sources for the entire beach nourishment project. The initial data indicated pockets of viable sand bodies along the study site. The west flank of the study area in Okaloosa County has high quality sand associated with the eastern part of the Destin East Pass ebb-tide delta. Alternate sites that deserved additional reconnaissance were located offshore in approximately 65 to 70 feet of water.

A large scale reconnaissance level geophysical, lithological, and granulomteric (grain size) investigation was undertaken off Walton County, Florida. Sub-bottom profiles were used initially to locate prospective core locations to identify high quality sand sources for beach nourishment. Vibracores and selected seismic records were interpreted in an attempt to confirm the presence and quality of sand off Walton County. The borrow area investigation locations are shown in Figure EA-5.

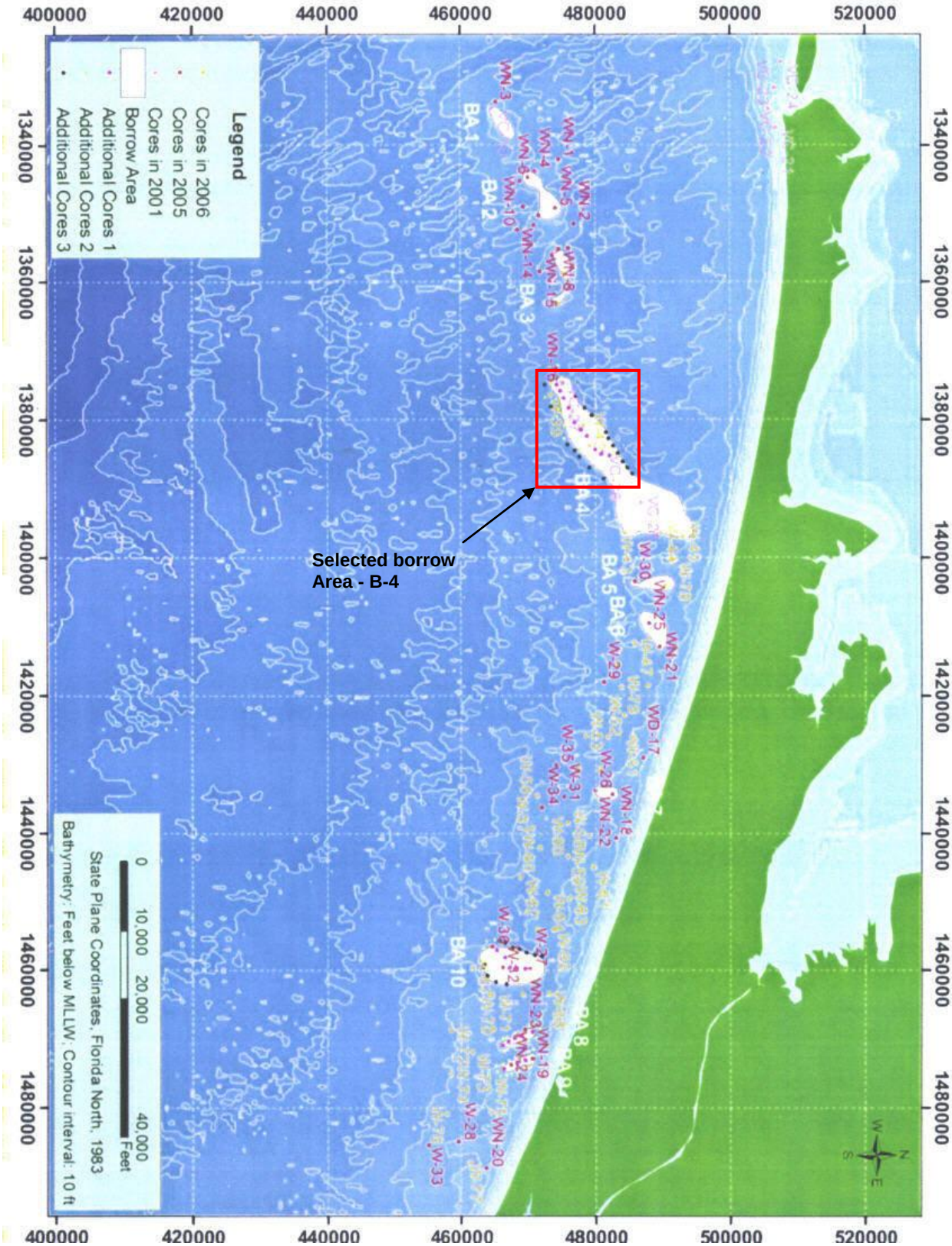

Figure EA-5. Borrow Area Investigation Locations and Selected Borrow Site

The proposed borrow area sediments are typically well sorted medium sand (1-2 phi). Monitoring of the borrow discharges will be a constant requirement for compliance with color and grain size criteria. Borrow area B-4 shown on Figure EA-5 is the most promising site with some 10,000,000 cy proven by these initial investigations. This volume covers the recommended locally preferred plan placement and the four planned subsequent renourishments for the next 50 years. The B-4 borrow area is centrally located and offers the best source for now and in the future. Based on the extensive geotechnical investigations, this borrow site has been demonstrated to be the most suitable source, has sand of color, size, and composition generally similar to that of the native beach. All materials used for beach nourishment will be excavated by hopper dredge, transported to the placement area offshore and pumped into the beach template. Small bulldozers will be used on land to shape the material to the prescribed template.

2.3 ENVIRONMENTAL RESTORATION OPPORTUNITIES

Coastal ecological resources throughout Walton County have consistently been diminished due to the high shoreline recession rates exhibited in this region. The result has been the loss of valuable habitat including sea turtle nesting habitat, shorebird foraging and roosting areas, dune habitat supporting various flora and fauna, and general beach ecosystem functions. Restoring a beach-dune system allows greater stability and sustainability of the coastal environment once it has become established. Restoring the beach habitat that supports a variety of associated flora and fauna contribute to the success and continual survival of several threatened or endangered species. The restoration effort will also contribute to the well-being of various other flora and fauna that naturally occur along the northern Gulf beaches.

There is currently little beach within the project area which reduces the capabilities of this area of supporting sea turtle nesting activities. By restoring berm width there will be increased opportunities towards protecting and enhancing sea turtle nesting opportunities. The enhanced berm creates additional habitat beneficial to a variety of shore birds as well as other inhabitants of the coastal environment. Wider beaches augment natural dune creation and maintenance, which will be beneficial for dune dwelling organisms and threatened and endangered species such as the Choctawhatchee beach mouse and the Gulf coast lupine.

The storm activities of recent years have left the fragile coastal dune lakes found throughout Walton County vulnerable to future damages and catastrophic breaching. The lakes support a variety of coastal wildlife with natural communities unique to this region. Coastal dune lakes are important breeding areas for insects and crustaceans. Many birds and mammals also utilize coastal dune lakes for food and habitat. Restoring a beach-dune system in the areas adjacent to the dune lake resources will provide for continued sustainability to the fragile ecosystems of the lakes.

When dune construction is complete, the dune will be planted with at least three species of dune vegetation. Sand dunes are dynamic coastal features, which are formed and maintained by the accumulation of wind-blown sand. The dune restoration activities will be designed to create a dune that matches the surrounding natural dune patterns in the

area. Upon reconstruction immediate steps will be taken to plant and stabilize the dune for rapid stabilization. This will be accomplished through the use of sand fences and dune plants. The dune plants will be planted to cover 60-80 percent of the total area. Plantings will occur across the entire dune on approximate two-foot spacing. The vegetation will consist of local dominant species that populate nearby natural dune systems. The selection of the dune vegetation will consist of species that are most widely used for dune restoration and are readily available from local nurseries and suppliers. The selection will be coordinated with local environmental experts familiar with dune ecosystems in the immediate area. Dune plant species being considered are:

- sea oats *(Uniola paniculata)*
- bitter panic grass *(Panicum ararum)*
- sea rocket *(Cakile constricta)*
- beach morning glory *(Ipomoea imperati)*
- railroad vine *(Ipmea pes-caprae)*
- blue stem *(Schizachyrium scoparium)*
- blanket flower *(Gaillardi pulchella)*

3.0 AFFECTED ENVIRONMENT

3.1 GENERAL ENVIRONMENTAL SETTING

Coastal Walton County consists of approximately 26 miles of both developed and undeveloped beach and dune systems including six miles of state parks and nine miles of state-designated critical eroding areas. The county's coastline also supports a number of coastal dune lakes considered rare worldwide and unique to the northern Gulf of Mexico the United States. The existing coastal resources within the study area range from natural pristine systems found within state park recreational areas to severely disturbed systems found within the more developed areas. The dune systems fronting developed areas range from little or no dune to larger relatively healthy dune systems. North of the county's coastal areas lies Choctawhatchee Bay. The ecosystem associated with Choctawhatchee Bay is typical of northern gulf coast estuaries including wetlands consistent with adjacent estuaries and submerged aquatic vegetation. It is not expected that the Bay will be affected by the proposed beach restoration and will not be considered further in this evaluation.

The area has been further characterized by a previous study conducted by Taylor Engineering, Inc. (2003), under contract to the non-Federal sponsor, as a coastal peninsula extending west from the mainland defining the western two-thirds of the coastline and mainland beaches characterizing the eastern third. Behind the county dune system, upland drainage feeds the coastal dune lakes that intermittently breach the dune system and discharge directly into the Gulf of Mexico. The area supports a variety of coastal wildlife with natural communities consistent with that of the northern Gulf of Mexico. The proposed beach restoration effort may potentially affect three beach zones which define the natural communities within the placement and borrow areas. These zones, addressed in this evaluation, are classified as coastal beach and dune, intertidal swash, and nearshore.

The study conducted by Taylor Engineering, Inc. (2003) evaluated the native beach characteristics of Walton County and found that the sand in the beach system was fairly uniform throughout the study area. The beach system sediments consist of medium-grained sand with minor amounts of carbonate material. A color analysis determined the Munsell color classification of the native beach sand. Generally, the native sand is described as white with slight variations in localized areas.

3.2 PHYSICAL CHARACTERISTICS

3.2.1 Tides. Taylor Engineering, Inc. (2003) determined single values for mean high water (MHW) and mean low water (MLW) representative of the entire project area by averaging the tidal datum elevations at several representative locations. The studies have determined that MHW is located at +0.65 ft NAVD and MLW at -0.62 ft NAVD in Walton County.

3.2.2 Waves. Waves provide important sediment transport mechanisms along the open coast of Walton County. Waves are primarily driven by local wind patterns, transport sand cross-shore (approximately north-south) and longshore (approximately east-west) within the subaqueous regions. Independent of wave direction, wave heights and periods of one foot and three seconds characterize the predominant waves, occurring nearly 30 percent of the time. Locally generated waves or sea conditions characterize these waves. Swell waves of higher wave height and wave period occur less frequently. On average, higher wave heights occur during the winter months and smaller wave heights occur during the summer months. Absolute maximum wave heights indicate that extreme wave heights, associated with hurricanes and tropical storms, can occur during the summer months.

3.2.3 Littoral Transport. Littoral transport analyses indicate primarily westerly net longshore transport along the project area. Net longshore transport rates, reaching 63,000 cubic yards per year (cy/yr) and 58,000 cy/yr reveal an accretive trend; however, Taylor Engineering, Inc. (2003) has shown that the Walton County beaches have had insufficient recovery times between storms resulting in the present unhealthy beach conditions.

3.2.4 Winds. Winds provide the primary wave-generating mechanism and directly transport sand on and off the dry beach. Winds blow from a wide variety of directions with the highest percentage of time (10.4 percent) from the east. Overall, winds blow less than 25 miles per hour (mph) 90 – 95 percent of the time (Taylor Engineering, Inc., 2003).

3.2.5 Aeolian (wind) Sand Transport. Aeolian transport can remove and redistribute sand within the littoral zone. Onshore winds can carry sand from the beach and deposit it behind dunes (essentially removing it from the littoral system) and offshore winds can carry sand into the ocean (redistributing it within the littoral system). Taylor Engineering, Inc. (2003) reports that onshore aeolian transport rates range from 0.1 – 2.2 cy/yr per linear foot of beach. These rates translate into approximately 6,300 cy/yr of sand lost from the littoral sediment via aeolian transport over the project area.

3.2.6 Native Beach Sediment. An average grain size, derived from 34 samples in the project area, of 0.26 millimeters (mm) characterizes the native beach sediments. The Unified Soils and Wentworth Classifications classify the Walton County beach sand as fine and medium-to-fine sand with less than one percent shell content.

3.2.7 Offshore Borrow Area Sediment. The proposed 1,558-acre borrow area consists of several cells with different excavation depths. Analysis of sediment data obtained from 51, 20-foot vibracores defined the horizontal and vertical boundaries which determined the limits of beach compatible sand according to color, composition, and grain size compared to the native beach sand. The average grain size and composition of the borrow area consists of sand 0.30 (mm) and classified as medium grained marine sand.

3.3 ENVIRONMENTAL CHARACTERISITICS

3.3.1 Beach and Dune Areas. A prominent feature characterizing portions of the Walton County shoreline is the high dune elevations. This is partly attributed to the presence of Pleistocene bluffs formed as a result of an exposed submarine berm formed during inundation of the Florida Panhandle during that period; however, natural dunes occur in isolated pockets with some of the dunes occurring at beachfront development. In some developed areas the dunes exhibit little relief and limited habitat value. In these areas, dune enhancements are common and typically contain planted vegetation such as sea oats (*Uniola paniculata*) to promote stabilization and growth. Some pioneer vegetation such as beach morning glory (*Ipomoea imperati*), railroad vine (*Ipomoea pes-caprae*), beach grass (*Ammophila breviligulata*) and sea rocket (*Cakile edentula*) have become established within the enhanced dune areas.

Topsail Hill Preserve State Park, Grayton Beach State Park, and Deer Lake State Park all feature relatively unaltered beach and dune ecosystems. In some instances the primary dune crests reach over 30 feet in height. Pioneer species including sea oats, beach morning glory, railroad vine, sea rocket, beach elder (*Iva imbricata*), camphor weed (*Heterotheca subaxillaris*), and bitter panicum (*Panicum amarum*) grow on the low primary dunes facing the ocean while Gulf bluestem (*Schizachyrium maritimum*), Cruise's golden aster (*Chrysopsis gossypina*), annual jointweed (*Polygonella articulata*), and the endangered Gulf coast lupine (*Lupinus westianus*) are found on the more stabilized dunes.

The natural dunes described above provide optimal habitat for the Choctawhatchee beach mouse throughout the primary and secondary dunes and occasionally scrub and interdunal areas. This nocturnal species feeds primarily on the seeds and fruits of dune vegetation such as bluestem, sea oats, and evening primrose (*Oenothera humifusa*). The decline of the populations results from five key factors: habitat loss and fragmentation primarily due to beachfront development, disease, predation, competition from exotic species, and loss of genetic diversity (USFWS, 1987).

The beaches (sub-aerial portions of the beaches above the water) are typical of beaches throughout the northern Gulf of Mexico. Beaches are a dynamic environment that changes drastically as a function of weather and wave conditions. The direction of the net longshore transport along this region is from east to west. The constantly

shifting sand does not allow vegetation to become established in the unconsolidated sandy substrate. The dynamic nature of the beach is generally a harsh unstable environment providing low animal and plant densities. The wildlife that does inhabit the beaches and dunes include sea turtles (for nesting), shorebirds (for foraging and resting), crustaceans such as ghost crabs (*Ocypode quadrata*), reptiles such as six-lined racerunners (*Cnemidophorus sexlineatus*), and various predators such as raccoons (*Procyon lotor*) and snakes. Beaches are important wintering areas for shorebirds such as sanderling (*Calidria alba*), dunlin (*Calidris alpine*), short and long-billed dowitchers (*Limnodromus griseus and Limnodromus scolopaceus)*), plovers (*Charadrius spp*. and *Pluvialis spp*.), and willet (*Catoptrophorus semipalmatus*). Beaches and dunes are also important nesting sites for birds including terns (*Sterna spp.*), black skimmer (*Rhynchops niger*), and plovers.

3.3.2 Intertidal/Swash Zone. The sandy substrate of the intertidal swash zone as defined by the Florida Natural Area Inventory (1990) defines the unconsolidated substrate community in this zone as expansive, relatively open areas of subtidal, intertidal, and supertidal zones which lack dense populations of sessile plant and animal species. This area of the beach provides habitat for benthic and infaunal communities characterized by low species diversity. Saloman and Naughton (1978 and 1984) investigated benthic macroinvertebrate assemblages inhabiting the swash zone at Panama City Beach, Florida. Sampling data showed four dominant species representing four families: *Donax texasianus*, a burrowing bivalve; *Scolelepis squamata*, a polychaete worm; *Haustorius sp*., an amphipod; and *Emerita talpoida*, an anomuran crab. The studies conducted by Saloman and Naughton (1984) concluded that benthic communities inhabiting the swash zone of Panama City Beach were typical of other sandy Gulf of Mexico beaches. Cutler and Mahadevan (1982) conducted a similar study with comparable results and also found the previous species dominant in the subtidal zone. Similar benthic communities in this zone should exist along the beaches of Walton County. This portion of the beach also provides foraging and resting habitat for numerous seabirds and shorebirds such as terns, gulls (*Larus spp.*), sandpipers (*Tringa*, *Calidris*, and *Actitis spp*.), plovers, skimmers, and oystercatchers (*Haematopus spp.*). Fish and invertebrates within the intertidal zone are the staple diet for these avian species.

3.3.3 Nearshore. As typical of the sandy panhandle coastline, the nearshore zone along Walton County consists of two distinct longshore sandbars. For Florida Panhandle shorelines, the first and second sandbars are typically located approximately 50 to 80 feet and 425 to 460 feet offshore (Wolfe et al., 1988). These sandbars and associated troughs provide habitat for a diverse benthic community. Saloman (1976) investigated benthic faunal populations inhabiting the nearshore zone off Panama City Beach, Florida. A variety of crabs, marine worms, clams, cumaceas, and sand hoppers dominate the nearshore zone. *Donax texasianus,* a burrowing bivalve*,* commonly occurred on both sandbars and troughs in between. Saloman and Naughton (1984) in a similar study found other dominant species found on the first offshore bar include *Haustorius sp*. (an amphipod), *Mancocuma sp*. (a cumacea), and *Scolelepis squamata* (a polychaete worm). Additional dominant species found on the second sandbar and adjacent landward trough includes the haustoriid amphipods *Acanthohaustorius n*. *sp*., *Protohaustorius n. sp*., and *Pseudohaustorius n. sp*. Dial Cordy and Associates Inc. (2002) found that mollusks and annelids predominant the

infaunal taxa up to 3.5 miles offshore of Pensacola Beach. Overall, mollusca and annelida represented a majority of the taxa in this region. The assumption that similar benthic communities exist in the nearshore marine zone off Walton County is reasonable. Many commercially, recreationally, and ecologically important fish species are known to inhabit the nearshore area of Florida's northern gulf coast. Table EA-3 lists abundant fish species likely to occur in the nearshore marine waters of Walton County.

Table EA-3. Common Nearshore Fish Species Found in Walton County

Common and Scientific Name	Common and Scientific Name
Bull shark *Carcharhinus leucas*	Bonnethead *Sphyrna tiburo*
Bluntnose stingray *Dasyatis sayi*	Ladyfish *Elops saurus*
Speckled worm eel *Myrophis punctatus*	Scaled sardine *Harengula pensacolae*
Striped anchovy *Anchoa hepsetus*	Bay anchovy *Anchoa mitchilli*
Dusky anchovy *Anchoa lyolepis*	Silver anchovy *Engraulis eurystole*
Scaled sardine *Harengula jaguana*	Sea catfish *Arius felis*
Gulf toadfish *Opsanus beta*	Halfbeak *Hyporhamphus unifasciatus*
Atlantic needlefish *Strongylura marina*	Redfin needlefish *Strongylura notata*
Sheepshead minnow *Cyprinodon variegates*	Longnose killifish *Fundulus grandis*
Roush silverside *Membras martinica*	Tidewater silverside *Menidia beryllina*
Gulf pipefish *Syngnathus scovelli*	Bluefish *Pomatomus saltatrix*
Cobia *Rachycentron canadum*	Northern sennet *Sphyraena borealis*
Crevalle jack *Caranx hippos*	Yellow jack *Caranx bartholomaei*
Atlantic bumper *Chloroscombrus chrysurus*	Leatherjacket *Oligoplites saurus*
Florida pompano *Trachinotus carolinus*	Spotfin mojarra *Eucinostomus argenteus*
Silver jenny *Eucinostomus gula*	Pigfish *Orthopristis chrysoptera*
Sheepshead *Archosargus probatocephalus*	Pinfish *Lagodon rhomboides*
Silver perch *Bairdiella chrysura*	Spotted seatrout *Cynoscion nebulosus*
Sand seatrout *Cynoscion arenarius*	Silver seatrout *Cynoscion nothus*
Spot *Leiostomus xanthurus*	Atlantic croaker *Micropogon undulates*
Southern kingfish *Menticirrhus americanus*	Gulf kingfish *Menticirrhus littoralis*
Minkfish *Menticirrhus focaliger*	Black drum *Pogonius cromis*
Atlantic spadefish *Chaetodipterus faber*	Striped mullet *Mugil cephalus*
White mullet *Mugil curema*	Atlantic threadfin *Polydactylus octonemus*
Southern stargazer *Astroscopus y-graecum*	Leopard searobin *Prionotus scitulus*
Spotted whiff *Citharichthys macrops*	Gulf flounder *Paralichthys albigutta*
Planehead filefish *Monacanthus ciliatus*	Striped burrfish *Chilomycterus schoepfi*
Permit *Trachinotus falcatus*	Lizardfish *Synodus foetens*
Bull shark *Carcharhinus leucas*	Bonnethead *Sphyrna tiburo*
Bluntnose stingray *Dasyatis sayi*	Ladyfish *Elops saurus*
Speckled worm eel *Myrophis punctatus*	Scaled sardine *Harengula pensacolae*
Striped anchovy *Anchoa hepsetus*	Bay anchovy *Anchoa mitchilli*
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Cobia *Rachycentron canadum*	Northern sennet *Sphyraena borealis*
Crevalle jack *Caranx hippos*	Yellow jack *Caranx bartholomaei*
Atlantic bumper *Chloroscombrus chrysurus*	Leatherjacket *Oligoplites saurus*
Florida pompano *Trachinotus carolinus*	Spotfin mojarra *Eucinostomus argenteus*
Silver jenny *Eucinostomus gula*	Pigfish *Orthopristis chrysoptera*
Sheepshead *Archosargus probatocephalus*	Pinfish *Lagodon rhomboides*
Silver perch *Bairdiella chrysura*	Spotted seatrout *Cynoscion nebulosus*
Sand seatrout *Cynoscion arenarius*	Silver seatrout *Cynoscion nothus*
Spot *Leiostomus xanthurus*	Atlantic croaker *Micropogon undulates*
Southern kingfish *Menticirrhus americanus*	Gulf kingfish *Menticirrhus littoralis*
Minkfish *Menticirrhus focaliger*	Black drum *Pogonius cromis*

3.3.4 Dune Lakes. An unusual attribute of the Walton County's coastal beach and dune community is the presence of coastal dune lakes. There are a number of dune lakes throughout the Walton County coast as shown in Figure EA-6. Coastal dune lakes are relatively small bodies of water that occur in coastal communities along the northern Gulf of Mexico. The lakes are typically separated from the Gulf by a barrier beach and dune system which may be intermittent with or without a meandering tidal outlet and example of which is shown in Figure EA-7. Some of the coastal dune lakes have dune systems 500 feet wide and ridges extending 10-30 feet high. The intermittent connection to the Gulf is what distinguishes these lakes as rare. The Florida Natural Areas Inventory designates the coastal dune lakes as "critically impaired in Florida because of extreme rarity."

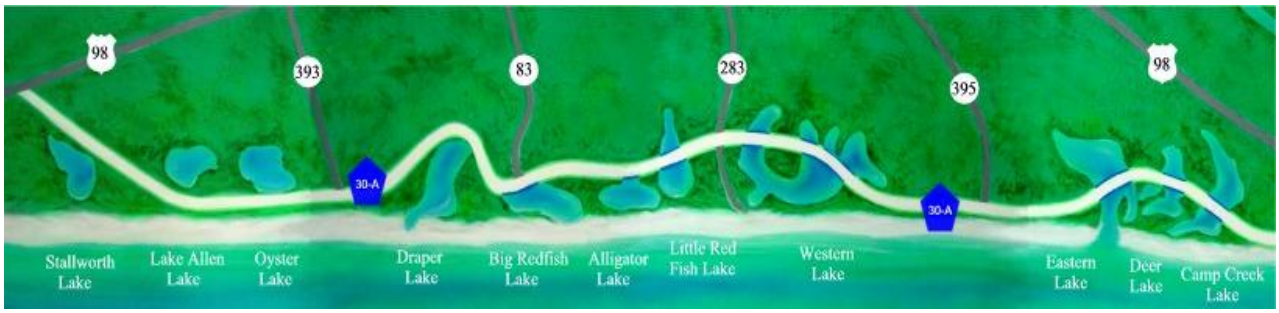

Figure EA-6. Approximate Locations of Coastal Dune Lakes throughout Walton County

Figure EA-7. Example of the Coastal Dune Lakes in Walton County

Coastal dune lakes are important breeding areas for insects and crustaceans. Many birds and mammals also utilize coastal dune lakes for food and habitat. The rapid rise of development in the South Walton area, including around the coastal dune lakes, raises the concern that nutrient runoff and sedimentation may impact the fragile ecosystems of the lakes. The lakes generally acquire water through lateral groundwater seepage and are shallow with depths typically around five feet. The most distinct characteristic of these lakes is their intermittent connection with the Gulf of Mexico. During periods of high water, caused by rainfall, runoff, groundwater seepage, or other inflow, water levels will sometimes reach a critical height causing a lake to "blow out" and connect with the gulf allowing for the exchange of fresh and salt water. The result is an unusual brackish environment that hosts a very diverse biological community.

Vegetation may be largely restricted to a narrow band along the shore, composed of various grasses and herbs or a dense shrub thicket, depending on fire frequency and/or water fluctuations. Shallow, gradually sloping shorelines may have much broader bands of emergent vegetation with submersed aquatic plants occasionally dominating much of the surface. Typical plants include rushes, sedges, marsh pennywort, cattail, sawgrass, water lilies, water shield, royal fern, marsh fleabane, marsh elder, salt myrtle, and black willow. Typical animals associated with this community include mosquitofish, sailfin molly, American alligator, mud turtle, saltmarsh snake, little blue heron, coot, and otter.

The substrate of the coastal dune lakes is primarily composed of sands with organic deposits increasing with water depth. Coastal dune Lakes characteristically have slightly acidic, hard water with high mineral content, predominately sodium and chloride. Salinity levels often vary greatly, depending on local rainfall and storms. Storms occasionally provide large inputs of salt water and salinities vary dramatically over the long-term.

3.3.5 Protected and Endangered Species. This section addresses listed species know to exist in the project areas. The presence of these species necessitates coordination with appropriate agencies as required by the ESA. Table EA-4 contains a more comprehensive list of State and Federal Protected Species in the Walton County area.

Florida's Panhandle beaches provide nesting grounds for federally listed (threatened and endangered) sea turtles. Sea turtle nesting season in this area spans from May 1 through October 31. The threatened Atlantic loggerhead turtle (*Caretta caretta*) and the endangered green turtle (*Chelonia mydas mydas*) frequently nest on the beaches of Walton County and Destin. The endangered leatherback (*Dermochelys coriacea*), Kemp's ridley (*Lepidochelys kempi*), and hawksbill (*Eretmochelys imbricata*) sea turtles may also occasionally nest on northwest Florida's beaches.

The swash and nearshore zone is host to the endangered Gulf sturgeon *(Acipenser oxyrinchus*) during certain times of the year and has been determined as sturgeon wintering feeding ground from the Yellow River, Choctawhatchee River, and Apalachicola River subpopulations. The project areas from the Mean High Water (MHW) line of the mainland shoreline extending seaward one nautical mile is designated as Gulf sturgeon critical habitat.

The Choctawhatchee beach mouse, a federally listed endangered species, inhabits the coastal dune communities along portions of the northern Gulf Coast. This endemic subspecies once had a historic range from East Pass in Okaloosa County to Shell Island in Bay County. Today, only three main populations exist in Topsail Hill Preserve State Park, Grayton Beach State Park in Walton County, and Shell Island in Bay County. The USFWS designated all three areas as critical habitat for the Choctawhatchee beach mouse. In Walton County, Topsail Hill Preserve State Park comprises about 200 acres of critical habitat along 2.7 miles of coastline. Critical habitat within Grayton Beach State Park consists of 67 acres along 1.7 miles of coastline.

Table EA-4. List of Protected Species in the Walton County Area

Common Name	*Scientific Name*	*State*	*Federal*
Fish			
Gulf Sturgeon	*Acipenser oxyrinchus desotoi*	SSC	T
Reptiles			
American alligator	*Alligator mississippiensis*	SSC	T (s/a)
Eastern indigo snake	*Drymarchon corais couperi*	T	T
Atlantic loggerhead turtle	*Caretta caretta*	T	T
leatherback turtle	*Dermochelys coriacea*	E	E
Kemp's ridley	*Lepidochelys kempi*	E	E
Green sea turtle	*Chelonia mydas mydas*	E	E
Hawksbill turtle	*Eretmochelys imbricata imbricata*	E	E
Birds			
Arctic peregrine falcon	*Falco peregrinus tundrius*	CE	CE
Wakulla seaside sparrow	*Ammodramus maritimus juncicolus*	SSC	n/a
bald eagle	*Haliaeetus leucocephalus*	**	**
brown pelican	*Pelecanus occidentalis*	SSC	n/a
least tern	*Sterna antillarum*	T	n/a
Southeastern American kestrel	*Falco sparverius paulus*	T	n/a
black skimmer	*Rynchops niger*	SSC	n/a
Southeastern snowy plover	*Charadrius alexandrinus tenuirostris*	T	n/a
snowy egret	*Egretta thula*	SSC	n/a
reddish egret	*Egretta rufescens*	SSC	SSC
tricolored heron	*Egretta tricolor*	SSC	n/a
little blue heron	*Egretta caerulea*	SSC	n/a
piping plover	*Charadrius melodus*	T	T
American oystercatcher	*Haematopus palliatus*	SSC	n/a
white ibis	*Eudocimus albus*	SSC	n/a
seaside sparrow	*Ammodramus maritimus*	SSC	n/a
grasshopper sparrow	*Ammodramous savannarum*	E	E
Florida sandhill crane	*Grus canadensis pratensis*	T	n/a
marsh wren	*Cistothorus palustris*	SSC	n/a
Mammals			
West Indian manatee	*Trichechus manatus floridanus*	E	E
Choctawhatchee beach mouse	*Peromyscus polionotus allophrys*	E	E
Plants			
Gulf coast lupine	*Lupinus westianus*	T	n/a

E = Endangered. T = Threatened. T (s/a) = Threatened due to similarity in appearance. SSC= Species of Special Concern. UR = Under review. CE = Consideration Encouraged, n/a = information not available or no designation listed.
** Protected under the Bald and Golden Eagle Protection Act.

The Florida Department of Environmental Protection (FDEP) manages these areas. The population at Grayton Beach State Park exists only as a result of a translocation program in cooperation with the Florida Fish and Wildlife Conservation Commission (FWCC) and the FDEP.

Several protected bird species use beach habitat for foraging, resting, or nesting. The black skimmer, least tern (*Sterna antillarum*), and southeastern snowy plover (*Charadrius alexandrinustenuirostris*) have all used portions of the beach within Walton County. In Florida, migratory bird nesting season spans from April 1 through August 31.

The piping plover (*Charadrius melodus*) nests well to the north, but winters in different areas of Florida including the gulf coast. The State of Florida designates the black skimmer as a species of special concern, and the southeastern snowy plover and least tern as threatened species. Both Federal and State entities consider the piping plover a threatened species.

The endangered Gulf coast lupine *(Lupinus westianus)* is a plant that inhabits the coastal dunes of Walton County. This species is specific to the coastal areas of the eastern and northern Gulf of Mexico. Coastal development and storm induced dune erosion has a direct impact towards sustaining suitable habitat for this species.

3.3.6 Essential Fish Habitat (EFH). EFH is defined as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity and include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include aquatic areas historically used by fish where appropriate. The near and offshore areas of the Walton County project reaches supports a variety of fish species, primarily small species and juveniles of larger fish species. EFH for many of these species occurs within the project area and include such species managed under the purview of the NMFS and identified in Table EA-5.

Table EA-5. Essential Fish Habitat for Managed Species within the Project Area

Species	Life Stage	Habitat
Brown Shrimp	Adult	Soft bottom; estuarine dependent
Cobia	Adult, juveniles/subadults, larvae, eggs	Pelagic; drifting or stationary floating objects
Dolphin (Mahi)	Adult, juveniles/subadults, larvae, eggs	Pelagic; floating objects
Greater Amberjack	Adult, juveniles/subadults, larvae, eggs	Pelagic and epibenthic; reefs and wrecks; to 400m
Gray Snapper	Adult	All bottom types; 0 to 130m
King Mackerel	Adult	Pelagic
Lesser Amberjack	Adult, juveniles/subadults, larvae, eggs	Pelagic
Lane Snapper	Adult, juveniles/subadults, larvae, eggs	Soft and hard bottom; 0 to 130m
Little Tunny	Adult, juveniles/subadults, larvae, eggs	Pelagic
Pink Shrimp	Adult	Soft, hard bottom; inshore to 65m
Brown Shrimp	Adults (year-round)	Year-round in water depth >14 m; soft bottom
Red Drum	Adult	Soft bottom, oyster reefs, estuarine to 40 m
Stone Crab	Adult	Soft, hard, or vegetated bottom
Spanish Mackerel	Adult, juveniles/subadults, larvae, eggs	Pelagic; inshore to 200 m
Tilefish	Adult	Soft bottom, steep slopes; 80 to 540m
White Shrimp	Adult juveniles/subadults, larvae, eggs	Soft bottom; inshore to 40m

The MSFCMA require that Federal agencies assess potential impacts to EFH for NMFS managed commercial fisheries. In accordance with the MSFCMA, any Federal action that has the potential to adversely affect EFH requires consultation with the NMFS. As defined by the MSFCMA, fish includes finfish, mollusks, crustaceans, and all other forms of marine animal and plant life. EFH communities range from naturally occurring hard-bottom areas and artificial reefs to floating mats of *Sargassum sp.* (brown- algae). Fish habitat utilized by a species can change with life history stage, abundance of the species and competition from other species, and environmental variability in time and space. The type of habitat available, its attributes, and its functions are important to species productivity and societal benefits. Some potential threats to habitat include certain fishing practices, marina construction, navigation projects, dredging, alteration of freshwater input into estuaries, and runoff.

3.4 WATER QUALITY

The FDEP classifies the coastal water in the project area as Class III, defined as waters suitable for recreation and propagation of fish and wildlife. The FDEP sets water quality standards and requires monitoring of water quality during sand excavation and beach placement operations. A water quality certification must be obtained for the activities with the borrow area and beach placement areas associated with this project.

3.5 SEDIMENT QUALITY

A compatibility analysis was conducted by Taylor Engineering, Inc. (2003). Borrow area and beach samples were taken to compare and provide a comparison between the beach and proposed borrow area. Walton County beaches as well as in the submerged active profile. The sediment characteristics of both the beach and borrow area are presented in sections 3.2.6 and 3.2.7 respectively. The proposed borrow area contains sediments that have been approved by the State of Florida as being similar and compatible to the existing beach sands in both grain size and color characteristics.

3.6 HAZARDOUS, TOXIC, AND RADIO ACTIVE WASTE

The project area lies primarily in residential and recreational areas. The Corps knows of no sources of hazardous, toxic and radioactive waste (HTRW) in the project area.

3.7 AIR QUALITY

The FDEP operates air quality monitors in various counties throughout the state (FDEP, 2003). Although there are no ambient monitors in Okaloosa County, there are monitors in neighboring Santa Rosa and Bay Counties. U.S. Environmental Protection Agency (EPA) has classified all counties within the state of Florida as “attainment” for criteria pollutants per FDEP. Non-point sources such as vehicular traffic exist within the area; however, air quality along the Walton County beaches is good due to the presence of either on or offshore breezes that readily disperse airborne pollutants. Walton County is classified as an attainment area for all Federal Air Quality Standards.

The Air Quality Index (AQI) is an index for reporting daily air quality. It tells you how clean or polluted your air is, and what associated health effects might be a concern for you. The AQI focuses on health effects you may experience within a few hours or days after breathing polluted air. EPA calculates the AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide, and nitrogen dioxide. For each of these pollutants, EPA has established national air quality standards to protect public health. Ground-level ozone and airborne particles are the two pollutants that pose the greatest threat to human health in this country. AQI ratings for the areas throughout the Florida Panhandle fall consistently within the highest quality rating of "good" for all the pollutants regulated by EPA.

3.8 NOISE

Noise is sound that interferes with normal activities or that otherwise diminishes the quality of the environment. It may be intermittent or continuous, steady or impulsive, stationary or transient. Stationary sources are normally related to specific land uses (for example, a factory). Transient noise sources move through the environment, either along relatively established paths (for example, highways and railroads), or randomly. There is wide diversity in responses to noise that not only vary according to the type of noise and the characteristics of the sound source, but also according to the sensitivity of the receptor (a person or animal), the time of day, and the distance between the noise source and the receptor.

Ambient noise levels in the project area are low to moderate. Because of the urbanization near the beaches and the popularity of the beach environment, elevated noise levels primarily from vehicles, may occur during weekends and summer months. The major noise producing source of the area year round is breaking surf adjacent to residential and resort areas.

3.9 AESTHETICS

The signature white sandy beaches and the relatively low wave energy of the Gulf of Mexico provide a visually-pleasing environment along the beaches of Walton County.

3.10 RECREATION

Locals and tourist spend much time sunbathing, sailing, fishing, walking and engaging in other active and passive activities near the beach. Beach usage peaks during the summer and subsides during the winter.

3.11 HISTORIC AND CULTURAL RESOURCES

The Walton County shoreline has been the site of numerous cultural resources investigations since the 1940s. Over forty (40) archaeological and historical sites are known to exist within one mile inland of the current beachfront with at least two of those sites considered potentially eligible or eligible for the National Register of Historic Places. Known archaeological sites suggest that humans have occupied the area as far back as 8500 BC, beginning with the Archaic period. The Walton County coast has been continually, although sparsely, inhabited up to the present.

In order to fully assess the study area for cultural resources that may be impacted by the proposed beach renourishment project, a more defined area of potential effect has to be established. The area of potential effect will primarily be defined by the property, both terrestrial and submerged, that is directly impacted by project activities including access roads, staging areas, borrow areas, and temporary dikes that might be constructed to contain sand. Once clearly defined, the Florida State Site Files and other appropriate background records were consulted regarding the locations of known archaeological sites within the impact area. Areas found to possess a medium or high potential for intact resources have been systematically investigated in a cultural resource survey. The locations of offshore impact areas have been investigated for the presence of submerged cultural resources through systematic remote sensing surveys.

In accordance with Section 106 of the National Historic Preservation Act and other relevant cultural resource laws, recommendations and actions have been coordinated with the Florida State Historic Preservation Officer (FLSHPO). Mobile District cultural resources staff has provided the appropriate narratives for the National Environmental Policy Act (NEPA) documentation summarizing the results of the cultural resources investigations and coordination. No significant cultural resources have been identified. More detailed information pertaining the cultural resources survey and Section 106 coordination is presented in Sections 4.17 and 5.6.

3.12 SOCIO-ECONOMIC CONSIDERATIONS

3.12.1 Demographics. Walton County is located in the State of Florida. Today the county incorporates 1,058 square miles the 2009 estimated population is 55,105 persons, a 35.7 percent increase over the base population estimate of 40,601 in 2000 making it one of the fastest growing counties in Florida. The estimated number of housing units in 2008 was 41,859 and 52 persons per square mile. The median household income was $43,779. Fourteen point nine percent (14.9%) of Walton's population was living below the poverty level. The median value of owner-occupied housing was $96,400. The makeup of the county in 2008 was estimated at 88.8 percent white, 7.6 percent African American 1.1 percent American Indian and Alaska Native, 0.7 percent Asian, 1.8 percent reported two or more races and there were 3.8 percent of Hispanic or Latino origin. Because the Gulf of Mexico borders Walton County to the south, the county, along with neighboring counties, comprise a total shoreline of over 200 miles of beaches.

3.12.2 Population. All five counties experienced population growth from 1980 to 2009. Combined the counties grew by about 91 percent, equaling the growth rate of Florida for that same time frame. Out of the five counties, Okaloosa County has the highest population, 178,473 and Gulf County the lowest 15,755. Most the growth took place in Santa Rosa and Walton Counties. Santa Rosa County led in growth from 1980 to 2009 by increasing over 171 percent followed by Walton County growth of 159 percent.

3.12.3 Employment. The number of persons in the labor force increase for all counties from 1990 to 2000. Total civilian labor force for the five counties out grew Florida civilian labor force in percentage terms. With an increase of over 42 percent, Santa Rosa County saw the biggest increase in the number of civil persons in

the labor force; however, despite out growing Florida civilian labor force, in 2000, the counties had a higher unemployment rate than Florida. Gulf County had highest rate of unemployment at 7.3 percent, while Walton County had the lowest at 3.2 percent.

3.12.4 Industry Employment. Selected employment characteristics by place of work for the state and counties for 2007 are shown in Table B-3 of the Economic Appendix in the main report. Florida had 10,679,883 non-farm workers employed in 2007. The Finance and Service trade industry leads all industries by having 6,080,653 workers within the state. Similarly, the greatest numbers of non-farm workers for the five counties combined are employed in the Finance and Service trade industry also. Okaloosa County had the highest numbers of non-farm workers employed with 130,560 and Gulf County with least amount with 6,118 non-farm workers employed.

3.12.5 Households. All five counties experienced a significant increase in the number of households from 1990 to 2000. With increases of over 46 percent, Santa Rosa and Walton Counties had the greatest growth in the number of households. Of the five counties, Okaloosa led with 66,269 households in 2000. The median household income also increased from 1989 to 2007 for the five counties. Of the five counties, Okaloosa County had the highest median household income in 2008, but Walton County had the greatest percentage increase from 1989 to 2008, 105.6 percent. The median household income for Santa Rosa and Okaloosa Counties both were higher than that of the State of Florida in 2008.

3.12.6 Per Capita Income. In 2007, Okaloosa had the highest per capita income out of the five counties and, except for Okaloosa, the remaining counties had a lower per capita income compared to the State of Florida. Florida per capita income was $38,417 in 2007 and Okaloosa County per capita income was $39,158 for that same year. Gulf and Walton Counties had higher percentages of persons living below the poverty level when compared to the State of Florida.

3.12.7 Transportation and Utilities. Walton County is services by one Federal interstate, I-10, and three U.S. highways; US90, US98 and US331 and four state highways; SR-20, SR81, SR83 and SR-85. One railroad provides rail service, the CSX Main Line. The nearest airport with scheduled commercial airline service is in neighboring Okaloosa Regional Airport. A general aviation airport is located at the DeFuniak Springs Municipal Airport. The local deep water port is 45 miles to the east in neighboring Bay County, the Panama City Port Authority.

There are two natural gas companies providing service, City of DeFuniak Springs and Okaloosa County Gas District. One telephone company, Sprint, provides residential and business services. Five water and sewer companies, City of DeFuniak Springs, City of Freeport, Regional Utilities, South Walton Utilities and Mossy Head Water Works compete in the area.

There are five elementary and five secondary public schools with a current enrollment of 6,522 students served by 323 educators for the county. Okaloosa-Walton Community College and the Walton County Vocational Technical School provide for education beyond the secondary level.

Walton County has three local radio stations two locally printed newspapers 12 banks, three credit unions and two hospitals, Health Mark Regional Medical Center and Sacred Heart Hospital on the Emerald Coast.

4.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

4.1 NO ACTION

In general, future conditions associated with not restoring the beach and dune system would result in the continued degradation of a valuable beach ecosystem and loss of these types of habitats and associated benefits. The already damaged habitats would remain particularly vulnerable to wave and storm activity that continually threaten and prevent the re-establishment of valuable natural resources. Opportunities would be lost to implement beach and dune restoration and re-vegetation for the critical areas in Walton County. Degradation of valuable dune and beach habitat including sea turtle nesting habitat, shorebird foraging and roosting areas, dune habitat that supports various flora and fauna, and general beach ecosystem functions would persist as the area continues to be vulnerable to even minor storm activity. A no-action scenario would not provide the much needed stability and sustainability that a healthy coastal environment could offer to the area.

4.2 BEACH RESOURCES

The proposed work would create disturbance to fauna species; such as crabs and shorebirds utilizing the terrestrial habitats within the project limits. This would mainly involve short-term disturbance from equipment, vehicles and personnel movements for the duration of work; however, these species are mobile and would generally avoid the site during construction. Some loss of beach flora may occur during nourishment; however this is expected to be minimal. Based on previous coordination with the State and USFWS, a number of conservation measures associated with the protection of shorebirds will be incorporated into the project. These include: shorebird and shorebird nesting surveys for construction work conducted between February and September and buffer zones around identified shorebird courtship or nesting behavior within the project area.

Placement of material within the intertidal/swash and nearshore zones would result in significant mortality of non-motile benthic organisms; however, these organisms typically adapt well to the dynamic coastal environment. With their high fecundity and recruitment potential, it is believed that they will repopulate the affected areas in a relative short time. Several past studies have shown no significant long-term effects on benthic communities from beach restoration. Saloman and Naughton (1984) studied the effect of beach restoration with offshore excavated sand on the nearshore macorinfauana at Panama City Beach, Florida. They concluded that restoration had minor, short-term effects on benthic macroinvertebrates, noting that populations appeared to stabilize within five to six weeks after restoration. As noted in previous studies, intertidal benthic assemblages declined in abundance and diversity immediately following restoration, but recovered within several weeks.

The material to be utilized during restoration of the beach meets the criteria set forth in 20 CFR 230.60(b). The material is characterized as clean sand which is sufficiently removed from sources of pollution and is located in areas of high current velocities to provide reasonable assurance that the placement areas would not be contaminated by such pollution. In addition, the material originates in the near vicinity of the placement activity and is similar to the substrate of the placement site, and receives the same overlying waters as the placement site.

4.2.1 No Action. Future conditions associated with not restoring the beach and dune system would result in the continued degradation of a valuable beach ecosystem and loss of these types of habitats and associated benefits. The already damaged beach and dune system would remain particularly vulnerable to wave and storm activity that continually threaten and prevent the re-establishment of valuable natural resources. A no-action scenario would not provide the much needed stability and sustainability that a healthy coastal environment could offer to the area.

4.3 OFFSHORE RESOURCES (Borrow Site)

Offshore equipment employed for borrow area excavation typically consists of a hopper dredge and possibly pipelines, equipment barges, marker buoys, and small tugs. Dredging would temporarily affect water quality by increasing local turbidity levels around the dredging sites. Increased water column turbidity during sand excavation would be temporary and localized. The spatial extent of elevated turbidity is expected to be within 1,000 meters of the operation, with turbidity levels returning to ambient conditions within a few hours after completion of the dredging activities. Therefore, no significant long-term impacts to water quality are expected to occur. Elevated turbidity levels resulting from construction should not have a significant negative effect on organisms inhabiting the area.

Given the naturally dynamic waters of the Gulf of Mexico coast, organisms inhabiting the offshore areas adapt well to reasonable environmental changes such as moderate increases in turbidity. Fish and other mobile species may temporarily leave the dredging site if turbidity becomes too great. Dredging activities would result in significant mortality of non-motile benthic organisms. No significant impacts to managed species of finfish or shellfish populations are anticipated from the borrow area excavation operations.

4.3.1 No Action. The future conditions resulting by not constructing this project would result in no impact to the offshore borrow areas and associated resources.

4.4 COASTAL DUNE LAKES

These lakes are positioned behind the dune systems throughout the county. Upland drainage feeds the coastal dune lakes that intermittently breach the dune system and discharge directly into the Gulf of Mexico. Their characteristic and sustenance is dependent upon the periodic breaching process. The lakes support a variety of coastal wildlife with natural communities unique to this region. Engineering design for the shoreline restoration must be cognizant of the dune lake processes. Breaching conditions are dependent upon fronting beach elevation rather than beach width. Any

berm and dune placement in the vicinity of the lakes must be conducted in a manner that will preserve the intermittent breaching processes. Beach placement design will be such as to not increase berm elevations in the immediate vicinity of the dune lake outfalls.

To avoid impacts to the natural dune lake breaching process, construction of the tentatively selected plan does not include placement of dunes or berm in front of the coastal lake outfalls. The proposed beach fill design for the selected plan discussed in Section 2.1.4 includes maintaining the natural berm elevations and providing a 100-foot buffer east and west of the existing outfall channel banks with a fill shall slope 1V:15H from the design elevations of the construction template to the existing grade at the buffer zone locations. This same design criterion for avoiding impacts to the lake outfalls was also proposed by the non-Federal sponsor during their independent coordinations and was determined as acceptable by the FDEP and other supporting agencies and therefore will be adopted for the tentatively selected plan and will be included in Federal JCP permit application. This avoidance criterion has also been included in the Federal coordinations and consultations with the other support agencies.

4.4.1 No Action. Future conditions associated with not restoring the beach and dune system would result in the continued degradation and protection that these resources provide to the dune lakes. By not providing such protection, the already damaged habitats allow the dune lakes to be particularly vulnerable to wave and storm activity that continually threaten these resources. A no-action scenario would not provide the much needed stability and sustainability that a healthy coastal environment could offer to the area.

4.5 SEDIMENT COMPATIBILITY

Shoreline storm protection and restoration activities that artificially place sand on the beach from remote sources must use sand similar to the native beach sand in order to preserve the beach's natural characteristics to the maximum extent practicable. The physical characteristics of the borrowed material including mineral composition, grain size, and color must be matched as closely as possible with the native beach sand. Geotechnical investigations have been conducted to identify and select a suitable borrow site that contains the necessary volumes and exhibit the required characteristics of the Walton County beach systems. Analysis of native beach sand samples were used to determine the grain size distributions, composition, and compaction characteristics at representative locations. Such beach sand characteristics have been identified as important turtle-nesting parameters.

The geotechnical investigations also involve a two-phased sand source investigation, which explored the offshore sediments and identified the borrow area for use by both the local and tentatively selected plans. The first phase, reconnaissance level, searched three areas that included region-wide offshore areas, an offshore sand ridge, and a potential source in a nearby ebb tidal shoal. The results of these investigations were used to define selected borrow areas for the Walton County beach restoration activities.

Compatibility of the sand is expressed quantitatively in terms of size and composition of the borrow area sediments with the native beach sediments in terms of an adjustment or overfill factor which is defined as the volume of material required to produce a unit volume of stable beach with the same grain size distribution as the native beach. The method developed by Dean (2002), which applies the concept of equilibrium beach profiles, computed an overfill ratio of 1.0. The overfill ratio between the borrowed and beach sand indicates that the borrow material and the native beach have very similar characteristics in composition and mean grain size, which is about 0.30 mm (Taylor Engineering, Inc., 2003). Because the same borrow site investigated for the local plan is being used for the tentatively selected plan and placement areas are essentially the same, this analysis directly applies and has been used for the compatibility determination for the tentatively selected plan and will be included in the Federal JCP application package.

As discussed in Section 4.2, the material to be utilized during restoration of the beach meets the criteria set forth in 40 CFR 230.60(b) as clean sand which is sufficiently removed from sources of pollution and is located in areas of high current velocities to provide reasonable assurance that the material would not be contaminated by such pollution. Hence, no further physical, biological, or chemical testing is required pursuant to the 404(b)(1) Guidelines. Based on the information presented, no mitigation requirements have been identified. More specific details pertaining to sediment quality is included in the 404(b)(1) Evaluation Report included in EA-APPENDIX A.

It must be considered that any proposed borrow areas located within the outer continental shelf (i.e., 3 miles offshore) will require authorization from the Department of Interior, Minerals Management Service (MMS); however, no borrow areas are being considered that fall under MMS jurisdiction. Results of the geotechnical investigations are presented in Appendix A, Engineering Design, Section 2, Geotechnical Considerations.

4.5.1 No Action. The future conditions resulting by not constructing this project would result in no impact to the native beach sediment that currently exists on Walton County's beaches.

4.6 THREATENED AND ENDANGERED SPECIES

Coordination with the USFWS has been initiated in accordance with the ESA. Species of concern within the project area include sea turtles, Gulf sturgeon, Florida manatee, Choctawhatchee beach mouse, and Piping plover (as well as other avian species).

As mentioned earlier in Section 2.1.5 the non-Federal sponsor for this project has proceeded with pursuing beach restoration on their own with a local plan that totally envelopes the tentatively selected plan. Subsequently, the non-Federal sponsor has already completed the processes of coordinating for threatened and endangered species. As a result of their formal consultation, a biological opinion (BO) has been issued from the USFWS in accordance with Section 7 of the ESA for their local plan. The determination and conditions specified in the BO are consistent with and typical of other beach restoration projects in the area. This existing BO for the local plan has made the following determinations that the proposed local plan is not likely to:

- jeopardize the continued existence of sea turtle
- jeopardize the continued existence of the Choctawhatchee beach mouse
- destroy or adversely modify Choctawhatchee beach mouse critical habitat
- jeopardize the continued existence of non-breeding piping plover

The non-Federal sponsor also completed formal Section 7 consultation with the NMFS and has received a letter of concurrence which states that the proposed local plan:

- Should observe and adhere to the terms and conditions of the RBO for hopper dredging
- Is not likely to adversely affect sea turtles and Gulf sturgeon
- Is not likely to adversely affect modify Gulf sturgeon critical habitat
- In not likely to adversely affect any other listed species under the NMFS purview

Although the coordination efforts already conducted by the sponsor for the local plan, the Corps has, in addition and independently conducted formal Section 7 consultation with the USFWS and NMFS for the tentatively selected plan. Biological assessments (BA) have been prepared addressing the potential impacts to the listed species and/or critical habitats within the tentatively selected plan. It is expected that the same activities will be required to avoid or minimize impacts to these species or where possible to provide activities that may enhance the species continued survival or critical habitat.

In response to BA's submitted to the USFWS and NMFS, both agencies have determined that the actions associated with this project are covered under existing regional programmatic biological opinions. With construction of the project likely being conducted using hopper dredging equipment and/or hydraulic pipeline equipment the dredging activities at the offshore borrow site has already been analyzed and coordinated under the November 19, 2003 Regional Biological Opinion (RBO) entitled "Dredging of the Gulf of Mexico Navigation Channels and Sand Mining Areas Using Hopper Dredges (Consultation Number F/SER/2000/01287). The activities associated with placement of the sand on the Walton County beaches have been analyzed and coordinated under the August 2011 Statewide Programmatic Biological Opinion for Shoreline Protection Activities along the Coast of Florida. This PBO, however, due to issues that could not be resolved, does not include a determination for the piping plover and Choctawhatchee beach mouse which will require separate coordination. Dredging and placement activities associated with the tentatively selected plan will be conducted in accordance with these biological opinions.

In addition to the formal ESA consultations being conducted, the Fish and Wildlife Coordination Act (FWCA) requires that Federal agencies consult with the USFWS with regarding fish and wildlife resources in the project area. Such coordination will result in a Fish and Wildlife Coordination Act Report. This consultation has been completed for the tentatively selected plan.

4.6.1 Sea Turtles. The effects of beach disposal and impacts on nesting sea turtles has been extensively documented and indicate that, in nesting success rates may decrease the year following beach placement as a result of escarpments, altered

beach profiles, and sand compaction. All efforts will be made to conduct the proposed dredging and placement activities outside of the sea turtle nesting window. Additionally, the conservation measures and recommendations specified in the RBO for Dredging of Gulf of Mexico Navigation Channels and Sand Mining Areas Using Hopper Dredges and PBO for Shoreline Protection Activities along the State of Florida will be followed to the maximum extent practicable; however, it is inevitable that some of the placed sand will remain on the beach during subsequent nesting seasons. Given these considerations it is determined that the proposed action may adversely affect sea turtles and the PBO for sand placement on Florida beaches or other resulting BO's will be observed for the tentatively selected plan.

4.6.1.1 No Action. The future conditions associated with not restoring the beach and dune system would result in the continued degradation of a valuable beach ecosystem and loss sea turtle nesting habitat. The already damaged habitats would remain particularly vulnerable to wave and storm activity that continually threaten and prevent the re-establishment of valuable natural resources critical towards maintaining sea turtle nesting areas. Degradation of valuable dune and beach habitat including sea turtle nesting habitat would persist as the area continues to be vulnerable to even minor storm activity.

4.6.2 Gulf Sturgeon. Effects to Gulf sturgeon resulting from the proposed dredging and disposal activities would be confined to direct impacts associated with the dredge equipment at the offshore borrow site. Effects resulting from the use of hopper dredges were considered in the RBO. Mobile District will abide by the reasonable and prudent measures set forth in that opinion. No effects to Gulf sturgeon are anticipated with the use of a hydraulic cutter-head dredge, as they are not known to impact Gulf sturgeon By email dated March 1, 2010, the NMFS has indicated that the Walton County Federal project would not result in additional impacts already. The PBO for Shoreline Protection Measures along the State of Florida or other resulting BO's will be observed for the tentatively selected plan coordinated for the non-Federal sponsor.

4.6.2.1 No Action. The future conditions resulting by not constructing this project would result in no impact to the Gulf sturgeon that may utilize the area.

4.6.3 West Indian Manatee. Manatees may be occasionally found in the shallow waters of the project area during the warmer months of the year. Given their slow-moving and low visibility nature, it is possible that manatees could wander into close proximity of the dredging and placement operations. To minimize contact and potential injury to manatees, the Manatee Construction Conservation Measures as specified by the USFWS will be strictly observed. In addition, there will be NMFS approved observers on board all hopper dredge operations. The PBO or other resulting BO's will be observed for the tentatively selected plan.

4.6.3.1 No Action. The future conditions resulting by not constructing this project would result in no impact to the West Indian Manatee that may utilize the project area.

4.6.4 Piping Plover. The beach placement proposed during this action may actually enhance beach habitat and even potentially restore lost habitat in the long term; however, short-term impacts to foraging and roosting habitat may occur during beach construction operations. Since piping plovers do not nest in Florida, construction activities will not impact breeding and nesting activities. Wintering habitat for roosting and foraging may be impacted; however, project construction limits will avoid areas designated as critical habitat area to the maximum extent practicable. Direct short-term foraging habitat losses may occur during the placement of sediment on the beach and associated construction operations. Since only a small portion of the foraging habitat is directly affected at and around the discharge site, adjacent habitat is still available and the overall direct loss of foraging habitat will be minimal and short-term; however, the placement of sediment on the beach may temporarily impact foraging, sheltering, and roosting habitat. The terms and conditions resulting from formal consultation for the tentatively selected plan will be observed.

4.6.4.1 No Action. Future conditions associated with not restoring the beach and dune system would result in the continued degradation of a valuable beach ecosystem and loss of habitats utilized by shorebirds such as the piping plover. The already damaged habitats would remain particularly vulnerable to wave and storm activity that continually threaten and prevent the re-establishment of valuable natural resources. Degradation of valuable dune and beach habitat including shorebird foraging and roosting areas and general beach ecosystem functions would persist as the area continues to be vulnerable to even minor storm activity.

4.6.5 Choctawhatchee Beach Mouse. Direct beach placement of compatible sand may enhance existing habitat or establish new habitat for beach mice. Recent hurricane activity has eroded a significant portion of the primary dune and bluff systems throughout Walton County. It is not known at this time where dune vegetation is beginning to re-establish itself prior to construction of the project. With these considerations in mind and the uncertainties associated with the direct beach and dune placement there may be some impacts to the Choctawhatchee beach mouse during project construction. The terms and conditions resulting from formal consultation for the tentatively selected plan will be observed.

4.6.5.1 No Action. Future conditions associated with not restoring the beach and dune system would result in the continued degradation of a valuable beach ecosystem and loss of habitats utilized by the Choctawhatchee beach mouse. The already damaged habitats would remain particularly vulnerable to wave and storm activity that continually threaten and prevent the re-establishment of valuable natural resources. Degradation of valuable dune and beach habitat including the habitat valuable towards the continued existence of the beach mouse and general beach ecosystem functions would persist as the area continues to be vulnerable to even minor storm activity.

4.7 CRITICAL HABITATS

4.7.1 Gulf Sturgeon. The proposed beach restoration area falls within the designated Gulf sturgeon Florida Nearshore Gulf of Mexico critical habitat. This area falls under the jurisdiction of the NMFS. Consultation with NMFS regarding the

effects of the proposed action on Gulf sturgeon and subsequent potential modification to Gulf sturgeon critical habitat has been initiated for the tentatively selected plan. Direct placement of beach material will increase shoreline width and extend into the critical habitat area. The increased width is intended to restore the shoreline position to pre-hurricane positions and believed not to have an effect on critical habitat areas. The PBO for sand placement on Florida beaches or other resulting BO's will be observed for the tentatively selected plan. By email dated March 1, 2010, the NMFS has indicated that the Walton County Federal project would not result in additional impacts already coordinated for the non-Federal sponsor.

4.7.1.1 No Action. The future conditions resulting by not constructing this project would result in no impact to the critical habitat areas utilizes by the Gulf sturgeon.

4.7.2 Choctawhatchee Beach Mouse. The direct dune and beach placement is adjacent to designated critical habitat for the Choctawhatchee beach mouse. The placement of sediment directly on the beach and seaward of the toe of the existing primary dune line would not generally impact existing habitat. Pipeline routes for beach construction will typically avoid identified primary constituent elements for critical habitat. Considering that much of the mature coastal barrier sand dunes and scrub dune habitat on the Gulf and Atlantic Coasts of Florida have been lost and populations of beach mice have declined as a result, the development of new habitat or enhancement of existing habitat is beneficial to the recovery goals of beach mice. Dune restoration activities allows for the availability of materials for the natural formation and growth of primary and secondary dunes. Such processes would help in the development of new beach mouse habitat and may aid in the enhancement and expansion of existing populations by stabilizing and enhancing existing dune communities with available sand and associated aeolian transport processes. This in turn promotes natural recruitment of native dune vegetation that contributes to the primary constituent elements for critical habitat by providing food resources for beach mice. Consultation with USFWS regarding the effects of the tentatively selected plan on Choctawhatchee beach mouse critical habitat has been initiated. The terms and conditions resulting from formal consultation for the tentatively selected plan will be observed.

4.7.2.1 No Action. Future conditions associated with not restoring the beach and dune system would result in the continued degradation of a valuable beach ecosystem and loss of critical habitat utilized by the Choctawhatchee beach mouse. The already damaged habitat would remain particularly vulnerable to wave and storm activity that continually threaten and prevent the re-establishment of valuable natural resources. Degradation of valuable dune and beach habitat including the habitat valuable towards the continued existence of the beach mouse and general beach ecosystem functions would persist as the area continues to be vulnerable to even minor storm activity.

4.8 ESSENTIAL FISH HABITAT

As discussed in Section 3.3.6, the proposed borrow and placement areas serve as habitat various species identified in Table EA-3. It is believed that the proposed action

will not fill or destroy habitat considered necessary to sustain these species. Coordination with the NMFS, Habitat Conservation Division in accordance with the MSFCMA has been completed involving the dredging and placement activities for the tentatively selected plan. Activities have been undertaken to assure that plans identified for this study are not in conflict with existing Federal fishery management plans or do not result in unacceptable impacts to the habitats of managed species.

As discussed in Sections 3.3.2 and 3.3.3, the intertidal swash zone and nearshore areas along the northern Gulf of Mexico is defined by the Florida Natural Area Inventory (1990) as consisting of expansive unconsolidated substrate which lack dense populations characterized by sea grasses, oyster reefs, coral reefs, or other hard-bottom structures. This area of the beach provides habitat for benthic and infaunal communities characterized by low species diversity. The studies by Cutler and Mahadevan (1982), Saloman and Naughton (1984), and Dial Cordy and Associates Inc. (2002) concluded that benthic communities inhabiting the swash and nearshore zones of Panama City Beach and Pensacola Beach were typical of the sandy panhandle Gulf of Mexico coastline. Therefore, a similar nearshore structure should exist along the beaches of Walton County.

Material will be removed from the selected borrow area via hopper dredge and pumped onto the beach to create the desired template. This method is preferable in terms of turbidity reduction and minimizing the potential impact to fish and wildlife. Most of the motile benthic and pelagic fauna, such as crab, shrimp, and fish, should able to avoid the disturbed area and should recover shortly after the activity is completed. The selected borrow area is characterized as sandy bottom and does not contain any hard-bottoms, coral reefs, oyster beds, or seagrass as indicated by extensive geotechnical offshore investigations performed to identify suitable offshore borrow areas as discussed in Section 2.2. No hard-bottom structures were identified in and around the proposed borrow area during these investigations.

No long-term direct impacts to managed species are anticipated; however, it is reasonable to anticipate some non-motile and motile invertebrate species will be physically affected through the dredging and placement operations. These species would recover rapidly following construction activities (Cutler and Mahadevan,1982).

4.8.1 No Action. The future conditions resulting by not constructing this project would result in no EFH impacts.

4.9 COASTAL BARRIER RESOURCES

The Coastal Barrier Resources Act of 1982 (PL 97-348) restricts Federal expenditures and financial assistance within designated CBRA zones in the Gulf and Atlantic Coasts. Several CBRA units are located within the project area. Coordination with the USFWS concerning the consistency of the tentatively selected plan in accordance with the requirements of CBRA for the six system units has been completed to ensure that the expenditure of Federal funds does not enhance the potential for development within these units. Those CBRA units that fall within the projects limits include FL-94, FL-96, FL-95P, FL-93P, P32, and P31A as illustrated in Figure EA-8. Below is a description of each CBRA Unit and how it relates to the project:

Unit P32 - This unit is located at the western-most end of the project area and corresponds with project segments R1-1 thru R1-4 which lies within a reach (segments R1-1 thru R1-10) that is not justifiable for Federal funding. Therefore, this reach is considered as part of the Locally Preferred Plan (LLP) and will be 100 percent funded by the non-Federal sponsor. Since no Federal funding will be used in the construction of this segment of the project, the CBRA is not applicable with the reach of the project.

Unit P31A - Located in the western one third of the project, this unit for the most part, is located in an area that is not within the construction area except for the eastern-most boundary of the unit, which contains an approximate 400-foot portion of the berm and dune transition. This unit corresponds to the Topsail Hill Preserve State Park. Even though the construct reach is small, it is believed that establishing the proposed beach-dune system will contribute to the overall sustainability of the fish and wildlife and various other natural resources including the dune lakes. Work conducted within this unit will be 100 percent funded by the non-Federal sponsor

Unit FL-96 - This CBRA unit is associated with Draper Lake, one of the many coastal dune lakes in the county. The construction of the berm-dune system tapers to an end on each side (approximately 500 feet on the west side and 200 feet on the east side) of the lake outfall in order to preserve the natural breaching capabilities. The restoration of the beach-dune system adjacent to the dune lake will provide valuable shoreline stability towards preventing catastrophic breaching of the already vulnerable ecosystems supported by the dune lake. A healthy and stable beach-dune system will contribute to the protection and overall sustainability of the fish and wildlife and various other natural resources which includes the dune lakes. Work conducted within this unit will be 100 percent funded by the non-Federal sponsor

Unit FL-95P - This unit is considered an Otherwise Protected Area (OPA) and only applies for Federal flood insurance which is not applicable to this project.

Unit FL- 94 - This unit is associated with the Deer Lake State Park. The bulk of the unit is excluded from the construction reaches except for the ends on either side (approximately 600 feet on the west side and 1,000 feet on the east side). The construction of the berm-dune system tapers to an end on each side of the lake outfall in order to preserve the natural breaching capabilities. The restoration of the beach-dune system adjacent to the dune lake complex will provide valuable shoreline stability towards preventing catastrophic breaching of the already vulnerable ecosystems supported by the dune lakes. A healthy and stable beach-dune system will contribute to the overall sustainability and protection of the fish and wildlife and various other natural resources including the dune lakes. Work conducted within this unit will be 100 percent funded by the non-Federal sponsor.

Unit FL-93P - This unit is considered an Otherwise Protected Area (OPA) and only applies for Federal flood insurance which is not applicable to this project.

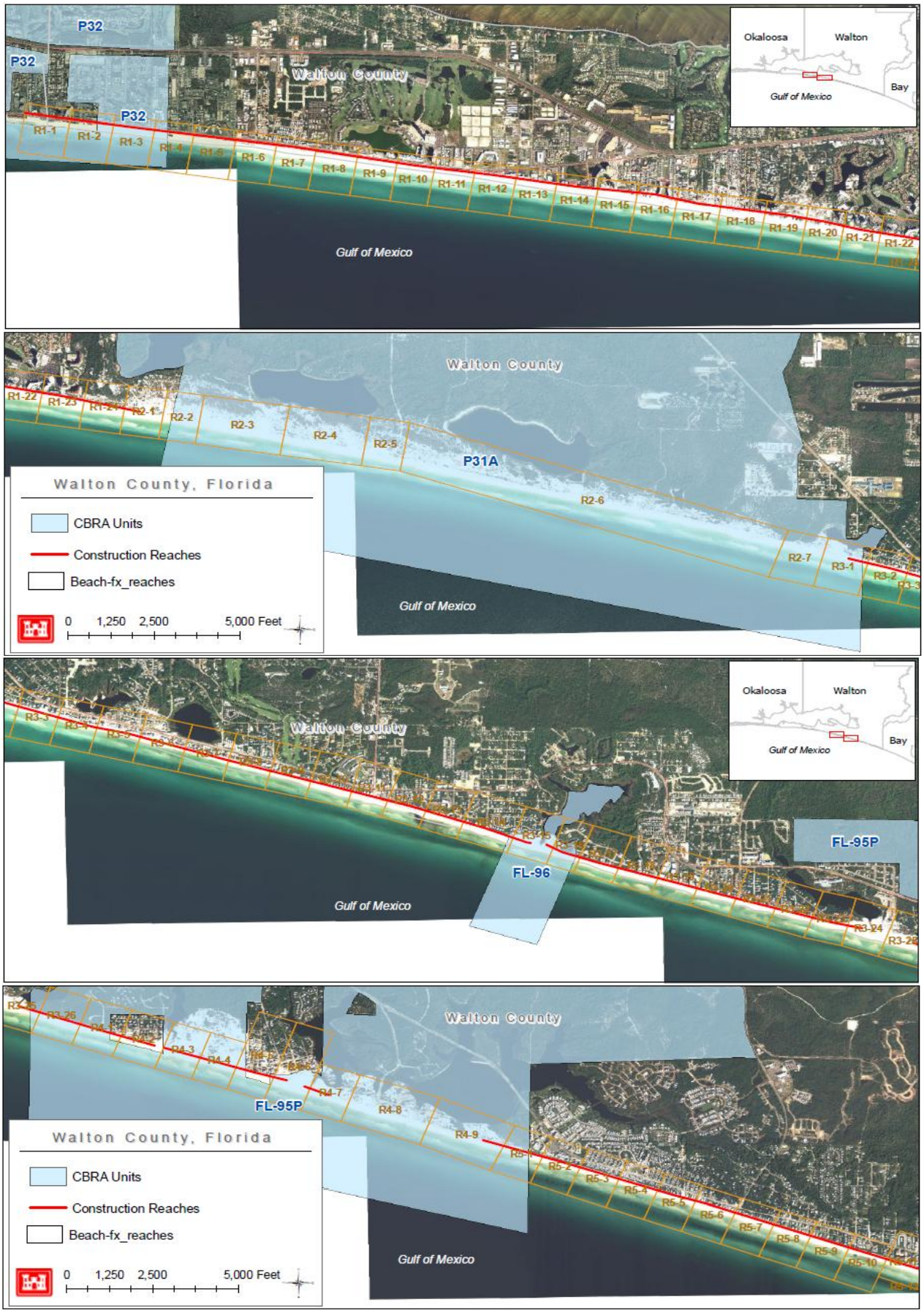

Figure EA-8. Locations of CBRA Units P32, P31A, FL-96 and FL-95P in Relation to the Project Area

Figure EA-8 (continued) - Locations of CBRA Units FL-94 and FL-93P in Relation to the Project Area

Based on the above criteria, the Corps has made the determination that this project would qualify for an exemption under Section 6 Exemptions for CBRA units P31A, FL-96, and FL-94. 16 U.S.C. § 3505 (a)(6)(A) identifies projects relating to the study, management, protection, and enhancement of fish and wildlife resources and habitats, including acquisition of fish and wildlife habitats and related lands, stabilization projects for fish and wildlife habitats, and recreational projects. 16 U.S.C § 3505 (a)(6)(G) also exempts nonstructural projects for shoreline stabilization that are designed to mimic, enhance, or restore natural stabilization systems; however, upon completion of the CBRA consultation, the USFWS does not agree with this determination and has made their determination that this project is not consistent with the purpose of CBRA. To resolve this issue, the Corps has taken steps to ensure that any and all work within the concerned CBRA zones will be 100% funded by the local sponsor so that no federal funding will be used towards construction within the CBRA areas. Additionally, the local sponsor will not receive any in-kind credits for their efforts that fall within these CBRA areas.

4.9.1 No Action. The future conditions associated with not restoring the beach and dune system would result in the continued degradation of a valuable beach ecosystem and loss of these types of habitats and associated benefits within the CBRA areas. The already damaged habitats would remain particularly vulnerable to wave and

storm activity that continually threaten and prevent the re-establishment of valuable natural resources. Opportunities would be lost to implement beach and dune restoration and re-vegetation for the critical areas in Walton County. Degradation of valuable dune and beach habitat that provide protection to the valuable natural resources contained within the CBRA areas would persist as the area continues to be vulnerable to even minor storm activity. A no-action scenario would not provide the much needed stability and sustainability that a healthy coastal environment could offer to the area.

4.10 WATER QUALITY

Some silty material will be associated with the dredging and placement operations and its suspension may result in a slight localized increase in turbidity at the dredging and disposal sites. The direct placement of material on the beach will consist of beach quality sandy material and no significant long-term elevation of turbidity is expected. The State of Florida's water quality standards would not be significantly affected and water clarity would return to ambient conditions shortly after sediment placement at the dredge and disposal sites. As required by the CWA, a Section 404 (b)(1) evaluation report for the borrow and placement of sediment at the proposed beach placement areas has been prepared and can be found in EA-Appendix A.

4.10.1 No Action. The future conditions resulting by not constructing this project would result in no water quality impacts.

4.11 SEDIMENT QUALITY

As discussed in Section 4.2, the material to be utilized during restoration of the beach meets the criteria set forth in 20 CFR 230.60(b) as clean sand which is sufficiently removed from sources of pollution and is located in areas of high current velocities to provide reasonable assurance that the material would not be contaminated by such pollution. Hence, no further physical, biological, or chemical testing is required pursuant to the 404(b)(1) Guidelines. More specific details pertaining to sediment quality is included in the 404(b)(1) Evaluation Report included in EA-Appendix A.

As stated in Section 3.5, a compatibility analysis was conducted by Taylor Engineering, Inc. (2003). Borrow area and beach samples were taken to provide a comparison between the beach and proposed borrow area. Compatibility is expressed by the quantitative characteristics (size and composition) of the borrow area sediments with the native beach sediments in terms of an adjustment or overfill factor. This overfill factor is defined as the volume of material required to produce a unit volume of stable beach with the same grain size distribution as the native beach. The method developed by Dean (2002), which applies the concept of equilibrium beach profiles, computed an overfill ratio of 1.0. The analysis indicates that the borrow material and the native beach have equal mean grain sizes (0.30 mm).

4.11.1 No Action. The future conditions resulting by not constructing this project would result in no sediment quality impacts.

4.12 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

No known hazardous, toxic or radioactive waste concerns are known to exist within the confines of the project area. Nor would any be added as a result of the proposed activities. The material to be excavated are naturally occurring marine sands in areas of high current activity and far removed from sources of pollution, thus providing reasonable assurance that the material is not contaminated. The material to be utilized during restoration of the beach meets the criteria set forth in 20 CFR 230.60(b) as clean sand which is sufficiently removed from sources of pollution and is located in areas of high current velocities to provide reasonable assurance that the material would not be contaminated by such pollution. Hence, no further physical, biological, or chemical testing is required pursuant to the 404(b)(1) Guidelines. More specific details pertaining to sediment quality is included in the 404(b)(1) Evaluation Report and is included in EA-Appendix A.

4.12.1 No Action. The future conditions resulting by not constructing this project would cause no impacts resulting from hazardous, toxic or radioactive waste.

4.13 AIR QUALITY

Air quality would be temporarily and insignificantly affected by the proposed action in Walton County. Emissions are expected to occur and would result from the operation of the dredge, land-based equipment, and any other support equipment which may be on or adjacent to the construction areas. The project area in Walton County is currently in attainment with National Ambient Air Quality Standards parameters. The proposed action would not affect the attainment status of the project area or region. A State Implementation Plan conformity determination (42 United States Code 7506 (c) is not required since the project area is in attainment for all criteria pollutants.

4.13.1 No Action. The future conditions resulting by not constructing this project would result in no air quality impacts.

4.14 NOISE

Noise from the dredge and other associated support equipment would be evident in the project area. Noise levels would be typical of what is already commonly accepted and occurring at the Corps' dredging operation sites. While this noise would be evident to those workers on the job, residents, and by-standers in close proximity of the project, it would be short-term and insignificant. No long-term increase in noise would occur in or around the project area. Normal noise levels would be achieved at the end of the construction period.

4.14.1 No Action. The future conditions resulting by not constructing this project would result in no noise impacts.

4.15 AESTHETICS

Aesthetics would be degraded in the project area during the dredging and disposal operations, due to the physical presence of the dredge and pipeline used to transport the dredged material as well as the presence of other land-based equipment. Some minor increases in turbidity may be noted in the immediate vicinity of excavation and placement activities but these increases would be minor and short term in nature. Some discoloration of the sand would occur following placement due to the fact that the sands to be placed on the beach are coming from anaerobic environment. Natural bleaching of the sand should occur within one to two months. Rainfall and wave action would act to filter out the fine grained materials from the restored beaches and increase the compatibility of the nourishment sands with those presently on the beach. These impacts will be temporary and insignificant in nature.

4.15.1 No Action. The future conditions resulting by not constructing this project would remain the same resulting in no aesthetic impacts.

4.16 RECREATION

For a short time, the construction process would limit the recreational activities, especially near the dredge pipe and equipment staging areas. Once completed, the project would provide aesthetically pleasing larger beaches and vegetated dunes which would supply more area for active and passive recreational activities as attracting coastal wildlife.

4.16.1 No Action. Future conditions associated with not restoring the beach and dune system would result in the continued degradation of a valuable beach ecosystem and loss of these types of habitats and associated benefits. The already damaged habitats would remain particularly vulnerable to wave and storm activity that continually threaten and prevent the re-establishment of valuable natural resources that are used for recreation. Opportunities would be lost to implement beach and dune restoration and re-vegetation for the critical areas in Walton County. Degradation of valuable dune and beach habitat including areas used for recreation would persist as the area continues to be vulnerable to even minor storm activity.

4.17 HISTORIC AND CULTURAL RESOURCES

In accordance with Section 106 of the National Historic Preservation Act and other relevant cultural resource laws, recommendations and actions have been coordinated with the FLSHPO and Federally recognized Native American Tribes. Plans to avoid or conduct more intensive evaluations of any cultural resources identified during the surveys will be developed and coordinated.

Sonographics, Inc under contract to the county conducted a cultural resource survey and detail phase sub-bottom seismic survey for the offshore areas and proposed borrow sites of Walton County in June 2007. Potential identified cultural resources were investigated using qualitative visual observations. It was determined that none of the anomalies detected appeared to represent any type of cultural resources and a determination was made that the activities associated with this project are unlikely to

affect any historic or cultural resources. The county subsequently initiated coordination with the Florida Division of Historic Resources presenting this determination. In a letter dated December 11, 2008, concurrence was issued by the Florida Division of Historic Resources for the local project. A copy of this letter is included in EA-Appendix B. It should be understood that this determination issued for the local plan covers the same areas as the tentatively selected plan. Subsequently, the Corps initiated coordination with the Florida Division of Historic Resources presenting this determination regarding the tentatively selected plan.

4.17.1 No Action. The future conditions resulting by not constructing this project would result in no impacts to any historic and cultural resources.

4.18 SOCIO-ECONOMIC IMPACTS

The tentatively selected plan would not require business or residential relocations. The proposed action would likely have a negligible effect on population growth trends within Walton County. As a result the proposed action is not expected to increase demands for community facilities, services, and housing other what would be expected as consistent with the projected population growth for Walton County and would not result in potentially significant impacts.

4.18.1 No Action. The future conditions resulting by not constructing this project would remain the same resulting in socio-economic impacts.

4.19 CUMULATIVE EFFECTS SUMMARY

Cumulative impacts are those impacts on the environment that result from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. This section analyzes the proposed action as well as any connected, cumulative, and similar existing and potential actions occurring in the area surrounding the site.

No projects are known to be interdependent upon this project. It is likely that renourishment events in the action area would occur in the future to maintain the beach design profile and additional sand sources would be used. Renourishment is expected to occur at regular intervals with increasing occurrence if the area is impacted by tropical storm events. Several other known beach renourishments are occurring, have recently occurred or are expected to occur within the Florida Panhandle. These include: Pensacola Beach Restoration (8.2 miles of shoreline), Navarre Beach and Dune (3.6 miles of shoreline), and City of Destin Beach renourishment (6.9 miles of shoreline and a 210-acre borrow area). In addition there is a proposed sand bypassing unit for the Mexico Beach Canal which is currently within the FDEP permitting process. This project, if approved, would consist of annual bypassing of sand via a hydraulic dredge from a 1.6-acre beach site west of the pass to a 4,500-foot stretch of beach to the east. The combined footprint is approximately 514 acres of seafloor and 37 miles of the shoreline. Not all of these projects are expected to occur within the same renourishment cycle (year), thus providing time for the natural system to recover.

Cumulative impacts that would arise from renourishment efforts are anticipated to be remote due to the conservation measures typically incorporated into beach nourishment projects and the dynamic nature of the nearshore zone and the rapid recovery time of the benthic assemblages.

5.0 STATUS OF ENVIRONMENTAL COMPLIANCE

This section identifies and indicates the status of the determinations, coordination, and consultations pertaining to the environmental compliance laws and regulations for this project. At the end of this section, Table EA-6 summarizes the status of the applicable coordination and consultations with the support agencies.

5.1 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) OF 1969

Environmental information on the tentatively selected plan has been compiled and this EA has been prepared in accordance with the NEPA. Upon finalization of this EA a determination will be made as to the significance of the impacts resulting from this project. If it is found that the total impacts are not considered significant, a Finding of No Significant Impacts (FONSI) will be prepared. If impacts are determined to be major, an EIS will be initiated. See Section 6.0 referencing the determination for the preparation of an EA.

As required by NEPA, a public notice for this project has been issued on April 27, 2010 in accordance with rules and regulations published in the Federal Register on 26 April 1988. These laws are applied whenever dredged or fill materials may enter waters of the United States, or for the transportation of dredged material for the purpose of placement into ocean waters.

The only comment received in response to the public notice was from the Seminole Tribe of Florida. By letter dated May 27, 2010, the Tribe indicated that they have no objection to the project. A copy of their letter is included in EA-Appendix B.

5.2 ENDANGERED SPECIES ACT OF 1973

The tentatively selected plan as described in Section 2.1.4 is in the process of formal consultation in accordance with the USFWS and NMFS as required under Section 7 of the ESA. Although there have been coordination efforts already conducted by the non-Federal sponsor for the local plan that totally encompasses the tentatively selected plan, as described previously in Section 2.1.5, the Corps has, in addition, initiated formal Section 7 consultation with the USFWS and NMFS. A BA has been prepared for consultation with both the USFWS and NMFS prepared using much of the same information generated by the non-Federal sponsor addressing the potential impacts to the listed species and/or critical habitats within the tentatively selected plan. A copy of the BA's is included in EA-Appendix B. It is expected that the same activities will be required to avoid or minimize impacts to these species or where possible to provide activities that may enhance the species continued survival or critical habitat.

Based on the evaluation for species and critical habitats under the purview of the USFWS for the tentatively selected plan described in the BA, it is the Corps' assessment that the actions may have an adverse affect on sea turtles, piping plovers, and Choctawhatchee beach mouse. Upon further consideration of the previous BO's issued for the local Walton County Beach Nourishment Project, it is the USFWS's opinion that the effects of the proposed activities are not likely to jeopardize the continued existence of these species and not likely to destroy or adversely modify designated critical habitat for the Choctawhatchee beach mouse. Given the results of the coordinations by the non-Federal sponsor, no additional issues are expected with the tentatively selected plan.

Based on the evaluation for species and critical habitats under the purview of the NMFS for the tentatively selected plan described in the BA, it is the Corps' assessment that the actions may have an adverse affect on sea turtles and Gulf sturgeon but not likely to jeopardize their continued existence and is not likely to adversely modify Gulf sturgeon critical habitat. This determination is consistent with the completed consultation conducted for the local plan in which NMFS has concurred by letters dated August 13, 2008 and August 13, 2008. Copies of these letters are included in EA-Appendix B. The Corps is therefore requesting that consideration be given to applying that coordination to the tentatively selected plan. Given the results of the coordinations already completed by the non-Federal sponsor, no additional issues are expected with the tentatively selected plan. By email dated March 1, 2010, the NMFS has indicated that the Walton County Federal project would not result in additional impacts already coordinated for the local plan.

In addition to the coordinations described above, hopper dredging operations have already been analyzed in the RBO and amendments. Another related biological opinion is pending for placement of sand on Florida beaches and is anticipated to be in place by the time this project is constructed.

By email dated March 1, 2010, the NMFS indicated that the Walton County Federal project would not result in additional impacts that have not already been coordinated for the non-Federal sponsor (EA-Appendix B). On May 6, 2010, the USFWS submitted a draft BO. The draft BO indicates that the USFWS has determined that the proposed action would not jeopardize the continued existence of nesting sea turtles or Choctawhatchee beach mouse or result in adverse modification of the Choctawhatchee beach mouse critical habitat; however, there is still a potential for incidental takes in the form of long-term and short-term impacts on sea turtles and the Choctawhatchee beach mouse. The USFWS has therefore imposed terms and conditions to be implemented that would minimize the potential for incidental takes. The USFWS also agrees with the Corps' determination that the proposed action may adversely affect (MAA) non-breeding piping plover and will be providing this consultation in a separate document. The USFWS also agrees with the Corps' determination that the selected plan would not likely adversely affect (NLAA) designated critical habitat for non-breeding piping plover and the West Indian manatee.

In August, 2011, the USFWS finalized the Statewide Programmatic Biological Opinion (PBO) for Shore Protection Activities along the Coast of Florida. The draft PBO

indicates that for sand placement actions such as this in the State of Florida, the USFWS has determined that the proposed action would not jeopardize the continued existence of nesting sea turtles. However, there is still a potential for incidental takes in the form of long-term and short-term impacts on sea turtles. The USFWS has therefore imposed terms and conditions to be implemented that would minimize the potential for incidental takes. The USFWS also agrees with the Corps' determination that the proposed action may adversely affect (MAA) non-breeding piping plover. Due to issues regarding piping plover and beach mice that could not be resolved, the PBO does not address these two species. Coordination for the piping plover and the Choctawhatchee beach mouse and will be providing this consultation in a separate document and will be completed prior to the final documentation. A copy of the final PBO is included in EA-Appendix B. Based on the formal consultations regarding threatened and endangered species and associated designated critical habitats, no mitigation requirements have been identified.

5.3 COASTAL ZONE MANAGEMENT ACT (CZMA) OF 1972

As previously stated, the non-Federal sponsor proceeded with pursuing the beach restoration and has selected a local plan that totally envelops the tentatively selected plan. The county has applied for the state WQC/CZC in which the FDEP has deemed their application complete but the final permit has not been issued. The state has indicated that since the local plan is larger than and totally encompasses the tentatively selected plan that the Corps could simply transfer that information in a new JCP application. The only thing that would be necessary is to replace the project description for the local plan with the tentatively selected plan.

The Corps determined that the proposed action is consistent with the Florida Coastal Management Program to the maximum extent practicable. The effect of this project on the coastal zone would be to enhance the zone's appearance and suitability for beach-type recreation and to restore some of the coastal zone's ability to provide protection against storms and flooding. Restoration of the state's beaches is a policy statement with the state Coastal Zone Management Plan Chapter 161 (Coastal Construction). A Coastal Zone Consistency (CZC) request will be included in the Federal JCP application package that will be prepared and issued along with the JCP permit. The Corps will be submitting an independent JCP permit application once the tentatively selected plan is approved.

5.4 CLEAN AIR ACT OF 1972

No air quality permits are required for this project.

5.5 CLEAN WATER ACT (CWA) OF 1972

A Section 401 water quality certification has been requested from the FDEP for the tentatively selected plan. A Section 404 (b)(1) evaluation report is included in this EA under EA-Appendix A. The report indicates no further physical, biological, or chemical testing is required pursuant to the 404(b)(1) Guidelines. Based on the information presented, no mitigation requirements have been identified.

As already discussed, the non-Federal sponsor proceeded with pursuing the beach restoration and has selected a local plan that totally envelops the tentatively selected plan. The state has indicated that since the local plan is larger than and totally encompasses the tentatively selected plan that ownership of the completed WQC/CZC application can be transferred to the Corps. A letter of transfer of the application must be submitted to the state by the non-Federal sponsor and the Corps. The Corps is currently coordinating this effort with the FDEP and non-Federal sponsor.

5.6 NATIONAL HISTORIC PRESERVATION ACT OF 1966 (PL 89-665, THE ARCHEOLOGY AND HISTORIC PRESERVATION ACT (PL 93-291), AND EXECUTIVE ORDER 11593)

Archival research and field work has been initiated by the non-Federal sponsor. Sonographics, Inc. conducted a cultural resource survey and detail phase sub-bottom seismic survey in June 2007. Potential identified cultural resources were investigated using qualitative visual observations. It was determined that none of the anomalies detected appeared to represent any type of cultural resources and a determination was made that the activities associated with this project are unlikely to affect any historic or cultural resources. The county subsequently initiated coordination with the Florida Division of Historic Resources presenting this determination. In a letter dated December 11, 2008, concurrence was issued by the Florida Division of Historic Resources for the project. This determination covers the same areas as the tentatively selected plan. Section 106 consultation has been initiated for the tentatively selected plan using this existing information.

In accordance with Section 106 of the National Historic Preservation Act and other relevant cultural resource laws, recommendations and actions have been coordinated with the FLSHPO. The Mobile District's cultural resources staff has composed a letter indicating that the Mobile District has reviewed the aforementioned cultural resources survey and review by the FLSHPO. Based on this information, and the nature of the project, the Mobile District, as lead Federal agency, has determined that the tentatively selected plan will have no effect on historic properties as per 36 CFR 800.4(d)(1). By letter dated March 11, 2010 the FLSHPO provided their concurrence that the Federal action will have no effect on historic properties. A copy of this coordination is included in EA-Appendix B. Based on the consultation regarding cultural resources, no mitigation requirements have been identified.

5.7 MIGRATORY BIRD TREATY ACT

No migratory birds would be adversely affected by project activities.

5.8 COASTAL BARRIER RESOURCES ACT (CBRA) AND COASTAL BARRIER IMPROVEMENT ACT OF 1990

The CBRA Units that are within the project limits include FL-94, FL-96, FL-95P, FL-93P, P32, and P31A. Coordination with the USFWS concerning the consistency of the tentatively selected plan in accordance with the requirements of CBRA for the six system units has been completed in an effort to ensure that the expenditure of Federal

funds does not enhance the potential for development within these units. A copy of the coordination document in included in EA-Appendix B.

CBRA units 95P and FL-93P are considered as otherwise protected areas (OPA) and only applies to Federal flood insurance which does not apply to this project. CBRA unit P32 falls within a segment of the project that cannot be justified for Federal funding and will be 100 percent locally funded, which is exempt from CBRA requirements. The Corps has made the initial determination that the tentatively selected plan qualifies for an exemption under Section 6 Exemptions for CBRA units P31A, FL-96, and FL-94. Section 6(a)(6)(A) identifies projects relating to the study, management, protection, or enhancement of fish and wildlife resources and habitats, including recreational projects. Section 6(a)(6)(G) also exempts nonstructural projects for shoreline stabilization that are designed to mimic, enhance, or restore natural stabilization systems.

As discussed in the Section 4.9, upon completion of the CBRA consultation, the USFWS does not agree with the Corps' determination for the CBRA exemptions for units P31A, FL-96, and FL-94. By letter dated February 22, 2010 the USFWS issued their determination that this project is not consistent with the purpose of CBRA. It should be recognized that CBRA units P31A, FL-96, and FL-94 are the only units that were determined to fall within the Federal cost-shared project reaches. These reaches are for the most part at the tapered ends of those reaches. To resolve this issue, the Corps has taken steps to ensure that any and all work within the concerned CBRA zones will be 100% funded by the local sponsor so that no federal funding will be used towards construction within the CBRA areas. Additionally, the local sponsor will not receive any in-kind credits for their efforts that fall within these CBRA areas. Since no Federal funding will be used in the construction of these segments of the project, the CBRA will no longer be applicable. By email April 18, 2012, the USFWS was made aware of the Corps' position and actions taken on how to proceed regarding this issue.

5.9 MAGNUSON – STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT (MSFCMA)

Coordination with the NMFS, Habitat Conservation Division in accordance with the MSFCMA has been initiated involving the dredging and placement activities for tentatively selected plan. Activities have been undertaken to assure that plans identified for this study are not in conflict with existing Federal fishery management plans or do not result in unacceptable impacts to the habitats of managed species.

The Corps will be adhering to water quality requirements under the conditions specified by the FDEP to further reduce impacts to EFH. Consultation with the NMFS, Habitat Conservation Division concerning EFH has been initiated for the tentatively selected plan pursuant to the MSFCMA (PL 94-265). A copy of the coordination documentation is included in EA-Appendix B. Based on the Corps' assessment of the project in relation to impacts to fisheries resources, the overall impact to identified species is considered negligible given the relatively small area and will not result in significant impacts to EFH.

By letter dated October 6, 2010, NOAA's National Marine Fisheries Service (NMFS), Habitat Conservation Division has stated that they have reviewed the Corps' EFH assessment and subsequent information for the proposed selected plan and determined that the NMFS does not have any EFH consultation recommendations to offer. A copy of this letter of determination in included in EA-Appendix B. Based on the formal consultations regarding EFH, no mitigation requirements have been identified.

5.10 FISH AND WILDLIFE COORDINATION ACT OF 1958, AS AMENDED

Although the non-Federal sponsor has conducted the coordination required by the ESA and Section 7 coordination has been conducted pertaining to the local plan, the Fish and Wildlife Coordination Act (FWCA) requires that Federal agencies consult with the USFWS regarding fish and wildlife resources in the project area. Such coordination will result in a Fish and Wildlife Coordination Act Report (FWCAR). This coordination has been conducted with the USFWS for the tentatively selected plan in accordance with the FWCA of 1958 regarding impacts to significant fish and wildlife resources and impacts to Federally listed or proposed species or their designated or proposed critical habitat, which is in accordance with Section 7 of the Endangered Species Act of 1973. A copy of the coordination letter requesting is included in EA-Appendix B. A scope of work and transfer of funds to the USFWS has been completed for the preparation of this report. The USFWS has completed and submitted a draft report to the Mobile District staff dated October 7, 2010. A copy of the FWCAR is included in EA-Appendix B.

5.11 MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT

The term "dumping" as defined in the Act (3[33 U.S.C. 1402](f)) does not apply to the disposal of material for beach nourishment. Therefore, the Marine Protection, Research and Sanctuaries Act does not apply to this project. The disposal activities addressed in this EA have been evaluated under Section 404 of the CWA.

5.12 EXECUTIVE ORDER (E.O.) 13045, PROTECTION OF CHILDREN

The proposed action complies with Executive Order 13045, "Protection of Children from Environmental Health Risks and Safety Risks", and does not represent disproportionally high and adverse environmental health or safety risks to children in the United States. The proposed site is not used disproportionally by children.

5.13 E.O. 12898, ENVIRONMENTAL JUSTICE

The proposed action complies with Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations", and does not represent disproportionally high and adverse human health or environmental effects on minority populations and low-income populations in the United States. The proposed site is not used disproportionally by these populations.

5.14 E.O. 13186, PROTECTION OF MIGRATORY BIRDS

These migratory bird conventions impose substantive obligations on the United States for the conservation of migratory birds and their habitats, and through the Migratory Bird

Treaty Act (Act), the United States has implemented these migratory bird conventions with respect to the United States. This Executive Order directs executive departments and agencies to take certain actions to further implement the Act. The proposed action will have no affects on migratory birds.

5.15 E.O. 11990, PROTECTION OF WETLANDS

The E.O. requires Federal agencies to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. No wetlands will be impacted by this action.

5.16 E.O. 11988, FLOODPLAIN MANAGEMENT

E.O.11988 requires Federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with occupancy and modification of floodplains. It further directs Federal agencies to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. The project is located in a highly developed area subject to inundation by the one-percent-annual-chance flood event with additional hazards due to storm-induced velocity wave action. The purpose of the project is to reduce damage to existing landward structures as a result of storm waves and storm-induced erosion, two major categories of storm damage. The project will not increase flooding along the landward structures or increase or prevent any damage from bay side flooding from saltwater that will flow into Choctawhatchee Bay through East Pass Inlet. The action has been evaluated and found to be in compliance with this E.O. as it will not adversely affect the floodplain based on the above findings.

6.0 PREVIOUS INTERAGENCY COORDINATION

On 29 June 2004, an interagency scoping meeting was held at the Walton County, Tourist Development Council facility in Santa Rosa Beach, Florida. The purpose of the meeting was to initiate environmental coordination with the interagency team involved in the permitting and environmental compliance processes for the Walton County Shore Protection Feasibility Study. The meeting's primary objects were to identify and discuss environmental issues and opportunities, permitting issues, and environmental compliance requirements associated with the proposed Walton County project. In attendance were representatives from the Corps, Walton County, USFWS, FDEP, and Florida Fish and Wildlife Conservation Commission (FWCC). It should be noted that representatives from the NMFS were invited to participate. Communications with the NMFS, Habitat Conservation Division expressed that the project did not raise issues that would require their representation. Representatives from the NMFS, Protected Resources Division did not respond. A Memorandum for Record (MFR) summarizing the meeting was prepared and distributed. A copy of the MFR is included in EA-Appendix B.

Table EA-6. Status of Agency Coordinations and Consultations

APPLICABLE LAW/REGUALTION	AGENCY	COORDINATION/CONSULTATION	
		INITIATED	STATUS
National Environmental Policy Act (NEPA)		Public Notice Issued April 27,2010	1 no objection comment received.
Endangered Species Act (ESA)	U.S. Fish and Wildlife Service	Consulted initiated January 15, 2010	In August, 2011, the USFWS finalized the Statewide Programmatic Biological Opinion (PBO) for Shore Protection Activities along the coast of Florida. The PBO indicates that for actions such as this in Florida, the USFWS has determined that the proposed action would not jeopardize the continued existence of nesting sea turtles. The final PBO will require separate coordination for the piping plover and beach mouse.
	NOAA-National Marine Fisheries Service, Office of Protected Resources	Consultation initiated January 15, 2010	Email dated March1, 2010, concurring that project would not result in additional impacts already coordinated for the non-Federal sponsor
Fish and Wildlife Coordination Act (FWCA)	U.S. Fish and Wildlife Service	Request for Fish and Wildlife Coordination Act Report (FWCAR) initiated January 8, 2010	Draft report received October 7, 2010.
Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) – Essential Fish Habitat (EFH)	NOAA-National Marine Fisheries Service, Habitat Conservation Division	EFH consultation initiated January 8, 2010	Letter received October 6, 2010, NMFS, Habitat Conservation Division determined that they do not have any EFH additional consultation recommendations to offer.
Coastal Barrier Resources Act (CBRA)	U.S. Fish and Wildlife Service	CBRA consultation initiated January 13, 2010	Letter received February 22, 20210 indicating USFWS's determination that project is not consistent with the purpose of CBRA. Areas within CBRA will be constructed using non-Federal funds
National Historic Preservation Act (NHPA)	Florida Division of Historic Resources	Cultural resources consultation initiated January 8, 2010	Letter received March 11, 2010 that FLSHPO concurred the action will have no effect on historic properties.
Clean Water Act (CWA)	Florida Department and Environmental Protection (FDEP)	No water quality certification application at this time	Draft 404(b)(1) Evaluation Report prepared. Currently coordinating with the FDEP and non-Federal sponsor
Coastal Zone Management Act (CZMA)	Florida Department and Environmental Protection (FDEP)	No application at this time	Currently coordinating with the FDEP and non-Federal sponsor

An important topic of discussion at the interagency meeting dealt with the NEPA process that should be conducted for the Walton County project, specifically whether the project would require an EA or EIS. The USFWS representatives expressed that their agency is not viewing this project as one that would require an EIS. Although the project area encompasses some 26 miles of shoreline, the activities will be comprised of segmented beach nourishment and/or dune restoration. The group in attendance felt that given the project characteristics, low level of controversy, and precedent set by other local beach projects that an EA would be the appropriate level of environmental documentation for the Walton County project; however, an EA must adequately address the cumulative impacts of the entire project and may be subject to future change into an EIS should any major issues and controversy arise. If the finding of the EA is that the major Federal undertaking will not significantly affect the environment then a Finding of No Significant Impact (FONSI) will be prepared.

The Corps has reopened communications with the interagency team to reaffirm this determination. Reaffirmation has been received from the team that their position is that an EA would still be the appropriate level of NEPA documentation. The USFWS, in an email dated December 9, 2009 concurs that with the information available an EA is still the appropriate level of NEPA documentation. Also in an email dated December 9, 2009, FDEP has indicated that they feel the determination as to the appropriate level of NEPA documentation is the Corps' decision as long as it adequately addresses the information outlined in the JCP application package. A conference call was held on December 16, 2009 between Corps representatives and representatives from EPA Region IV. After describing the project and answering several questions the EPA representatives felt that the Corps was justified in the determination to generate an EA. They also confirmed that this decision is the responsibility of the Corps; however, the information contained in the EA must support the determination for the FONSI. If the EA reveals significant impacts, then an EIS must be initiated.

The Mobile District maintains the position that based on project characteristics, low level of controversy, absence of chemical contamination, and precedent set by other local beach projects that an EA would be the appropriate level of NEPA documentation for the Walton County project. It should also be considered that all of the required formal consultations have been completed and no mitigation requirements have been identified for the proposed selected project.

7.0 CONCLUSIONS

All reports, documents, and coordination efforts to date have been reviewed by the Mobile District to ensure that they are in total compliance with Federal requirements including the guidelines set forth under the Environmental Operating Procedures (EOP) and the processes in ER 110502-100. Upon verification that all requirements are met and a determination has been made that the project will not result in significant environmental impacts, a FONSI will be prepared by the Mobile District for inclusion in the final feasibility report.

Based on the above discussion of the minor impacts, which would result from the implementation of the proposed action and due to the lack of long-term adverse impacts and that no mitigation requirements have been identified, it is believed that no significant cumulative impacts for the proposed beach restoration disposal sites, adjacent shorelines, and proposed borrow area would occur. Upon finalization of this EA a FONSI will be prepared.

REFERENCES

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EA-APPENDIX A

DRAFT 404(b)(1) EVALUATION REPORT
FOR
WALTON COUNTY, FLORIDA HURRICANE AND
STORM DAMAGE REDUCTION PROJECT
WALTON COUNTY, FLORIDA

404(b)(1) EVALUATION REPORT FOR WALTON COUNTY, FLORIDA HURRICANE AND STORM DAMAGE REDUCTION PROJECT WALTON COUNTY, FLORIDA

I. PROJECT DESCRIPTION

Please refer to the figures included in the Environmental Assessment (EA) to which this evaluation is appended.

a. Location. Walton County is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet (Figure 1 in EA). The western two-thirds of Walton County are comprised of a coastal peninsula extending from the mainland, and the eastern third is comprised of mainland beaches. Choctawhatchee Bay lies north of the peninsula. Walton County includes 11.9 miles of state-designated critically eroding areas and three Florida State Park areas that cover approximately six miles of the 26-mile shoreline.

b. General Description of Proposed Preferred Plan. The Walton County upland cross section is defined by dune elevations ranging from +9.5 to + 33 feet NAVD88 and a natural berm elevation of +5.5 feet NAVD88. The study region was divided into five study reaches based on structural development and state park areas as illustrated in Figure 2 in the EA. The historical and 2004 beach surveys were used to develop 11 representative profiles, which characterize the existing condition for the five study reaches. The representative profiles were identified based on similarity in shape of the upper beach profile (dune height and width, berm width, foreshore beach slope, and profile volume) and shape of the offshore profile. Because significant erosion occurred due to Hurricane Ivan in September 2004, the representative profiles were revised using the post-Ivan data to characterize the upper portion of the beach and to include the post-Ivan data in the submerged portion of the beach.

Modeling using a model called Beach-*fx* was used to simplify beach profiles representing a single trapezoidal dune, with a horizontal berm as shown in Figure 3 in the EA. The submerged profile is represented by a series of points or an approximate functional representation. The beach variables which change with storms are dune width, dune height, berm width, and upland elevation. Constant values are upland elevation, dune slope, berm height, foreslope, and shape of the submerged profile. Thus, in response to a given storm, the berm can be eroded or accreted; the dune height and/or width can change and translate landward or seaward.

Eleven simplified beach profiles were modified for various berm and dune configurations. Maximum dune and berm widths were determined based on volumes

provided by the Federal Emergency Management Agency (FEMA) post-Hurricane Ivan emergency beach nourishment. Other modeling was conducted using SBEACH to predict the response of each dune and berm configuration to the 552 storms developed for this study. Approximately 240,000 SBEACH simulations were conducted to develop the shoreline responses for the Beach-*fx* storm response database.

c. Authority and Purpose. This study was authorized by a resolution of both the United States Senate and House of Representatives, which reads as follows:

Resolution Adopted July 15, 2002, by The United States Senate:

> *"Resolved by the Committee on Environment and Public Works of the United States Senate, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and related improvements in Walton County, Florida, in the interest of protecting and restoring the environmental recourses on and behind the beach, including the feasibility of providing shoreline and erosion protection and related improvements consistent with the unique characteristics of the existing beach sand, and with consideration of the need to develop a comprehensive body of knowledge, information, and data on coastal area changes and processes as well as impacts from federally constructed projects in the vicinity of Walton County, Florida.*

Resolution Adopted July 24, 2002, by The United States House of Representatives:

> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and environmental restoration and protection in the vicinity of Walton County, Florida.*

The Non-Federal Sponsor is the Walton County Board of Commissioners. Their central point of contact is the Director of Beach Management for the Walton County Tourist Development Council (TDC).

The purpose of this study is to assess the needs for hurricane and storm damage protection and opportunities for environmental restoration and protection along the Gulf Coast of Walton County, Florida. The purpose of this report is to document the economic investigations, engineering analyses, and environmental considerations completed to formulate a shore protection project for Walton County, Florida, which will reduce the damaging effects of hurricanes and severe storms to properties along the coast and stabilize or restore the shoreline by eliminating long-term erosion. The project will be constructible, acceptable to the public, environmentally sustainable and justified by an economic evaluation.

In addition to storm damage protection the proposed action provides environmental restoration opportunities. A report produced by the State of Florida following Hurricane Ivan (2004) to assess damages and recovery plan as a result of the storm, the state recommends an assisted recovery plan to implement beach and dune restoration and re-vegetation for the critical areas in Walton County. Such action would restore

valuable dune and beach habitat including sea turtle nesting habitat, shorebird foraging and roosting areas, dune habitat supporting various flora and fauna and general beach ecosystem functions. Restoring a beach-dune system allows greater stability and sustainability of the coastal environment once it has become established. Restoring the beach habitat that supports a variety of associated flora and fauna contribute to the success and continual survival of several threatened or endangered species. The restoration effort will also contribute to the well-being of various other flora and fauna that naturally occur in the immediate vicinity. Future conditions associated with not restoring the beach and dune system would result in the continued degradation of a valuable beach ecosystem and loss of these types of habitats and associated benefits. The already damaged habitats would remain particularly vulnerable to wave and storm activity that continually threaten and prevent the re-establishment of valuable natural resources.

d. General Description of Borrow Material.

(1) General Characteristics of Material. The proposed borrow area sediments are typically well sorted medium sand (0.25 - 0.50 mm). The borrow area is centrally located and offers the best source for now and in the future. All materials used for beach nourishment will be excavated by hopper dredge, transported to the placement area offshore and pumped into the beach template.

(2) Quantity of Material. The proposed borrow area is believed to contain approximately 10,000,000 cubic yards proven by the initial investigations. This volume covers the initial locally preferred plan placement and the four planned subsequent renourishments for the next 50 years.

(3) Source of Material. Borrow area B-4 shown on Figure 5 in the EA is the most promising site.

e. General Description of Discharge Sites.

(1) Location. The proposed Walton County placement sites are located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet (Figure 1 in EA).

(2) Type of Site. The beach placement sites are typical of Florida Panhandle coastal beaches and the nearshore Gulf of Mexico with predominately marine sand substrate.

(3) Types of Habitat. The beach and nearshore area at the proposed Walton County project site support a highly variable marine environment that is typical of the nearshore zones of the northwest Florida Gulf of Mexico as described in the EA. These areas are characterized by clean white sands and clear blue-green ocean waters.

(4) Timing and Duration of Discharge. Timing of project construction is not known at this time. Once constructed, renourishment activities are expected to be conducted at predefined intervals or as necessary depending upon storm activity.

Renourishment activities would be scheduled as much as possible to coincide with environmental windows to avoid conflicts with sea turtles, shorebirds, and other protected species and critical habitats.

f. Description of Discharge Methods. All materials used for beach nourishment will be excavated by hopper dredge, transported to the placement area offshore and hydraulically pumped into the beach template. Heavy earth moving equipment such as bulldozers would be utilized to achieve the final design template. The use of hopper dredge equipment will adhere to the terms and conditions set forth within the Biological Opinions (BO) on hopper dredging in the U.S. South Atlantic and Gulf of Mexico waters (most recently, January 9, 2007, regional biological opinion (RBO) to the Corps' four Gulf of Mexico districts) would be implemented to minimize the potential of sea turtles and Gulf sturgeon take as a result of entrainment in the dredge. Placement of material on the proposed beach sites will adhere to the negotiated terms and conditions BO's resulting from the formal consultation processes and possibly already negotiated conditions specified under the Programmatic Biological Opinion (PBO) for Beach Placement and Shore Protection for the State of Florida. This PBO is not yet final but is expected to be implemented in 2010.

II. FACTUAL DETERMINATIONS

a. Physical Substrate Determinations.

(1) Substrate Elevation and Slope. The placement of material on the beach and in the nearshore areas would be accomplished in such a manner as to replicate the existing beach elevation/slope but at a distance seaward of the existing mean high water elevation as specified by the approved preferred plan. After placement, the beach fill would be subject to modifying effects of the natural wave climate of the Gulf of Mexico and within six months should reach equilibrium. This short-term change in natural elevation and slope would not pose a significant impact to the resources of the area or circulation in the nearshore Gulf of Mexico.

(2) Sediment Type. The material to be utilized in the beach renourishment project is predominantly medium sized sand (0.25 - .50 mm) with some shell hash and less than 10 percent fine grained material. This material is compatible with the sand on the Walton County beaches and nearshore littoral zone. Mineral composition and particle size of the substrate would not be significantly altered.

(3) Dredged/Fill Material Movement. Some of the fill material is expected to be transported westward along the shoreface in the littoral drift system. This movement would not have any adverse impact on the area as the littoral drift is a natural occurrence and the quantity of material expected to be lost to this system is minimal compared to that which is currently in circulation.

(4) Physical Effects on Benthos. The placement of the fill material would bury the benthos of the shoreface and to some extent that of the nearshore area. These communities are well adapted to this type of phenomena and should reestablish within six to 12 months after placement.

(5) Other effects. No other effects are anticipated.

(6) Actions Taken to Minimize Impacts (Subpart H). Since the material to be placed is naturally occurring sand similar to the substrate of the beach nourishment site, no further actions are deemed necessary.

b. Water Column Determinations

(1) Salinity. There would be no changes in gradients or patterns.

(2) Water Chemistry (pH, etc.). The material proposed for placement is medium grained marine sand as described in the EA. These areas are far removed from any known sources of contaminants. Also, the material is primarily composed of unconsolidated quartz sand which is considered inert and in areas of high current and wave energy conditions. Such materials under high energy conditions are considered most likely free of contaminants. Based on 40 CFR 230.60, no testing for contaminants will be necessary. This sandy material in relict beach sand, and is similar to the sand found on the proposed beach disposal site.

(3) Clarity. The discharging of effluent is expected to create some degree of construction-related turbidity in excess of the natural condition in the proximity of the placement site and the borrow area. These impacts are expected to be temporary, with suspended particles settling out within a short time without measurable effects on water quality. During construction, turbidity levels would be monitored at the dredge and the beach sites, to ensure compliance with FDEP's Water Quality Certification.

(4) Color. The color of the proposed borrow sand matches that of the beach sand to the extent acceptable by the State of Florida's Sand Quality Control (QC) and Quality Assurance (QA) required by paragraph 62B-41.008 (1) (k) (4b) F.A.C.

(5) Odor. No effect.

(6) Taste. No effect.

(7) Dissolved Gas Levels. No significant effect.

(8) Nutrients. No significant effect.

(9) Eutrophication. No effects.

c. Water Circulation, Fluctuation, and Salinity Determinations

(1) Current Patterns and Circulation.

(a) Current Patterns and Flow. Neither the placement of material on the beach nor the proposed excavation is expected to result in significant changes in current patterns or circulations. In the area of proposed excavation currents would be slightly modified due to the increase depth.

(b) Velocity. No significant effects.

(2) Stratification. No significant effects.

(3) Hydrologic Regime. See (a) and (b) above. No significant effects.

(4) Normal Water Level Fluctuations. No effects.

(5) Salinity Gradient. No significant effects.

d. Suspended Particulate/Turbidity Determination.

(1) Expected Changes in Suspended Particulates and Turbidity Levels in Vicinity of Placement Site. The discharging of effluent is expected to create some degree of construction-related turbidity in excess of the natural condition in the proximity of the placement site and the borrow area. These impacts are expected to be temporary, with suspended particles settling out within a short time without measurable effects on water quality. During construction, turbidity levels would be monitored at the dredge and the beach sites, to ensure compliance with Florida Department of Environmental Protection's Water Quality Certification.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light Penetration. Slight decreases in the degree of light penetration may occur during placement activities. These impacts would be temporary in nature and restricted to the immediate area of placement.

(b) Dissolved Oxygen. No significant effects.

(c) Toxic Metals and Organics. No effects.

(d) Pathogens. No effects.

(e) Aesthetics. Only temporary degradation to the aesthetic environment would occur as a result of excavation and placement operations. Impacts would primarily occur as a result of the physical presence of heavy equipment. Some minor increases in turbidity may be observed in the immediate vicinity of excavation and placement activities but these increases would be minor and short-term in nature.

(3) Effects on Biota.

(a) Primary Production Photosynthesis. No long-term significant impacts are expected to occur due to the physical nature of the material to be excavated. No submerged aquatic vegetation is located within the area of dredging or sand placement.

(b) Suspension/Filter Feeders. No significant effects. No oyster reefs, worm reefs, significant clam communities are known to be prominent within the vicinity of the project.

(c) Sight Feeders. No significant effects.

(4) Actions Taken to Minimize Impacts (Subpart H). No further actions are deemed appropriate.

e. Contaminant Determinations. The material to be utilized during restoration of the beach meets the criteria set forth in 20 CFR 230.60(b). The material is

characterized as clean sand which is sufficiently removed from sources of pollution and is located in areas of high current velocities to provide reasonable assurance that the material would not be contaminated by such pollution. In addition, the material originates in the near vicinity of the placement activity and is similar to the substrate of the placement site, and receives the same overlying waters as the placement site. Hence, no further physical, biological, or chemical testing is required pursuant to the 404(b)(1) Guidelines.

f. Aquatic Ecosystem and Organism Determinations. No significant effects.

(1) Effects on Plankton. Placement of nourishment material on the Walton County beaches and the nearshore area would destroy some phytoplankton and zooplankton, and could reduce light penetration which may tend to have an effect on the primary production by the phytoplankton. Due to the nature of the materials to be placed and the duration of the placement operations, these impacts would be short-term in nature and restricted to the general vicinity of the construction activity. Total impacts to the planktonic community would not be significant.

(2) Effects on Benthos. Temporary disruption of the aquatic community is anticipated by the excavation and placement activities. The excavation and direct placement of sands from the borrow sites would result in the mortality of some percentage of the existing benthic assemblages. Non-motile benthic fauna within the area may be destroyed by the proposed work, but should repopulate within several months after completion. Some of the motile benthic and pelagic fauna, such as crabs, shrimp, and fishes, are able to avoid the disturbed area and should return shortly after the activity is completed. Larval and juvenile stages of these forms may not be able to avoid the activity due to limited mobility.

(3) Effects on Nekton. Some fish within and in close proximity of the excavation and placement area would likely leave the area until condition return to be more favorable; however, it is not anticipated that all such organisms would vacate the area. It is logical to speculate that many organisms would avoid an area of disruption such as that associated with the placement of fill material. Some nektonic filter feeders may be killed as a result of being in the affected area and other organisms less capable of movement, such as larval forms, may be physically stressed by the placement of sand. Generally, most organisms would avoid the area and later return to the area. Total impacts to the nektonic community would quickly recover are not considered significant.

(4) Effects on Aquatic Food Web. No significant effects.

(5) Effects on Special Aquatic Sites. No significant effects.

(a) Sanctuaries and Refuges. Not applicable.

(b) Wetlands. Not applicable.

(c) Mud Flats. Not applicable.

(d) Vegetated Shallows. Not applicable.

(e) Coral Reefs. Not applicable.

(f) Riffle and Pool Complexes. Not applicable.

(6) Effects on Threatened and Endangered Species. Pursuant to Section 7 of the Endangered Species Act, the proposed Federal action is being coordinated with the U.S. Department of the Interior, U.S. Fish and Wildlife Service, and the U.S. Department of Commerce, National Marine Fisheries Service. Coordination with the agencies indicates that the proposed action would not jeopardize the continued existence of nesting sea turtles or Choctawhatchee beach mouse or result in adverse modification of the Choctawhatchee beach mouse critical habitat. The USFWS has, imposed terms and conditions to be implemented that would minimize the potential for incidental takes. It has also been determined that the proposed action may adversely affect (MAA) non-breeding piping plover. Consultation for piping plover is ongoing. The USFWS also agrees with the Corps' determination that the selected plan would not likely adversely affect designated critical habitat for non-breeding piping plover and the West Indian manatee. Based on the formal consultations regarding threatened and endangered species and associated designated critical habitats, no mitigation requirements have been identified.

The Mobile District would use Standard Manatee Protection Conditions during construction and survey for Piping plovers is expected to occur. To minimize the potential of sea turtles and Gulf sturgeon take during construction the Mobile District would continue to abide by the terms and conditions of the following: (1) GRBO for Dredging of Gulf of Mexico Navigation Channels and Sand Mining Areas Using Hopper Dredges by COE Galveston, New Orleans, Mobile, and Jacksonville Districts, dated November 19, 2003, as amended; pending Programmatic Biological Opinion (PBO) for Beach Placement and Shore Protection for the State of Florida; and other BO's and coordination documents that will result for this effort.

(7) Effects on Other Wildlife. No significant effect.

(8) Actions to Minimize Impacts. All reasonable and prudent measures recommended by the USFWS and NMFS would be initiated during excavation and placement activities.

g. Proposed Disposal Site Determinations.

(1) Mixing Zone Determination. The proposed action would comply with the zone of mixing as determined by the State of Florida. In the case of placement of material on the beach and a variance from the state mixing zone to cover specific climatic instances when the turbidity standard might be violated and will be incorporated into the WQC permit. A variance from the state mixing zone at the placement sites may be requested as part of the permitting process.

(2) Determination of Compliance with Applicable Water Quality Standards. As a result of previous WQC application activities, it is believed that the proposed Federal action would comply with applicable water quality standards. Water quality certification and consistency determination with the state coastal management plan was requested

from Florida Department of Environmental Protection for a larger local plan. The state has deemed that all requirements pertaining to the application is complete and that turbidity requirements would meet the State's WQC standards

(3) Potential Effects on Human Use Characteristics.

(a) Municipal and Private Water Supply. No impacts would occur to any water supply.

(b) Recreational and Commercial Fisheries. Minor impacts to recreational and commercial fisheries could occur during the construction period. These impacts would be short-term and restricted to the immediate area of construction activities.

(c) Water Related Recreation. Restoration of the beach would increase the area available for beach related water recreation. Restrictions of water-related recreational activities in the immediate areas of construction and dredging would result in short term losses of such opportunities. It has been determined that the benefits associated with the restoration of the beach outweigh these losses.

(d) Aesthetics. Only temporary degradation to the aesthetic environment would occur as a result of the proposed action. Impacts would primarily be a result of the physical presence of heavy equipment. Conducting work in late fall and early spring would miss the peak recreational season; however, it is impossible to completely avoid all impacts to the aesthetic appeal of the area. The presence of the dredge, dredge pipe, and associated water and land based equipment would be evident and would temporarily degrade aesthetic quantities of the area. Some discoloration of the sand would occur following placement due to the fact that the sands to be placed on the beach are coming from anaerobic environment. Bleaching of the sand should occur within one to two months. Rainfall and wave action would act to filter out the fine grained materials from the restored beaches and increase the compatibility of the nourishment sands with those presently on the beach.

(e) Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves. No adverse impacts are expected to occur and any of these resources.

(f) Other Effects. No effect.

h. Determination of Cumulative Effects on the Aquatic Ecosystem. The proposed action is not expected to have significant cumulative adverse impacts. The action would have cumulative beneficial impacts due to erosion attenuation.

i**. Determination of Secondary Effects of the Aquatic Ecosystem**. The proposed action is not expected to have any significant secondary adverse effects on the aquatic ecosystem.

III. FINDING OF COMPLIANCE

a. No significant adaptations of the Section 404(b)(1) guidelines were made relative to this evaluation.

b. No practicable alternative exists which meet the study objectives that does not involve discharge of fill into the waters of the United States.

c. After consideration of placement site dilution and dispersion, the placement fill material along the beach and nearshore zone would not cause or contribute to, violations of any applicable State water quality standards for Class III waters. A variance for an expanded mixing zone has been requested for the local project during the JCP application process. It is expected that information generated for the local plan will be used to request a variance for the proposed Federal project.

d. As required by the Coastal Zone Management Act, the proposed action is consistent with the Florida Coastal Zone Management Program to the maximum extent practicable.

e. The proposed excavation and beach restoration would not jeopardize the continued existence of any species listed as threatened or endangered or result in the likelihood of destruction or adverse modification of any critical habitat as specified by the Endangered Species Act of 1973, as amended.

f. The proposed excavation and beach restoration would not result in significant adverse effects on human health and welfare, including municipal and private water supplies; recreation and commercial fishing; life stages of organisms dependent upon the aquatic ecosystem; ecosystem diversity, productivity and stability; or recreational, aesthetic or economic values.

g. Appropriate and practicable steps to minimize potential adverse impacts on the aquatic ecosystem have been included in this evaluation.

h. On the basis of the guidelines, the proposed site for placement of fill materials is specified as complying with the requirements of these guidelines with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the aquatic ecosystem.

DATE_____ _____

Steven J. Roemhildt, P.E.
Colonel, Corps of Engineers
District Commander

EA-APPENDIX B

SECTION I

Previous Coordination Documents by Local Sponsor

C 2007-009

FLORIDA DEPARTMENT OF STATE
Kurt S. Browning
Secretary of State
DIVISION OF HISTORICAL RESOURCES

Mr. Michael Trudnak
Taylor Engineering, Inc.
10151 Deerwood Park Blvd., Bldg. 300, Suite 300
Jacksonville, Florida 32256

December 11, 2008

Re: DHR Project File No.: 2008-02705-B / Received by DHR: April 28, 2008
Additional Information Received: October 30, 2008
1A-32 Permit No.: 0607.006
A Submerged Cultural Resource Remote Sensing Survey of a Borrow Area Proposed for Beach Renourishment Offshore of Walton County, Florida

Dear Mr. Trudnak:

We note that in May and June 2007, Sonographics, Inc. (SI) conducted the above referenced survey for Taylor Engineering, Inc. in anticipation of a request by the Florida Division of Historical Resources (DHR) for a cultural resource assessment survey. Our office proceeded to review this report with the expectation that Taylor Engineering, Inc. will be engaging in permitting processes that will require this office to comment on possible adverse impacts tot cultural resources listed or eligible for listing in the National Register of Historic Places, or otherwise of historical, architectural, or archaeological significance. We recommend at the time such actions are taken, a copy of this letter be forwarded to the permitting agency(ies) with the application. This may eliminate the permitting agency(ies) from having to submit an application to the Division of Historical Resources for review, or, if applications are forwarded to the Division with this letter, it would facilitate our review.

SI identified thirty-nine magnetic anomalies and two side-scan sonar targets within the surveyed area during the investigation. SI determined that none of the anomalies within the proposed borrow area appears to represent significant cultural resources.

SI determined that the proposed sand borrow activities are unlikely to affect cultural resources. SI recommends no further investigation of the project area.

Based on the information provided, our office concurs with these determinations and finds the submitted report complete and sufficient in accordance with Chapter 1A-46, *Florida Administrative Code.*

For any questions concerning our comments, please contact April Westerman, Historic Preservationist, by electronic mail at amwesterman@dos.state.fl.us, or by phone at (850) 245-6333. We appreciate your continued interest in protecting Florida's historic properties.

Sincerely,

Frederick P. Gaske, Director, and
State Historic Preservation Officer

XC: Louis Tesar, Bureau of Archaeological Research

A Submerged Cultural Resource Remote Sensing Survey

Of A

Borrow Area

Proposed For Beach Restoration

Offshore Of

Walton County, Florida

By

Robert H. Baer
Registered Professional Archaeologist

DHR Permit No. 0607.76

Report Prepared For

Mr. Michael Trudnak, P.E.
Taylor Engineering, Inc.
9000 Cypress Green Drive, Suite 200
Jacksonville, Florida, 32256

Revised October 2008

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Appendix A: Copy 1-A-32 Permit

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Abstract

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Executive Summary

During the permit period 5/30/2007 - 6/30/2007 a remote sensing survey was performed of a single borrow area designated for shoreline nourishment offshore of Walton County, Florida (Figure 1). The remote sensing survey consisted of a magnetometer survey, side-scan sonar survey and a sub-bottom profile survey. The survey was performed by Sonographics, Inc. under contract with Taylor Engineering, Inc.

In the course of the survey, thirty - nine (39) magnetic anomalies, and two (2) side-scan sonar targets were recorded. The thirty - nine magnetic anomalies and two side-scan sonar targets were widely distributed over the bottom area. No concentrated pattern or scatter pattern of magnetic anomalies and side scan sonar targets were recorded that suggested the presence of shipwreck resources in the borrow area, nor did the sub-bottom profiler data indicate the presence of areas that would indicate prehistoric midden sites or other inundated habitation sites.

Based on the analysis of the remote sensing data it was the conclusion of the principal investigator that there are no sunken shipwreck resources, or other sunken cultural sites within the proposed borrow area. Based on this analysis it is the recommended that the Walton County shoreline nourishment project be authorized to proceed.

A Submerged Cultural Resource Remote Sensing Survey of a

Borrow Area

Proposed for Beach Restoration

Offshore of Walton County, Florida

Introduction

Walton County has requested a State of Florida Joint Coastal Permit and Sovereign Submerged Lands Authorization for an offshore borrow area to serve future beach nourishment operations within the county. The proposed borrow area lies in the Gulf of Mexico approximately 5.8 miles south of the Walton County shoreline and 1.3 miles east of the Walton/Okaloosa County border (Figure 1). Walton County's borrow area evaluation process included a cultural resource remote sensing survey to identify and determine if any objects within the borrow area are eligible for listing on the National Register of Historic Places (NRHP). This report presents the results of the remote sensing survey.

The remote sensing survey consisted of combined magnetometer, side-scan sonar, and sub-bottom profile surveys. The remote sensing survey complies with the National Historic Preservation Act of 1966, as amended (PL 89-665); the Archeological and Historic Preservation Act, as amended (PL 93-291); the Abandoned Shipwreck Act of 1987; the Advisory Council on Historic Preservation revised 36 CFR Part 800 Regulations; and Section 276.12, *Florida Statutes*, Chapter 1A-32 and 46 of the *Florida Administrative Code*. The State of Florida Division of Historical Resources approved the scope of work for the remote sensing survey as submitted in a Florida Bureau of Archaeological Research Permit (Chapter 1A-32) application prior to field operations; Appendix A contains Permit No. 0607.06. Field operations occurred between 5/30/2007 and 6/30/2007. The project staff, subcontracted by Taylor Engineering, Inc., included Robert H. Baer, RPA as project principal investigator and Rick Horgan as remote sensing specialist. Mr. Horgan owns and operates Sonographics Inc., Marine Geophysical Services, Wilton Manors, Florida.

Figure 1 Proposed Borrow Area Location Map

Project Location

The center of the proposed borrow area lies approximately 5.8 miles offshore Walton County and 1.3 miles east of the Walton/Okaloosa County border. Walton County lies on the northwest coast of Florida approximately 60 miles east of Pensacola, 100 miles west of Apalachicola and 115 miles southwest of Tallahassee. The county seat is De Funiak Springs. Walton County adjoins Okaloosa County to the west and Bay, Holmes and Washington Counties to the east. Figure 1 shows the position of the proposed borrow area in relation to the Walton County shoreline.

Project Research Objectives

The Submerged Cultural Resources survey aimed to identify and determine if any objects within the borrow area are eligible for listing on the National Register of Historic Places (NRHP). The survey utilized instruments specifically designed to identify shipwrecks, ferrous material, and geological anomalies such as submerged river beds and former terrestrial sites, both prehistoric and historic.

Potential for Cultural Resources in the Survey Area

The northwest Florida Gulf Coast has been settled since the middle of the seventeenth century. Pensacola, the oldest city on the northwest Florida Gulf coast, has had strategic importance since the Spanish first settled there in 1698. Pensacola and Apalachicola Bays and the barrier island estuary system that separates the Gulf of Mexico from the Florida peninsula have formed an essential commercial transit route for the Spanish, English, and later the citizens of the United States following the admittance of Florida to the Federal Union in 1845.

Over the long period of recorded history numerous ships have sunk in the waters of the northwest Florida Gulf Coast. The historic importance of the northwest Florida coastal zone is well documented. Early exploration, trade, commerce, warfare vicissitudes of weather and navigation error has generated numerous recorded shipwrecks. Due to sea level rise and the associated coastal erosion, the coastal waters also contain sites of both prehistoric and historic settlement. Based on three centuries of coastal navigation and settlement of the northwest Florida coastal zone the potential exists for the discovery of cultural materials in the proposed project area. To better understand the potential for the discovery of sunken cultural resources in the survey area a short review of northwest Florida geology, weather, and history follows. This review intends to document the importance of the Walton County coastal zone within the wider context of the northwest Florida Gulf Coast.

Archaeological Sites – Walton County Coastal Zone

Florida Master Site File Information

The State of Florida Division of Historical Resources has identified a number of archaeological master sites in the Walton County upland area and the coastal zone, including some dating between 7000 BC and 1500 AD. Older sites are found particularly along the Choctawhatchee River, its primary tributary creeks, and the littoral zone of Choctawhatchee Bay. Listed sites include Point Washington, Four Mile Point, Alaqua Bayou, Horseshoe Bayou, and Hogtown Bayou. These have occupation ranges from the Prehistoric Period to the Historic Period of settlement. Many of the Walton Coastal Zone archaeological sites in the south portion of the county contain shell middens, including the Destin Midden near the towns of Destin and Sandestin.

Environmental Background

The project area lies in the temperate region of Florida, characterized by mild winters and warm to hot summers. Associated seasonal temperatures average 54°F in winter and 81°F in summer. Walton County contains Florida's highest elevation: it rises to 345 ft near Lakewood in the northwest sector of the county. The county experiences a storm season between the months of June and October and experiences its highest annual rainfall in this period. Conversely, the months between December and February usually experience little rain. The annual average rainfall equals 57 inches. The growing season in north Florida averages 200 days as compared with 300 days in south Florida. Tidal fluctuations are moderate and average between 1.5 and 2 ft. According to a 1998 soil survey, the county has a total area of 1,338 square miles, including 90 square miles of water and 1,045 square miles of land. South Walton County has approximately 26 miles of sand beaches and associated dune systems. Approximately half of the beach and dune system lie between Choctawhatchee Bay and the Gulf of Mexico (Continental data base – facts on File 2007; Winsberg 2003:66, KH & Associates 2003).

Historic Weather Dynamics

The northwest Florida Gulf Coast is susceptible to the power of hurricanes and lesser tropical storms. Tropical storm activity in the Gulf of Mexico normally occurs during the period from June through October, reaching maximum frequency during the month of September. These common weather anomalies have affected shipping patterns in the vicinity of the survey area throughout recorded history. Thus, this study benefits from a brief summary of historic weather dynamics, including the depth and temperature of the Gulf of Mexico, the flow of the Loop Current, and the wind conditions within the unique hydrographic constraints of the wider Gulf of Mexico.

Hurricanes passing through the Gulf of Mexico generally originate in the southern Caribbean or off the west coast of Africa. The rotation of the earth sets these warm weather systems spinning counter clockwise and they create their own powerful micro weather systems. These circular rotating storms typically move across the Atlantic (west to east) or north through the Caribbean traveling along the routes of natural wind patterns. Two principal wind regimes prevail along the northwest Florida coast: southerly winds with an average annual velocity for the Walton County coastal zone of 16 – 17 kph and short lived but often strong northerly winds generally associated with winter weather conditions which may occasionally reach velocities of 38 to 40 kph. In the late winter and spring months, strong southerly winds emanate from low-pressure systems in east Texas and the plains states, often generating tornados. Wind velocities along the northwest Florida Gulf coast are generally constant throughout the year, ranging from a monthly average of 14.5 kph in September to 22.2 kph in April (Gore 1994: 102-107).

The northwest Florida Gulf coast has experienced hurricanes originating in the Atlantic and Caribbean. Hurricane Ivan, which made landfall north of Pensacola on September 16, 2004, was a serious Caribbean and Gulf Hurricane. Hurricane Katrina (2005) was the most devastating hurricane to reach the Gulf coast of the United States since the Galveston Hurricane of 1929. Katrina was an Atlantic hurricane that crossed Florida as a category 1 storm on August 25 and 26, then picked up speed and force in the warm shallow waters of the Gulf of Mexico before making landfall on the Gulf coast of Mississippi and striking New Orleans as a category 5 hurricane on August 29, 2005. In 2004, two hurricanes passed within fifty miles of the survey area; these included Hurricanes Jeanne and Francis (United States Weather Bureau Data Base 2007).

Little is known about the pattern of storms and hurricanes during the Colonial Era. However, in 1559 six vessels of the De Luna expedition to North Florida were lost in a storm in Pensacola Bay (Singer 1992: 22). Since the middle of the 19th Century at least 23 hurricanes and 28 tropical disturbances have passed within 100 miles of the survey area. Since 1990 at least one severe tropical storm or depression has crossed the northwest Florida coastal zone every five years (USWB 2006). Any serious anomaly of weather could prove fatal to a sailing vessel navigating within the confines of the Gulf of Mexico.

Geology & Barrier Island Development

Coastal geologists have classified barrier islands and coastal shorelines into a number of different categories based on their structure, geological attributes, and method of formation. Generally, all coastal barriers lie parallel to the shores that they protect. When they trend into or away from the shoreline, barrier islands may eventually develop into headlands that may form capes or gradually coalesce with the shore. The south Walton County shoreline of approximately 26 miles has a unique geological formation

and ecosystem. Approximately 13 miles of the shoreline is located between Choctawhatchee Bay and the Gulf of Mexico, and the remainder consists of dunes with a lake system that is found only in Walton County, Florida (Walton County Board of County Commissioners Report 2003).

The northwest Gulf coast and barrier island systems consist of a drowned delta that Paleo-Indians inhabited 12,000 years ago before they gradually migrated into the Florida peninsula and continental southeast. At that time, the present barrier island systems were upland regions, and the Gulf of Mexico shoreline west of the Florida peninsula extended approximately 75-100 miles seaward of the present shoreline (Milanich 1995: 17). As sea levels rose and shorelines assumed their present configuration, these prehistoric peoples withdrew to the upland regions. However, the Gulf coast shoreline continues to naturally erode, fragment, and prograde. Core analysis suggests that the northwest Florida to Texas Gulf coast was unbarred during the Middle to Late Holocene Transgression and that the present barrier island system did not originate seaward of their present locations. In other words, although the shoreline was substantially lower during the last Ice Age and inhabited during the latter stages of that period, the coastline as found today emerged from the shoals practically in place and has migrated shoreward and seaward as the result of coastal currents and other natural dynamics (Leatherman 1979: 315-16). During the Holocene Period, the late Archaic and Formative periods, native cultures of the northwest Florida and Gulf region developed and ninety percent of the archaeological sites in the present (upland) coastal zone were inhabited (Gagliano in Davis 1984: 17).

Survey Area History

The northwest Gulf coast and particularly the estuary areas and embayment areas from Apalachicola Bay to Pensacola Bay have a varied prehistoric and historic past. The native peoples who inhabited this coastal area exhibited a pattern of cultural continuity that evolved slowly over the past 10,000 years; then in the period 3000 BC, the culture of these peoples experienced a period of elaboration and diversification. This period of cultural development continued until the 16th century with the arrival of European explorers and settlers who established a permanent presence on the Gulf coast at Pensacola Bay in 1698.

The 160 miles of coastal zone between Pensacola Bay and Apalachicola Bay consist of a mixed bay and estuary system fed by rivers that flow to the southwest through the Florida peninsula. During the prehistoric period the native people that live in the Pensacola Bay-Apalachicola Bay drainage maintained contact with the cultures that lived in the lower Mississippi Valley and Central and South Georgia, most notably the people that lived in the Kolomoki Mound complex in southwest Georgia near present Blakely, Georgia. At the time of the European exploration and during the contact period the natives of the

northwest gulf were encountered by Tristan de Luna in 1559 - 60 who sailed the northwest coast before landing in Pensacola Bay (Milanich 1994: 180 – 185).

At the beginning of the European Contact period, in the 16th Century, the native populations of Florida extending north and west around the littoral of the Gulf of Mexico exhibited little cultural uniformity. According to anthropologist Vernon Knight, the native peoples of the pre-contact period exhibited a mixture of social and economic traits, from the stratified, but non agricultural Calusa of the southwest Florida coast to the partially agricultural chiefdoms of the Fort Walton and Weeden Island cultures of the northern Gulf, to the egalitarian hunter-gatherers of the Texas coast. The chiefdoms from Pensacola Bay (the Penzacola) to Apalachicola Bay (the Apalachee) became distinguished by the integration of their specialized delta horticulture into a traditional estuary oriented hunter-gatherer mixed economy. This led to a more balanced intake of nutrients and the possibility of higher and healthier population levels (Knight in Davis 1984: 199).

Spanish Colonial Period

In the early 16th Century, Spanish explorers began to investigate the northwest Florida coast. Pre-1520 voyages along the central coast of Florida include those of Diego Miruelo (1616) and Francis Hernandez de Cordova (1517). In 1519 Alonzo Alvarez de Pineda is believed to have sailed the entire coast of northwest Florida and landed in what was either Pensacola or Apalachicola Bay. Later in 1528 Panfilo de Narvaez and Alvar Nunez de Vaca entered the area in an unsuccessful attempt to trade with the natives. In 1528 Narvaez landed at what is believed to be Tampa Bay. After landing, Narvaez and a force of Spaniards marched north along the Gulf coast crossing the Withlacoochee and Suwannee rivers. After reaching an Apalachee village named Aute, Narvaez sent a lieutenant, Cabeza de Vaca, and a force of soldiers to locate the coast and the expedition ships that had been sent north from Tampa Bay. It has been suggested that Aute was near the Wakulla River which flows into the St. Marks River that in turn flows into Apalachee Bay. From the village of Aute, de Vaca and a force of soldiers were sent to locate the Gulf of Mexico, which they located a day's march to the west. Shortly thereafter Narvaez, along with de Vaca and the troops, constructed rafts at a location they named the 'Bay of Horses' and began to travel along the coast in an attempt to reach Mexico. The Spanish crossed Apalachee Bay and continued west along the littoral zone of northwest Florida. After an arduous journey in which the Spanish lost most of their party through hunger, disease and hostile Indians they eventually arrived in Vera Cruz. (Lopez – Morillas 1993: 12).

In 1559 the Tristan de Luna expedition sailed the coast of northwest Florida seeking to establish a base from which to explore a route across the southeast from the Gulf of Mexico to the Atlantic. Sailing

east along the northern gulf coast the expedition apparently missed the entrance to Mobile and Pensacola Bays then made landfall west of Apalachee Bay between Cape San Blas and present Walton County. Eventually they retraced their course to Pensacola Bay; while anchored in the bay the fleet was struck by a hurricane and nine ships were lost. The de Luna expedition failed in the attempt to traverse the southeast (Lopez – Morillas: 1993: 12).

In 1698, Andreas de Arriola was appointed the Governor of West Florida. With the establishment of the town of Pensacola, west Florida became connected by a series of missions to St. Augustine on the Atlantic coast – the Capitol of East Florida.

Walton County History

Documented European and American settlement in what is now Walton County began in the early 19th Century in the area known as the Euchee Valley generally located between present U.S. Highway 90 (Rock Hill Road), U.S. Highway 331, and the Choctawhatchee River. Another area of pioneer settlement was the Alaqua Creek basin that is now primarily located on the Eglin Air Force Reservation. Since the arrival of the Spanish in the 16th Century the rich natural resources of Choctawhatchee Bay and the Gulf of Mexico were harvested by Spanish fisherman that traveled the littoral zone of the Gulf of Mexico from Havana, Cuba, occasionally establishing fishing camps on the barrier system and in the bays and estuaries.

The first fully documented settlers of what is now Walton County were the McLendon brothers, who migrated to the area from North Carolina and settled along Bruce Creek near present Eucheeanna. The McLendons' successful homesteading influenced other North Carolinians to settle in the area. Walton County was created in 1824, shortly after the United States acquired West Florida from the Spanish. Originally Walton County consisted of 2,900 square miles, however the county lost a large portion of territory when Washington, Holmes, and Okaloosa counties were formed; the county now consists of 1,338 square miles. The first county census was carried out in 1830 and a population of 1,207 was recorded (Kimley Horn Inc., 2003).

The first settlers engaged in farming and fishing the rich natural resources of Choctawhatchee Bay. During the period of pioneer settlement the residents of the area navigated in short draft vessels out of what is now East Pass at Destin, to the port of Pensacola Bay and Escambia Bay 60 miles to the west and Apalachicola Bay 100 miles to the east. However, Pensacola became the primary port of coastal trade up to and through the era of the Civil War. Later, after the Civil War, Walton County became a prime timber growing area which supplied the timber and turpentine (naval stores) industries in Florida and the wider southeast through a widely expanding coastal trade (Walton County Historical Society).

Steamboat and barge landings on the Choctawhatchee River that included Moss Bend (Story's Landing) and Millers Ferry provided interior settlements with access to Choctawhatchee Bay and Gulf of Mexico shipping lanes. The upriver landings were often closed through low water and silting, thus Mallet's Landing and LaGrange, now Freeport were the first towns along the bay to develop as successful port communities. Present Portland where Alaqua Creek enters Choctawhatchee Bay, a few miles west of Freeport, became the site of a thriving sawmill that operated prior to and after the Civil War and was a major source of lumber production in northwest Florida (Walton County Historical Society).

During the period of the Civil War in Florida, 1861 – 1865, Walton County and the Choctawhatchee Bay area was affected by the Federal Blockade. For all practical purposes, this closed ports in the Gulf of Mexico to the normal commerce and trade that had grown over the first half of the 19th Century. There were no recorded engagements in Walton County during the five years of the Civil War, however, the Federal invasion of Pensacola in 1864 and the burning of the Port of Pensacola negatively influenced the economy of the entire northwest Gulf Region (Walton County Library Resources).

Walton County experienced an economic boom in 1884 with the completion of the Louisville & Nashville Railway line from Tallahassee to Pensacola with a link to DeFuniak Springs located in north central Walton County. This railway line opened the interior of the county to additional logging and then to the agriculture that began to flourish in the previously forested areas. The arrival of the railway decreased the amount of river traffic on the Choctawhatchee River, except for Freeport that continued to thrive as a port (Walton County Historical Society).

The beginning of what would become a flourishing tourism industry in Walton County began during the Civil War Reconstruction Era when the Florida Chautauqua opened in February of 1885 in DeFuniak Springs. The Florida Chautauqua consisted of educational and entertainment activities with a religious theme presented in a 'camp meeting' atmosphere. The Florida Chautauqua continued until the turn of the century and is credited with the bringing of the first motion pictures to Florida audiences. This advent of mass entertainment brought the end to Chautauqua in 1920 when radio and the widening Florida highway system offered other cultural opportunities for citizens and tourists alike (Walton County Historical Society).

After the Spanish American War of 1898 – 1899 additional settlers arrived in the area and the Walton County coastal zone became the site of towns that now line the 26 miles of Walton County coastline; these towns include from west to east – Destin, Sandestin, Santa Rosa Beach, Grayton Beach, Seagrove Beach and the unique architectural municipality that was incorporated as Seaside.

Historic Period Currents and Navigation

Geographically situated on the northwest Florida coast, the Walton County shoreline is strategically located at about the mid-point along the historic route of vessels departing the Mexico port of Vera Cruz for ports along the southeastern Gulf Coast or Havana, Cuba. A review of standard shipwreck resources (see below) confirms that at least a dozen vessels may have been lost in the waters offshore of Walton County or in Choctawhatchee Bay. The standard shipwreck lists document far more shipwreck sites in Apalachicola Bay to the east and Pensacola Bay to the west. However, the narrow entrance to Choctawhatchee Bay was known to be hazardous to coastal trading vessels. Due to the shallow waters in the area of the bay, navigation into the estuary was limited to shallow draft fishing vessels and coastal trading vessels. This section of the Cultural Resources Management report describes prevailing gulf currents, hazards to navigation, and a shipwreck history of the Walton County area.

The Loop Current is the primary current system in the Gulf of Mexico, utilized by Historic Era sailing vessels. This is the physical product of two major trans-Atlantic currents: the Equatorial Current and the Guiana Current. These combine and enter the Gulf of Mexico through the Yucatan Channel, north of the Yucatan Peninsula. The constriction of this narrow channel pushes masses of water into the gulf. Seasonal water mass velocities may exceed four nautical miles per hour in the summer, although they fall to a low speed of one mile per hour in the winter (Gore 1994: 67).

Once in the Gulf of Mexico the Loop Current divides into two components: a Gulf Basin component and a northern component. The Gulf Basin component arcs to the west, passing the Campeche banks, in a broad band of water 56 – 93 miles wide. This segment of the current did not provide easy navigation for sailing vessels and threatened to drive them onto the reefs and submerged rocks along the northern shoreline of the Yucatan peninsula. The northern half of the current is not of great importance to gulf shipping until a vessel attempts passage out of the gulf proper into the Straits of Florida. This segment of the Loop Current flows eastward along the northern coastline of Cuba that empties into the Florida Current separating the eastern seaboard of the Florida peninsula and the Bahamas Banks (Steinmiller 1984: 26).

The Loop Current is not a predictable physical system like the Florida Current (Gulf Stream), flowing northward in relatively the same position and at the same speed. The Loop Current is not so much a clearly defined unchangeable hydrographic entity, but rather the sum total of all the highly variable current patterns occurring offshore in the northern Gulf over a given period. Physical factors affecting the current are variations of wind, wave, and tide, along with the continual outflow of water from the Mississippi and other rivers that empty into the Gulf. Gyres may form anywhere at any time, but

only those forming in the northeastern Gulf east of the Mississippi Delta and the west coast of Florida are pertinent to this investigation. These anomalies in the current affect short term weather patterns because they transport fresh supplies of warm Gulf water into cooler, faster moving coastal currents. Such anomalies often produce storms that form and dissipate quickly, and together with high seas and darkened shorelines often proved hazardous to vessels under sail (Gore 1994:89).

Navigators in the historic period followed the Loop Current when sailing from Mexican Ports and other Gulf Ports in North America to Havana in the first leg of their return voyage to Spain. A number of such voyages have ended in shipwreck. Most notable are the Padre Island shipwrecks of 1554, located near the mouth of present Port Mansfield Channel that leads into contemporary Galveston Bay, Texas. Another representative Gulf Coast shipwreck is the *El Nuevo Constante* that foundered in shallow water off the coast of Louisiana in September, 1766. In 1980 the shipwreck site was discovered by commercial fisherman working in the offshore area (Pearson & Hoffman 1995: 1 – 7).

Area Shipwreck Research

The location of the borrow area offshore of Walton County, Florida and the long history of exploration and navigation along the northwest Florida coastal zone support the potential that historic shipwreck sites may exist in its coastal waters. Pursuant to this study, the principal investigator conducted a literature and records search to identify known shipwrecks and other historic data pertinent to the wider survey area.

The archival survey included communication with individuals and agencies at the state, county and local levels of government. The survey analyzed databases of prehistoric and historic archaeological sites that have been identified in the vicinity of the survey area. The survey focused on the documentation of activities that might have been contributing factors in the loss of vessels; such activities included exploration, colonization, agriculture, industry, trade, ship-building, commerce, warfare, transportation, and fishing.

The literature survey included the following sources: *The Encyclopedia of American Shipwrecks* (Berman 1972); *Merchant Steam Vessels of the United States 1909 – 1865* (Lyle and Holdcamper 1952); *Disasters of American Vessels, Sail and Steam 1841 – 1846* (Lockhead 1954); *Shipwrecks of the American Civil War, The Encyclopedia of Union and Confederate Naval Losses* (Schomette 1973); *Shipwrecks of the Western Hemisphere* (Marx 1971); *The Treasure Hunters Guide* (Potter 1972); *Shipwrecks of Florida* (Singer 1998); *Shipwrecks in Florida Waters* (Marx 1985). Other reference sources included the National Oceanic and Atmospheric Administration (NOAA) Historic Chart Database; The Florida State University Shipwreck Database, as well as The United States Coast Guard and recreational

boating charts of the waters of northwest Florida. Other archival charts utilized in a review of coastal waters were the Bernard Romans charts of 1775, and the Romans, *Natural History of Florida*. According to the Florida Master Site File, a number of Paleo-Indian terrestrial sites existed along the coastal zone northeast of the survey area.

Shipwrecks in the NW Florida – Walton County Coastal Waters

Shipwrecks represent the primary motivation for undertaking remote sensing surveys as part of the cultural resource assessment process. The location of some shipwrecks on the northwest Florida coast are known and documented such as the 'Six Ships of the De Luna expedition lost in a storm in Pensacola Bay in 1559 and an 'American Schooner' lost off the mouth of the Suwannee River in 1820. Potter refers to the 'The American Gulf Coast Wrecks', however, no specific locations are given. Potter does write that, "at least a dozen treasure laden vessels have been reported and rumored sunk along the American Gulf Coast" (Potter 1960: 167).

Vessels Lost Near Choctawhatchee Bay

* 1875: The *Three Sisters*, a 154 ton schooner bound from Pensacola to Apalachicola foundered in a storm before reaching port.

* 1892: The *J.P. Allen* – a schooner from Pensacola, 27 tons sand in a storm 60 miles east of Pensacola in the Gulf of Mexico.

* 1906: The *Gus Schammel*, a schooner of 42 tons, built in 1904, lost near Choctawhatchee Bay.

* 1909: The *James C. Clifford* a schooner of 377 tons abandoned 60 miles southwest of Pensacola Bay.

* 1911: The *Belle*, a side wheel schooner of 74 tons built in 1904 at Vernon, Florida was burned at pass into Choctawhatchee Bay.

* 1922: The Rollo a side-wheel schooner of 33 tons built in 1908 at Pinewood, Florida, sank in Choctawhatchee bay on March 30, 1922.

* The Miss. Becky, a 26 ton steel vessel lost in a collision off of Destin in the Gulf of Mexico.

Archival Research Summary

The above review of some credible and thorough archaeological reports indicates that the waters offshore Walton County contain very few of the known shipwreck sites off the Gulf Coast of Florida. None of the wrecks listed in the above references are found within the borrow area vicinity. Given the comprehensive nature of the above references, it is highly unlikely that the researchers overlooked any

wreck sites in the study area; thus, the current study did not conduct additional interviews. Information gained from this archival review will aid the understanding of the remote sensing survey results and will help the principal investigator determine the existence of any significant cultural resources within the study area.

Field Investigations

Magnetometer, Side-scan Sonar, Seismic Survey

Methodology

The Florida Division of Historical Resources approved the methodology and equipment for the remote sensing survey before it began. The remote sensing, magnetometer, side-scan sonar, and sub-bottom surveys of the borrow area were conducted between 5/30/2007 and 6/30/2007. The purpose of these surveys was to ascertain if any submerged cultural resources were located within the borrow area.

Magnetometer

The magnetometer survey utilized a Geometrics Model G-882 Digital Cesium System with a built in depth sensor and altimeter. The G-882 sampled the earth's magnetic field at the rate of 10 samples per second. The magnetometer delivered total field, depth, and altimeter data to a Hypack Navigation Computer. The Hypack software recorded the magnetometer tow-fish position with each incoming magnetometer reading. The surveyors monitored the display of the magnetometer throughout the survey to ensure that the equipment remained at the proper elevation. The survey collected data along straight lines spaced at 100 foot intervals.

Side-scan Sonar

The side-scan sonar survey utilized an Edge Tech Model 4200-FS digital CHIRP system. Once again, the side-scan sonar delivered imagery to the Hypack Navigation Computer, which geo-encoded it using the tow-fish position and stored it in the Edge Tech native (jsf) format. The survey followed the same tracklines as the magnetometer survey and occurred simultaneously. It collected dual frequency data at 120 kHz and 400 kHz and used a range scale of 50 m per side for a total swath of 100 m and 250% coverage.

Sub-Bottom Profiler

The sub-bottom survey utilized an Edge-Tech SB 424, which emits a high frequency CHIRP pulse. This X-Star Full Spectrum Sonar has a versatile wide-ban FM profiler that generates cross-sectional images of the seabed and collects digital normal incidence reflection data over many frequency

ranges. The tapered wave form spectrum results in images that have virtually constant resolution with depth.

Electronic Navigation

Throughout the survey, a Trimble DSM 232-L – Real Time Differential Global Positioning System (GPS) fed navigation data into the Coastal Oceanographic (Hypack) Hydrographic Data Collection and Processing System. The DSM 212-L has a differential (GPS) beacon receiver which uses the U.S. Coast Guard Differential Correction Signal to send accurate differential GPS corrections to the onboard GPS receiver. The U.S. Coast Guard Pensacola Beacon provided the differential correction signal for this survey.

The DSM-232 provides moderate precision static and dynamic position and velocity data at a rate of one reading per second. Accounting for the differential correction, it has an accuracy of approximately 1 meter. All data references the Florida State Plane Traverse Mercator – Projection Coordinate System, North Zone (NAD 83).

Survey Area Parameters

Figure 1 shows the position of the borrow area, centered approximately 5.8 miles offshore Walton County. The borrow area has a roughly rectangular shape and measures approximately 10,200 ft (1.9 miles) by 5,300 ft (1.0 miles). The average water depth in the borrow area equals 70 ft.

Figure 2 shows the remote sensing tracklines and the positions of the 39 magnetic anomalies and 2 side-scan sonar targets. Side-scan target S1 corresponds to magnetometer anomaly M5 and side-scan target S2 corresponds to magnetometer anomaly M39. Table 1 presents pertinent data associated with each magnetometer anomaly. The table includes latitude, longitude, easting, and northing data, along with the intensity of each anomaly and an estimated ferrous weight. Estimated weights were computed using formula and techniques from the *Geometrics Applications Manual for Portable Magnetometers* by Sheldon Brenier (1973). Figures 3 – 5 show images of side-scan sonar target S1, and Figures 6 – 8 show images of S2.

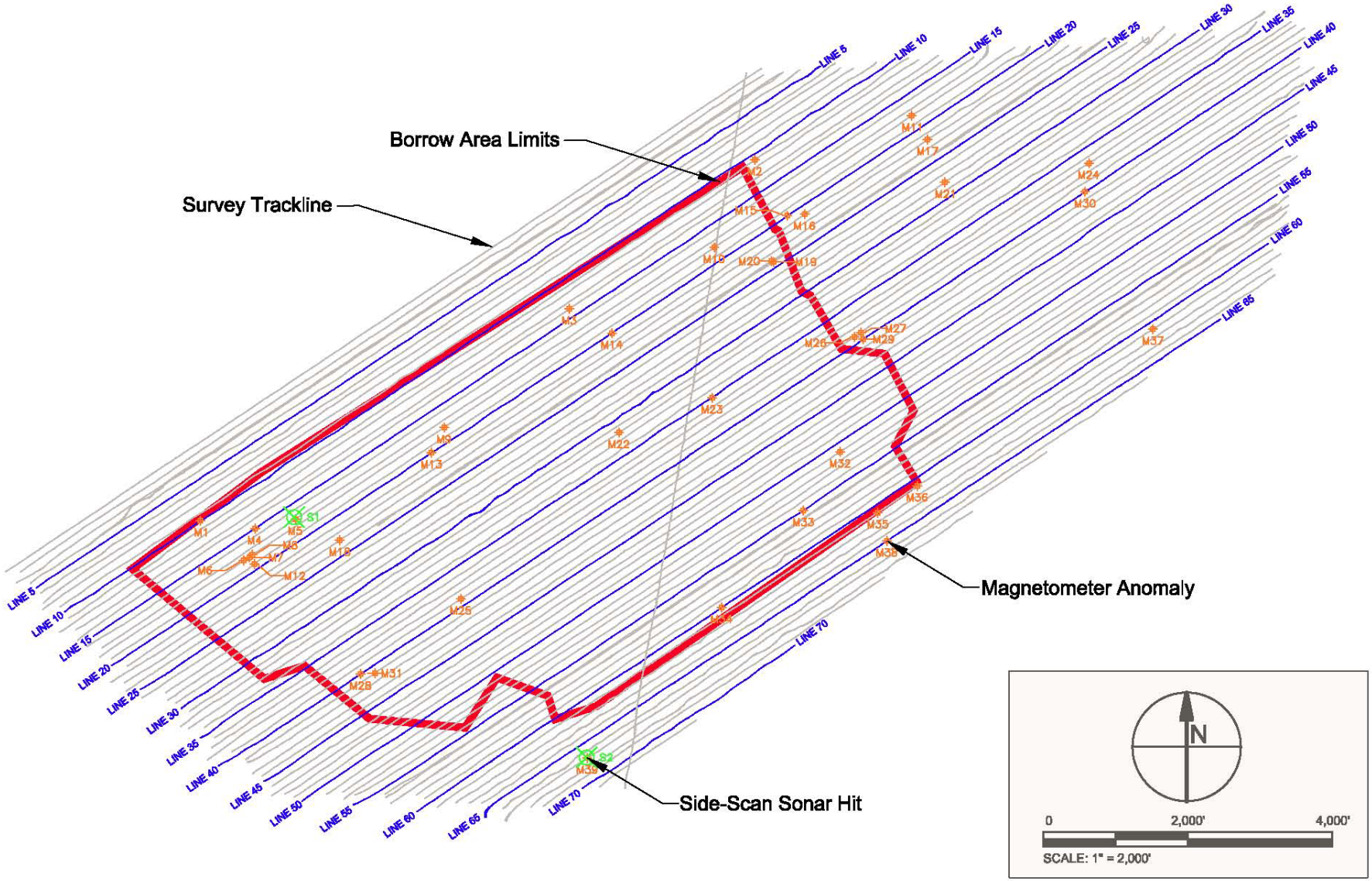

Figure 2 Seismic Tracklines with Magnetometer and Side-Scan Sonar Hits

Table 1 Magnetometer Survey Results

Number	Location (ft-NAD83, FL-N)		Survey Line No.	Intensity (gammas)	Range (ft)	Horizontal Range (ft)	Estimated Mass (lb)
	Easting	Northing					
M1	1371724.120	475229.610	10	13.0	28	13	250
M2	1379397.450	480217.850	11	23.0	26	9	350
M3	1376827.890	478156.820	14	16.0	31	23	400
M4	1372475.520	475122.080	15	7.4	15	0	24
M5, S1	1373035.190	475251.600	17	25.1	35	32	500
M6	1372324.000	474681.600	18	1.1	18	0	5
M7	1372394.500	474724.900	18	1.1	19	0	9
M8	1372444.300	474761.000	18	0.2	14	18	0
M9	1375092.700	476516.330	18	1.5	30	22	42
M10	1378831.820	479006.050	18	1.3	16	0	10
M11	1381567.590	480829.520	18	1.1	23	0	14
M12	1372467.860	474635.210	19	1.0	14	0	3
M13	1374918.530	476170.220	20	2.0	21	0	19
M14	1377418.640	477825.400	20	1.0	24	10	12
M15	1379842.650	479443.980	20	0.1	25	14	23
M16	1380085.530	479465.370	21	1.0	21	0	10
M17	1381788.350	480499.520	22	1.0	13	0	2
M18	1373651.390	474961.920	23	1.2	15	0	5
M19	1379651.540	478807.810	24	0.2	17	0	10
M20	1379622.550	478815.690	24	3.0	22	0	28
M21	1382025.100	479905.930	28	1.0	19	0	8
M22	1377515.530	476447.230	32	2.0	30	11	55
M23	1378802.230	476930.560	35	0.1	23	20	14
M24	1384019.470	480173.670	37	2.0	16	0	9
M25	1375325.700	474149.060	39	1.0	24	0	12
M26	1380776.830	477771.410	39	1.1	16	0	6
M27	1380865.480	477829.810	39	1.1	10	0	8
M28	1373939.230	473112.100	40	2.2	29	15	46
M29	1380893.830	477737.390	40	3.1	11	0	4
M30	1383967.320	479775.770	40	0.3	35	26	109
M31	1374136.850	473123.070	41	2.0	11	0	2
M32	1380577.750	476184.750	51	1.0	17	0	7
M33	1380068.420	475371.510	55	0.2	25	0	22
M34	1378938.070	474031.320	60	0.2	26	0	27
M35	1381097.910	475343.880	61	3.0	32	16	87
M36	1381644.310	475714.210	61	2.2	26	0	29
M37	1384907.870	477876.720	61	1.0	16	0	27
M38	1381224.030	474951.970	65	3.3	11	0	5
M39, S2	1377074.960	471949.970	67	4.0	31	12	119

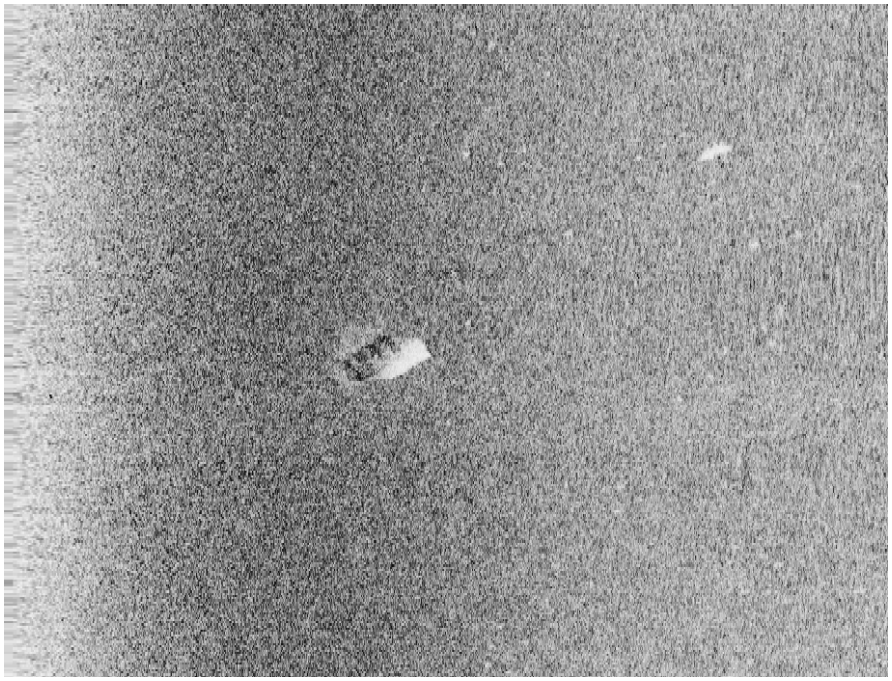

Figure 3 Sonar Target S1 at Range 62 ft on Survey Line 16NE, Heading 054T, Sweeping Left to Right

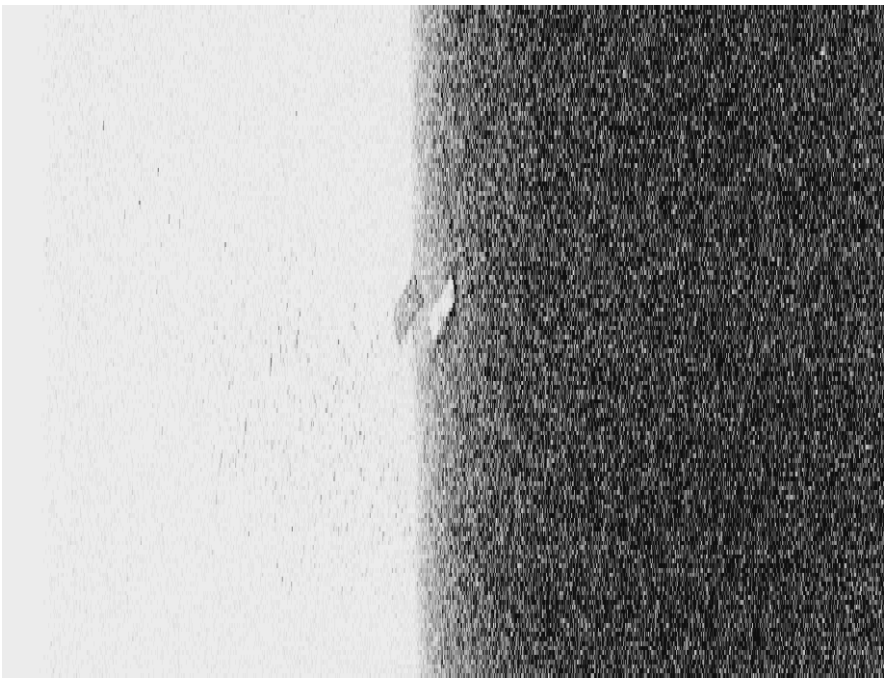

Figure 4 Sonar Target S1 at Range 16 ft on Survey Line 17SW, Heading 234T, Sweeping Left to Right. Image is zoomed with water column not removed as target was almost under the towfish. The top of the target appears suspended. However, very faint supports are visible on two corners. Small fish are visible in the water column, apparently attracted to this target.

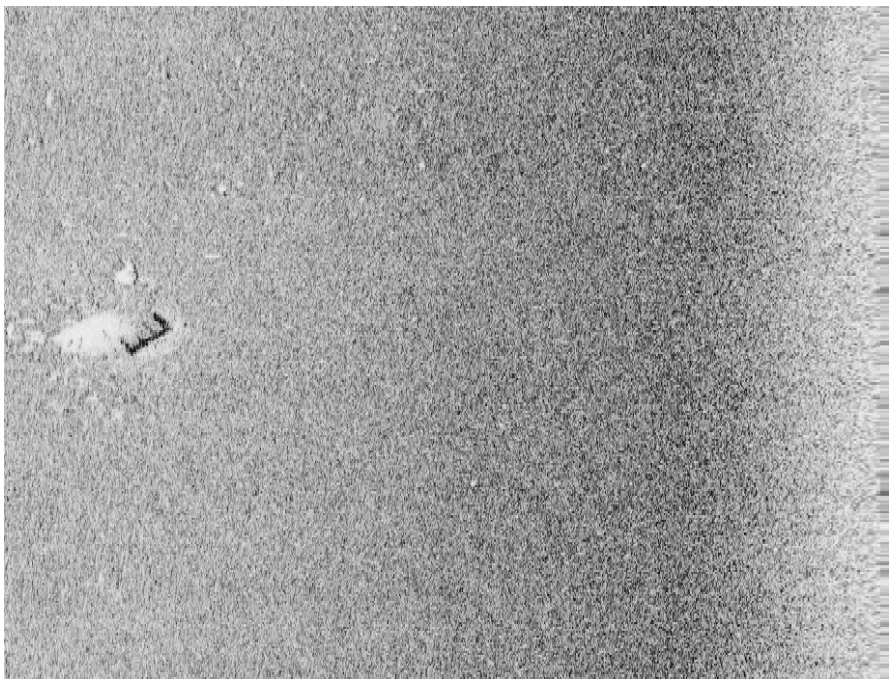

Figure 5 Sonar Target S1 at Range 127 ft on Survey Line 18NE, Heading 054T, Sweeping Right to Left

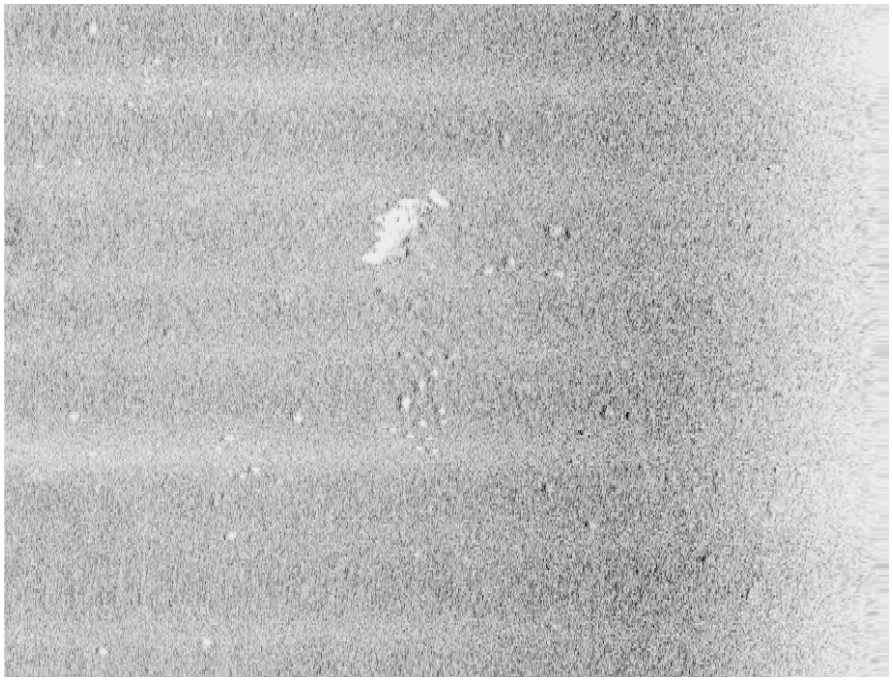

Figure 6 Sonar Target S2 at Range 80 ft on Survey Line 66SW, Heading 251T, Sweeping Left to Right. Note holes (targets with white in front) in the seafloor. These are unique to the area surrounding this target. They likely are habitat for creatures attracted to this target.

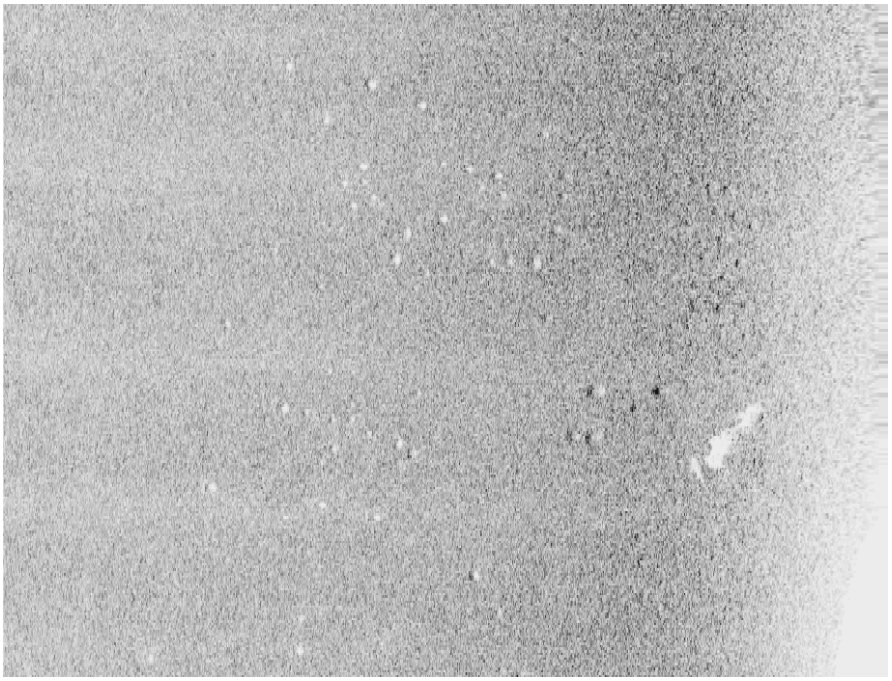

Figure 7 Sonar Target S2 at Range 24 ft on Survey Line 67NE, Heading 049T, Sweeping Left to Right.

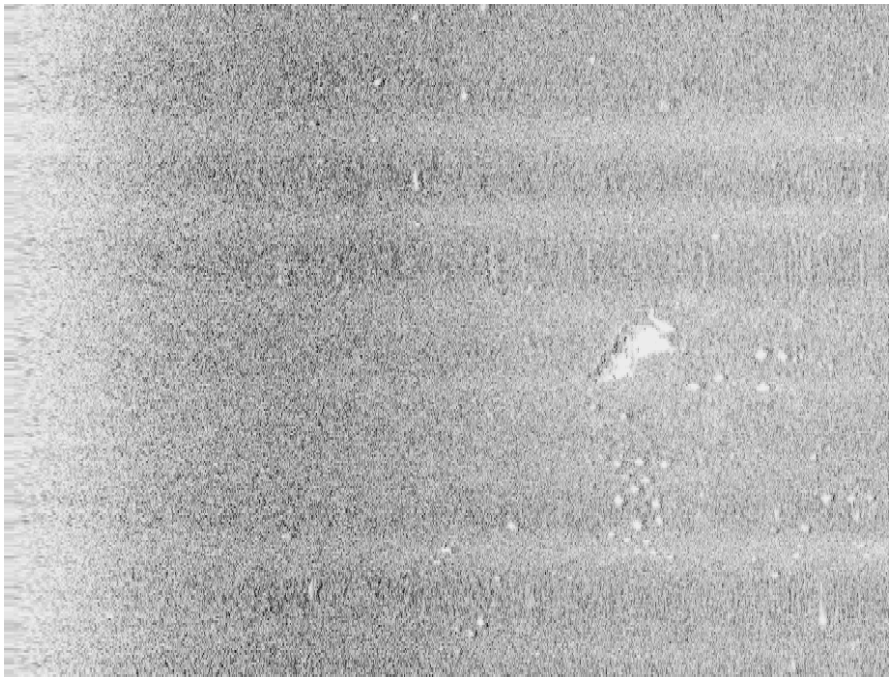

Figure 8 Sonar Target S2 at Range 105 ft on Survey Line 68SW, Heading 250T, Sweeping Right to Left.

Data Analysis

Following the investigation in the field, the survey team conducted initial data analysis of the recorded magnetometer data, side-scan sonar data, and sub-bottom profile data, and then submitted everything to the principal investigator. The role of the principal investigator was to determine the absence or presence of anomaly patterns and side-scan sonar images that would indicate the possibility of sunken cultural resources in the borrow area.

Sub-Bottom Profile Data

The principal investigator reviewed all of the sub-bottom profile data for geologic structures such as prehistoric creek and river beds that might include features that suggest aboriginal habitation sites. The data revealed no evidence of any such sites and no indication of shell midden material on the seabed. The side-scan sonar data, which would have registered such material, confirmed its absence in the project area.

Survey Results

Magnetometer and Side-Scan Sonar Survey

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Discussion

The remote sensing survey identified 39 magnetic anomalies and 2 side-scan sonar targets within the survey area. The anomalies primarily lie isolated from other anomalies, have low intensity and weight, and do not suggest the existence of any object of significance. Two exceptions warrant further analysis; the side-scan sonar target S1 and the cluster of anomalies including M4 – M8 and M-12 in the southwest corner of the proposed borrow area and the cluster of anomalies including M26, M27, and M29 just outside the borrow area boundary to the northeast suggest the possibility of submerged cultural resources. Note that side-scan sonar target S2 and the associated magnetic anomaly M39 lie approximately 600 ft outside of the borrow area and, thus, were excluded from further analysis.

Analysis

The first of the two areas identified for further analysis lies in the southwest corner of the proposed borrow area and contains magnetometer anomalies M4, M5, M6, M7, M8, M12, and side-scan sonar target S1. Although located in close proximity to one another, anomalies M6, M7, M8, and M12 each have very low intensity suggesting a submerged mass of no more than 9 ferrous pounds. However, magnetometer anomaly M5 recorded high intensity and has a computed mass of approximately 500

ferrous pounds. Figures 3 – 5 contain images from the associated side-scan sonar target S1. The article in these figures exhibits low relief and modest weight. It measures approximately 8 ft by 5 ft and appears to be acoustically transparent except for its rectangular top and bottom surfaces. It likely derives from local fishing activity and conforms to a ferrous object such as a steel fish trap.

The second of the two areas identified for further analysis lies just outside the proposed borrow area to the northeast but close enough to the boundary to potentially affect dredging activities. The cluster contains magnetic anomalies M26, M27, and M29. Each of these has very low intensity suggesting a submerged mass of no more than 8 ferrous pounds. Since the borrow area lies in a well populated coastal zone near a well used pass (East Pass), the low weight and low intensity ferrous anomalies are likely related to modern fishing and boating activities and have no historical significance.

Conclusions and Recommendations

The principal investigator concludes after an analysis of the remote sensing data that no shipwreck resources exist in the survey area. This conclusion is supported by the relatively few clusters of anomalies in the borrow area and the widely dispersed pattern of the remaining anomalies. Further, the lack of side-scan images does not suggest the presence of any raised area that would indicate inundated midden sites from a prehistoric terrestrial environment. The principal investigator recommends that the borrow area be utilized for the proposed beach re-nourishment project.

While this study did not identify any significant cultural resources, significant shipwrecks can go unrecognized even with the application of modern remote sensing methods. If any project activities encounter significant cultural resources, all work should cease at the site and the project state and/or federal agencies should be contacted.

Project Curation

All project records will be maintained by Taylor Engineering Inc, Jacksonville, Florida as well as in the archives of the Florida Division of Historical Resources, Tallahassee, Florida.

References

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Reports

Kimley Horn Assoc., Evaluation Appraisal report, Walton County, Florida.

Other Sources

Continental data Base – Facts on File

United States Weather Bureau

Walton County Florida Chamber of Commerce

Walton County Florida Historical Society

Appendix – A

Permit: 1-A-32 Correspondence

FLORIDA DEPARTMENT OF STATE
Kurt S. Browning
Secretary of State
DIVISION OF HISTORICAL RESOURCES

June 05, 2007

Robert H. Baer
Taylor Engineering, Inc.
9000 Cypress Green Drive, Ste. 200
Jacksonville, Florida, 32256

Re: 1A-32 Archaeological Research Permit Number 0607.76
Walton County Sand Survey

Dear Mr. Baer:

Please find the enclosed 1A-32 Archaeological Research permit. In an effort to streamline the permitting process, the permit format and conditions have changed, so please read the document carefully. In particular, please note that there are six lines for your initials under General Condition 3 and that there is a line for the land manager's (if applicable) signature.

To execute this permit, please send the signed permit to the Bureau of Archaeological Research, Permit Administrator, at the address below. If you have any questions about the permit process or about requirements, please contact me at (850) 245-6301 or via email at rjwheeler@dos.state.fl.us. Please refer to the permit number in all such contacts.

Sincerely,

Ryan J. Wheeler, Ph.D.
Chief, Bureau of Archaeological Research

FLORIDA DEPARTMENT OF STATE
Kurt S. Browning
Secretary of State
DIVISION OF HISTORICAL RESOURCES

ARCHAEOLOGICAL RESEARCH PERMIT

Permit No. 0607.76 Field Begin Date: 5/30/2007 Field End Date: 6/30/2007

PERMITTEE/AUTHORIZED ENTITY:
Taylor Engineering, Inc.
c/o Robert H. Baer
9000 Cypress Green Drive, Ste. 200
Jacksonville, Florida 32256

Report/Artifact Due Date: 6/30/2007
Project: Walton County Sand Survey

This permit is issued under the authority of Chapters 267.031 (1) and 267.12, Florida Statutes (F.S.) and Rule 1A-32, Florida Administrative Code (F.A.C.), and is administered by the Florida Bureau of Archaeological Research (BAR), Florida Division of Historical Resources (DHR).

ACTIVITY DESCRIPTION:
Submerged remote sensing survey for archaeological resources, pursuant to Rule 1A-46, F.A.C.

LOCATION DESCRIPTION:
offshore Walton County, FL
DEP, Sovereignty Submerged Lands

GENERAL CONDITIONS:

1. The Principal Investigator listed above or another qualified archaeologist designated by the applicant shall be responsible for all archaeological investigations, production of a final report, and be on site during all fieldwork.

2. A copy of this permit shall be provided to the land managing agency (when applicable) and field personnel shall carry a copy during fieldwork.

3. The permittee shall (initial each item as indicated):
   a. prepare a final report that meets standards and guidelines required by Rule 1A-46, F.A.C., including the necessary Florida Master Site File forms; RHB
   b. inform the BAR permit administrator that a report has been completed and submitted to the Division of Historical Resources; or submit a copy of the final report to the BAR permit administrator; _____
   c. provide proper curation and conservation of recovered artifacts and other recovered site materials until such time as those artifacts and other site materials are conveyed to the BAR for curation; _____
   d. convey all artifacts and related materials obtained from state-owned or controlled land to the BAR permit administrator for permanent curation or processing for loan; RHB

e. convey copies of all notes, maps, photographs, videotapes, and other field records pertaining to research conducted under this permit to the BAR permit administrator following completion of the project DAB;

f. and not remove from a stable environment artifacts and materials which the permit recipient is unable to properly curate and conserve before conveying to BAR. DAB

4. The effective field investigation dates are subject to receipt of permission from the land management agency and, in some instances, State/Federal dredge-and-fill permitting programs. Those agencies may also require work performance conditions relevant to their natural resource management and permitting responsibilities. A representative of the land managing agency (if one exists) will need to sign this permit document prior to BAR executing this permit (see page 3).

5. Unless approved in writing by BAR, no work beyond that described in the "ACTIVITY DESCRIPTION" and attached to your application shall be performed.

6. This permit is valid for up to one year following the requested report due date. Requests for approval for amendments to fieldwork, fieldwork end date and report/artifact due date are required during this time. Such requests may be made and approved by phone, email, or in writing during this time and do not require amendments to this document.

7. In any release of information, including public presentations, media contacts, and the final written report, there shall be acknowledgement that the portion of the project involving state-owned and controlled land was conducted under the terms of an archaeological research permit issued by the Florida Department of State, Division of Historical Resources, Bureau of Archaeological Research.

8. If Unmarked Human Burials are discovered, permit recipient shall comply with the provisions of 872.05, F.S., and when appropriate, Rule 1A-44, F.A.C. Specifically, upon discovery of unmarked human remains, all activities that might further affect those remains shall be halted and the remains protected from further disturbance until an appropriate course of action has been determined by the local medical examiner or by the State Archaeologist, as appropriate.

9. In issuing this permit, the State assumes no liability for the acts, omissions to act or negligence of the permittee, its agents, servants or employees; nor shall this permittee exclude liability for its own acts, omissions to act or negligence to the State.

10. The permittee, unless the permittee is an agency of the State, agrees to assume all responsibility for, indemnify, defend and hold harmless the Division of Historical Resources from and against any and all claims, demands, or liabilities, or suits of any nature whatsoever arising out of, because of, or due to any act or occurrence of omission or commission arising out of the permittee's operations pursuant to this permit and shall investigate all claims at its own expense. In addition, the permittee hereby agrees to be responsible for any injury or property damage resulting from any activities conducted by the permittee.

11. The parties hereto agree that the permittee, its officers, agents and employees, in performance of this permit, shall act in the capacity of an independent contractor and not as an officer, employee, or agent of the State.

The undersigned, as representative of the Permittee/Authorized Entity, understands and accepts the terms of this 1A-32 Archaeological Research Permit.

Robert H Bay _____ Date: 6/14/2007

Signature

The undersigned, as representative of the land managing agency for the managed area/state property described in the "LOCATION DESCRIPTION" section of this document, hereby permits the activity described above.

_____ Date: _____

n/a

Title: _____

This permit will not become effective until it has been executed by the Chief of BAR. Before BAR can execute this permit, the Permittee must have a land management representative (if applicable) sign in the space provided above. Please send the signed permit to the Permit Administrator at the address above.

A copy of the executed permit will be sent to you prior to commencing fieldwork.

Executed in Tallahassee, Florida

STATE OF FLORIDA
DEPARTMENT OF STATE

_____

RJW/apw

Ryan J. Wheeler, Ph.D.
Chief, Bureau of Archaeological Research

Date of Issue_____

Enclosures:
Rule 1A-46, F.A.C.
BAR Collections and Curation Guidelines
How to Package Documents, Florida Master Site File

Copies furnished to:

Appendix – B

Master Site File Form

Ent D (FMSF only)___/___/___

Survey Log Sheet

Florida Master Site File
Version 4.1 1/07

Survey # (FMSF only) _____

Consult *Guide to the Survey Log Sheet* for detailed instructions.

Identification and Bibliographic Information

Survey Project (name and project phase) **Walton County Sand Survey**

Report Title (exactly as on title page) **A Submerged Cultural Resource Remote Sensing Survey of a Borrow Area Proposed For Beach Restoration Offshore of Walton County, Florida**

Report Author(s) (as on title page– individual or corporate; last names first) **Robert H. Baer, Registered Professional Archaeologist**

Publication Date (year) **4/20/08** Total Number of Pages in Report (count text, figures, tables, not site forms) **28 pages**

Publication Information (Give series and no. in series, publisher and city. For article or chapter, cite page numbers. Use the style of *American Antiquity*.)
N/A

Supervisor(s) of Fieldwork (whether or not the same as author(s); last name first) **Robert Baer, RPA**

Affiliation of Fieldworkers (organization, city) **Taylor Engineering, Jacksonville, FL, 32256**

Key Words/Phrases (Don't use the county, or common words like *archaeology, structure, survey, architecture*. Limit each word or phrase to 25 haracters.)
Choctawhatchee Bay, Choctawhatchee River, Freeport, McLendon Brothers

Survey Sponsors (corporation, government unit, or person who is directly paying for fieldwork)
Name **Mr. Michael Trudnak, P.E.**
Address/Phone **Taylor Engineering 9000, Cypress Creek Drive, Jacksonville, Fl, 32256 (904) 256 - 1342**

Recorder of *Log Sheet* **Robert H. Baer, RPA** Date *Log Sheet* Completed **04/20/08**

Is this survey or project a continuation of a previous project? **X No** ☐ Yes: Previous survey #(s) (FMSF only) _____

Mapping

Counties (List each one in which field survey was done - do not abbreviate; use supplement sheet if necessary) **Walton County, Florida**

USGS 1:24,000 Map(s) : Map Name/Date of Latest Revision (use supplement sheet if necessary): **N/A**

Description of Survey Area

Dates for Fieldwork: **Start 5/30/0 End 6/30/07** Total Area Surveyed (fill in one) 640 hectares 1585 acres

Number of Distinct Tracts or Areas Surveyed 1

If Corridor (fill in one for each): **N/A**
Width _____ meters _____ feet Length _____ kilometers _____ miles

Survey Log Sheet

Survey # _____

Research and Field Methods

Types of Survey (check all that apply): **X archaeological** ❑ architectural ❑ historical/archival **X underwater** ❑ other: _____

Preliminary Methods (✓ Check as many as apply to the project as a whole.)

❑ Florida Archives (Gray Building)
❑ Florida Photo Archives (Gray Building)
❑ Site File property search
❑ Site File survey search
❑ other (describe) _____

X library research- *local public*
❑ library-special collection - *nonlocal*
❑ Public Lands Survey (maps at DEP)
X local informant(s)

❑ local property or tax records
❑ newspaper files
❑ literature search
❑ Sanborn Insurance maps

X other historic maps
❑ soils maps or data
❑ windshield survey
❑ aerial photography

Archaeological Methods (✓ Check as many as apply to the project as a whole.)

❑ Check here if **NO** archaeological methods were used.

❑ surface collection, controlled
❑ surface collection, uncontrolled
❑ shovel test-1/4"screen
❑ shovel test-1/8" screen
❑ shovel test 1/16"screen
❑ shovel test-unscreened
❑ other (describe): _____

❑ other screen shovel test (size: ____)
❑ water screen (finest size: ____)
❑ posthole tests
❑ auger (size: ____)
❑ coring
❑ test excavation (at least 1x2 M)

❑ block excavation (at least 2x2 M)
❑ soil resistivity
X magnetometer
X side scan sonar
X sub-bottom profiler

Historical/Architectural Methods (✓ Check as many as apply to the project as a whole.)

X Check here if NO historical/architectural methods were used.

❑ building permits
❑ commercial permits
❑ interior documentation
❑ other (describe): _____

❑ demolition permits
❑ exposed ground inspected
❑ local property records

❑ neighbor interview
❑ occupant interview
❑ occupation permits

❑ subdivision maps
❑ tax records
❑ unknown

Scope/Intensity/Procedures **N/A** _____

Survey Results (cultural resources recorded)

Site Significance Evaluated? ❑ Yes **X No** If *Yes*, circle NR-eligible/significant site numbers below.

Site Counts: Previously Recorded Sites **N/A** _____ Newly Recorded Sites **N/A** _____

Previously Recorded Site #'s with Site File Update Forms (List site #'s without "8." Attach supplementary pages if necessary) **N/A** _____

Newly Recorded Site #'s (Are you sure all are originals and not updates? Identify methods used to check for updates, i.e., researched Site File records. List site #'s without "8." Attach supplementary pages if necessary.) **N/A** _____

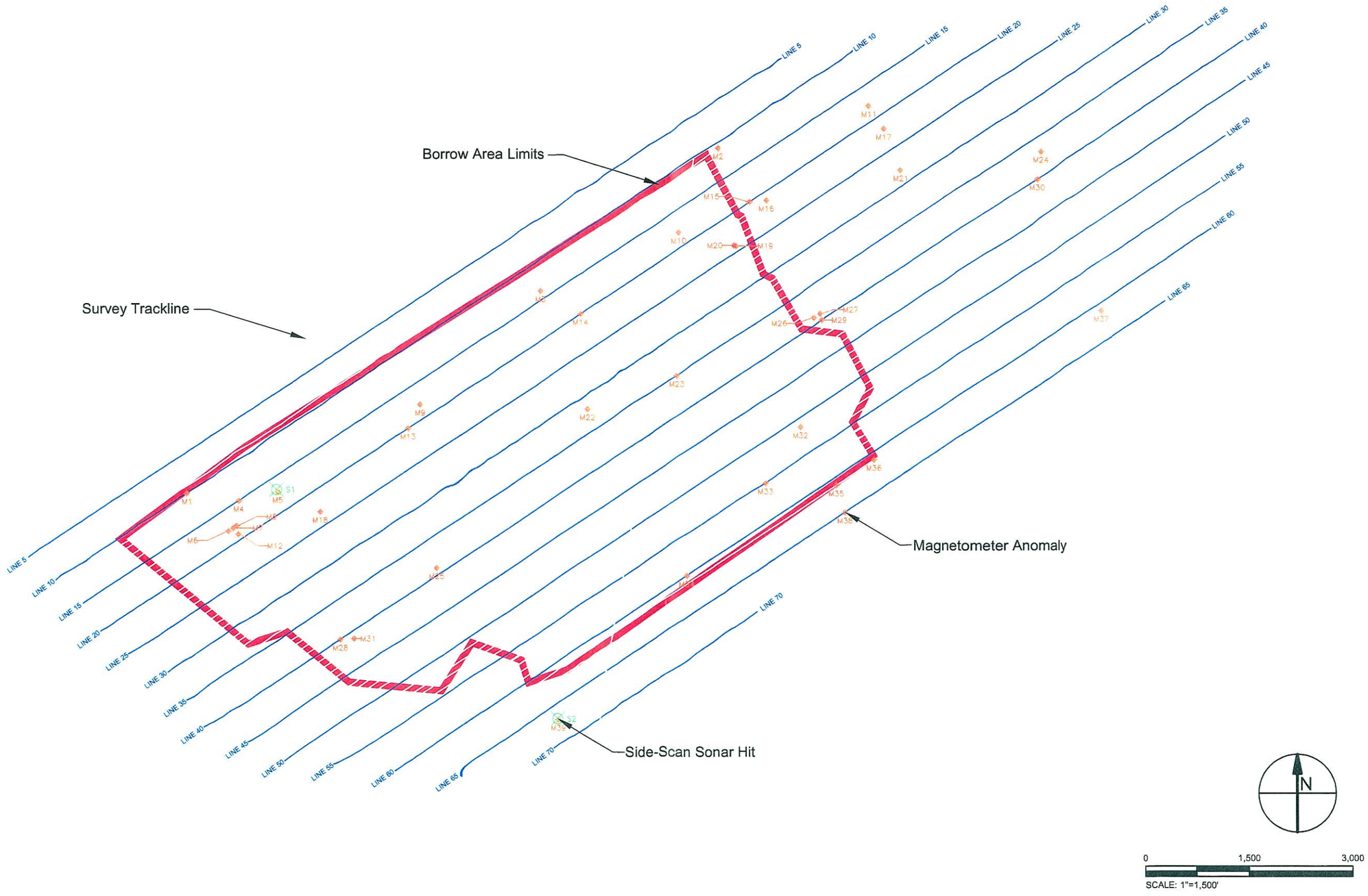
Site Form Used: ❑ Site File Paper Form **X Smart Form II Electronic Recording Form**

REQUIRED: ATTACH PLOT OF SURVEY AREA ON PHOTOCOPIES OF USGS 1:24,000 MAP(S)

DO NOT USE SITE FILE USE ONLY DO NOT USE

Appendix – C

Figure B - Fold Out



PROJECT	C2005-085
DRAWN BY	JCH
SHEET	1 of 1
DATE	OCT 2008

Figure 2
Seismic Tracklines with Magnetometer & Side-scan Hits
Walton County, Florida

TAYLOR ENGINEERING INC.
10151 Deerwood Park Blvd., Bldg. 300, Suite 300
Jacksonville, Florida 32256
CERTIFICATE OF AUTHORIZATION # 4815

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701-5505
(727) 824-5317 FAX 824-5309
http://sero.nmfs.noaa.gov

AUG 13 2008

F/SER31:DK

Mr. Osvaldo Collazo
Panama City Regulatory Office
Jacksonville District Corps of Engineers
1002 West 23rd Street, Suite 350
Panama City, FL 32405

RECEIVED
AUG 18 2008
JACKSONVILLE DISTRICT
USACE

Re: SAJ-2007-5152 (IP-DEB)

Dear Mr. Collazo:

This responds to your letter dated October 15, 2007, regarding the referenced U.S. Army Corps of Engineers' (COE) permit application submitted by the Walton County Board of County Commissioners. The applicant proposes to nourish 13.5 miles of beach and restore dunes along the Gulf of Mexico. The project is located in Walton County, Florida, and includes four reaches: from the Florida Department of Environmental Protection (FDEP) survey monument R-41 to R-64, from R-67 to R-72, from R-78 to R-98, and from R-105.5 to R-127. The central coordinates for the proposed fill area are latitude 30.31629°N, longitude 86.12845°W. You requested concurrence from the National Marine Fisheries Service (NMFS), pursuant to section 7 of the Endangered Species Act (ESA), with your determination that the proposed project may affect the federally-listed loggerhead, leatherback, hawksbill, Kemp's ridley, and green sea turtles, and Gulf sturgeon. You also determined that the proposed project, portions of which will occur in designated Gulf sturgeon critical habitat Unit 11 (nearshore Gulf of Mexico in Florida), may adversely modify sturgeon critical habitat. NMFS' determinations regarding the effects of the proposed action are based on the description of the action in this informal consultation. You are reminded that any changes to the proposed action may negate the findings of the present consultation and may require reinitiation of consultation with NMFS.

The intent of the Walton County beach nourishment and dune management project is to increase the storm protection function and restore the recreational capacity of the beach. The proposed project includes renourishing approximately 13.5 miles of beach over a span of four segments as described above. The total volume of sand to be placed along the beach is approximately 5,682,000 cubic yards (cy), with an average volume density of 79 cy/ft. The material will be obtained from a proposed borrow area located approximately 5 miles offshore western Walton County within a northeast/southwest-oriented ridge with water depths ranging from 70-80 ft below NAVD. The COE and applicant have not specified the dredge type to be used at this time. If a hopper dredge is to be used, the potential impacts from the hopper dredging portion of the project are covered by the incidental take statement of the regional biological opinion on hopper dredging for the Gulf of Mexico, dated November 19, 2003, and the reasonable and prudent

measures and terms and conditions of that opinion would be required to be followed for this action. The other possible dredge type to be used is a hydraulic cutterhead/pipeline dredge, the potential impacts of which will be addressed below. The borrow area contains fine- to medium-to-fine sand with less than 1 percent shell content. The grain size and composition is similar to the native beach sediment. Much of the sand placement will take place above the water level, using a berm design. A typical section will include sand placement for the dune crest, back berm, mid berm, and fore berm, all above the MHW level. The foreshore slope will be constructed from the fore berm seaward out to the existing bottom, extending a couple of hundred feet past the MHW mark. This slope is steeper than the natural slope and, between berm erosion and equilibration, is expected to adjust rapidly until it approaches a more natural slope. The bottom areas below MHW that will be covered by the initial placement and later equilibration consist of sediments similar to those on the beach, with no hardbottom habitat, corals, or seagrasses. This project is a one-time restoration that is expected, in the absence of large storm events, to maintain as much as 60 percent of the fill for a 10 year period.

Conservation measures that have been incorporated into the project description include:

1. As required by the FDEP, a minimum of a 1-foot buffer will be maintained between sediments consistent with the type removed from the borrow area and any underlying materials (e.g., mud, dark sands, or rock). This ensures that the surface sediments in the borrow area will be the same post-construction as they were pre-construction.

2. Sand dikes for purposes of turbidity control will be utilized as needed to maintain state water quality standards, as indicated by the FDEP's Bureau of Beaches and Coastal Systems.

3. Turbidity levels will be monitored twice daily at both the borrow area and the beach; if turbidity values exceed values permitted by the state, all dredging and deposition activities will be suspended until water quality meets state standards.

4. The applicant has agreed to utilize NMFS' Sea Turtle and Smalltooth Sawfish Construction Conditions to reduce the potential for impacts to listed species.

NMFS believes the following listed species may be present and affected by the proposed beach renourishment project: loggerhead, leatherback, Kemp's ridley, hawksbill, and green sea turtles, and Gulf sturgeon. NMFS has previously determined that non-hopper-type dredging activities, including hydraulic-type dredges, are not likely to adversely affect sea turtles and Gulf sturgeon. These species will likely temporarily avoid the immediate project vicinity during construction (i.e., dredging and sand pumping) due to vessel and machinery noise; however, this avoidance will not affect migration and foraging behaviors. If sea turtles or Gulf sturgeon do enter the project site during dredging activities, they are unlikely to be harmed by the hydraulic dredge. Listed species may also be affected if they were to be struck by the dredge as it transits the site or by the pipeline as it is being positioned or moved to place sand on the beach; however, due to their mobility, the likelihood of this occurring is discountable. The likelihood of creating an obstacle for turtles approaching and exiting the beach during nesting season is minimized by the perpendicular placement of the sand discharge pipe on the seafloor from the dredge to the beach,

which reduces the length of pipe necessary for renourishment. Seaward bound sea turtle hatchlings could be affected by project activities. However, this is unlikely because daily sea turtle nest surveys will be completed during nesting season and construction will not occur on any segment of the beach with active nests. In summary, NMFS believes that listed species under its purview will not be adversely affected by the proposed action. Note that this consultation does not cover onshore impacts, such as to nesting sea turtles on the beach, or sea turtle nests or hatchlings on the beach. A consultation with the U.S. Fish and Wildlife Service is required to ensure ESA compliance for onshore impacts to sea turtles.

Gulf sturgeon critical habitat was designated in 2003 (50 CFR 226.214). The portion of the beach renourishment area below MHW is located within critical habitat Unit 11. The primary constituent elements (PCEs) present in Unit 11 and essential for the conservation of Gulf sturgeon include abundant prey items, water quality, sediment quality, and safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats. Of these PCEs, NMFS believes only prey abundance and water quality may be affected. No impacts to sediment quality are expected as sediment composition at the borrow sites and on the beach are expected to be the same pre- and post-construction, and all sediments are free of contaminants. Project construction will not impede migratory pathways either during or after construction, as the project site is not located within, or adjacent to, a major river system, where construction activities could deter Gulf sturgeon from migrating between their riverine and estuarine habitats.

Gulf sturgeon could be affected by impacts to the abundance and diversity of their prey items, but these effects are expected to be insignificant, as these benthic macro-invertebrates have been found to recolonize within one year of a dredging disturbance when sediment composition and depth remain consistent. Additionally, the majority of sand placed below MHW will be in water depths less than 5 ft (1.5 meters). While Gulf sturgeon are known to occasionally forage in very shallow waters, normal foraging depths are usually deeper than 5 ft. Further, it is likely that any Gulf sturgeon in the project area will find appropriate and abundant prey in the areas adjacent to the project location, as many nearby sandy areas exist.

Effects to Gulf sturgeon from impacts to water quality are expected to be insignificant. They will be minor and temporary. Because the material from the borrow site consists of mostly sand, with only ca. 1 percent fines (similar to the existing sand), almost no turbidity is expected to ensue. Potential impacts to water quality will be further minimized by compliance with the twice-daily state water quality sampling requirement which will ensure that turbidity levels remain low. No changes to temperature, salinity, pH, hardness, oxygen content, or other water quality parameter will occur.

In summary, NMFS has determined that the project will not impact sediment quality or migratory pathways, and effects to prey abundance and water quality will be insignificant. Therefore, we conclude that the proposed action is not likely to adversely affect Gulf sturgeon critical habitat.

This concludes your consultation responsibilities under the ESA for species under NMFS' purview. Consultation must be reinitiated if a take occurs or new information reveals effects of the action not previously considered, or the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat in a manner or to an extent not previously considered, or if a new species is listed or critical habitat designated that may be affected by the identified action. We have enclosed additional information on other statutory requirements that may apply to this action, and on NMFS' Public Consultation Tracking System (PCTS) to allow you to track the status of ESA consultations.

If you have any questions regarding this ESA consultation or PCTS use, please contact Dennis Klemm, Fishery Biologist, at (727) 824-5312, or by e-mail at dennis.klemm@noaa.gov.

Sincerely,

James E. Weaver

for Roy E. Crabtree, Ph.D.
Southeast Regional Administrator

Enclosures (2)

File: 1514-22.F.1.FL
Ref: I/SER/2007/06965

PCTS Access and Additional Considerations for ESA Section 7 Consultations (Revised 5-13-2008)

Public Consultation Tracking System (PCTS) Guidance: PCTS is an online query system at **https://pcts.nmfs.noaa.gov/** that allows federal agencies and U.S. Army Corps of Engineers' (COE) permit applicants and their consultants to ascertain the status of NMFS' Endangered Species Act (ESA) and Essential Fish Habitat (EFH) consultations, conducted pursuant to ESA section 7, and Magnuson-Stevens Fishery Conservation and Management Act's (MSA) sections 305(b)2 and 305(b)(4), respectively. Federal agencies are required to enter an agency-specific username and password to query the Federal Agency Site. The COE "Permit Site" (no password needed) allows COE permit applicants and consultants to check on the current status of Clean Water Act section 404 permit actions for which NMFS has conducted, or is in the process of conducting, an ESA or EFH consultation with the COE.

For COE-permitted projects, click on "Enter Corps Permit Site." From the "Choose Agency Subdivision (Required)" list, pick the appropriate COE district. At "Enter Agency Permit Number" type in the COE district identifier, hyphen, year, hyphen, number. The COE is in the processing of converting its permit application database to PCTS-compatible "ORM." An example permit number is: SAJ-2005-000001234-IPS-1. For the Jacksonville District, which has already converted to ORM, permit application numbers should be entered as SAJ (hyphen), followed by 4-digit year (hyphen), followed by permit application numeric identifier with no preceding zeros. For example: SAJ-2005-123; SAJ-2005-1234; SAJ-2005-12345.

For inquiries regarding applications processed by COE districts that have not yet made the conversion to ORM (e.g., Mobile District), enter the 9-digit numeric identifier, or convert the existing COE-assigned application number to 9 numeric digits by deleting all letters, hyphens, and commas; converting the year to 4-digit format (e.g., -04 to 2004); and adding additional zeros in front of the numeric identifier to make a total of 9 numeric digits. For example: AL05-982-F converts to 200500982; MS05-04401-A converts to 200504401. PCTS questions should be directed to Eric Hawk at Eric.Hawk@noaa.gov. Requests for username and password should be directed to PCTS.Usersupport@noaa.gov.

EFH Recommendations: In addition to its protected species/critical habitat consultation requirements with NMFS' Protected Resources Division pursuant to section 7 of the ESA, prior to proceeding with the proposed action the action agency must also consult with NMFS' Habitat Conservation Division (HCD) pursuant to the MSA requirements for EFH consultation (16 U.S.C. 1855 (b)(2) and 50 CFR 600.905-.930, subpart K). The action agency should also ensure that the applicant understands the ESA and EFH processes; that ESA and EFH consultations are separate, distinct, and guided by different statutes, goals, and time lines for responding to the action agency; and that the action agency will (and the applicant may) receive separate consultation correspondence on NMFS letterhead from HCD regarding their concerns and/or finalizing EFH consultation.

Marine Mammal Protection Act (MMPA) Recommendations: The ESA section 7 process does not authorize incidental takes of listed or non-listed marine mammals. If such takes may occur an incidental take authorization under MMPA section 101 (a)(5) is necessary. Contact Ken Hollingshead of our NMFS Headquarters' Protected Resources staff at (301) 713-2323 for more information on MMPA permitting procedures.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701

SEA TURTLE AND SMALLTOOTH SAWFISH CONSTRUCTION CONDITIONS

The permittee shall comply with the following protected species construction conditions:

a. The permittee shall instruct all personnel associated with the project of the potential presence of these species and the need to avoid collisions with sea turtles and smalltooth sawfish. All construction personnel are responsible for observing water-related activities for the presence of these species.

b. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles or smalltooth sawfish, which are protected under the Endangered Species Act of 1973.

c. Siltation barriers shall be made of material in which a sea turtle or smalltooth sawfish cannot become entangled, be properly secured, and be regularly monitored to avoid protected species entrapment. Barriers may not block sea turtle or smalltooth sawfish entry to or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.

d. All vessels associated with the construction project shall operate at "no wake/idle" speeds at all times while in the construction area and while in water depths where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will preferentially follow deep-water routes (e.g., marked channels) whenever possible.

e. If a sea turtle or smalltooth sawfish is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle or smalltooth sawfish. Operation of any mechanical construction equipment shall cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities may not resume until the protected species has departed the project area of its own volition.

f. Any collision with and/or injury to a sea turtle or smalltooth sawfish shall be reported immediately to the National Marine Fisheries Service's Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.

g. Any special construction conditions, required of your specific project, outside these general conditions, if applicable, will be addressed in the primary consultation.

Revised: March 23, 2006
O:\forms\Sea Turtle and Smalltooth Sawfish Construction Conditions.doc

Walton County Beach Nourishment Project
SAJ-2007-5152 (IP-DEB)/FWS 2008-F-0060
Walton County, Florida

Biological Opinion
October 2, 2008

Prepared by:
U.S. Fish and Wildlife Service
1601 Balboa Avenue
Panama City, FL

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Acronyms

ABM	Alabama Beach Mouse
Act	Endangered Species Act
BO	Biological Opinion
CAHA	Cape Hatteras National Seashore
CBM	Choctawhatchee Beach Mouse
Corps	Corps of Engineers
CR	County Road
DPS	Distinct Population Segment
FDEP	Florida Department of Environmental Protection
FEMA	Federal Emergency Management Agency
FWC	Fish and Wildlife Conservation Commission
FWRI	Fish and Wildlife Research Institute
GOM	Gulf of Mexico
GUIS	Gulf Island National Seashore
HCP	Habitat Conservation Plan
INBS	Index Nesting Beach Survey
MA	May Adversely Affect
MHWL	Mean High Water Line
MLW	Mean Low Water
NAM	Not Adversely Modify
NLAA	Not Likely Adversely Affect

NMFS	National Marines Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
ORV	Off Road Vehicles
PCE	Primary Constituent Elements
PHVA	Population and Habitat Viability Analysis
PKBM	Perdido Key Beach Mouse
PSI	Per Square Inch
PVA	Population Viability Analysis
Service	U.S. Fish and Wildlife Service
STSSN	Sea Turtle Stranding and Salvage Network
TEDS	Turtle Excluder Devices
USDA	United States Department of Agriculture

United States Department of the Interior

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IN REPLY REFER TO:

October 2, 2008

Mr. Osvaldo Collazo
U.S. Army Corps of Engineers
Jacksonville District, Corps of Engineers
1002 West 23 Street, Suite 350
Panama City, Florida 32405

Attn: Mr. Dale Beter

Re: FWS Log No. 2008-F-0060
Date Started: November 2, 2007
Applicant: Walton County Board of County Commissioners
Project Title: Walton County Phase 2 Beach Nourishment
Public Notice: SAJ-2007-5152 (IP-DEB)
Location: Gulf of Mexico
Ecosystem: NE Gulf
County: Walton County, Florida

Dear Mr. Collazo:

Enclosed is the Fish and Wildlife Service's (Service) biological opinion (BO) for the Walton County, Phase 2 Beach Nourishment Project in Escambia County, Florida, and its effects on nesting loggerhead, green, leatherback, and Kemp's ridley sea turtles, Choctawhatchee beach mouse, and non-breeding piping plover, and designated critical habitat for the beach mouse. The Army Corps of Engineers (Corps) has determined that the project would not likely adversely affect (NLAA) the West Indian manatee, and not adversely modify (NAM) designated critical habitat for the piping plover. The Service concurs with your determination of: may adversely affect (MA) for nesting sea turtles, Choctawhatchee beach mouse, and the piping plover, and designated critical habitat for the beach mouse and NLAA for the manatee, and NAM determination for designated critical habitat for the piping plover (**Table 1**). The manatee determination is based upon inclusion of the standard Manatee Conditions for In-Water Work.

This opinion is provided in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq*.). We have assigned log number 2008-F-0060 to this consultation.

This biological opinion is based on the permit application file, environmental assessment, and information provided during meetings and discussions with the Applicant, the Applicant's consultant's, Taylor Engineering, Inc., information from the Florida Fish and Wildlife Research Institute sea turtle nesting database, South Walton Turtle Watch turtle nesting monitoring, and information in our files. A complete administrative record of this consultation is on file in the Service's Panama City, Florida Field Office.

Table 1. Species and Critical Habitat Evaluated for Effects from the Proposed Action but not discussed further in this Biological Opinion.

SPECIES OR CRITICAL HABITAT	PRESENT IN ACTION AREA	PRESENT IN ACTION AREA BUT "NOT LIKELY TO ADVERSELY AFFECT" OR "NOT LIKELY TO ADVERSELY MODIFY"
West Indian manatee	Yes	Yes
Non-breeding piping plover critical habitat	No	No

Consultation History

May 18, 2007 — The Service attends an interagency meeting on the Walton County Phase 2 Beach Nourishment Project.

May 23, 2007 — The Service provides via email to the applicant's consultant, Taylor Engineering, Inc., additional information for conservation of piping plover.

October 18, 2007 — The Service receives a request via regular mail from the Jacksonville District, Corps, for initiation of formal consultation under section 7 of the Endangered Species Act for nesting sea turtles, non-breeding piping plover, and Choctawhatchee beach mice. The Corps provides a copy of the public notice and supporting information in the request.

November 2, 2007 — The Service transmits a letter via regular mail to the Corps our acknowledgement of the Corps request for concurrence of may adversely affect determination for nesting sea turtles, piping plover, and Choctawhatchee beach mice, and NLAA determination for manatee.

February 14, 2008	The Service provides via email to the applicant's consultant, Taylor Engineering, Inc., a list of outstanding information needs for the consultation.
February 22, 2008	The Service participates in a conference call about the project.
March 4, 2008	The Service receives via regular mail from the applicant's consultant, Taylor Engineering, Inc., dated March 3, 2008, the outstanding information needed to complete the consultation.
May 14, 2008	The Service provides a letter via regular mail to the Corps notifying them they have received the needed information to complete the consultation and that a draft BO would be completed by August 12, 2008.
August 12, 2008	The Service provides via email to the Corps that the submittal of the draft BO will be delayed because of Service work schedules.
August 13, 2008	The Service receives via email a response from the Corps concurring with the draft BO submittal delay.
August 21, 2008	The Service provides via regular mail to the Corps a draft BO.
September 24, 2008	The Service receives via email from the Corps concurrence to finalize the BO.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The Applicant, Walton County, proposes to construct a dune, berm, and beach restoration project (dune, berm, and beach fill project) along a 13.5-mile stretch of the Gulf of Mexico (GOM) shoreline along the mainland of Walton County (**Figure 1**).

The project will be located between DNR monuments R-41 and R-64, R-67 and R-72, R-78 and R-98, R-105.5 and R-127. Approximately 5,682,000 cubic yards of beach quality material along four segments from west to east along the project GOM shoreline.

The project would include a berm consisting of a flat back-berm extending 50 feet from the existing 9.5 foot NAVD, and 8 foot wide transitional slope (1V:4H) from the back berm to the mid-berm, a variable width flat mid-berm at elevation 7.5 ft NAVD, a 100 foot wide fore-berm sloping 1V:100H from 7.5 feet to 6.5 feet NAVD, and a 1V:15H foreshore slope extending from the seaward edge of the fore-berm out to the existing bottom. In addition, a dune with a flat 10 foot wide crest would extend from the existing 14.5 foot NAVD contour and the dune face would slope 1V:4H down to the back berm. The seaward slope of the construction profile would

be steeper than the native beach slope so that the equilibrium profile would mimic the existing profile shape. The volume density of the beach fill design averages about 79 cubic yards per linear foot of beach. The project includes planting appropriate vegetation along the dune crest and dune face.

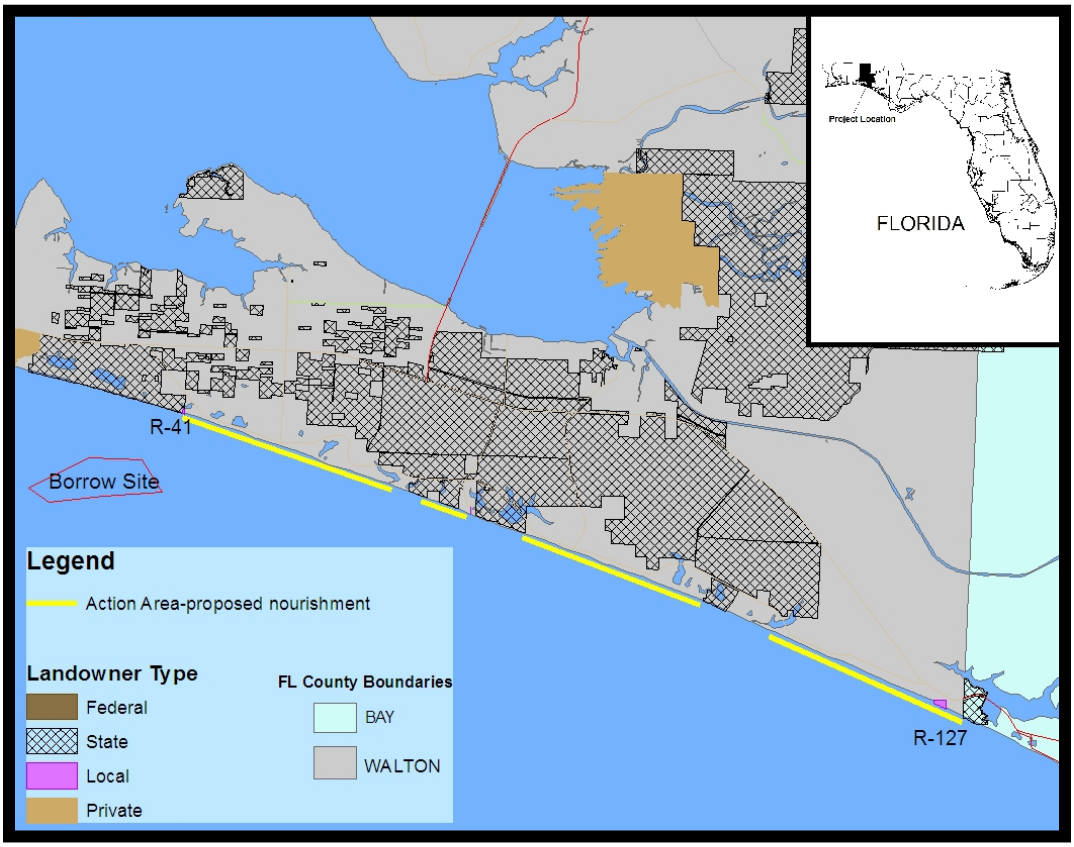

Figure 1. **Location of the proposed Walton County beach restoration project, Walton County, Florida.**

The beach fill material would be excavated from a 1,558-acre offshore borrow site located approximately 5 miles due southwest of the western project limit in water depths of approximately -74 to -80 ft NAVD. Compatible material has a Munsell color classification lighter than or equal to 5Y 6/2 and composition and grain size of material in the borrow area is 0.30 mm.

Beach accesses to be used for the project equipment, vehicles, and associated material will be at existing South Walton Tourist Development beach accesses (**Table 2**). In addition to the access and storage/staging areas, the contractor will utilize the approximately 500-foot wide daily construction zone for storage/staging.

Table 2. Locations of project equipment, vehicle access, and project-associated materials.

Work Type	Location
Vehicle Access	Dune Allen Ed Walline Park Grayton Beach (2) Seagrove Beach Inlet Beach
Storage/Staging Areas	Grayton Beach Seagrove Beach Inlet Beach

Conservation Measures

Beach Mice

The dune features proposed for construction within project would be enhanced with salt-tolerant vegetation.

Manatees

The standard Construction Conservation Measures for manatees will be incorporated into the project plans.

Action Area

The Action Area for nesting sea turtles, Choctawhatchee Beach Mouse (CBM), and non-breeding piping plovers is the 13.5 miles of shoreline proposed for nourishment in Walton County (**Figure 1**). The project fill site is located in the GOM, in four reaches (segments) between: R-41 and R-64, R-67 and R-72, R-78 and R-98, and R-105.5 and R-127. It begins at mean low water (MLW) along the GOM and includes intertidal areas of the GOM and coastal dune lakes, wrack lines, ephemeral pools, inlets, and the upper sandy beach with sparse or no vegetation and coastal dune lakes sand and mud flats habitat as well as any overwash areas that occur adjacent or connecting the GOM and the coastal dune lakes.

SEA TURTLES

STATUS OF THE SPECIES/CRITICAL HABITAT

Species/critical habitat description

The Service has responsibility for implementing recovery of sea turtles when they come ashore to nest. This biological opinion addresses nesting sea turtles, their nests and eggs, and hatchlings

as they emerge from the nest and crawl to the sea. The National Oceanic and Atmospheric Administration-Fisheries (NOAA-Fisheries) has jurisdiction over sea turtles in the marine environment.

Four species of sea turtles are analyzed in this biological opinion: the threatened loggerhead sea turtle (*Caretta caretta*), the endangered green sea turtle (*Chelonia mydas*), the endangered leatherback sea turtle *(Dermochelys coriace*a), and the endangered Kemp's ridley sea turtle (*Lepidochelys kempii)*.

Loggerhead Sea Turtle

The loggerhead sea turtle was listed as a threatened species on July 28, 1978 (43 FR 32800). The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans.

Within the continental U.S., loggerheads nest from Texas to Virginia with major nesting concentrations found in South Florida. Additional nesting concentrations occur on coastal islands of North Carolina, South Carolina, and Georgia, and on the Atlantic and Gulf coasts of Florida (NMFS and Service 1991). Within the western Atlantic, loggerheads also nest in Mexico and the Caribbean.

The loggerhead sea turtle grows to an average weight of about 200 pounds and is characterized by a large head with blunt jaws. Adults and subadults have a reddish-brown carapace. Scales on the top of the head and top of the flippers are also reddish-brown with yellow on the borders. Hatchlings are a dull brown color (NOAA Fisheries 2002a). The loggerhead feeds on mollusks, crustaceans, fish, and other marine animals.

The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. However, the majority of loggerhead nesting is at the western rims of the Atlantic and Indian Oceans. The species is widely distributed within its range. It may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers. Coral reefs, rocky places, and ship wrecks are often used as feeding areas. Nesting occurs mainly on open beaches or along narrow bays having suitable sand, and often in association with other species of sea turtles.

No critical habitat has been designated for the loggerhead sea turtle.

On November 16, 2007, the Service and NMFS received a petition from Oceana and the Center for Biological Diversity requesting that loggerhead turtles in the western North Atlantic Ocean be reclassified as a Distinct Population Segments (DPS) with endangered status and that critical habitat be designated. A DPS is a population segment that is discrete in relation to the remainder of the species to which it belongs, and significant to the species to which it belongs. The National Marine Fisheries Service (NMFS) took the lead on the petition response and issued a 90–day finding on March 5, 2008, in the federal register, that the petition presents substantial scientific information indicating that the petitioned action may be warranted. The NMFS has

initiated a review of the status of the species to determine whether the petitioned action is warranted and to determine whether any additional changes to the current listing of the loggerhead turtle are warranted and solicited public comment that ended on May 5, 2008 (73 FR 11849).

Green Sea Turtle

The green sea turtle was federally listed as a protected species on July 28, 1978 (43 FR 32800). Breeding populations of the green turtle in Florida and along the Pacific coast of Mexico are listed as endangered; all other populations are listed as threatened. The green sea turtle has a worldwide distribution in tropical and subtropical waters. Major green turtle nesting colonies in the Atlantic occur on Ascension Island, Aves Island, Costa Rica, and Surinam. Within the U.S., green turtles nest in small numbers in the U.S. Virgin Islands and Puerto Rico, and in larger numbers along the east coast of Florida, particularly in Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties (NOAA Fisheries and Service 1991a). Nesting also has been documented along the Gulf coast of Florida from Escambia County through Franklin County in northwest Florida and from Pinellas County through Collier County in southwest Florida (FWC statewide nesting database). Green turtles have been known to nest in Georgia, but only on rare occasions (Georgia Department of Natural Resources statewide nesting database). The green turtle also nests sporadically in North Carolina and South Carolina (North Carolina Wildlife Resources Commission statewide nesting database; South Carolina Department of Natural Resources statewide nesting database). Unconfirmed nesting of green turtles in Alabama has also been reported (Bon Secour National Wildlife Refuge nesting reports).

Green sea turtles are generally found in fairly shallow waters (except when migrating) inside reefs, bays, and inlets. The green turtle is attracted to lagoons and shoals with an abundance of marine grass and algae. Open beaches with a sloping platform and minimal disturbance are required for nesting.

The green sea turtle grows to a maximum size of about 4 feet and a weight of 440 pounds. It has a heart-shaped shell, small head, and single-clawed flippers. The carapace is smooth and colored gray, green, brown and black. Hatchlings are black on top and white on the bottom (NOAA Fisheries 2002b). Hatchling green turtles eat a variety of plants and animals, but adults feed almost exclusively on seagrasses and marine algae.

Critical habitat for the green sea turtle has been designated for the waters surrounding Culebra Island, Puerto Rico, and its outlying keys.

Leatherback Sea Turtle

The leatherback sea turtle listed as an endangered species on June 2, 1970 (35 FR 8491), nests on shores of the Atlantic, Pacific and Indian Oceans. Leatherbacks have the widest distribution of sea turtles with nesting on beaches in the tropics and sub-tropics and foraging excursions into higher-latitude sub-polar waters. They have evolved physiological and anatomical adaptations (Frair et al. 1972; Greer et al. 1973) that allow them to exploit waters far colder than any other

sea turtle species would be capable of surviving. Non-breeding animals have been recorded as far north as the British Isles and the Maritime Provinces of Canada and as far south as Argentina and the Cape of Good Hope (Pritchard 1992). Nesting grounds are distributed worldwide, with the Pacific coast of Mexico supporting the world's largest known concentration of nesting leatherbacks. The largest nesting colony in the wider Caribbean region is found in French Guiana, but nesting occurs frequently, although in lesser numbers, from Costa Rica to Columbia and in Guyana, Surinam, and Trinidad (NOAA Fisheries and Service 1992; National Research Council 1990a).

The leatherback regularly nests in the U.S., in Puerto Rico, the U.S. Virgin Islands, and along the Atlantic coast of Florida as far north as Georgia (NOAA Fisheries and Service 1992). Leatherback turtles have been known to nest in Georgia, South Carolina, and North Carolina, but only on rare occasions (North Carolina Wildlife Resources Commission; South Carolina Department of Natural Resources; and Georgia Department of Natural Resources statewide nesting databases). Leatherback nesting has also been reported on the northwest coast of Florida (LeBuff 1990; FWC statewide nesting database); and in southwest Florida a false crawl (non-nesting emergence) has been observed on Sanibel Island (LeBuff 1990).

This is the largest, deepest diving of all sea turtle species. The adult leatherback can reach 4 to 8 feet in length and weigh 500 to 2,000 pounds. The carapace is distinguished by a rubber-like texture, about 1.6 inches thick, made primarily of tough, oil-saturated connective tissue. Hatchlings are dorsally mostly black and are covered with tiny scales; the flippers are edged in white, and rows of white scales appear as stripes along the length of the back (NOAA Fisheries 2002c). Jellyfish are the main staple of its diet, but it is also known to feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed.

Adult females require sandy-nesting beaches backed with vegetation and sloped sufficiently so the distance to dry sand is limited. Their preferred beaches have proximity to deep water and generally rough seas.

Marine and terrestrial critical habitat for the leatherback sea turtle has been designated at Sandy Point on the western end of the island of St. Croix, U.S. Virgin Islands (50 CFR 17.95).

Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle was listed as endangered on December 2, 1970 (35 FR 18320). The Kemp's ridley, along with the flatback sea turtle (*Natator depressus*), has the most geographically restricted distribution of any sea turtle species. The range of the Kemp's ridley includes the Gulf coasts of Mexico and the U.S., and the Atlantic coast of North America as far north as Nova Scotia and Newfoundland. The majority of nesting for the entire species occurs on the primary nesting beach at Rancho Nuevo (Marquez-M. 1994).

Outside of nesting, adult Kemp's ridleys are believed to spend most of their time in the GOM, while juveniles and subadults also regularly occur along the eastern seaboard of the U.S. (Service and NOAA Fisheries 1992). There have been rare instances when immature ridleys have been

documented making transatlantic movements (Service and NOAA Fisheries 1992). It was originally speculated that ridleys that make it out of the GOM might be lost to the breeding population (Hendrickson 1980), but data indicate that many of these turtles are capable of moving back into the GOM (Henwood and Ogren 1987). In fact, there are documented cases of ridleys captured in the Atlantic that migrated back to the nesting beach at Rancho Nuevo (Schmid and Witzell 1997; Schmid 1998; Witzell 1998).

Hatchlings, after leaving the nesting beach, are believed to become entrained in eddies within the GOM, where they are dispersed within the Gulf and Atlantic by oceanic surface currents until they reach about 7.9 inches in length, at which size they enter coastal shallow water habitats (Ogren 1989).

No critical habitat has been designated for the Kemp's ridley sea turtle.

Life history

Loggerhead Sea Turtles

Loggerheads have a complex life history that encompasses terrestrial, nearshore, and open ocean habitats. The three basic ecosystems in which loggerheads live are the: Terrestrial zone (supralittoral) - the nesting beach where both oviposition (egg laying) and embryonic development and hatching occur.

Neritic zone is the inshore marine environment (from the surface to the sea floor) where water depths do not exceed 656 feet (200 meters). The neritic zone generally includes the continental shelf, but in areas where the continental shelf is very narrow or non-existent, the neritic zone conventionally extends to areas where water depths are less than 656 feet (200 meters).

Oceanic zone is the vast open ocean environment (from the surface to the sea floor) where water depths are greater than 656 feet (200 meters).

The basic life cycle of the loggerhead turtle in the western North Atlantic consists of seven life stages (**Figure 2**) that are based on the size of the sea turtles at different ages (Bolten 2003; Crouse et al. 1987).

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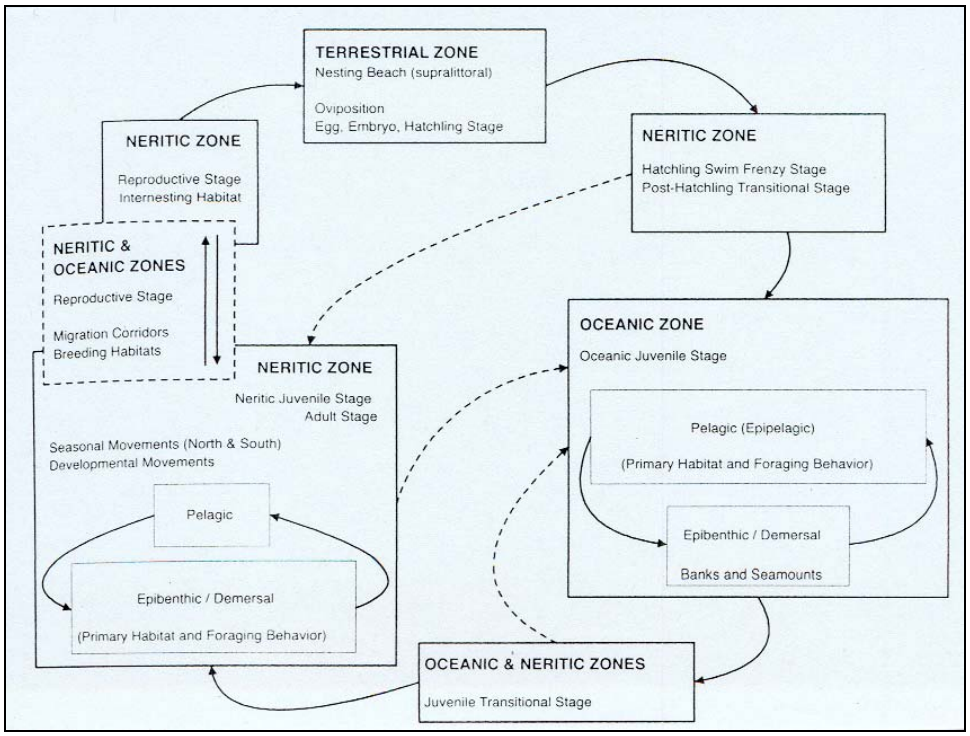

Figure 2. Life history stages of a loggerhead turtle. The boxes represent life stages and the corresponding ecosystems, solid lines represent movements between life stages and ecosystems, and dotted lines are speculative (Bolten 2003).

Numbers of nests and nesting females are often highly variable from year to year due to a number of factors including environmental stochasticity, periodicity in ocean conditions, anthropogenic effects, and density-dependent and density-independent factors affecting survival, growth, and reproduction (Meylan 1982; Hays 2000; Chaloupka 2001; Solow et al. 2002). Despite these sources of variation, and because female turtles exhibit strong nest site fidelity, a nesting beach survey can provide a valuable assessment of changes in the adult female population, provided that the study is sufficiently long and effort and methods are standardized (Meylan 1982; Gerrodette and Brandon 2000; Reina et al. 2002) (**Table 3**).

Table 3. Summary of research on life history traits for loggerhead sea turtles.

Life History Trait	Data
Clutch size (mean)	100-126 eggs[1]
Incubation duration (varies depending on time of year and latitude)	Range = 42-75 days[2,3]
Juvenile (<87 cm CCL) sex ratio	65-70% female[4]
Pivotal temperature (incubation temperature that produces an equal number of males and females)	29.0˚C[5]

Life History Trait	Data
Nest productivity (emerged hatchlings/total eggs) x 100 (varies depending on site specific factors)	Range = 45-70%[2,6]
Clutch frequency (number of nests/female/season)	3-4 nests[7]
Internesting interval (number of days between successive nests within a season)	12-15 days[8]
Remigration interval (number of years between successive nesting migrations)	2.5-3.7 years[9]
Nesting season	late April-early September
Hatching season	late June-early November
Age at sexual maturity	32-35 years[10]
Life span	>57 years[11]

1 Dodd 1988.
2 Dodd and Mackinnon (1999, 2000, 2001, 2002, 2003, 2004).
3 Blair Witherington, FWC, personal communication, 2006 (information based on nests monitored throughout Florida beaches in 2005, n=865).
4 National Marine Fisheries Service (2001); Allen Foley, FWC, personal communication, 2005.
5 Mrosovsky (1988); Marcovaldi *et al*. (1997).
6 Blair Witherington, FWC, personal communication, 2006 (information based on nests monitored throughout Florida beaches in 2005, n=1,680).
7 Murphy and Hopkins (1984); Frazer and Richardson (1985); Ehrhart, unpublished data.
8 Caldwell (1962), Dodd (1988).
9 Richardson *et al*. (1978); Bjorndal *et al*. (1983); Ehrhart, unpublished data.
10 Melissa Snover, NMFS, personal communication, 2005.
11 Dahlen *et al*. (2000).

Loggerheads nest on ocean beaches and occasionally on estuarine shorelines with suitable sand. Nests are typically laid between the high tide line and the dune front (Routa 1968; Witherington 1986; Hailman and Elowson 1992). Wood and Bjorndal (2000) evaluated four environmental factors (slope, temperature, moisture, and salinity) and found that slope had the greatest influence on loggerhead nest-site selection. Loggerheads appear to prefer relatively narrow, steeply sloped, coarse-grained beaches, although nearshore contours may also play a role in nesting beach site selection (Provancha and Ehrhart 1987).

Sea turtle eggs require a high-humidity substrate that allows for sufficient gas exchange for development (Miller 1997; Miller et al. 2003). Loggerhead nests incubate for variable periods of time. The length of the incubation period (commonly measured from the time of egg deposition

to hatchling emergence) is inversely related to nest temperature, such that between 26°C and 32°C, a change of 1°C adds or subtracts approximately 5 days (Mrosovsky 1980).

The warmer the sand surrounding the egg chamber, the faster the embryos develop (Mrosovsky and Yntema 1980). Sediment temperatures prevailing during the middle third of the incubation period also determine the sex of hatchling sea turtles (Mrosovsky and Yntema 1980). Incubation temperatures near the upper end of the tolerable range produce only female hatchlings while incubation temperatures near the lower end of the tolerable range produce only male hatchlings. The pivotal temperature (i.e., the incubation temperature that produces equal numbers of males and females) in loggerheads is approximately 29°C (Limpus et al. 1983; Mrosovsky 1988; Marcovaldi et al. 1997). However, clutches with the same average temperature may have different sex ratios depending on the fluctuation of temperature during incubation (Georges et al. 1994). Moisture conditions in the nest similarly influence incubation period, hatching success, and hatchling size (McGehee 1990; Carthy et al. 2003).

Loggerhead hatchlings pip and escape from their eggs over a 1- to 3-day interval and move upward and out of the nest over a 2- to 4-day interval (Christens 1990). The time from pipping to emergence ranges from 4 to 7 days with an average of 4.1 days (Godfrey and Mrosovsky 1997). Hatchlings emerge from their nests en masse almost exclusively at night, and presumably using decreasing sand temperature as a cue (Hendrickson 1958; Mrosovsky 1968; Witherington et al. 1990). Moran et al. (1999) concluded that a lowering of sand temperatures below a critical threshold, which most typically occurs after nightfall, is the most probable trigger for hatchling emergence from a nest. After an initial emergence, there may be secondary emergences on subsequent nights (Carr and Ogren 1960; Witherington 1986; Ernest and Martin 1993).

Hatchlings use a progression of orientation cues to guide their movement from the nest to the marine environments where they spend their early years (Lohmann and Lohmann 2003). Hatchlings first use light cues to find the ocean. On naturally lighted beaches without artificial lighting, ambient light from the open sky creates a relatively bright horizon compared to the dark silhouette of the dune and vegetation landward of the nest. This contrast guides the hatchlings to the ocean (Daniel and Smith 1947; Limpus 1971; Salmon et al. 1992; Witherington 1997; Witherington and Martin 1996).

Green Sea Turtles

Green turtles deposit from one to nine clutches within a nesting season, but the overall average is about 3.3 nests. The interval between nesting events within a season varies around a mean of about 13 days (Hirth 1997). Mean clutch size varies widely among populations. Average clutch size reported for Florida was 136 eggs in 130 clutches (Witherington and Ehrhart 1989). Only occasionally do females produce clutches in successive years. Usually two, three, four or more years intervene between breeding seasons (NOAA Fisheries and Service 1991a). Age at sexual maturity is believed to be 20 to 50 years (Hirth 1997).

Leatherback Sea Turtles

Leatherbacks nest an average of five to seven times within a nesting season, with an observed maximum of 11 nests (NOAA Fisheries and Service 1992). The interval between nesting events within a season is about 9 to 10 days. Clutch size averages 80 to 85 yolked eggs, with the addition of usually a few dozen smaller, yolkless eggs, mostly laid toward the end of the clutch (Pritchard 1992). Nesting migration intervals of 2 to 3 years were observed in leatherbacks nesting on the Sandy Point National Wildlife Refuge, St. Croix, U.S. Virgin Islands (McDonald and Dutton 1996). Leatherbacks are believed to reach sexual maturity in 6 to 10 years (Zug and Parham 1996).

Kemp's Ridley Sea Turtles

Nesting occurs from April into July during which time the turtles appear off the Tamaulipas and Veracruz coasts of Mexico. Precipitated by strong winds, the females swarm to mass nesting emergences, known as *arribadas* or *arribazones*, to nest during daylight hours. The period between Kemp's ridley arribadas averages approximately 25 days (Rostal et al. 1997), but the precise timing of the arribadas is highly variable and unpredictable (Bernardo and Plotkin 2007). Clutch size averages 100 eggs and eggs typically take 45 to 58 days to hatch depending on temperatures (Marquez-M. 1994; Rostal 2007).

Some females breed annually and nest an average of 1 to 4 times in a season at intervals of 10 to 28 days. Analysis by Rostal (2007) suggested that ridley females lay approximately 3.075 nests per nesting. Interannual remigration rate for female ridleys is estimated to be approximately 1.8 (Rostal 2007) to 2.0 years (Marquez Millan et al. 1989; TEWG 2000). Age at sexual maturity is believed to be between 10 to 17 years (Snover et al. (2007).

Population dynamics

Loggerhead Sea Turtles

The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. However, the majority of loggerhead nesting is at the western rims of the Atlantic and Indian Oceans. The most recent reviews show that only two loggerhead nesting beaches have greater than 10,000 females nesting per year (Baldwin et al. 2003; Ehrhart et al. 2003; Kamezaki et al. 2003; Limpus and Limpus 2003; Margaritoulis et al. 2003): South Florida (U.S.) and Masirah (Oman). Those beaches with 1,000 to 9,999 females nesting each year are Georgia through North Carolina (U.S.), Quintana Roo and Yucatán (Mexico), Cape Verde Islands (Cape Verde, eastern Atlantic off Africa), and Western Australia (Australia). Smaller nesting aggregations with 100 to 999 nesting females annually occur in the Northern Gulf of Mexico (U.S.), Dry Tortugas (U.S.), Cay Sal Bank (Bahamas), Sergipe and Northern Bahia (Brazil), Southern Bahia to Rio de Janerio (Brazil), Tongaland (South Africa), Mozambique, Arabian Sea Coast (Oman), Halaniyat Islands (Oman), Cyprus, Peloponnesus (Greece), Island of Zakynthos (Greece), Turkey, Queensland (Australia), and Japan.

The loggerhead is commonly found throughout the North Atlantic including the GOM of Mexico, the northern Caribbean, the Bahamas archipelago, and eastward to West Africa, the western Mediterranean, and the west coast of Europe.

The major nesting concentrations in the U.S. are found in South Florida. However, loggerheads nest from Texas to Virginia. Total estimated nesting in the U.S. has fluctuated between 47,000 and 90,000 nests per year over the last decade (FWC, unpublished data; GDNR, unpublished data; SCDNR, unpublished data; NCWRC, unpublished data). About 80 percent of loggerhead nesting in the southeast U.S. occurs in six Florida counties (Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward counties). Adult loggerheads are known to make considerable migrations between foraging areas and nesting beaches (Schroeder et al. 2003; Foley et al. in press). During non-nesting years, adult females from U.S. beaches are distributed in waters off the eastern U.S. and throughout the Gulf of Mexico, Bahamas, Greater Antilles, and Yucatán.

From a global perspective, the U.S. nesting aggregation is of paramount importance to the survival of the species and is second in size only to that which nests on islands in the Arabian Sea off Oman (Ross 1982; Ehrhart 1989). The status of the Oman colony has not been evaluated recently, but its location in a part of the world that is vulnerable to disruptive events (e.g., political upheavals, conflicts, catastrophic oil spills) is cause for considerable concern (Meylan et al. 1995). The loggerhead nesting aggregations in Oman, the U.S., and Australia account for about 88 percent of nesting worldwide (NOAA-Fisheries and Service 1991b).

Green Sea Turtles

About 150 to 3,000 females are estimated to nest on beaches in the continental U.S. annually (FWC 2005). In the U.S. Pacific, over 90 percent of nesting throughout the Hawaiian archipelago occurs at the French Frigate Shoals, where about 200 to 700 females nest each year (NOAA Fisheries and Service 1998a). Elsewhere in the U.S. Pacific, nesting takes place at scattered locations in the Commonwealth of the Northern Marianas, Guam, and American Samoa. In the western Pacific, the largest green turtle nesting aggregation in the world occurs on Raine Island, Australia, where thousands of females nest nightly in an average nesting season (Limpus et al. 1993). In the Indian Ocean, major nesting beaches occur in Oman where 30,000 females are reported to nest annually (Ross and Barwani 1995).

Leatherback Sea Turtles

A dramatic drop in nesting numbers has been recorded on major nesting beaches in the Pacific. Spotila et al. (2000) have highlighted the dramatic and possible extirpation of leatherbacks in the Pacific.

The East Pacific and Malaysia leatherback populations have collapsed. Spotila et al. (1996) estimated that only 34,500 females nested annually worldwide in 1995, which is a dramatic decline from the 115,000 estimated in 1980 (Pritchard 1982). In the eastern Pacific, the major nesting beaches occur in Costa Rica and Mexico. At Playa Grande, Costa Rica, considered the

most important nesting beach in the eastern Pacific, numbers have dropped from 1,367 leatherbacks in 1988-1989 to an average of 188 females nesting between 2000-2001 and 2003-2004. In Pacific Mexico in 1982, through aerial surveys of adult female leatherbacks, this area became the most important leatherback nesting beach in the world. Tens of thousands of nests were laid on the beaches in 1980s but during the 2003-2004 seasons, a total of 120 nests was recorded. In the western Pacific, the major nesting beaches lie in Papua New Guinea, Papua, Indonesia, and the Solomon Islands. These are some of the last remaining significant nesting assemblages in the Pacific. Compiled nesting data estimated approximately 5,000-9,200 nests annually with 75 percent of the nests being laid in Papua, Indonesia.

However, the most recent population size estimate for the North Atlantic alone is a range of 34,000-94,000 adult leatherbacks (Turtle Expert Working Group 2007). In Florida, an increase in leatherback nesting numbers from 98 nests in 1989 to between 800 and 900 nests in the early 2000s has been documented.

Nesting in the Southern Caribbean occurs in the Guianas (Guyana, Suriname, and French Guiana), Trinidad, Dominica, and Venezuela. The largest nesting populations at present occur in the western Atlantic in French Guiana with nesting varying between approximately 5,029 and 63,294 nests between 1967 and 2005 (Turtle Expert Working Group 2007). Trinidad supports an estimated 6,000 leatherbacks nesting annually, which represents more than 80 percent of the nesting in the insular Caribbean Sea. Leatherback nesting along the Caribbean Central American coast takes place between the Honduras and Colombia. In Atlantic Costa Rica, at Tortuguero, the number of nests laid annually between 1995 and 2006 was estimated to range from 199-1,623; modeling of these data indicated that the nesting population has decreased by 67.8 percent over this time period.

In Puerto Rico, the main nesting areas are at Fajardo on the main island of Puerto Rico and on the island of Culebra. Between 1978 and 2005, nesting increased in Puerto Rico with a minimum of 9 nests recorded in 1978 and a minimum of 469-882 nests recorded each year between 2000 and 2005. Recorded leatherback nesting on the Sandy Point National Wildlife Refuge on the island of St. Croix, U.S. Virgin Islands between 1990 and 2005, ranged from a low of 143 in 1990 to a high of 1,008 in 2001. In the British Virgin Islands, annual nest numbers have increased in Tortola from 0-6 nests per year in the late 1980s to 35-65 nests per year in the 2000s.

The most important nesting beach for leatherbacks in the eastern Atlantic lies in Gabon, Africa. It was estimated there were 30,000 nests along 60 miles (96.5 km) of Mayumba Beach in southern Gabon during the 1999 - 2000 nesting season. Some nesting has been reported in Mauritania, Senegal, the Bijagos Archipelago of Guinea-Bissau, Turtle Islands and Sherbro Island of Sierra Leone, Liberia, Togo, Benin, Nigeria, Cameroon, Sao Tome and Principe, continental Equatorial Guinea, Islands of Corisco in the Gulf of Guinea and the Democratic Republic of the Congo, and Angola. A larger nesting population is found on the island of Bioko (Equatorial Guinea).

Kemp's Ridley Sea Turtles

In contrast to other sea turtle species, the Kemp's ridley has only one primary nesting beach, which consists of an approximate 25-miles (40-km) stretch of beach occurring near Rancho Nuevo (Service 2006). There is a limited amount of scattered nesting to the north and south of the primary nesting beach. Historic information indicates that tens of thousands of ridleys nested near Rancho Nuevo, Mexico, during the late 1940s (Hildebrand 1963). The Kemp's ridley population experienced a devastating decline between the late 1940s and the mid 1980s. The total number of nests per nesting season at Rancho Nuevo remained below 1,000 throughout the 1980s, but gradually began to increase in the 1990s. In 2006, approximately 7,866 nests were laid at Rancho Nuevo, and the total number of nests for all the beaches was estimated to be 12,143 (Service 2006). In addition, approximately 100 nests were recorded during 2006 in the U.S., primarily in Texas. In addition, rare nesting events have been reported in Florida, Alabama, Georgia, South Carolina, and North Carolina. Most recently, the 2007 nesting season included an arribada of over 4,000 turtles over a 3-day period at Rancho Nuevo during May.

Status and Distribution

Nesting and hatchling sea turtles in the Florida panhandle have been affected by a variety of activities including military missions and testing, coastal development and associated activities, oil and gas exploration, and navigation channel dredging (**Table 4**).

Table 4. Previous biological opinions within northwest Florida that have been issued for all projects that had adverse impact to the nesting sea turtles.

SPECIES **Loggerhead, green, leatherback, and Kemp's ridley sea turtles**	YEAR	**IMPACT (Habitat/critical habitat/individuals)**
Tyndall Air Force Base mission related driving on the beach	1998	18 miles
Panama City Beach beach nourishment original and Amd. 1-8	1998, 2001-2007	16 miles
Lake Powell Emergency Opening	1998-2008	1,500 ft
Destin Dome OCS offshore oil and gas drilling	2000	No take
East Pass re-opening	2001	2 miles
Eglin AFB porous groin within season	2001	3,390 ft
City of Mexico Beach sand bypass system	2001-2007	3,700 ft
Eglin AFB INRMP	2002-2007	17 miles
Eglin 737 Sensor Test Site 13-A SRI	2002	0.12 mile
SPECIES	YEAR	IMPACT

Loggerhead, green, leatherback, and Kemp's ridley sea turtles		**(Habitat/critical habitat/individuals)**
Pensacola Beach beach nourishment original Amd. 1	2002-2005	8.3 miles CC - 14 nests CM - 1 nest DC - 1 nest LK - 1 nest
Eglin Marine Expeditionary Unit Training	2003	17 miles
Eglin AFB U.S. Army Ranger Los Banos	2003	7miles
Alligator Point beach nourishment	2004	2,500 ft CC – 2 nets CM & DC – 1 nest Project never started
Eglin AFB Airborne Littoral Reconnaissance Test and amd 1	2004-2008	0.5 mile
Eglin AFB Advance Skills Training	2004	7 miles
Navarre beach nourishment emergency consultation and amd. 1-6	2005	4.1 miles
FEMA beach berms post Hurricane Ivan emergency consultation	2005	Walton Co. - 20 miles Okaloosa Co. – 4.2 miles Mexico Bch- 1 mile Panama City Bch – Unk St. Joseph peninsula- Unk Perdido Key – Unk Navarre - Unk
Eglin Santa Rosa Island Programmatic	2005-2008	17 miles
Tyndall AFB INRMP	2006-2008	18 miles
Western Lake Emergency Opening	2006	0.5 mile
St. Joseph Peninsula beach restoration and amd 2	2007-2008	7.5 miles
Alligator Point beach restoration	2007	2,500 ft
Eastern Lake Emergency Opening	2007	0.5 mile
Panama City Harbor	2003-2008	500 ft – 1 mile
FEMA FL Statewide Emergency Berms programmatic	2008	50 miles
Eglin AFB SRI beach and dune restoration	2008	5 miles
Perdido Key beach nourishment	2008	6.5 miles

Loggerhead Sea Turtles

Genetic research involving analysis of mitochondrial DNA has identified five different loggerhead subpopulations/nesting aggregations in the western North Atlantic: (1) the Northern Subpopulation occurring from North Carolina to around Cape Canaveral, Florida (about 29° N.); (2) South Florida Subpopulation occurring from about 29° N. on Florida's east coast to Sarasota on Florida's west coast; (3) Dry Tortugas, Florida, Subpopulation, (4) Northwest Florida Subpopulation occurring at Eglin Air Force Base and the beaches near Panama City; and (5) Yucatán Subpopulation occurring on the eastern Yucatán Peninsula, Mexico (Bowen 1994, 1995; Bowen et al. 1993; Encalada et al. 1998; Pearce 2001). These data indicate that gene flow between these five regions is very low. If nesting females are extirpated from one of these regions, regional dispersal will not be sufficient to replenish the depleted nesting subpopulation.

The Northern Subpopulation has declined substantially since the early 1970s. Recent estimates of loggerhead nesting trends from standardized daily beach surveys showed significant declines ranging from 1.5 percent to 2.0 percent annually (Mark Dodd, Georgia Department of Natural Resources, pers. comm. 2005). Nest totals from aerial surveys conducted by the South Carolina Department of Natural Resources showed a 3.3 percent annual decline in nesting since 1980. Overall, there is strong statistical evidence to suggest the Northern Subpopulation has sustained a long-term decline.

Data from all beaches where nesting activity has been recorded indicate that the South Florida Subpopulation has shown significant increases over the last 25 years. However, an analysis of nesting data from the Florida Index Nesting Beach Survey (INBS) Program from 1989 to 2002 (a period encompassing index surveys that are more consistent and more accurate than surveys in previous years), has shown no detectable trend and, more recently (1998 through 2002), has shown evidence of a declining trend (Blair Witherington, FWC, pers. comm. 2003). Given inherent annual fluctuations in nesting and the short time period over which the decline has been noted, caution is warranted in interpreting the decrease in terms of nesting trends.

A near census of the Florida Panhandle Subpopulation undertaken from 1989 to 2002 reveals a mean of 1,028 nests per year, which equates to about 251 females nesting per year (FWC 2003). However, preliminary analysis for nine years (1997 to 2006) of INBS data for the Florida Panhandle subpopulation shows a declining trend (Blair Witherington, FWC, pers. comm. 2007).

A near census of the Dry Tortugas Subpopulation undertaken from 1995 to 2001 reveals a mean of 213 nests per year, which equates to about 50 females nesting per year (FWC 2003). The trend data for the Dry Tortugas Subpopulation are from beaches that were not included in Florida's INBS program prior to 2004, but have moderately good monitoring consistency. There are 7 continuous years (1995 to 2001) of data for this Subpopulation, but the time series is too short to detect a trend (Blair Witherington, FWC, pers. comm. 2005).

Nesting surveys in the Yucatán Subpopulation has been too irregular to date to allow for a meaningful trend analysis (Turtle Expert Working Group 1998, 2000).

Loggerheads are the most common nesting sea turtle and account for over 99 percent of the sea turtle nests in northwest Florida. The eastern portion of the region has the majority of loggerhead nesting (**Figure 3**). Nesting densities range from 1.1 to 9.7 nests per mile in the region. The loggerhead sea turtle nesting and hatching season for the region is generally considered to extend between May 1 and November 1. The earliest nest documented was on May 1 (Franklin and Okaloosa counties) and the latest nest was on November 1 (Bay County) (FWC/FWRI statewide sea turtle nesting database). Nest incubation ranges from about 49 to 95 days.

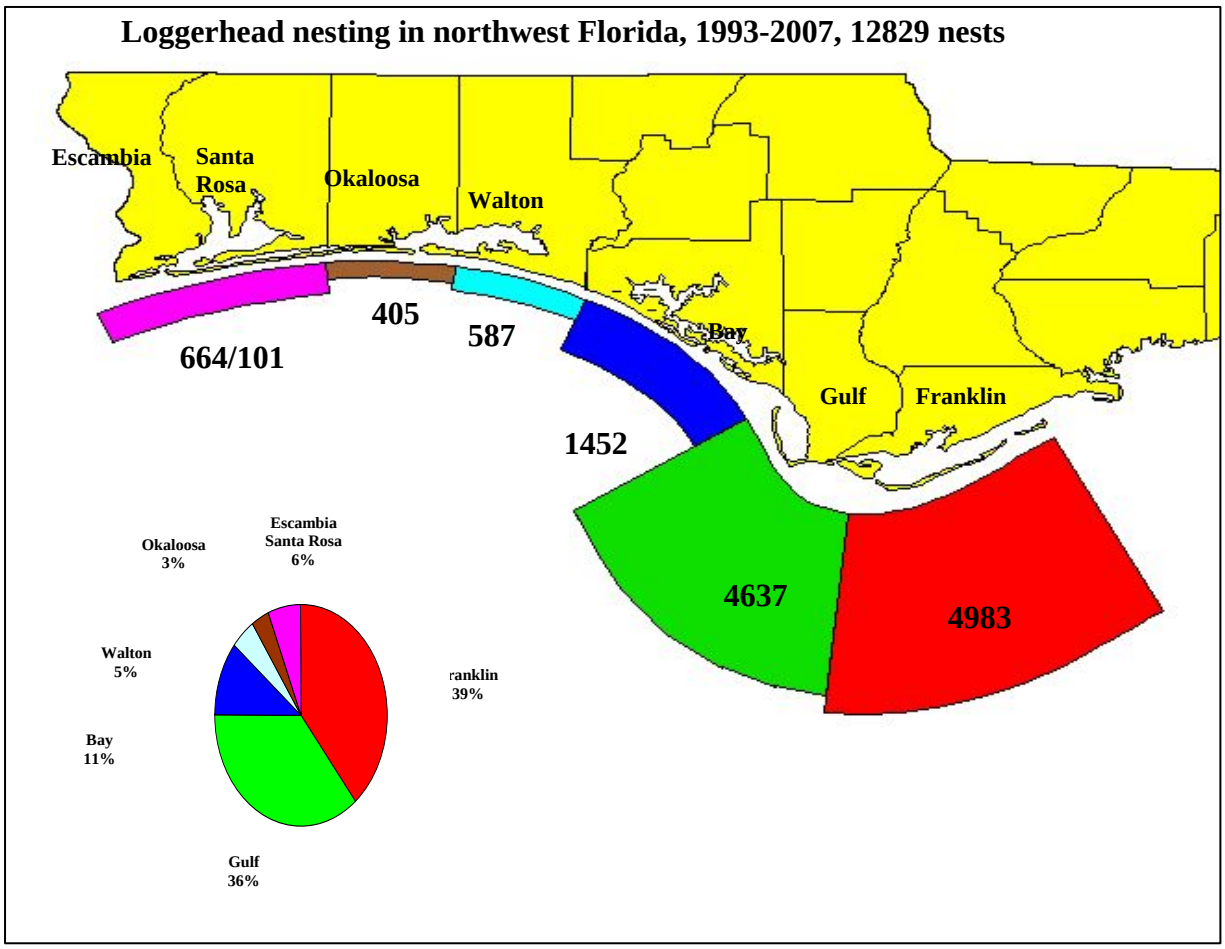

Figure 3. **Loggerhead nesting in northwest Florida, 1993-2007.**

Recovery criteria

The southeastern U.S. loggerhead population can be considered for delisting where, over a period of 25 years, the following conditions are met:

1. The adult female population in Florida is increasing and in North Carolina, South Carolina, and Georgia, it has returned to pre-listing levels (NC - 800, SC - 10,000,

and GA - 2,000 nests per season). The above conditions shall be met with the data from standardized surveys, which would continue for at least five years after delisting.

2. At least 25 percent (348 miles) of all available nesting beaches (1,400 miles) are in public ownership, distributed over the entire nesting range and encompassing at least 50 percent of the nesting activity in each state.

3. All priority one tasks identified in the recovery plan have been successfully implemented.

The Recovery Plan for the loggerhead sea turtle is currently under revision. An initial Recovery Plan for the loggerhead turtle was approved on September 19, 1984. This initial plan was a multi-species plan for all six species of sea turtles occurring in the U.S. On December 26, 1991, a separate recovery plan for the U.S. Atlantic population of the loggerhead turtle was approved. Since approval of the first revised plan in 1991, significant research has been accomplished and important conservation and recovery activities have been undertaken. As a result, we have a greater knowledge of the species and its status. Thus, a revision of the Recovery Plan was drafted and distributed for public comment on May 30, 2008 (73 FR 31066). Comments are requested by July 29, 2008.

The Service and the National Marine Fisheries Service completed a five-year status review of the loggerhead sea turtle in August 2007 (National Marine Fisheries Service and Service 2007a). A recommendation has been made to determine the application of the DPS policy for the species. A DPS is a population segment that is discrete in relation to the remainder of the species to which it belongs, and significant to the species to which it belongs. This indicates that there is enough information available to consider designating DPS for the separate nesting subpopulations of loggerhead sea turtles, including the Florida panhandle subpopulation.

Green Sea Turtles

Total population estimates for the green turtle are unavailable, and trends based on nesting data are difficult to assess because of large annual fluctuations in numbers of nesting females. For instance, in Florida, where the majority of green turtle nesting in the southeastern U.S. occurs, estimates range from 150 to 2,750 females nesting annually (FWC 2003).

Green sea turtle nesting has been documented in all counties (but not on all beaches) in northwest Florida (**Figure 4)**. The green sea turtle nesting and hatching season for this region extends from May 1 through October 31, the earliest nest was documented on May 19 (Franklin County) and the latest nest was documented on August 23 (Escambia County). Nest incubation ranges from about 60 to 90 days. Nesting in northwest Florida has been consistently documented at least every other year since 1990 (FWC/FWRI statewide sea turtle nesting database).

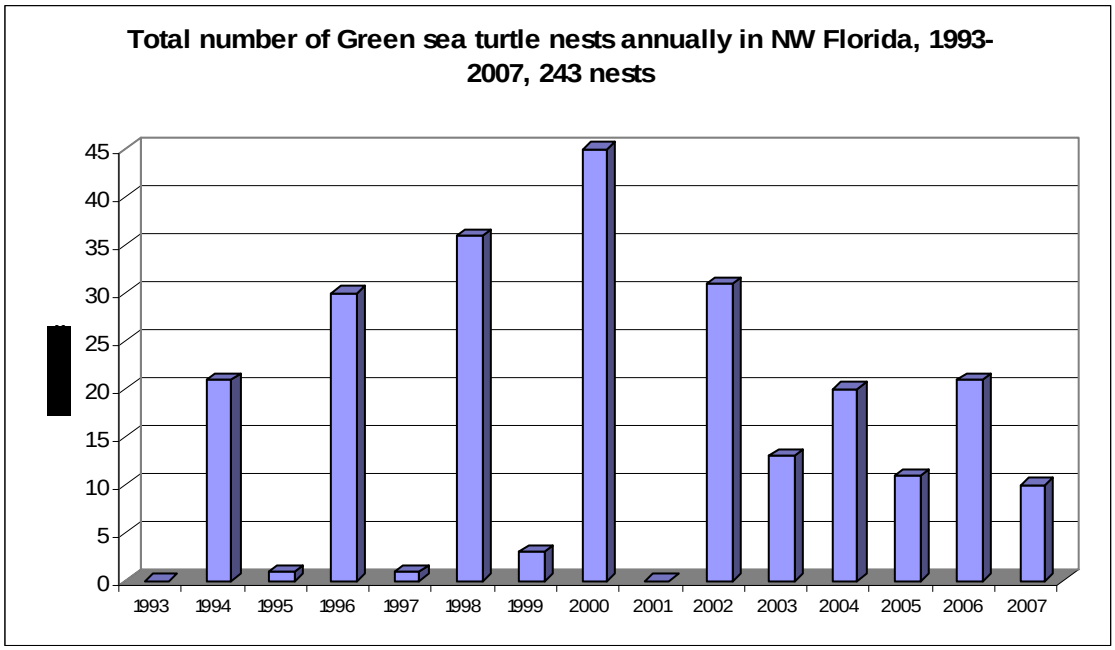

Figure 4. Green sea turtle nesting in northwest Florida, 1993-2007.

Recovery criteria

The U.S. population of green sea turtles can be considered for delisting when, over a period of 25 years the following conditions are met:

1. The level of nesting in Florida has increased to an average of 5,000 nests per year for at least six years. Nesting data shall be based on standardized surveys.

2. At least 25 percent (65 miles) of all available nesting beaches (260 miles) are in public ownership and encompass at least 50 percent of the nesting activity.

3. A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds.

4. All priority one tasks identified in the recovery plan have been successfully implemented.

The current "Recovery Plan for the U.S. Population of Atlantic Green Turtle (*Chelonia mydas*)" was completed in 1991, the Recovery Plan for U.S. Pacific Populations of the Green Turtle (*Chelonia mydas*)" was completed in 1998, and the "Recovery Plan for U.S. Pacific Populations of the East Pacific Green Turtle (*Chelonia mydas*)" was completed in 1998. The recovery criteria contained in the plans, while not strictly adhering to all elements of the Recovery Planning Guidelines (Service and NOAA), are a viable measure of the species status.

The Service and the National Marine Fisheries Service completed a five-year status review of the green sea turtle in August 2007 (National Marine Fisheries Service and Service 2007b). A recommendation has been made to conduct an analysis and review of the species to determine the application of the DPS policy for the species. A DPS is a population segment that is discrete in relation to the remainder of the species to which it belongs, and significant to the species to which it belongs. Since the species' listing, a substantial amount of information has become available on population structure (through genetic studies) and distribution (through telemetry, tagging, and genetic studies). The data has not been fully assembled or analyzed; however, at a minimum, these data appear to indicate a possible separation of populations by ocean basins.

Leatherback Sea Turtles

Declines in leatherback nesting have occurred over the last two decades along the Pacific coasts of Mexico and Costa Rica. The Mexican leatherback nesting population, once considered to be the world's largest leatherback nesting population (historically estimated to be 65 percent of worldwide population), is now less than one percent of its estimated size in 1980. Spotila et al. (1996) estimated the number of leatherback sea turtles nesting on 28 beaches throughout the world from the literature and from communications with investigators studying those beaches. The estimated worldwide population of leatherbacks in 1995 was about 34,500 females on these beaches with a lower limit of about 26,200 and an upper limit of about 42,900. This is less than one third the 1980 estimate of 115,000. Leatherbacks are rare in the Indian Ocean and in very low numbers in the western Pacific Ocean. The largest population is in the western Atlantic. Using an age-based demographic model, Spotila et al. (1996) determined that leatherback populations in the Indian Ocean and western Pacific Ocean cannot withstand even moderate levels of adult mortality and that even the Atlantic populations are being exploited at a rate that cannot be sustained. They concluded that leatherbacks are on the road to extinction and further population declines can be expected unless action is taken to reduce adult mortality and increase survival of eggs and hatchlings.

Documented leatherback nests are rare in northwest Florida. From 1993 to 2007, a total of 47 nests have been reported on northwest Florida beaches (FWC/FWRI statewide sea turtle nesting database) (**Figure 5**). The first recorded leatherback nest in the region was in 1974, on St. Vincent Island, Franklin County. The majority of the nests have had low natural hatching success. The greatest number of successful nests in any one season occurred in 2000, when three leatherback nests were documented to produce hatchlings that successfully emerged from the nest. One nest was on the Fort Pickens Area of GUIS, Escambia County, and two of the nests were on Eglin Air Force Base, Santa Rosa Island, Okaloosa County. The leatherback sea turtle nesting and hatching season for this region extends from late April through October 31. For confirmed nesting, the earliest nest was documented on April 18 (Franklin County) and the latest nest documented on July 24 (Bay County). Documented nest incubation in northwest Florida ranges from about 63 to 84 days (FWC/FWRI statewide sea turtle nesting database).

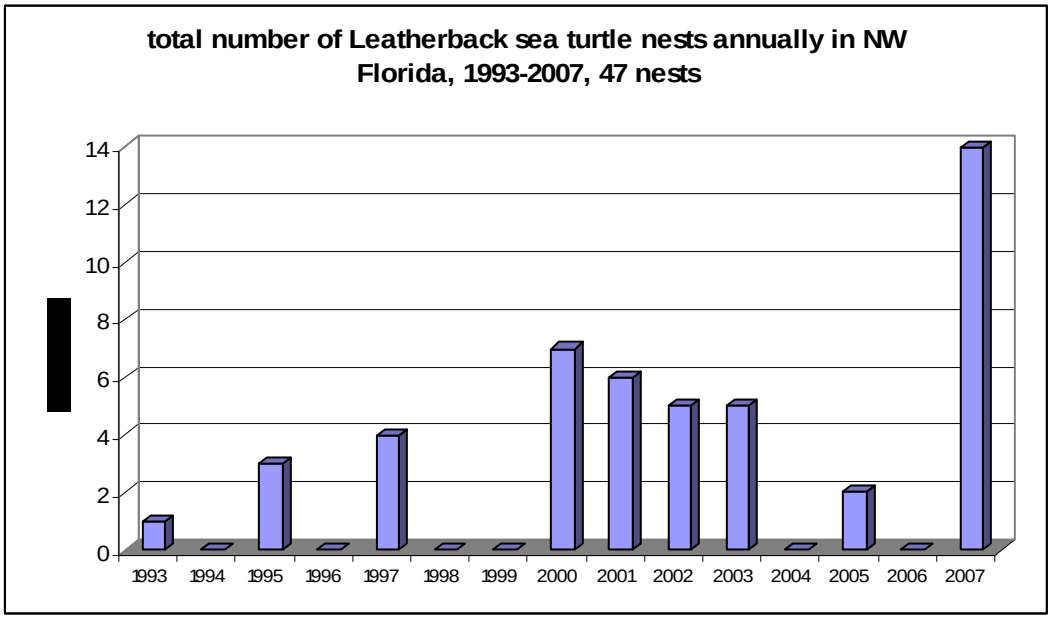

Figure 5. Number of leatherback sea turtle nests in NW Florida 1993-2007.

Recovery criteria

The U.S. population of leatherbacks can be considered for delisting when the following conditions are met:

1. The adult female population increases over the next 25 years, as evidenced by a statistically significant trend in the number of nests at Culebra, Puerto Rico, St. Croix, U.S. Virgin Island, and along the east coast of Florida.

2. Nesting habitat encompassing at least 75 percent of nesting activity in U.S. Virgin Islands, Puerto Rico, and Florida is in public ownership.

3. All priority one tasks identified in the recovery plan have been successfully implemented.

The current "Recovery Plan for the Leatherback Turtles (*Dermochelys coriacea*)" in the U.S. Caribbean, Atlantic, and Gulf of Mexico" was signed in 1992 and the "Recovery Plan for U.S. Pacific Populations of the Leatherback Turtle (*Dermochelys coriacea*)" was signed in 1998. The recovery criteria contained in the plans, while not strictly adhering to all elements of the Recovery Planning Guidelines (Service and NOAA), are a viable measure of the species status.

The Service and the National Marine Fisheries Service completed a five-year status review of the leatherback sea turtle in August 2007 (National Marine Fisheries Service and Service 2007c). A recommendation has been made to conduct an analysis and review of the species to determine the application of the DPS policy for the species. A DPS is a population segment that is discrete in relation to the remainder of the species to which it belongs, and significant to the species to

which it belongs. Since the species' listing, a substantial amount of information has become available on population structure (through genetic studies) and distribution (through telemetry, tagging, and genetic studies). The data has not been fully assembled or analyzed; however, at a minimum, these data appear to indicate a possible separation of populations by ocean basins.

Kemp's Ridley Sea Turtles

Today, under strict protection, the population appears to be in the early stages of recovery. The recent nesting increase can be attributed to full protection of nesting females and their nests in Mexico resulting from a bi-national effort between Mexico and the U.S. to prevent the extinction of the Kemp's ridley, and the requirement to use Turtle Excluder Devices (TEDs) in shrimp trawls both in the United States and Mexico.

The Mexico government also prohibits harvesting and is working to increase the population through more intensive law enforcement, by fencing nest areas to diminish natural predation, and by relocating most nests into corrals to prevent poaching and predation. While relocation of nests into corrals is currently a necessary management measure, this relocation and concentration of eggs into a "safe" area is of concern since it makes the eggs more susceptible to reduced viability.

Twenty-nine Kemp's ridley nests have now been documented in Florida in Brevard, Escambia, Gulf, Lee, Martin, Palm Beach, Pinellas, Santa Rosa, Sarasota, and Volusia counties (FWC/FWRI statewide sea turtle nesting database) (**Figure 6**). The Kemp's ridley sea turtle nesting and hatching season for this region extends from May 1 through October 31. For confirmed nesting, the earliest nest in northwest Florida was documented on May 14 (Escambia County) and the latest nest July 21 (Escambia County).

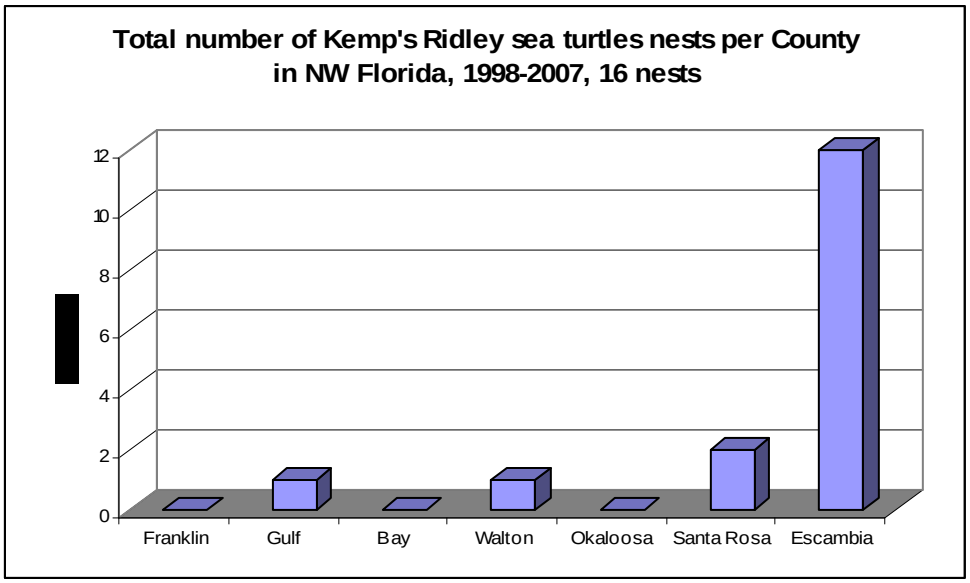

Figure 6. Number of Kemp's ridley sea turtle nests in NW Florida 1998-2007.

Recovery criteria

The goal of the Recovery Plan is for the species to be reduced from endangered to threatened status. The Recovery Team members feel that the criteria for a complete removal of this species from the endangered species list need not be considered now, but rather left for future revisions of the plan. Complete removal from the federal list would certainly necessitate that some other instrument of protection, similar to the Marine Mammal Protection Act, be in place and be international in scope. Kemp's ridley can be considered for downlisting to threatened when the following four criteria are met:

1. Protection of the known nesting habitat and the water adjacent to the nesting beach (concentrating on the Ranch Nuevo area) and continuation of the bi-national project.

2. Elimination of the mortality from incidental catch from commercial shrimping in the U.S. and Mexico through the use of TEDs and full compliance with the regulations requiring TED use.

3. Attainment of a population of at least 10,000 females nesting in a season.

4. All priority one recovery tasks in the recovery plan are successfully implemented.

The current Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*) was signed in 1992. Significant new information on the biology and population status of Kemp's ridley has become available since 1992. Consequently, a full revision of the recovery plan has been undertaken by the Service and NOAA and is nearing completion. The revised plan will provide updated species biology and population status information, objective and measurable recovery criteria, and updated and prioritized recovery actions. The Service and the National Marine Fisheries Service completed a five-year status review of the Kemp's Ridley sea turtle in August 2007 (National Marine Fisheries Service and Service 2007d). Recommendations provided in the five-year review focused on the protection of the species both in the water (enforcement of TED use) and on land (nesting habitat).

Threats to Sea Turtles

Loggerhead Sea Turtles

Anthropogenic (human) factors that impact hatchlings and adult female turtles on land, or the success of nesting and hatching include: beach erosion, armoring and nourishment; artificial lighting; beach cleaning; increased human presence; recreational beach equipment; beach driving; coastal construction and fishing piers; exotic dune and beach vegetation; and poaching. An increased human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs, and an increased presence of native species (*e.g.*, raccoons, armadillos, and opossums), which raid and feed on

turtle eggs. Although sea turtle nesting beaches are protected along large expanses of the western North Atlantic coast, other areas along these coasts have limited or no protection.

Loggerhead turtles are affected by a completely different set of anthropogenic threats in the marine environment. These include oil and gas exploration and transportation; marine pollution; underwater explosions; hopper dredging, offshore artificial lighting; power plant entrainment and/or impingement; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; poaching and fishery interactions. In the oceanic environment, loggerheads are exposed to a series of longline fisheries that include the U.S. Atlantic tuna and swordfish longline fisheries, an Azorean longline fleet, a Spanish longline fleet, and various fleets in the Mediterranean Sea (Aguilar et al. 1995; Bolten et al 1994; Crouse 1999). There is particular concern about the extensive incidental take of juvenile loggerheads in the eastern Atlantic by longline fishing vessels. In the neritic environment in waters off the coastal U.S., loggerheads are exposed to a suite of fisheries in federal and state waters including trawl, purse seine, hook and line, gillnet, pound net, longline, dredge, and trap fisheries.

Green Sea Turtles

A major factor contributing to the green turtle's decline worldwide is commercial harvest for eggs and food. Fibropapillomatosis, a disease of sea turtles characterized by the development of multiple tumors on the skin and internal organs, is also a mortality factor and has seriously impacted green turtle populations in Florida, Hawaii, and other parts of the world. The tumors interfere with swimming, eating, breathing, vision, and reproduction, and turtles with heavy tumor burdens may die. Other threats include loss or degradation of nesting habitat from coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and incidental take from channel dredging and commercial fishing operations.

Leatherback Sea Turtles

The crash of the Pacific leatherback population is believed primarily to be the result of exploitation by humans for the eggs and meat, as well as incidental take in numerous commercial fisheries of the Pacific. Other factors threatening leatherbacks globally include loss or degradation of nesting habitat from coastal development; disorientation of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; and watercraft strikes.

Kemp’s Ridley Sea Turtle

The decline of this species was primarily due to human activities, including the direct harvest of adults and eggs and incidental capture in commercial fishing operations. Nest relocation has assisted in increasing the population of this species; however, egg relocation has its own host of problems due to movement-induced mortality, disease vectors, catastrophic events like hurricanes, and marine predators once the predators learn where to concentrate their efforts.

All Sea Turtles

Coastal Development

Loss of nesting habitat related to coastal development has had the greatest impact on nesting sea turtles in Florida. Beachfront development not only causes the loss of suitable nesting habitat, but can result in the disruption of powerful coastal processes accelerating erosion and interrupting the natural shoreline migration (National Research Council 1990b). This may in turn cause the need to protect upland structures and infrastructure by armoring, groin placement, beach emergency berm construction and repair, and beach nourishment which cause changes in, additional loss, or impact to the remaining sea turtle habitat.

Hurricanes

Hurricanes were probably responsible for maintaining coastal beach habitat upon which sea turtles depend through repeated cycles of destruction, alteration, and recovery of beach and dune habitat. Hurricanes generally produce damaging winds, storm tides and surges, and rain and can result in severe erosion of the beach and dune systems. Overwash and blowouts are common on barrier islands. Hurricanes and other storms can result in the direct or indirect loss of sea turtle nests, either by erosion or washing away of the nests by wave action or inundation or "drowning" of the eggs or hatchlings developing within the nest or indirectly by loss of nesting habitat. Depending on their frequency, storms can affect sea turtles on either a short-term basis (nests lost for one season and/or temporary loss of nesting habitat) or long term, if frequent (habitat unable to recover). How hurricanes affect sea turtle nesting also depends on its characteristics (winds, storm surge, rainfall), the time of year (within or outside of the nesting season), and where the northeast edge of the hurricane crosses land.

Because of the limited remaining nesting habitat, frequent or successive severe weather events could threaten the ability of certain sea turtle populations to survive and recover. Sea turtles evolved under natural coastal environmental events such as hurricanes. The extensive amount of pre-development coastal beach and dune habitat allowed sea turtles to survive even the most severe hurricane events. It is only within the last 20 to 30 years that the combination of habitat loss to beachfront development and destruction of remaining habitat by hurricanes has increased the threat to sea turtle survival and recovery. On developed beaches, typically little space remains for sandy beaches to become re-established after periodic storms. While the beach itself moves landward during such storms, reconstruction or persistence of structures at their pre-storm locations can result in a major loss of nesting habitat.

The 2004 hurricane season was the most active storm season in Florida since weather records began in 1851. Hurricanes Charley, Frances, Ivan, and Jeanne, along with Tropical Storm Bonnie, damaged the beach and dune system, upland structures and properties, and infrastructure in the majority of Florida's coastal counties. The cumulative impact of these storms exacerbated erosion conditions throughout the state.

The 2005 hurricane season was a record-breaking season with 27 named storms. Hurricanes Dennis, Katrina, Ophelia, Rita, and Wilma, and Tropical Storms Arlene and Tammy impacted Florida. The cumulative impact of these storms exacerbated erosion conditions in south and northwest Florida.

Erosion

The designation of a Critically Eroded Beach is a planning requirement of the State's Beach Erosion Control Funding Assistance Program. A segment of beach shall first be designated as critically eroded in order to be eligible for State funding. A critically eroded area is a segment of the shoreline where natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost. Critically eroded areas may also include peripheral segments or gaps between identified critically eroded areas which, although they may be stable or slightly erosional now, their inclusion is necessary for continuity of management of the coastal system or for the design integrity of adjacent beach management projects (FDEP 2005). It is important to note, that for an erosion problem area to be critical, there shall exist a threat to or loss of one of four specific interests – upland development, recreation, wildlife habitat, or important cultural resources. The total of critically eroded beaches statewide in Florida for 2007 is 388 miles of 497 miles of shoreline. Seventy-eight (78) percent of the State's shoreline is considered to be critically eroded.

Beachfront Lighting

Artificial beachfront lighting may cause disorientation (loss of bearings) and misorientation (incorrect orientation) of sea turtle hatchlings. Visual signs are the primary sea-finding mechanism for hatchlings (Mrosovsky and Carr 1967; Mrosovsky and Shettleworth 1968; Dickerson and Nelson 1989; Witherington and Bjorndal 1991). Artificial beachfront lighting is a documented cause of hatchling disorientation and misorientation on nesting beaches (Philibosian 1976; Mann 1977; FWC 2006). The emergence from the nest and crawl to the sea is one of the most critical periods of a sea turtle's life. Hatchlings that do not make it to the sea quickly become food for ghost crabs, birds, and other predators or become dehydrated and may never reach the sea. Some types of beachfront lighting attract hatchlings away from the sea while some lights cause adult turtles to avoid stretches of brightly illuminated beach. Research has documented significant reduction in sea turtle nesting activity on beaches illuminated with artificial lights (Witherington 1992). Lighting disorientations continued to increase on Florida's beaches (**Table 5**). Exterior and interior lighting associated with condominiums has the greatest impact causing approximately 42 percent of all the disorientation/misorientation in 2007. Other causes included sky glow and street lights (http://www.myfwc.com/seaturtle/Lighting/Light_Disorient.htm).

Table 5. Documented Disorientations along the Florida coast (Conti 2006).

Year	Total Number of Hatchling Disorientation Events	Total Number of Hatchlings Involved in Disorientation Events	Total Number of Adult Disorientation Events
2001	743	28,674	19
2002	896	43,226	37
2003	1,446	79,357	18
2004	888	46,487	24
2005	976	41,521	50
2006	1,521	71,798	40
2007	1,410	64,433	25

Armoring

Research has shown that armoring changes essential behaviors (nesting) of female sea turtles in accessing, locating and selecting a suitable nest site, depositing nests in sub-optimal habitats, and decreasing nesting activity. Shoreline changes as a result of armoring can have various detrimental effects to sea turtles and their nesting habitat. Over the long term, the physical presence of an armored shoreline will result in the annual displacement of sea turtle nests. The existing habitat behind armoring structures is lost to nesting turtles and the beaches in front of armoring structures represent suboptimal nesting habitat and incubation environments. In summary, armoring results in the: 1) loss of available nesting habitat; 2) change turtle nesting behavior during the sea turtle nesting season (May 1 through October 31); and 3) contribute to physical changes of the coastline that would result in decreased nesting habitat quality and result in harm to nests laid seaward of armoring structures.

Predation

Depredation of sea turtle eggs and hatchlings by natural and introduced species occurs on almost all nesting beaches. Depredation by a variety of predators can considerably decrease sea turtle nest hatching success. The most common predators in the southeastern United States are ghost crabs (*Ocypode quadrata*), raccoons (*Procyon lotor*), feral hogs (*Sus scrofa*), foxes (*Urocyon cinereoargenteus* and *Vulpes vulpes*), coyotes (*Canis latrans*), armadillos (*Dasypus novemcinctus*), cats (*Felis catus)*, and fire ants (*Solenopsis* spp.) (Dodd 1988; Stancyk 1995). Raccoons are particularly destructive on the Atlantic coast and may take up to 96 percent of all nests deposited on a beach (Davis and Whiting 1977; Hopkins and Murphy 1980; Stancyk et al. 1980; Talbert et al. 1980; Schroeder 1981; Labisky et al. 1986). As nesting habitat dwindles, it is essential that nest production be naturally maximized so the turtles may continue to exist in the wild.

In response to increasing depredation of sea turtle nests by coyote, fox, hog, and raccoon, multi-agency cooperative efforts have been initiated and are ongoing throughout Florida, in particular on public lands.

Driving on the Beach

The operation of motor vehicles on the beach affects sea turtle nesting by: interrupting a female turtle approaching the beach; headlights disorienting or misorienting emergent hatchlings; vehicles running over hatchlings attempting to reach the ocean; and vehicle tracks traversing the beach which interfere with hatchlings crawling to the ocean. Apparently, hatchlings become diverted not because they cannot physically climb out of the rut (Hughes and Caine 1994), but because the sides of the track cast a shadow and the hatchlings lose their line of sight to the ocean horizon (Mann 1977). The extended period of travel required to negotiate tire tracks and ruts may increase the susceptibility of hatchlings to dehydration and depredation during migration to the ocean (Hosier et al. 1981). Driving directly above or over incubating egg clutches or on the beach can cause sand compaction which may result in adverse impacts on nest site selection, digging behavior, clutch viability, and emergence by hatchlings, decreasing nest success and directly killing pre-emergent hatchlings (Mann 1977; Nelson and Dickerson 1987; Nelson 1988).

The physical changes and loss of plant cover caused by vehicles on dunes can lead to various degrees of instability, and therefore encourage dune migration. As vehicles move either up or down a slope, sand is displaced downward, lowering the trail. Since the vehicles also inhibit plant growth, and open the area to wind erosion, dunes may become unstable, and begin to migrate. Unvegetated sand dunes may continue to migrate across stable areas as long as vehicle traffic continues. Vehicular traffic through dune breaches or low dunes on an eroding beach may cause accelerated rate of overwash and beach erosion (Godfrey et al. 1978). If driving is required, the area where the least amount of impact occurs is the beach between the low and high tide water lines. Vegetation on the dunes can quickly re-establish provided the mechanical impact is removed.

In 1985, the Florida Legislature severely restricted vehicular driving on Florida's beaches, except that which is necessary for cleanup, repair, or public safety. This legislation also allowed an exception for five counties to continue to allow vehicular access on coastal beaches due to the availability of less than 50 percent of its peak user demand for off-beach parking. The counties affected by this exception are Volusia, St. Johns, Gulf, Nassau, and Flagler counties, as well as limited vehicular access on Walton County beaches for boat launching.

Sea Turtle Strandings

NOAA Fisheries leads the Sea Turtle Stranding and Salvage Network (STSSN). In Florida, strandings are documented by the FWRI staff biologists and by a network of permitted participants located around the state. Since the start of the program in 1980, loggerhead strandings (dead or debilitated turtles) documented by the Florida STSSN have increased significantly from 1989 to 2005 with the two highest yearly totals occurring in 2003 and 2005.

Analysis of the species/critical habitat likely to be affected

The northwest Florida loggerhead sea turtle nesting subpopulation has significantly declined in nesting based on data analyzed by the State of Florida from 1997 to 2006. While all turtle nesting beaches are adequately surveyed following standard operating procedures and management is in place on most beaches, nest numbers continue to decrease. A variety of factors have been indicated to contributing to the decline of the nesting: incidental take in offshore commercial fishing, an increase in boat strikes, and loss of nesting habitat from coastal development and associated activities including armoring, nourishment, lighting, predation, and increased human presence on the beach at night. In recent years, survival and success of nest hatching has been affected by severe weather events. All four species of sea turtles (loggerhead, green, leatherback, and Kemp's ridley sea turtles) have been documented to nest on Walton County beaches.

ENVIRONMENTAL BASELINE

Status of the species within the action area

Sea turtle surveys are conducted on non-State managed beaches by the South Walton Turtle Watch. Nesting surveys have been conducted since 1993 and are conducted seven days a week from May 1 to September 1. Nest hatching surveys may continue into mid-November depending on nest incubation. Surveys begin at sunrise. Surveys are conducted on foot. Turtle crawls are identified as a true nesting crawl or false crawl. Nests are marked with stakes and surrounded with surveyor flagging tape, and if needed screened to prevent predation. The marked nests are monitored throughout the incubation period for storm damage, predation, hatching activity and hatch and emergence success. Nests are relocated if threatened by erosion or inundation. Nests are relocated within the first 12 hours of being deposited, or before 9 a.m. the morning following deposition. All monitoring is conducted in accordance with guidelines provided by the Florida Fish and Wildlife Conservation Commission (FWC).

The Florida Park Service conducts sea turtle monitoring on the State parks in Walton County (Topsail Hill Preserve State Park, Grayton Beach State Park, and Deer Lake State Park). Sea turtle surveys have been conducted since 1993. The monitoring is conducted by Park volunteers or staff. Nesting surveys are conducted seven days a week from May 1 to September 1. Nest hatching surveys may continue into mid-November depending on nest incubation. Surveys begin at sunrise. Surveys are conducted on foot or by using all terrain vehicles (ATVs). Turtle crawls are identified as a true nesting crawl or false crawl. Nests are marked with stakes and surrounded with surveyor flagging tape, and if needed screened to prevent predation. The marked nests are monitored throughout the incubation period for storm damage, predation, hatching activity and hatch and emergence success. Nests are relocated if threatened by erosion or inundation. Nests are relocated within the first 12 hours of being deposited, or before 9 a.m. the morning following deposition. All monitoring is conducted in accordance with guidelines provided by the FWC.

The loggerhead sea turtle average annual nesting density for the beaches of Walton County is 1.6 nests per mile (**Figure 7**). From 1993 to 2007, 584 loggerhead nests and 263 false crawls were documented, with an annual average of 39 nests. The nest to false crawl ratio for the beaches is approximately 1:2.2.

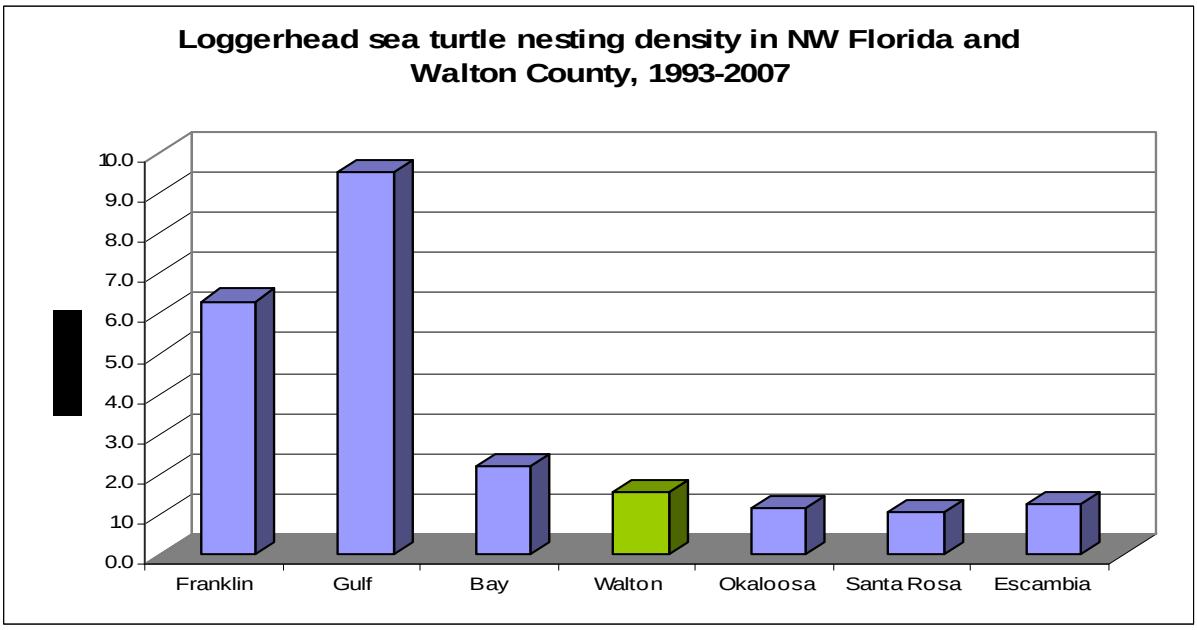

Figure 7. Loggerhead sea turtle nesting density in northwest Florida and the project area from 1993 to 2007.

Thirty-four green sea turtle nests have been documented on Walton County beaches from 1993-2007 (**Figure 8).**

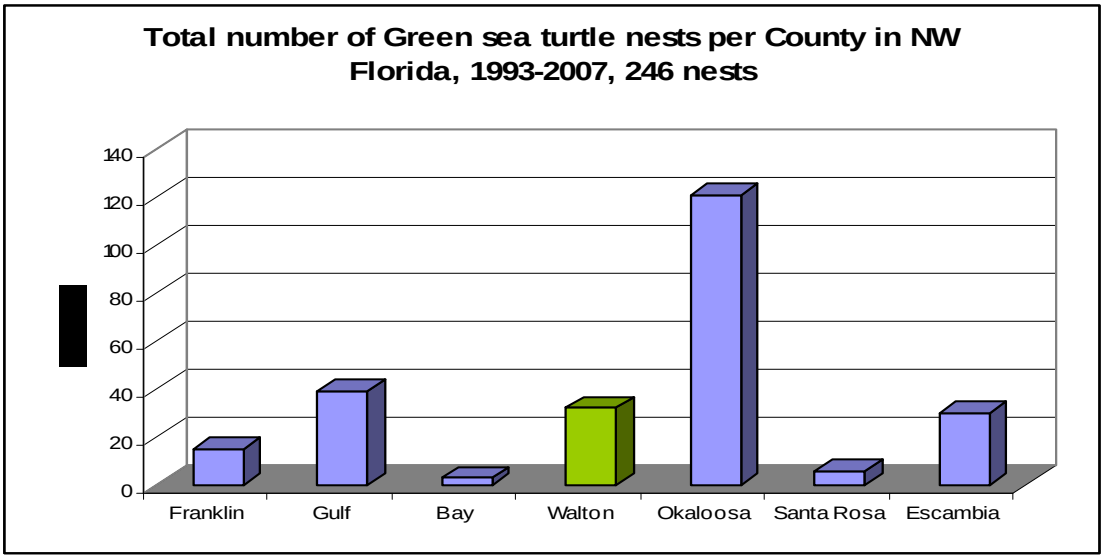

Figure 8. Total number of green sea turtle nests in northwest Florida and the project area from 1993 to 2007.

Only one leatherback sea turtle nest has been documented in Walton County (**Figure 9**). It was found in 2007 and successfully hatched.

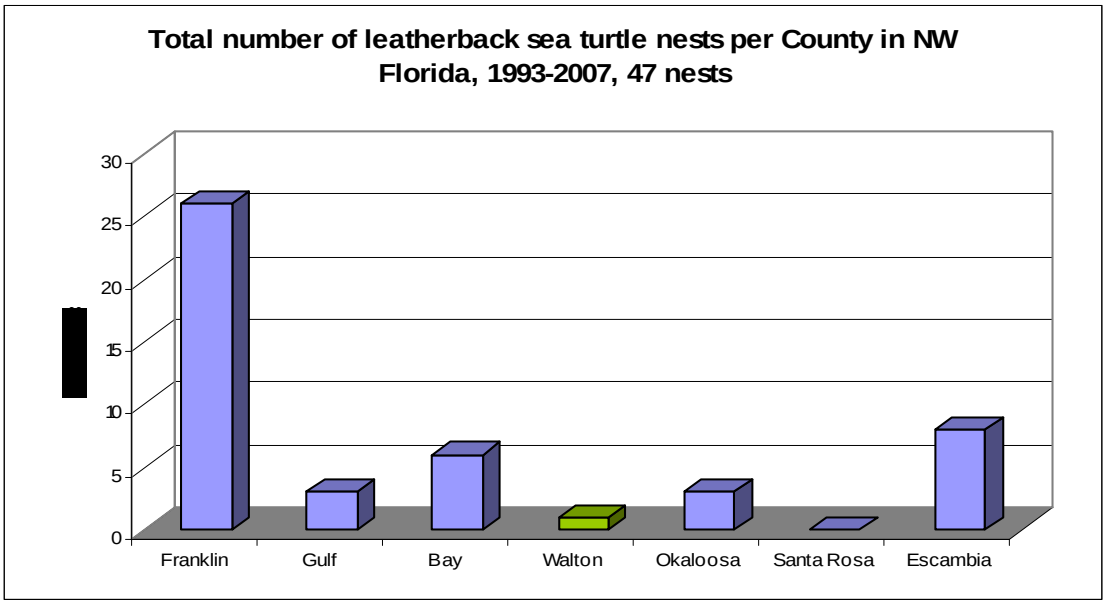

Figure 9. Total number of leatherback sea turtle nests in northwest Florida and the project area from 1993 to 2007.

Only one Ridley sea turtle nest has been documented in Walton County (**Figure 10**). It was found in 2007 and successfully hatched.

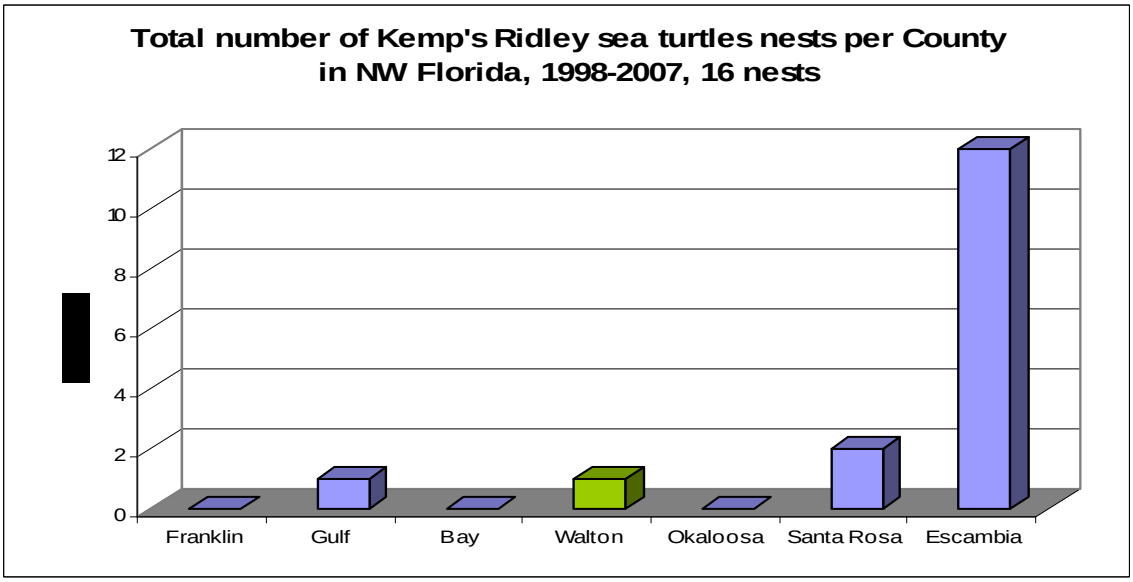

Figure 10. Total number of Kemp's Ridley sea turtle nests in northwest Florida and the project area from 1993 to 2007.

Factors affecting species environment within the action area

Primary impacts to sea turtle nesting within the Action Area include weather events, post weather-event actions, lighting disorientations, and disturbance by humans.

Artificial Beachfront Lighting

The South Walton Turtle Watch has documented an average annual nest disorientation rate of 20 percent (**Figure 11**) (unpublished data provided by FWC 2007). Walton County has not enacted a beachfront lighting ordinance. A 2006 survey of the nourished beach following the Western beach restoration project revealed 136 lighting problems over the 3.6-mile project shoreline (Taylor Engineering 2006). Of that, 39 percent were attributed to balcony or wall mounted lights, 19 percent to floodlights, 18 percent to streetlights, and 10 percent to pole mounted lights (excluding streetlights). Other problems included general commercial lighting, signs, landscape lighting, and interior lights.

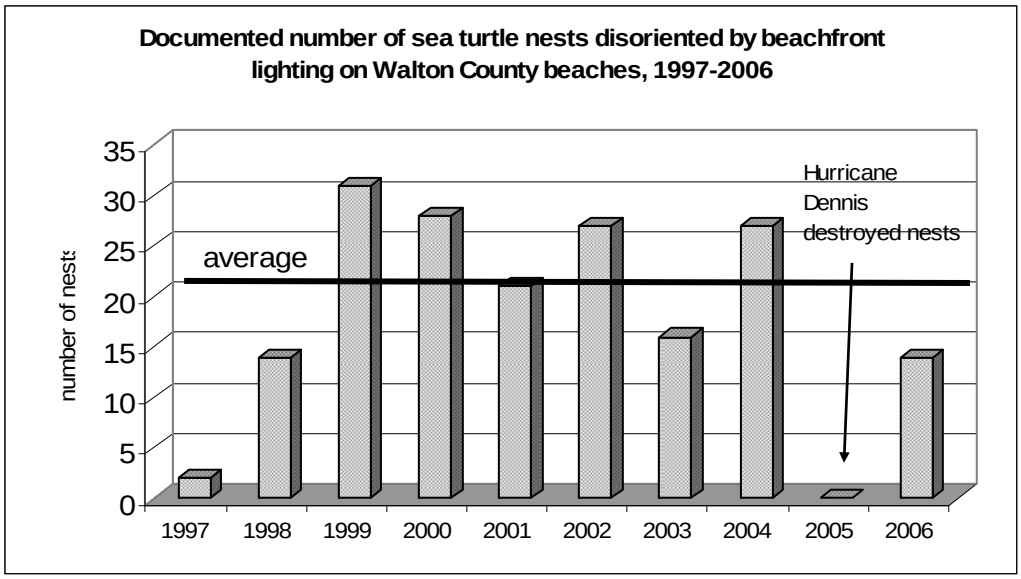

Figure 11. Lighting disorientation documented by the South Walton Turtle Watch from 1997 through 2006.

Erosion

There are eight critically eroded areas designated in Walton County (14.3 miles) by the Florida Department of Environmental Protection (FDEP), Bureau of Beaches and Coastal Systems (FDEP 2007). The western 5.0 miles (R-1 to R-22.8) threaten development, recreational interests, and the coastal road. This area had a beach restoration project completed in 2007. A 2.7-mile critically eroded segment at Dune Allen (R-41 to R-54.5) threatens development, Fort Panic Road, and County Road 30A. A 1.0-mile segment of Blue Mountain Beach (R-58 to R-63) is critically eroded where development is threatened by erosion of the bluff. To the east, erosion of a 0.2-mile segment of Gulf Trace (R-67.3 to R-68.3) and a 0.1-mile segment of Grayton Beach (R-70.95 to R-71.4) also threaten development. A 3.1-mile segment of critical erosion threatens development along Seagrove Beach (R-82 to R-98). To the east along Seacrest Beach, is another 1.8-mile segment (R-105.5 to R-114.7) where development is threatened by

erosion of the bluff. A 0.4-mile segment at Inlet Beach (R-122 to R-124) is designated critically eroded due to its post-storm vulnerability threatening development interests.

Weather Events

The 2004 hurricane season was the most active storm season in Florida since weather records began in 1851. Hurricanes Charley, Frances, Ivan, and Jeanne, along with Tropical Storm Bonnie, damaged the beach and dune system, upland structures and properties, and infrastructure in the majority of Florida's coastal counties. The cumulative impact of these storms exacerbated erosion conditions throughout the state. With the impact of Hurricane Ivan along the northern Gulf of Mexico coast, segments in Escambia (1.2 miles), Santa Rosa (0.7 mile), Okaloosa (2.8 miles), Walton (5.1 miles), and Gulf (0.5 mile) counties were added to the State list of critically eroded beaches.

The 2005 hurricane season was a record breaking season with 27 named storms. Florida was impacted by Hurricanes Dennis, Katrina, Ophelia, Rita, and Wilma, and Tropical Storms Arlene and Tammy. The cumulative impact of these storms exacerbated erosion conditions in south and northwest Florida. In northwest Florida, following the impact of Hurricane Dennis along with additional fringe impacts of Hurricanes Katrina and Rita, critically eroded segments were added in Okaloosa (1.6 miles), Walton (2.4 miles), Gulf (2.4 miles), Franklin (7.4 miles) and Perdido Key, Escambia (1.2 miles) counties.

The entire coast of Walton County sustained major beach and dune erosion (condition IV) and major damage to numerous structures from the impact of Hurricane Dennis. The erosion impact was comparable to the impact of Hurricanes Eloise (1975), Opal (1995), and Ivan (2004). The impact of Dennis exacerbated the severe erosion conditions which had not recovered from the 2004 storms (FDEP 2005).

The continual effects of increased tidal surges and the frequency of storms have caused beach erosion, dune damage, and structure damage. Sea turtles nests were lost from tidal inundation or wave action and were subjected to changed beach profiles and sand characteristics, eroded beaches, physical barriers, and disturbance from humans.

Coastal Development

The beaches of Walton County continue to grow along with the rest of Florida. Coastal development is on the rise. Shorefront development, increasing population growth and hurricane recovery resulted in a construction boom across the northwest region of Florida. However, for the past few years construction has declined especially in second home, resort, and vacation-targeted development. Development along the beachfront impacts sea turtles through the loss of nesting habitat, the increased use and presence of humans on the beach and associated effects (lighting, recreational furniture on the beach, impacts to the dunes). Incorporation of standard coastal construction measures significantly reduces these potential impacts. Development in the

adjacent inland areas may also cause a huge influx of human use of the beach where more facilities may be needed to accommodate or service the number of users (parking, dune walkovers, public restrooms, restaurants, businesses).

Development along the coastline within the Action Area has contributed to a reduction in the width and quality of beach and dune habitats used by sea turtle for nesting. The physical presence of development interferes or disrupts the dynamic shoreline process of erosion and accretion such that erosion is accelerated within the Action Area. The degradation of the quality of the nesting beach habitat may be exacerbated by beachfront lighting and increased human presence.

Armoring

Following the passage of Hurricane Dennis in 2005, the Walton County Board of County Commissioners issued temporary emergency permits to allow property owners to protect their properties along the GOM beachfront. Approximately 200 properties had some type of armoring installed along the shoreline. The Service, Walton County, and the FDEP are working together to resolve the permanent installation of these structures (if appropriate and in accordance with federal and state laws and regulations including the Endangered Species Act.

Other Actions

Other activities have affected conservation of sea turtles and required consultation with the Service. The following consultations have been completed within the Action Area (**Table 6**).

Table 6. Activities for which consultation have been completed for sea turtles within the Action Area under the Endangered Species Act.

SPECIES LOGGERHEAD, GREEN, LEATHERBACK, AND KEMP'S RIDLEY SEA TURTLES	YEAR	IMPACT (Habitat/critical habitat/individuals)
LAKE POWELL EMERGENCY OPENING	1998-2008	1,500 ft
FEMA BEACH BERMS POST HURRICANE IVAN EMERGENCY CONSULTATION	2005	Walton Co. - 20 miles
WESTERN LAKE EMERGENCY OPENING	2006	0.5 mile
EASTERN LAKE EMERGENCY OPENING	2007	0.5 mile
FEMA FL STATEWIDE EMERGENCY BERMS PROGRAMMATIC	2008	50 miles

EFFECTS OF THE ACTION

Factors to be considered

The proposed beach nourishment project will occur within habitat that is used by sea turtles for nesting and may be constructed during a portion of the sea turtle nesting season. Long-term and permanent impacts could include a change in the nest incubation environment from the dune, berm, and beach fill project material. Short-term and temporary impacts to sea turtle nesting activities could result from project work occurring on the nesting beach during the active nesting or hatching period, changes in the physical characteristics of the beach from the placement of the

dune, berm, and beach fill material and change in the nest incubation environment from the material.

Proximity of action: The beach nourishment project activities would occur directly in and adjacent to former and existing nesting habitat for sea turtles and dune habitats that ensure the stability and integrity of the GOM beaches in Walton County. Specifically, the project would potentially impact nesting and hatchling loggerhead, green, leatherback, and Kemp's ridley sea turtles.

Distribution: The beach nourishment project activities that may impact nesting and hatchling sea turtles would occur along 13.5 miles of beachfront along GOM shoreline of Walton County. Specifically, the project activities will cover the GOM beachfront between FDEP reference monuments R-41 and R-64, R-67 and R-72, R-78 and R-98, and R-105.5 and R-127 within Walton County.

Timing: The sea turtle nesting season for northwest Florida is considered to extend between May 1 and October 31. The timing of the beach nourishment project activities could directly and indirectly impact nesting and hatchling sea turtles when conducted between these times. Based on nesting survey data, the majority sea turtle nesting and hatching season on Walton County beaches occurs between mid May and early August.

Nature of the effect: The effects of the beach nourishment project activities may change nest environment and the nesting behavior of adult female sea turtles or diminish the nesting success, and change the behavior of hatchling sea turtles in future nesting seasons. Any decrease in productivity and/or survival rates would contribute to the vulnerability of the northwest Florida subpopulation of loggerhead sea turtles.

Duration: The beach nourishment project is a one-time activity and will take between 6 and 9 months to complete. Tentative plans are to begin the project in late 2008 or early 2009. Indirect effects from the activity may continue to impact nesting and hatchling sea turtles in subsequent nesting seasons.

Disturbance frequency: The northwest Florida loggerhead sea turtle nesting population may experience decreased nesting success, hatching success and hatchling emergence in the Action Area during subsequent nesting seasons.

Disturbance intensity and severity: Depending on the timing of the sand placement activities during sea turtle nesting season, effects to the loggerhead could be important. As noted in the "Status of the Species," the northern loggerhead subpopulation has experienced a long-term decline. Additional losses will likely result in additional declines. The significance of sea turtle nesting in northwest Florida to the conservation of the U.S. population of green, leatherback or Kemp's ridley sea turtles is unknown.

Analyses for effects of the action

The effects of the beach nourishment project include impacts associated with the project construction and maintenance within the Action Area. The construction would have short-term impacts while the presence of the nourished beach would have long-term impacts.

Beneficial effects

The placement of sand on a beach with reduced dry fore-dune habitat may increase sea turtle nesting habitat if the placed sand is highly compatible (i.e., grain size, shape, color, etc.) with naturally occurring beach sediments in the area, and compaction and escarpment remediation measures are incorporated into the project. In addition, a nourished beach that is designed and constructed to mimic a natural beach system may be more stable than the eroding one it replaces, thereby benefiting sea turtles.

Through many years of research, it has been documented that beach nourishment can have adverse effects on sea turtle adults and hatchlings. Results of monitoring of sea turtle nesting and beach nourishment activities provide additional information on how sea turtles respond to nourished beaches, minimization measures, and other factors that influence nesting, hatching, and emergence success. Science-based information on sea turtle nesting biology and review of empirical data on beach nourishment monitoring is used to manage beach nourishment activities to eliminate or reduce impacts to nesting and hatchling sea turtles so that beach nourishment can be accomplished (**Table 7**). Measures can be incorporated pre-, during, and post-construction to reduce impacts to sea turtles. Because of the long history of beach nourishment activity in Florida, it is not necessary to require studies on each project beach to document those effects each time.

Table 7. Effects of beach nourishment on sea turtles and minimization measure.

FACTOR	POST CONSTRUCTION	SEA TURTLE BEHAVIOR	MINIMIZATION		
			PRE	DURING	POST
Profile	Scarps Nest site selection Hatchling orientation	Shift nests seaward Misorientation landward than seaward	Design	Implement	Reconfigure Natural reworking
Elevation	Nest site selection Unnatural profile Disorientation	Shift nests seaward	Design	Implement	Natural reworking
Barriers - physical and visual	Scarps	Abort nesting	Design	Implement	Reconfigure Natural reworking
Substrate	Compaction Cementation Color	Abort nesting, Barrier to hatching Change in incubation length/sex ratio	Material quality	QA/QC Plan Limit equipment driving over beach fill	Tilling
Lights	Landward development	Confusion of adults Dis- and mis-orientation of hatchlings	Install Wildlife Lighting	Stop gap, lights off during times of nest hatching	Install Wildlife Lighting

Direct effects

Direct effects are those direct or immediate effects of a project on the species or its habitat. Placement of sand on a beach in and of itself may not provide suitable nesting habitat for sea turtles. Although beach fill/nourishment may increase the potential nesting area, significant negative impacts to sea turtles may result if protective measures are not incorporated during project construction. Nourishment during the nesting season, particularly on or near high density nesting beaches, can cause increased loss of eggs and hatchlings and, along with other mortality sources, may significantly impact the long-term survival of the species. For instance, projects conducted during the nesting and hatching season could result in the loss of sea turtles through disruption of adult nesting activity and by burial or crushing of nests or hatchlings. While a nest monitoring and egg relocation program would reduce these impacts, nests may be inadvertently missed (when crawls are obscured by rainfall, wind, and/or tides) or misidentified as false crawls during daily patrols. In addition, nests may be destroyed by operations at night prior to beach patrols being performed. Even under the best of conditions, about 7 percent of the nests can be misidentified as false crawls by experienced sea turtle nest surveyors (Schroeder 1994). The project is planned to occur outside of the sea turtle nesting season and minimize direct impacts to nesting and hatchling sea turtles. However, there is the possibility that the project schedule may be delayed because of weather, mechanical breakdowns or other reasons that may result in the project being constructed in a portion of the sea turtle nesting season.

1. *Nest relocation*

Besides the potential for missing nests during a nest relocation program, there is a potential for eggs to be damaged by nest movement or relocation, particularly if eggs are not relocated within 12 hours of deposition (Limpus et al. 1979). Nest relocation can have adverse impacts on incubation temperature (and hence sex ratios), gas exchange parameters, hydric environment of nests, hatching success, and hatchling emergence (Limpus et al. 1979; Ackerman 1980; Parmenter 1980; Spotila et al. 1983; McGehee 1990). Relocating nests into sands deficient in oxygen or moisture can result in mortality, morbidity, and reduced behavioral competence of hatchlings. Water availability is known to influence the incubation environment of the embryos and hatchlings of turtles with flexible-shelled eggs, which has been shown to affect nitrogen excretion (Packard et al. 1984), mobilization of calcium (Packard and Packard 1986), mobilization of yolk nutrients (Packard et al. 1985), hatchling size (Packard et al. 1981; McGehee 1990), energy reserves in the yolk at hatching (Packard et al. 1988), and locomotory ability of hatchlings (Miller et al. 1987).

In a 1994 Florida study comparing loggerhead hatching and emergence success of relocated nests with *in situ* nests, Moody (1998) found that hatching success was lower in relocated nests at 9 of 12 beaches evaluated. In addition, emergence success was lower in relocated nests at 10 of 12 beaches surveyed in 1993 and 1994. If the project is constructed outside the nesting season, relocation of sea turtle nests would not be needed. Thus, direct impacts to sea turtles from nest relocation would be avoided. However, there is the possibility that the project schedule may be delayed because of weather, mechanical breakdowns or other reasons that may result in the project being constructed in a portion of the sea turtle nesting season.

2. *Equipment*

The placement of pipelines and the use of heavy machinery on the beach during a dune, berm, and beach fill project may also have adverse effects on sea turtles. They can create barriers to nesting females emerging from the surf and crawling up the beach, causing a higher incidence of false crawls and unnecessary energy expenditure. The project is expected to be conducted outside the sea turtle nesting season. Thus, the severity of the direct impacts would be minimized. However, there is the possibility that the project schedule may be delayed because of weather, mechanical breakdowns or other reasons that may result in the project being constructed in a portion of the sea turtle nesting season.

3. *Artificial lighting*

Visual cues are the primary sea-finding mechanism for hatchling sea turtles (Mrosovsky and Carr 1967; Mrosovsky and Shettleworth 1968; Dickerson and Nelson 1989; Witherington and Bjorndal 1991). When artificial lighting is present on or near the beach, it can misdirect hatchlings once they emerge from their nests and prevent them from reaching the ocean (Philibosian 1976; Mann 1977; FWC sea turtle disorientation database). In addition, a significant reduction in sea turtle nesting activity has been documented on beaches illuminated with artificial lights (Witherington 1992). Therefore, construction lights along a project beach and on the dredging vessel may deter females from coming ashore to nest, misdirect females trying to return to the surf after a nesting event, and misdirect emergent hatchlings from adjacent non-project beaches. Any source of bright lighting can profoundly affect the orientation of hatchlings, both during the crawl from the beach to the ocean and once they begin swimming offshore. Hatchlings attracted to light sources on dredging barges may not only suffer from interference in migration, but may also experience higher probabilities of predation to predatory fishes that are also attracted to the barge lights. This impact could be reduced by using the minimum amount of light necessary (may require shielding) or low pressure sodium lighting during project construction.

The newly created wider and flatter beach berm exposes sea turtles and their nests to lights that were less visible, or not at all visible, from nesting areas before the beach nourishment. Review of over ten years of empirical information from beach nourishment projects indicates that the number of sea turtles impacted by lights increases on the post-construction berm. A review of selected nourished beaches in Florida (South Brevard, North Brevard, Captiva Island, Ocean Ridge, Boca Raton, Town of Palm Beach, Longboat Key, and Bonita Beach) indicated disorientation reporting increased by approximately 300% ($\pm$ 282 std. dev.) the first nesting season after project construction and up to 542% (+ 872 std. Dev.) the second year compared to pre-nourishment reports (Trindell et al. 2005) (**Figure 12)**.

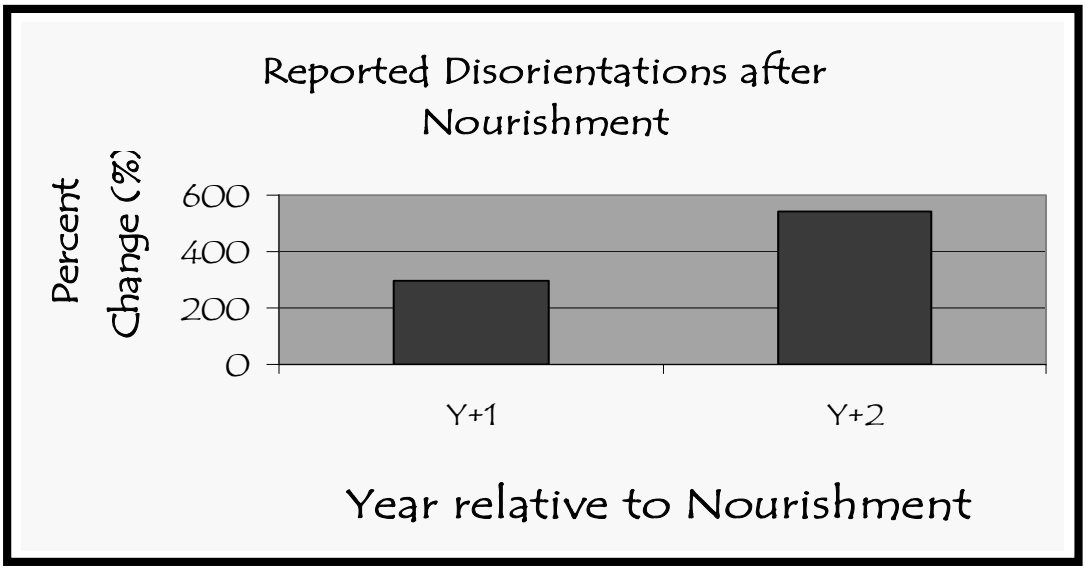

Figure 12. **Reported disorientations from seven nourished beaches compared to pre-nourishment.**

Specific examples of increased lighting disorientations after a beach nourishment project include Brevard and Palm Beach counties, Florida. A nourishment project in Brevard County, completed in 2002, showed an increase of 130 percent in disorientations in the nourished area. Disorientations on beaches in the County that were not nourished remained constant (R. Trindell, pers. comm. 2007). This same result was also documented in 2003 when another beach in Brevard County was nourished and the disorientations increased by 480 percent (R. Trindell, pers. comm. 2007). Installing appropriate beachfront lighting is the most effective method to decrease the number of disorientations on any developed beach including nourished beaches.

A shoreline protection project was constructed at Ocean Ridge in Palm Beach County, Florida between August 1997 and April 1998. Lighting disorientation events increased after nourishment. In spite of continued aggressive efforts to identify and correct lighting violations in 1998 and 1999, 86 percent of the disorientation reports were in the nourished area in 1998 and 66 percent of the reports were in the nourished area in 1999 (Howard and Davis 1999).

While the effects of artificial lighting have not been specifically studied on each beach that is nourished in Florida, based on the experience of increased artificial lighting disorientations on other Florida beaches, impacts are expected to potentially occur on all nourished beaches statewide.

Changing to sea turtle compatible lighting can be easily accomplished at the local level through voluntary compliance or by adopting appropriate regulations. Of the 64 coastal counties in Florida, 17 have passed beachfront lighting ordinances in addition to 49 municipalities. Local governments have realized that adopting a lighting ordinance is the most effective method to address artificial lighting along the beachfront.

Indirect effects

Indirect effects are those effects that are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Effects from the proposed beach nourishment project

may continue to affect sea turtle nesting on the project beach and adjacent beaches in future years.

Many of the direct effects of the dune, berm, and beach fill project may persist over time and become indirect impacts. These indirect effects include increased susceptibility of relocated nests to catastrophic events, the consequences of potential increased beachfront development, changes in the physical characteristics of the beach, the formation of escarpments, and future sand migration.

1. *Increased susceptibility to catastrophic events*

Nest relocation may concentrate eggs in an area making them more susceptible to catastrophic events. Hatchlings released from concentrated areas also may be subject to greater predation rates from both land and marine predators, because the predators learn where to concentrate their efforts (Glenn 1998; Wyneken et al. 1998). The timing of the project occurring within or outside the sea turtle nesting season would affect the severity of direct impacts to nesting and hatchling sea turtles.

2. *Increased beachfront development*

Pilkey and Dixon (1996) state that beach replenishment frequently leads to more development in greater density within shorefront communities that then require further replenishment or more drastic stabilization measures. Dean (1999) also notes that the very existence of a beach nourishment project can encourage more development in coastal areas. Following completion of a beach nourishment project in Miami during 1982, investment in new and updated facilities substantially increased tourism there (National Research Council 1995). Increased building density immediately adjacent to the beach often resulted as older buildings were replaced by much larger ones that accommodated more beach users. Overall, shoreline management creates an upward spiral of initial protective measures resulting in more expensive development which leads to the need for more and larger protective measures. Increased shoreline development may adversely affect sea turtle nesting success. Greater development may support larger populations of mammalian predators, such as foxes and raccoons, than undeveloped areas (National Research Council 1990a), and can also result in greater adverse effects due to artificial lighting, as discussed above.

3. *Changes in the physical environment*

Beach nourishment may result in changes in sand density (compaction), beach shear resistance (hardness), beach moisture content, beach slope, sand color, sand grain size, sand grain shape, and sand grain mineral content if the placed sand is dissimilar from the original beach sand (Nelson and Dickerson 1988a). These changes could result in adverse impacts on nest site selection, digging behavior, clutch viability, and emergence by hatchlings (Nelson and Dickerson 1987; Nelson 1988). The Florida Department of Environmental Protection will determine whether the dredged material to be placed on the beaches meet the State's criteria under 62B-41.007, Florida Administrative Code, for beach placement.

Beach nourishment projects create an elevated, wider and unnatural flat slope berm (beach). Sea turtles nest closer to the water the first few years after nourishment because of the altered profile

(and perhaps unnatural sediment grain size distribution) (Ernest and Martin 1999; Trindell 2005) (**Figure 13**).

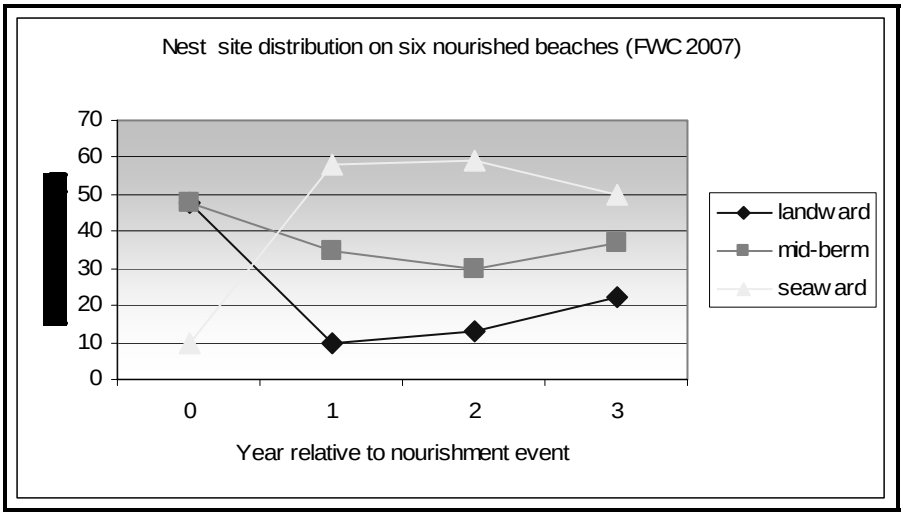

Figure 13. **Review of sea turtle nesting site selection following nourishment (Trindell 2005).**

Beach compaction and unnatural beach profiles that may result from beach nourishment activities could negatively impact sea turtles regardless of the timing of projects. Very fine sand and/or the use of heavy machinery can cause sand compaction on nourished beaches (Nelson et al. 1987; Nelson and Dickerson 1988a). Significant reductions in nesting success (i.e., false crawls occurred more frequently) have been documented on severely compacted nourished beaches (Fletemeyer 1980; Raymond 1984; Nelson and Dickerson 1987; Nelson et al. 1987), and increased false crawls may result in increased physiological stress to nesting females. Sand compaction may increase the length of time required for female sea turtles to excavate nests and also cause increased physiological stress to the animals (Nelson and Dickerson 1988b). Nelson and Dickerson (1988c) concluded that, in general, beaches nourished from offshore borrow sites are harder than natural beaches, and while some may soften over time through erosion and accretion of sand, others may remain hard for 10 years or more.

These impacts can be minimized by using suitable sand and by tilling compacted sand after project completion. The level of compaction of a beach can be assessed by measuring sand compaction using a cone penetrometer (Nelson 1987). Tilling of a nourished beach with a root rake may reduce the sand compaction to levels comparable to unnourished beaches. However, a pilot study by Nelson and Dickerson (1988c) showed that a tilled nourished beach will remain un-compacted for up to one year. Multi-year beach compaction monitoring and, if necessary, tilling would ensure that project impacts on sea turtles are minimized.

A change in sediment color on a beach could change the natural incubation temperatures of nests in an area, which, in turn, could alter natural sex ratios. To provide the most suitable sediment for nesting sea turtles, the color of the nourished sediments must resemble the natural beach sand in the area. Natural reworking of sediments and bleaching from exposure to the sun would help to lighten dark nourishment sediments; however, the timeframe for sediment mixing and bleaching to occur could be critical to a successful sea turtle nesting season.

4. *Escarpment formation*

On nourished beaches, steep escarpments may develop along the water line interface as the beach adjusts from an unnatural construction profile to a more natural beach profile (Coastal Engineering Research Center 1984; Nelson et al. 1987). These escarpments can hamper or prevent access to nesting sites (Nelson and Blihovde 1998). Researchers have shown that female turtles coming ashore to nest can be discouraged by the formation of an escarpment, leading to situations where they choose marginal or unsuitable nesting areas to deposit eggs (*e.g.*, in front of the escarpments, which often results in failure of nests due to prolonged tidal inundation). This impact can be minimized by leveling any escarpments prior to the nesting season.

Species' response to the proposed action

The following summary illustrates sea turtle responses to and recovery from a nourishment project. A significantly larger proportion of turtles emerging on nourished beaches abandoned their nesting attempts than turtles emerging on natural or pre-nourished beaches. This reduction in nesting success is most pronounced during the first year following project construction and is most likely the result of changes in physical beach characteristics associated with the nourishment project (*e.g.*, beach profile, sediment grain size, beach compaction, frequency and extent of escarpments). During the first post-construction year, the time required for turtles to excavate an egg chamber on untilled, hard-packed sands increases significantly relative to natural and background conditions. However, tilling is effective in reducing sediment compaction to levels that did not significantly prolong digging times. As natural processes reduced compaction levels on nourished beaches during the second post-construction year, digging times returned to background levels (Ernest and Martin 1999; Crain et al. 1995; Trindell et al. 2000).

During the first post-construction year, nests on nourished beaches are deposited significantly seaward of the toe of the dune and significantly landward of the tide line than nests on natural beaches. As the width of nourished beaches decreased during the second year, nest placement diminishes. More nests are washed out on the wide, flat beaches of the nourished treatments than on the narrower steeply sloped beaches of the non-nourished areas. This phenomenon may persist through the second post-construction year monitoring and resulting from the placement of nests near the seaward edge of the beach berm where dramatic profile changes, caused by erosion and scarping, occurred as the beach equilibrated to a more natural contour.

The principal effect of nourishment on sea turtle reproduction is a reduction in nesting success during the first year following project construction. Although most studies have attributed this phenomenon to an increase in beach compaction and escarpment formation, Ernest and Martin (1999) indicated that changes in beach profile may be more important. Regardless, as a nourished beach is reworked by natural processes in subsequent years and adjusts from an unnatural construction profile to a more natural beach profile, beach compaction and the frequency of escarpment formation decline, and nesting and nesting success return to levels found on natural beaches.

CHOCTAWHATCHEE BEACH MOUSE

STATUS OF THE SPECIES/CRITICAL HABITAT

Species/critical habitat description

The formal taxonomic classification of beach mouse subspecies follows the geographic variation in pelage and skeletal measurements documented by Bowen (1968). This peer-reviewed, published classification was also accepted by Hall (1981). The taxonomic validity of the beach mouse subspecies came into question when three of the Gulf Coast subspecies, CBM, Alabama Beach Mouse (ABM), and Perdido Key beach mouse (PKBM) were proposed for listing (1984-1985). Two unpublished letters (Dawson 1983; Griswold undated) were submitted to the Service for consideration in response to the proposed listing. The conclusion reached by these authors was that three of the beach mouse subspecies did not differ sufficiently from inland populations to warrant their recognition as subspecies. Close consideration of the Dawson and Griswold unpublished papers by Service biologists determined that neither paper constituted completed studies. Furthermore, Dawson clearly expressed the need for further taxonomic studies to adequately answer the questions concerning subspecific taxonomy of beach mice. To date, Bowen's work is the latest published comprehensive review of beach mice and is the taxonomy on which the Service continues to rely.

Since the listing of the beach mice, further research concerning the taxonomic validity of the subspecific classification of beach mice has been initiated and/or conducted. Preliminary results from these studies support the separation of beach mice from inland forms, and support the currently accepted taxonomy (Bowen 1968). Recent research using mitochondrial DNA data illustrates that Gulf Coast beach mouse subspecies form a well-supported and independent evolutionary cluster within the global population of the mainland or inland old field mice (VanZant 2006).

The old-field mouse (*Peromyscus polionotus)* is different in form and structure as well as being genetically diverse throughout its range in the southeastern United States (Bowen 1968; Selander et al. 1971). Currently there are sixteen recognized subspecies of old-field mice (Hall 1981). Eight subspecies of the old-field mouse occupy coastal rather than inland habitat and are referred to as beach mice (Bowen 1968). Two existing subspecies of beach mouse and one extinct subspecies are known from the Atlantic coast of Florida. Five subspecies of the beach mice live along the Gulf coast of Alabama and northwestern Florida.

Rivers and various inlets bisect the Gulf beaches and isolate habitats in which the beach mice live. Where populations are not separated by water, human development may have fragmented the ranges of the subspecies. The outer coastline and barrier islands are typically separated from the mainland by lagoons, swamps, tidal marshes, and flatwood areas with hardpan soil conditions. However, these dispersal barriers are not absolute; sections of sand peninsulas may from time to time be cut off by storms and shift over time due to wind and current action. A consequence of coastal development and the dynamic nature of the coastal environment, beach mouse populations are generally comprised of various disjunct populations.

The CBM was listed with the PKBM and ABM as endangered species under the Act in 1985 (50 FR 23872). The PKBM is also listed as an endangered species by the State of Florida. Critical habitat was designated for the CBM, PKBM, and the ABM at the time of listing (50 Code of Federal Regulations [CFR] § 17.95, 50 FR 23872), and revised October 12, 2006 (71 FR 60238).

Since the listing of the CBM, research has refined previous knowledge of beach mouse habitat requirements and factors that influence their use of habitat. Based on our current knowledge of the life history, biology, and ecology of the species and the requirements of the habitat to sustain the essential life history functions of the species, we have determined that the PKBM critical habitat primary constituent elements include:

1. A contiguous mosaic of primary, secondary and scrub vegetation and dune structure, with a balanced level of competition and predation and few or no competitive or predaceous nonnative species present, that collectively provide foraging opportunities, cover, and burrow sites.

2. Primary and secondary dunes, generally dominated by sea oats, that, despite occasional temporary impacts and reconfiguration from tropical storms and hurricanes, provide abundant food resources, burrow sites, and protection from predators.

3. Scrub dunes, generally dominated by scrub oaks, that provide food resources and burrow sites, and provide elevated refugia during and after intense flooding due to rainfall and/or hurricane induced storm surge.

4. Functional, unobstructed habitat connections that facilitate genetic exchange, dispersal, natural exploratory movements, and recolonization of locally extirpated areas.

5. A natural light regime within the coastal dune ecosystem, compatible with the nocturnal activity of beach mice, necessary for normal behavior, growth and viability of all life stages.

We have designated critical habitat on lands that have been determined to be essential to the conservation of the CBM. An area is considered essential if it possesses one or more of the primary constituent elements and the following characteristics: (1) supports a core population of beach mice; (2) was occupied by CBM at the time of listing; (3) is currently occupied by the beach mouse and is an area essential to the conservation of the species because it represents an existing population needed for conservation. Five units were designated as critical habitat for the CBM consisting of 2,404 acres in Okaloosa, Walton, and Bay Counties, Florida (**Figure 14 and Table 8**).

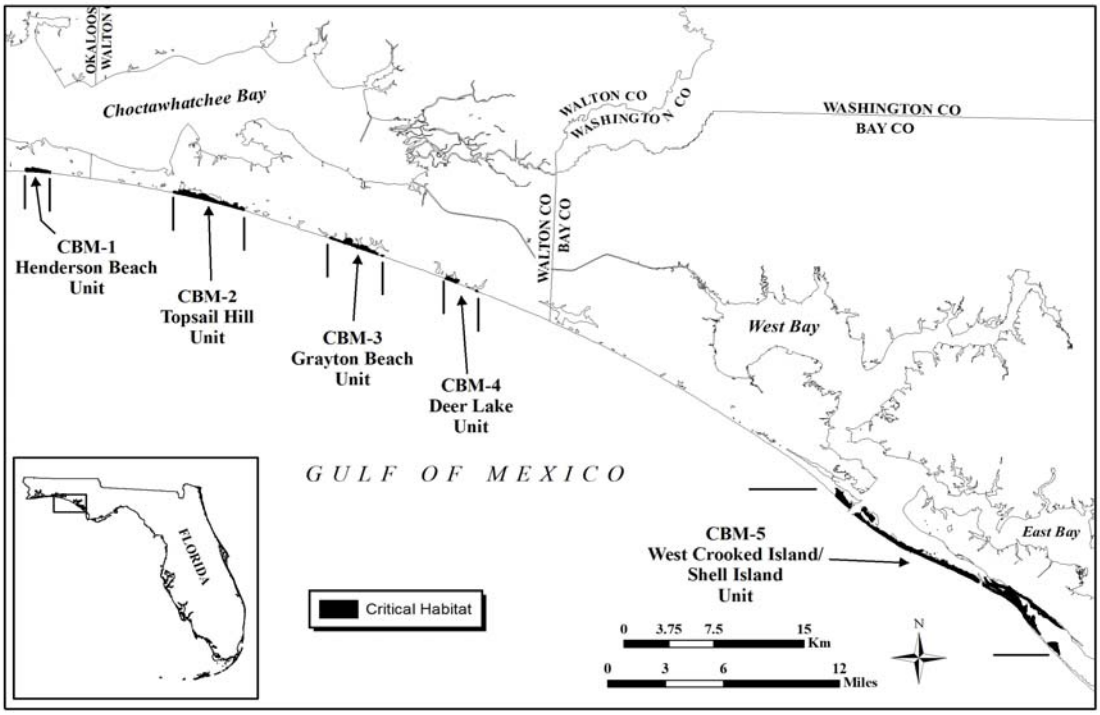

Figure 14. Critical habitat units designated for the Choctawhatchee beach mouse.

Table 8. Critical habitat units designated for the Choctawhatchee beach mouse.

Choctawhatchee Beach Mouse Critical Habitat Units	Federal Acres	State Acres	Local and Private Acres	Total Acres
1. Henderson Beach Unit	0	96	0	96
2. Topsail Hill Unit	0	277	31	308
3. Grayton Beach Unit	0	162	17	179
4. Deer Lake Unit	0	40	9	49
5. W. Crooked Island/Shell Island Unit	1333	408	30	1771
Total	1333	982	87	2404

The Henderson Beach unit (CBM–1) consists of 96 acres in Okaloosa County, Florida. This unit encompasses essential features of beach mouse habitat within the boundary of Henderson Beach State Park from 0.5 mi east of the intersection of Highway 98 and Scenic Highway 98 to 0.25 mi west of Matthew Boulevard and the area from the mean high water line (MHWL) north to the seaward extent of the maritime forest. This westernmost unit provides primary, secondary, and scrub dune habitat (PCEs 2 and 3). This unit is within the historic range of the subspecies; however, it was not known to be occupied at the time of listing and current occupancy is unknown because no recent efforts have been made to document beach mouse presence or absence. Because this unit includes protected, high-elevation scrub habitat, it may serve as a refuge during storm events and as an important source population if storms extirpate or greatly reduce local populations or populations to the east.

This unit is managed by the Florida Park Service and is essential to the conservation of the species. Threats specific to this unit that may require special management considerations include habitat fragmentation, Park development, artificial lighting, presence of feral cats as well as other predators at unnatural levels, and high recreational use that may result in soil compaction, damage to dunes, or other decrease in habitat quality.

The Topsail Hill Unit (CBM–2) consists of 308 acres in Walton County, Florida. This unit encompasses essential features of beach mouse habitat within the boundary of Topsail Hill Preserve State Park, as well as adjacent private lands from 0.1 mile east of the Gulf Pines subdivision to 0.6 mi west of the inlet of Oyster Lake and the area from the MHWL north to the seaward extent of human development or maritime forest. This unit provides primary, secondary, and scrub dune habitat and possesses all five PCEs. Its large, contiguous, high-quality habitat allows for natural movements and population expansion. CBM were confirmed present in the unit in 1979 (Humphrey 1992a), were present at the time of listing, and are still present. Beach mice have been captured on Stallworth County Park and Stallworth Preserve subdivision, a private development within the unit, east of the Park (Service 2003a). The population of CBM inhabiting this unit appears to harbor unique genetic variation and displays a relatively high degree of genetic divergence considering the close proximity of this population to other populations (Wooten and Holler 1999).

This unit has portions with different ownership, purposes, and mandates. Threats specific to this unit that may require special management considerations include Park and residential development, artificial lighting, presence of feral cats as well as other predators at unnatural levels, and high recreational use that may result in soil compaction, damage to dunes, or other decrease in habitat quality.

Lands containing the features essential to the conservation of the CBM within the area covered under the HCP for the Stallworth County Preserve (4 acres) are excluded from critical habitat designation under section 4(b)(2) of the Act.

The Grayton Beach Unit (CBM–3) consists of 179 acres in Walton County, Florida. This unit encompasses essential features of beach mouse habitat within the boundary of Grayton Beach State Park, as well as adjacent private lands and inholdings, from 0.3 mi west of the inlet of Alligator Lake east to 0.8 mi west of Seagrove Beach and the area from the MHWL north to the seaward extent of human development or maritime forest. This unit provides primary, secondary, and scrub dune habitat (PCEs 2 and 3), habitat connectivity (PCE 4) and is essential to the conservation of the species. This unit also provides a relatively natural light regime (PCE 5). Beach mice were not detected in the unit in 1979 (Holler 1992); however, they were found to be present in 1995 after Hurricane Opal (Moyers et al. 1999). While it seems likely that beach mice were present at the time of listing (and may have been present, but not detected, in 1979), we do not have data to confirm this assumption. Therefore, we consider this unit to be unoccupied at the time of listing. A program to strengthen and reestablish the population began in 1989 and yielded a persistent population at the State Park. Recent evidence of beach mice on State Park land was documented in 2004 (Service 2004). Beach mice are also known to currently occupy the private lands immediately east of the park.

This unit has portions with different ownership, purposes, and mandates. Threats specific to this unit that may require special management considerations include hurricane impacts that may require dune restoration and revegetation, excessive open, unvegetated habitat due to recreational

use or storm impacts that may require revegetation, Park development, artificial lighting, presence of feral cats as well as other predators at unnatural levels, and high recreational use that may result in soil compaction, damage to dunes, or other decrease in habitat quality.

Lands containing the features essential to the conservation of the CBM within the area covered under the HCP for the Watercolor development (4 acres) are excluded from critical habitat designation under section 4(b)(2) of the Act.

The Deer Lake Unit (CBM–4) consists of 49 acres in Walton County, Florida. This unit encompasses essential features of beach mouse habitat within the boundary of Deer Lake State Park as well as adjacent private lands from approximately 1 mi east of the Camp Creek Lake inlet west to approximately 0.5 mi west of the inlet of Deer Lake and the area from the MHWL north to the seaward extent of maritime forest or human development. This unit provides primary, secondary, and scrub dune habitat (PCEs 2 and 3), habitat connectivity to adjacent lands (PCE 4), and is essential to the conservation of the species. This unit also provides a relatively natural light regime (PCE 5). Because live-trapping efforts in this area have been limited to incidental trapping, and beach mice were not detected in 1998 (Auburn University 1999), we consider this unit to be unoccupied at the time of listing. CBM were translocated from Topsail Hill Preserve State Park to private lands adjacent to this unit in 2003 and 2005 (Service 2003b, 2005a, 2005b, 2005c, 2005d). Tracking within the adjacent State park lands have indicated expansion of the population into the park.

This unit has portions with different ownership, purposes, and mandates. Threats specific to this unit that may require special management considerations include artificial lighting, presence of feral cats as well as other predators at unnatural levels, and high recreational use that may result in soil compaction, damage to dunes, or other decrease in habitat quality.

Lands containing the features essential to the conservation of the CBM within the area covered under the HCP for Watersound (71 acres) are excluded from critical habitat designation under section 4(b)(2) of the Act (see Application of Section 4(a)(3) and Exclusions Under Section 4(b)(2) of the Act section below). This excluded area is 0.5 mi west of the Camp Creek Lake inlet to 0.5 mi east of the Camp Creek Lake inlet.

The West Crooked Island/ Shell Island Unit (CBM–5) consists of 1,771 acres in Bay County, Florida. This unit encompasses essential features of beach mouse habitat within the boundaries of St. Andrew State Park mainland from 0.1 mile east of Venture Boulevard east to the entrance channel of St. Andrew Sound, Shell Island east of the entrance of St. Andrew Sound east to East Pass, and West Crooked Island southwest of East Bay and east of the entrance channel of St. Andrew Sound, and areas from the MHWL north to the seaward extent of the maritime forest. Shell Island consists of State lands, Tyndall AFB lands, and small private inholdings. CBM were known to inhabit the majority of Shell Island in 1987 (Holler 1992b) and were again confirmed present in 1998 (Auburn University 1999), 2002, and 2003 (Lynn 2004). Because beach mice inhabited nearly the entire suitable habitat on the island less than two years prior to listing and were reconfirmed after listing, we consider this area to be occupied at the time of listing. The West Crooked Island population is the result of a natural expansion of the Shell Island population after the two islands became connected in 1998 and 1999, a result of Hurricanes Opal and Georges (Service 2003b). Shell Island was connected to the mainland prior to the 1930s when a navigation inlet severed the connection on the western end. Beach mice were documented at St. Andrew State Park mainland as late as the 1960s (Bowen 1968), though

no records of survey efforts exist again until Humphrey and Barbour (1981) and Meyers (1983) at which time beach mice were not detected. Therefore, it seems likely that this area was not occupied at the time of listing. Current beach mouse population levels at this site are unknown, and live-trapping to document the absence of mice has not been conducted. Similar to the original designation, this Park was designated as critical habitat because it has features essential to the CBM. It is also within the historic range of the mouse. This unit supports the easternmost population of CBM, with the next known population 22 miles to the west.

This unit provides primary, secondary, and scrub dune habitat and possesses all five PCEs. Portions of this unit are managed by the Florida Park Service, while the remaining areas are federally (Tyndall AFB) and privately owned. Threats specific to this unit that may require special management considerations include artificial lighting, presence of feral cats as well as other predators at unnatural levels, and high residential or recreational use that may result in soil compaction, damage to dunes, or other decrease in habitat quality.

Historic Range

The historic range of the CBM extended 53 miles between the Destin Pass, Choctawhatchee Bay in Okaloosa County and East Pass in St. Andrew Bay, Bay County in Florida (**Figure 15**).

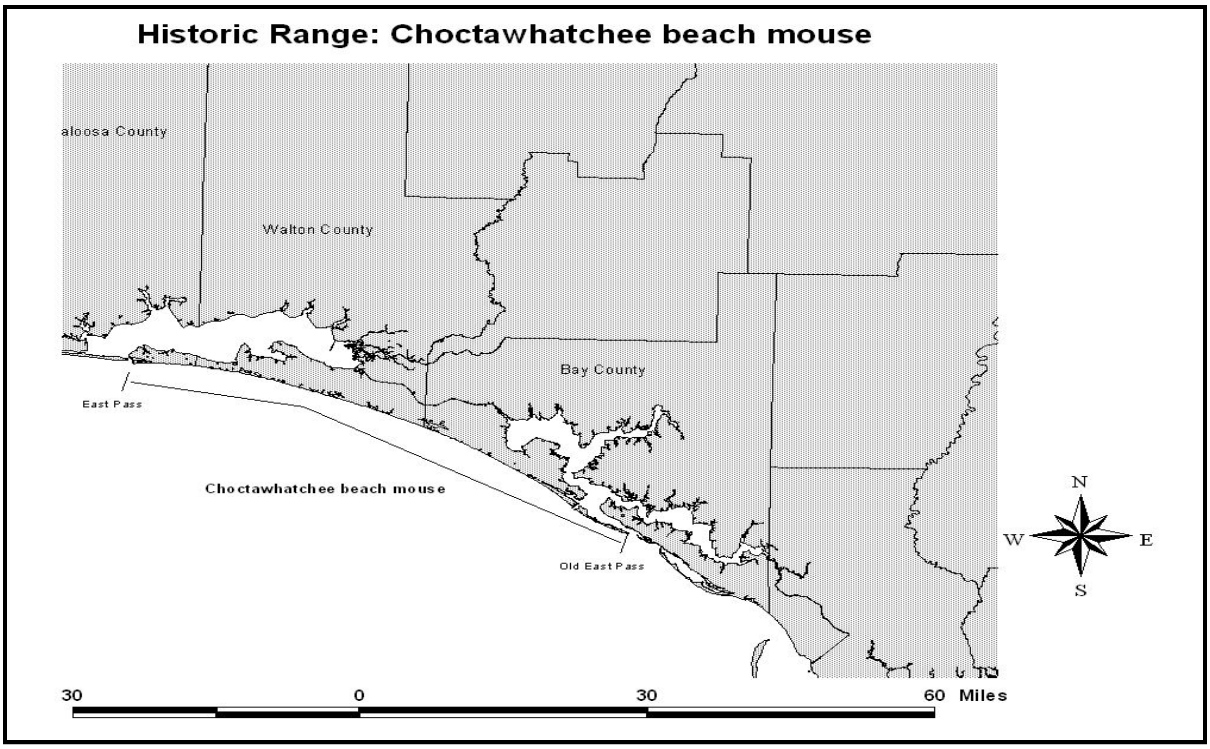

Figure 15. Historic range of the Choctawhatchee Beach Mouse.

Life history

All beach mice are differentiated from the inland subspecies because of a variety of fur (pelage) patterns on the head, shoulders, and rump. The overall dorsal coloration, in coastal subspecies, is lighter in color and less extensive than on those of the inland subspecies (Sumner 1926; Bowen 1968).

CBM have head and body lengths ranging from 2.7 to 3.5 inches (Holler 1992a). This beach mouse is distinctly more orange-brown to yellow-brown than the other Gulf coast beach mouse subspecies (Bowen 1968). Pigmentation on the head either extends along the dorsal surface of the nose to the tip, or ends posterior to the eyes leaving the cheeks white. A dorsal tail stripe is either present or absent.

Behavior

Peromyscus polionotus is the only member of the genus that digs an extensive burrow. Beach mice are semifossorial, using their complex burrows as a place to rest during the day and between nightly foraging bouts, escape from predators, have and care for young, and hold limited food caches. Burrows of *P. polionotus* generally consist of an entrance tunnel, nest chamber, and escape tunnel. Burrow entrances are usually placed on the sloping side of a dune at the base of a shrub or clump of grass. The nest chamber is formed at the end of the level portion of the entrance tunnel at a depth of 23.6 to 35.4 inches (60 cm to 90 cm), and the escape tunnel rises from the nest chamber to within 9.8 inches (2.5 cm) of the surface (Blair 1951). Nests of beach mice are constructed in the nest chamber of their burrows, a spherical cavity about 4 to 6 cm in diameter. The nest comprises about one fourth of the size of the cavity and is composed of sea oat roots, stems, leaves and the chaffy parts of the panicles (Ivey 1949). Beach mice have been found to select burrow sites based on a suite of biotic and abiotic features including dune slope, soil compaction, vegetative cover, and height above sea level (Lynn 2000; Sneckenberger 2001). A shortage of potential burrow sites is considered to be a possible limiting resource.

Like other beach mice, CBM are nocturnal and forage for food throughout the dune system. Beach mice feed primarily upon seeds and fruits, but have been shown to prey on insects (Moyers 1996). In most cases, seeds and fruits consumed by PKBM are either produced by low-growing, prostrate plants, or become available as fallen seeds (Moyers 1996). Beach mice appear to forage on food items based on availability and have shown no preferences for particular seeds or fruits (Moyers 1996). Research suggests that the availability of food resources fluctuates seasonally in Gulf Coast coastal dune habitat, specifically that the frontal dunes appear to have more species of high quality foods, but these sources are primarily grasses and annuals that produce large quantities of small seeds in a short period of time. Foods available in the scrub consist of larger seeds and fruits that are produced throughout a greater length of time and linger in the landscape (Sneckenberger 2001). Nutritional analysis of foods available in each habitat revealed that seeds of plant species in both habitats provide a similar range of nutritional quality.

Reproduction and Demography

Studies on *Peromyscus* species in peninsular Florida suggest that these species may achieve greater densities and undergo more significant population fluctuations than their temperate relatives, partially because of their extended reproductive season (Bigler and Jenkins 1975). Subtropical beach mice can reproduce throughout the year; however their peak reproductive activity is generally during late summer, fall, and early winter.

Sex ratios in beach mouse populations are generally 1:1 (Extine 1980; Rave and Holler 1992).

Beach mice are believed to be generally monogamous (Smith 1966; Foltz 1981; Lynn 2000). While a majority of individuals appear to pair for life, paired males may sire extra litters with unpaired females. Beach mice are considered sexually mature at 55 days of age; however some are capable of breeding earlier (Weston 2007). Gestation averages 28 to 30 days (Weston 2007) and the average litter size is four pups (Kaufman and Kaufman 1987). Littering intervals may be as short as 26 days (Bowen 1968). Peak breeding season for beach mice is autumn and winter, declining in spring, and falling to low levels in summer (Rave and Holler 1992, Blair 1951). However, pregnant and lactating beach mice have been observed in all seasons (Moyers et al. 1999).

Apparent survival rate estimates (products of true survival and site fidelity) of beach mice along the Gulf coasts of Florida and Alabama have demonstrated that their average life span is about nine months (Swilling 2000). Other research indicated that 63 percent of Alabama beach mice lived (or remained in the trapping area) for four months or less, 37 percent lived five months or greater and 2 percent lived 12 to 20 months (Rave and Holler 1992). Less than half (44 percent) of beach mice captured for the first time were recaptured the next season (Holler et al. 1997). Greater than ten percent of mice were recaptured three seasons after first capture, and four to eight percent were recaptured more than one year after initial capture. Beach mice held in captivity have lived three years or more (Blair 1951; Holler 1995).

Habitat and Movement

Beach mice inhabit coastal dune ecosystems on the Atlantic and Gulf coasts of Florida and the Gulf coast of Alabama. The dune habitat is generally categorized as: primary dunes (characterized by sea oats and other grasses), secondary dunes (similar to primary dunes but also frequently include such plants as woody goldenrod, false rosemary), and interior or scrub dunes (often dominated by scrub oaks and yaupon holly). Contrary to the early belief that beach mice were restricted to (Howell 1909, 1921; Ivey 1949), or preferred the frontal dunes (Blair 1951; Pournelle and Barrington 1953; Bowen 1968), more recent research has shown that scrub habitat serves an invaluable role in the persistence of beach mouse populations (Swilling et al. 1998; Sneckenberger 2001). Beach mice occupy scrub dunes on a permanent basis and studies have found no detectable differences between scrub and frontal dunes in beach mouse body mass, home range size, dispersal, reproduction, survival, food quality, and burrow site availability (Swilling et al. 1998; Swilling 2000; Sneckenberger 2001). While seasonally abundant, the availability of food resources in the primary and secondary dunes fluctuates (Sneckenberger 2001). In contrast, the scrub habitat provides a more stable level of food resources, which becomes crucial when food is scarce or nonexistent in the primary and secondary dunes. This suggests that access to primary, secondary and scrub dune habitat is essential to beach mice at the individual level.

Two main types of movement have been identified for small mammals: within home-range activity and long-range dispersal. Such movements are influenced by a suite of factors, such as availability of mates, predation risk, and habitat quality. Movement and home range studies have been conducted for most beach mouse subspecies, but are limited to natural habitat (i.e., research has been conducted on public lands within contiguous beach mouse habitat, not within a development or in a fragmented landscape). Studies of the home range size of beach mice (using trapping and telemetry data) have yielded estimates of 1 to 5 acres (Novak 1997; Lynn 2000). Individual beach mice have been observed traveling extensive distances (several hundreds to thousands of feet up to a mile) during one night (Swilling et al. 1998; Lynn 2000; Moyers and

Shea 2002). Beach mice have also been documented crossing two-lane roads within public lands (Gore and Schaefer 1993; Service 2004).

Significant seasonal differences in the movement of ABM have been found, which may be a result of seasonal fluctuations in food availability, food quality, and nutritional needs (Sneckenberger 2001). Santa Rosa beach mice demonstrated an increase in movement as habitat isolation increased suggesting that longer travel distances were needed to obtain necessary resources (Smith 2003). Santa Rosa beach mice also preferred vegetative cover and connectivity, which is likely a behavioral response to increased predation risk in open areas. Thus, while beach mice are able to travel great distances, the travel pathways should have vegetated cover and only a few large gaps or large open areas. Previous connectivity research suggests critical thresholds exist for species persistence in fragmented landscapes (With and Crist 1995). As connectivity becomes more reduced, species ability to move through and between habitats is reduced in a nonlinear fashion.

Population dynamics

Population size

Estimating animal abundance or population size is an important and challenging scientific issue in wildlife biology (Otis et al. 1978; Pollock et al. 1990). A number of different census methods are available to estimate wildlife populations, each with particular benefits and biases. Beach mouse surveys involve relatively standardized scientific methods, common to the study of small mammals. The basic census method for beach mice involves mark-recapture by live trapping. Mice are captured at night in live traps placed along lines or grids. Each captured animal is checked to determine if it has been captured for the first time (unmarked) or if it is a recapture (marked). A five-night minimum trapping period has been standard practice since 1987 for Gulf Coast beach mice. Data from such surveys have been analyzed using various methods with differing degrees of accuracy and bias, as number of individuals captured, minimum number known alive, number captured per 100 trap nights, or a mathematically modeled statistical population estimate (program CAPTURE, Otis et al. 1978) (**Table 9)**. As the referenced trapping events were not designed similarly or using a standardized sampling techniques, data should not compared between subspecies or trapping events, nor should densities (mice per 100 trap nights) be inferred beyond the trapping area during that trapping session. Additionally, tracking tubes have recently been used to estimate the distribution of beach mice within an area.

Table 9. Beach mouse trapping sessions and population density estimates.

Subspecies	Location	Reference	Dates of trapping	Number of mice per 100 trap nights	Range (mice per 100 trap nights)
CBM	Shell Island	Humphrey and Barbour (1981)	1979	8.60	NA
CBM	Shell Island	Meyers (1983)	1982	3.20	NA

Subspecies	Location	Reference	Dates of trapping	Number of mice per 100 trap nights	Range (mice per 100 trap nights)
CBM	Shell Island	Moyers et al. (1999)	1996	9.11	5.33 - 15.33
CBM	Topsail Hill Preserve State Park	Moyers et al. (1999)	1995 - 1998	0.68	0.23 - 2.21
CBM	Grayton Beach State Park - central unit	Moyers et al. (1999)	1995 - 1998	1.87	0.67 - 2.13
CBM	Shell Island		2002	1.06	NA
CBM	West Crooked Island Tyndall AFB	Lynn (2002a)	2002	0.72	0.13 - 1.86
CBM	Topsail Hill Preserve	Lynn (2002a, b)	2002	0.89	0.7 - 1.08
CBM	WaterSound	St. Joe Company (2004)	2003	1.66	1.66
CBM	WaterColor	St. Joe Company (2004)	2003	0	NA
CBM	WaterColor	St. Joe Company (2005)	2004	0	NA
CBM	WaterSound	St. Joe Company (2005)	2004	0	NA
CBM	Topsail Hill Preserve	US FWS (2005a, b, c)	2005	2.35	0.9 – 4.5
CBM	WaterColor	St. Joe Company (2006)	2005	0	NA
CBM	WaterSound	St. Joe Company (2006)	2005	0	NA
CBM	Topsail Hill Preserve	US FWS (2006)	2006	1.75	1.75
CBM	Topsail Hill Preserve	US FWS (2006)	2006	0	NA
CBM	WaterSound	St. Joe Company (2006)	2006	4.7	4.5 - 4.8

Population densities of beach mice typically reach peak numbers in the late autumn into spring (Rave and Holler 1992; Holler et al. 1997). Peak breeding period occurs in fall and winter, apparently coinciding with the increased availability of seeds and fruits from the previous growing season. Seasonal and annual variation in size of individual populations may be great (Rave and Holler 1992; Holler et al. 1997). Food supplementation studies showed that old field mice populations increased when foods were abundant; thus, populations of old field mice appear to be food-limited (Smith 1971; Galindo-Leal and Krebs 1998). Similar studies have not been conducted with beach mouse populations.

Population variability

Beach mouse populations fluctuate on a seasonal and annual basis. Attempts to explain population dynamics have revealed an incomplete understanding of the species and its population cycles. It is clear that beach mice, like all rodents, are known for high reproductive rates and experience extreme highs and lows in population numbers. Tropical storms and drought may be associated with depressed beach mouse populations, perhaps resulting from elimination of habitat and food supply reduction. These fluctuations can be a result of reproduction rates, food availability, habitat quality and quantity, catastrophic events, disease, and predation (Blair 1951; Bowen 1968; Smith 1971; Hill 1989; Rave and Holler 1992; Swilling et al. 1998; Swilling 2000).

Population stability

Population viability analysis (PVA) is essentially a demographic modeling exercise to predict the likelihood a population will continue to exist over time (Groom and Pascual 1997). The true value in using this analytical approach is not to determine the probability of a species' extinction, but to clarify factors that have the most influence on a species' persistence. From 1996 to 1999, the Service's Panama City Florida Field Office funded Auburn University to develop PVAs for two PKBM and two ABM subpopulations (Holler et al. 1999; Oli et al. 2001). The subpopulations modeled consisted of two subpopulations of PKBM, one at GUIS-Perdido Key Area and one at Gulf State Park - Florida Point, and two subpopulations of ABM, one at Bon Secour NWR and one at Ft. Morgan State Park. They used a stochastic (random) differential equation (Wiener-drift) model, applied to long term demographic data. The model is "stochastic" because it incorporates the variable effects of the environment upon population change. However, it did not model the effects of hurricanes on the habitat or population of beach mice.

The Oli et al. (2001) analyses indicated that all four subpopulations were at risk of extinction, with habitat fragmentation as the most influential factor. The GUIS-Perdido Key Area has the highest risk for extinction; the PKBM had a 100 percent chance of reaching one individual (becoming functionally extinct) within 21 (mode) or 45 (median) years. At Gulf State Park - Florida Point, the PKBM had a low risk of becoming functionally extinct (1.3 percent) within 13 to 20 years. However, following Hurricane Opal in 1995 and subsequent predation pressure, the PKBM population at Florida Point was believed to be extirpated in 1998. This localized extirpation clearly demonstrates that while PVAs are useful in determining significant factors in species survival, they have limited use in predicting the time to extinction for a given species.

More recently, the Conservation Breeding Specialist Group (Traylor-Holzer 2004, 2005, 2006) was contracted by the Service to conduct a population and habitat viability analysis (PHVA) on

ABM using the Vortex population simulation model (Lacy 1993). The goal was to develop an ABM population model and use the model to assess the status of the ABM habitat and populations and projections for continued existence. This model, unlike the earlier one, includes the potential effects of hurricanes. The PHVA results project the ABM to have a 26.8% ± 1.0% likelihood of extinction over the next 100 years. Much of this risk is due to hurricane impacts on ABM populations and habitat which can result in population declines. The model suggests that hurricanes are a driving force for ABM populations, both directly and also indirectly as their impacts interact with other factors, including development of higher elevation (scrub) habitat and predation by cats. Due to the similarities in the subspecies and proximal location, it can be inferred that these factors also have a strong influence on the persistence of beach mouse populations. (Again, when reviewing PHVA results, it is crucial that the actual values for the risk of extinction are not the focus of the interpretation. The true value of a PHVA is the ability to compare management strategies and development scenarios, run sensitivity analyses, and determine the main influence(s) on population persistence.) The true value of a PHVA is the ability to compare management strategies and development scenarios, run sensitivity analyses, and determine the main influence(s) on population persistence). However, it is notable that a 5 to 10 percent chance of extinction in 100 years is considered high to very high (Shaffer 1981; IUCN 2001).

The Service contracted with The Georgia Cooperative Fish and Wildlife Research Unit to critique the PVAs for the ABM accomplished by Oli et al. (2001) and Conservation Breeding Specialist Group (Traylor-Holzer 2005). Conroy and Runge (2006) indicate that neither PVA provide reliable estimates of extinction probability for ABM. They recommended that future PVA work should incorporate sampling, temporal, and possibly spatial variance for input variables and should clearly and explicitly express uncertainty in extinction output. Until this can be done, reliable estimates of extinction probability for the ABM (and other beach mouse subspecies such as PKBM) cannot be estimated.

Species which are protected across their ranges have lower probabilities of extinction (Soulé and Wilcox 1980). Beach mouse populations naturally persist through local extirpations due to storm events or the harsh, stochastic nature of coastal ecosystems. Historically, these areas would be recolonized as population densities increase and dispersal occurs from adjacent populated areas. From a genetic perspective, beach mice recover well from population size reductions (Wooten 1994), given sufficient habitat is available for population expansion after the bottleneck occurs. As human development has fragmented the coastal dune landscape, beach mice can no longer recolonize along these areas as they did in the past (Holliman 1983). As a continuous presence of beach mice or suitable habitat along the coastline is no longer possible and any hurricane can impact the entire range of each subspecies, the probability of beach mice persisting would be enhanced by the presence of contiguous tracts of suitable habitat occupied by multiple independent populations (Danielson 2005). The history of the PKBM illustrates the need for multiple populations (a now extirpated population was the source of the two remaining populations of the subspecies) (Holler et al. 1989; Service 2006). While maintaining multiple populations of beach mouse subspecies provides protection from total loss (extinction), especially when migration and relocations are possible (Oli et al. 2001), conservation of each subspecies necessitates protection of genetic variability throughout their ranges (Ehrlich 1988). Preservation of natural populations is therefore crucial, as the loss of a population of beach mice can result in a permanent loss of alleles (Wooten et al. 1999). This loss of genetic variability cannot be regained through translocations or other efforts.

Status and distribution

The CBM was listed as an endangered species primarily because of the fragmentation, adverse alteration, and loss of habitat due to coastal development. This subspecies is assigned a high recovery priority because the degree of threat to its persistence is high, it is a subspecies with high level of taxonomic distinctness, and its potential for recovery is great if threats can be eliminated or minimized. Recovery of the CBM is in conflict with economic activities, a factor which further elevates its priority ranking.

The threat of development-related habitat loss continues to increase. Additional contributing factors include low population numbers, habitat loss from other causes (including hurricanes), predation (fox, coyotes, and cats), and competition by animals associated with human development (house mice), and regulatory weaknesses regarding coastal development.

Coastal development

Habitat loss and fragmentation associated with residential and commercial real estate development are important factors contributing to the endangered status of beach mice (Holler 1992; Humphrey 1992; James 1992; Stout 1992). Beachfront development along the Gulf coast of Florida began in the 1950s and continues to this day. Coastal development has fragmented all the subspecies into disjunct populations. Isolation of habitats by imposing barriers to species movement is an effect of fragmentation that equates to reduction in total habitat (Noss and Csuti 1997). These factors, along with the influx of development-related predators such as the domestic cat and competition with house mice, probably caused the extinction of the Pallid beach mouse (Humphrey 1992).

Isolation of small populations of beach mice reduces or precludes gene flow between populations and can result in the loss of genetic diversity. Demographic factors such as predation (especially by domestic cats), diseases, and competition with house mice, are intensified in small, isolated populations, which may be rapidly extirpated by these pressures. Especially when coupled with events such as storms, reduced food availability, and/or reduced reproductive success, isolated or fragmented populations may experience severe declines or extirpation (Caughley and Gunn 1996). Contiguous tracts or functionally connected patches of suitable habitat are essential to the long-term conservation of beach mice.

CBM are now known to occupy approximately 15 miles of GOM beachfront; 12 of those miles are publicly owned lands. In the 1950s, the CBM was widespread and abundant at that time according to Bowen (1968). By 1979, Humphrey and Barbour (1981) reported only 40 percent of the original habitat remained undeveloped in non-contiguous areas. They also documented that the CBM had been extirpated from seven of its nine historical localities being restricted to the Topsail Hill area in Walton County and Shell Island in Bay County. In 1985 when the CBM became federally protected, CBM were still only known from the Topsail Hill area and Shell Island, an area consisting of about ten miles of coastline (50 FR 23872).

There are four sub-populations of CBM that currently exist: 1) Topsail Hill Preserve State Park (and adjacent eastern and western private lands), 2) Shell Island (includes St. Andrew State Park mainland and Shell Island with private inholdings and Tyndall Air Force Base), 3) Grayton

Beach (and adjacent eastern private lands), and 4) West Crooked Island. Approximately 96 percent of the lands known to be occupied by CBM are public lands.

Topsail Hill Preserve State Park consists of 1,637 acres of which 262 acres provide CBM habitat; the majority being occupied by CBM. The Florida Park Service prepared a Unit Management Plan for the Preserve that explicitly plans for conservation and protection of CBM habitats (FDEP 2000). Private lands on the east side consist of approximately 9.63 acres. Of that, 7 acres consist of the development known as the Stallworth Preserve. The Service issued an ITP for CBM to the Stallworth Preserve development in 1995; an amendment to the permit was issued in 1999. The remaining 2.63 acres has been purchased by Walton County with a grant from the Service. Private lands on the west side of the Preserve consist of 24 acres and include Four-Mile Village, a low density single family development, and the Coffeen Nature Preserve managed by the Sierra Club.

At Topsail Hill Preserve State Park, trapping conducted in March 2003 and March 2005 yielded a population estimate of 190 to 250 CBM (Service 2005d). From late 2006 through 2007 results of tracking tubes surveys at Topsail Hill Preserve State Park suggested that the CBM population was not densely distributed (FWC 2008). Trapping of four 100-trap transects yielded population estimates of 190, 250, <10 (too few to estimate), and 87 in 2003, 2005, 2006, and 2007 (Service 2007a). The track and trapping data together indicate that Topsail Hill Preserve State Park currently does not support a high population of beach mice. In 2003 and again in 2005, a total of 26 mice were translocated from Topsail Hill Preserve State Park to the WaterSound private development adjacent to Deer Lake State Park. Trapping has been sporadic on WaterSound but has yielded population estimates of 5 to 46 individuals in 2003 to 2007 (Moyers 2007). Deer Lake State Park has not been trapped, however tracks have been observed as recently as 2006 (FWC 2008).

Shell Island consists of lands within the St. Andrew State Park, Tyndall Air Force Base, and private lands. The Unit Management Plan for the State Park was completed in 1999. The plan identifies the need for protection and management of the CBM. Tyndall Air Force Base manages their portion of Shell Island under the installation's Integrated Natural Resources Management Plan. The Service has joined with the State Park and Tyndall AFB since 1995 by providing funding to protect and restore CBM habitats on Shell Island.

Population estimates using CAPTURE on Shell Island from February 1993 to March 1994, ranged from 105 to 338 CBM on a 23-acre study area (Novak 1997). Just prior to Hurricane Opal in 1995, it was estimated that Shell Island supported 800 to 1,200 CBM (Gore, FWC, personal communication 1999). Three years following Hurricane Opal in June 1998, one trapping effort at six different sites on Shell Island resulted in a cumulative population estimate of 195 CBM (164 CBM captured) (Moyers et al. 1999). The east portion of Shell Island has been trapped from 2000 to 2003. Population estimates have ranged between 24 and 67 CBM (Lynn 2004). In 1999, with the closing of East Pass and Shell Island connecting to West Crooked Island, CBM increased their range by approximately four miles (Lynn 2004). CBM are now known to occupy approximately 15 miles of Gulf of Mexico beachfront; 12 of the 15 miles are publicly owned lands.

The St. Andrew State Park mainland consists of 1,260 acres of which 123 acres are beach mouse habitat. Several tracking efforts looking for signs of CBM on the mainland were made between 1995 and 1998; no evidence was found that indicated the presence of the beach mouse (Moyers

et al. 1996; Moyers et al. 1999). However, live-trapping to document the absence of the mouse has not been conducted. Reintroduction of this area is considered an action to support recovery of CBM.

The Grayton Beach sub-population consists of two units in Grayton Beach State Park. The Park is divided into a central and western unit and is currently connected by a narrow band of primary dunes. Total acreage of the Park is 2,236 acres with 153 acres providing suitable CBM habitat. The Unit Management Plan for the Park identified the protection of the CBM as an important component. The Park has requested and received funds from the Service to implement CBM habitat restoration and protection. Portions of private lands (WaterColor and Seaside developments) on the east side of the central unit are occupied by CBM or provide suitable habitat.

In 1989, a cooperative interagency effort reintroduced CBM onto the central and west units of Grayton Beach State Park increasing the occupied coastline by another mile (Holler and Mason 1989). Population estimates from trapping at Grayton Beach State Park (main unit) from 1995 to 2000, ranged from 25 to 116 CBM (Moyers et al. 1999; VanZant 2000). The central unit was trapped for 3 nights in August 2002; however, no mice were captured (Lynn 2002c). Limited tracking surveys were accomplished in 2003, 2004 and 2005 and beach mouse tracks were observed (Kovatch 2003; Toothacker 2004; FWC 2008). The western area, although it provides CBM habitat, has not been documented as occupied by CBM (Moyers et al. 1999; VanZant 2000). The population estimates for the WaterColor development for the two years prior to and one year following development ranged from 3 to 7 CBM (The St. Joe Company 1999). CBM were last captured in February of 2001 at WaterColor; quarterly trapping has continued on the site through mid-2008 without CBM being captured (St. Joe/Arvida 2003).

West Crooked Island consists of 1,558 acres of which 730 acres provide CBM habitat and remains occupied by CBM (Lynn 2004). The West Crooked Island sub-population resulted from its connection to Shell Island in 1998 -1999. The construction of the St. Andrew Pass navigation inlet in the early 1930s severed Shell Island from the mainland on its western end. Since then, the original pass, East Pass (or Old Pass) began to close. After passage of Hurricane Opal in 1995, East Pass temporarily closed and reopened; however, after passage of hurricanes Earl and Georges in 1998, the pass closed (Coastal Tech 1999; Middlemas1999). CBM dispersed onto West Crooked Island from Shell Island colonizing most of the island within two years (Lynn 2004). Auburn University trapped West Crooked Island in October 2000, and the Service trapped the area in 2001 to 2003. The population estimate ranged from a low of 174 to a high of 244 CBM (Lynn 2004). East Pass was reopened as a joint venture between Tyndall Air Force Base and Bay County in December of 2001 but has since closed again.

Recovery criteria

The Recovery Plan for the CBM, PKBM, and ABM (Service 1987) identifies the primary recovery objectives to be the stabilization of present populations by preventing further habitat deterioration, and the re-establishment of populations in areas where they were extirpated. For each of the subspecies to be considered for downlisting to threatened, it is required that there be a minimum of at least three distinct self-sustaining populations in designated critical habitat with at least 50 percent of the critical habitat being protected and occupied by beach mice (Service 1987).

While this is the currently approved Recovery Plan for the three beach mouse subspecies, studies and research since the Recovery Plan publication has provided additional information concerning recovery needs for the subspecies. Protection and enhancement of existing populations and their habitat, plus reestablishment of populations in suitable areas within their historic ranges, are necessary for the subspecies survival and recovery. Core beach mouse populations remain isolated and are vulnerable to natural and anthropogenic factors that may further reduce or degrade habitat and/or directly reduce beach mouse population sizes. Maximizing the number of independent populations is critical to species survival. Protection of a single, isolated, minimally viable population risks the extirpation or extinction of a species as a result of harsh environmental conditions, catastrophic events, or genetic deterioration over several generations (Kautz and Cox 2001). To reduce the risk of extinction through these processes, it is important to establish multiple protected populations across the landscape (Soule and Simberloff 1986; Wiens 1996). Through the critical habitat designation process we are addressing this by designating five independent units for the subspecies spaced throughout its historic range, depending on the relative fragmentation, size, and health of habitat, as well as availability of areas with beach mouse primary constituent elements.

The Service completed a five-year status review of the Choctawhatchee and Perdido Key beach mice in August 2007 (Service 2007a, 2007b). For both subspecies the following is recommended: designate a beach mouse recovery coordinator, revise the Recovery Plan, accomplish habitat, population, and habitat improvement monitoring, and corridor persistence, hurricane response, and genetic studies, conduct translocations as necessary and education and outreach, complete an emergency response plan.

In accordance with the Act, the Service completes consultations with federal agencies (including ourselves) for actions that may adversely affect beach mice and their designated habitat. In Florida consultations have included military missions and operations, beach nourishment and other shoreline protection, and actions related to protection of coastal development (**Table 10**).

Table 10. Previous biological opinions within Florida that have been issued for projects that had adverse impact to CBM.

PROJECT	YEAR	IMPACT (Habitat/critical habitat/individuals)
Stallworth Preserve Development	1995	7 acres
Navy Panama City Beach site 4 construction	2000	0.01 acre
East Pass Re-opening	2001	Temporary, indirect take
WaterColor and WaterSound Developments	2000	7.6 acres
FWS scientific collecting permit	2004-2005	1 beach mouse per 400 trap-nights per area
FEMA beach berms post hurricane Ivan emergency consultation	2005	Consultation not complete
Western Lake Reopening consultation	2006	2.7 acres annually for five years

PROJECT	YEAR	IMPACT (Habitat/critical habitat/individuals)
Alligator Lake emergency Opening	2007	0.5 mile
Eastern Lake emergency opening	2007	0.5 mile
FEMA FL emergency berm programmatic	2007	75 miles

Threats to Choctawhatchee beach mice

Habitat Loss or Degradation

Coastal dune ecosystems are continually responding to inlets, tides, waves, erosion and deposition, longshore sediment transport, and depletion, and fluctuations in sea level. The location and shape of barrier island beaches perpetually adjusts to these physical forces. Winds move sediment across the dry beach forming dunes and the island interior landscape. The natural communities contain plants and animals that are subject to shoreline erosion and deposition, salt spray, wind, drought conditions, and sandy soils. Vegetative communities include foredunes, primary and secondary dunes, interdunal swales, sand pine scrub, and maritime forests. During storm events, overwash is common and may breach the island at dune gaps or other weak spots, depositing sediments on the interior and backsides of islands, increasing island elevation and accreting the sound shoreline. Breaches may result in new inlets through the island.

The quality of the dune habitat (primary, secondary, and scrub) is an important factor in maintaining and facilitating beach mouse recovery. Habitat manipulation is an old and widely used tool in wildlife management. It is especially useful in improving habitat suitability to increase local populations of a species. For beach mice, improving habitat can enhance the abundance and diversity of food resources, increase the chances of meeting a mate, and reduce competition for food and burrow sites.

Long-term trapping data has shown that beach mouse densities are cyclic and fluctuate by magnitudes on a seasonal and annual basis. These fluctuations can be a result of reproduction rates, food availability, habitat quality and quantity, catastrophic events, disease, and predation (Blair 1951; Bowen 1968; Smith 1971; Hill 1989; Rave and Holler 1992; Swilling et al. 1998; Swilling 2000; Sneckenberger 2001). Without suitable habitat sufficient in size to support the natural cyclic nature of beach mouse populations, subspecies are at risk from local extirpation and extinction, and may not attain the densities necessary to persist through storm events and seasonal fluctuations of resources.

Habitat loss and fragmentation associated with residential and commercial real estate development is the primary threat contributing to the endangered status of beach mice (Holler 1992; Humphrey 1992). Coastal development has fragmented all the subspecies into disjunct populations. Isolation of habitats by imposing barriers to species movement is an effect of fragmentation that equates to reduction in total habitat (Noss and Csuti 1997). Furthermore, isolation of small populations of beach mice reduces or precludes gene flow between populations and can result in the loss of genetic diversity. Demographic factors such as predation (especially by domestic cats), diseases, and competition with house mice, are intensified in small, isolated

populations, which may be rapidly extirpated by these pressures. Especially when coupled with events such as storms, reduced food availability, and/or reduced reproductive success, isolated populations may experience severe declines or extirpation (Caughley and Gunn 1996). The influence these factors have on populations or individuals is largely dependent on the degree of isolation.

The conservation of multiple large, contiguous tracts of habitat is essential to the persistence of beach mice. At present, large parcels exist mainly on public lands. Protection, management, and recovery of beach mice on public areas have been complicated by increased recreational use as public lands are rapidly becoming the only natural areas left on the coast. Public lands and their staff are now under pressure to manage for both the recovery of endangered species and recreational use. Where protection of large contiguous tracts of beach mouse habitat along the coast is not possible, establishing multiple independent populations is the best defense against local and complete extinctions due to storms and other stochastic events (Danielson 2005). Protecting multiple populations increases the chance that at least one population within the range of a subspecies will survive episodic storm events and persist while vegetation and dune structure recover.

Habitat connectivity also becomes essential where mice occupy fragmented areas lacking one or more habitat types. If scrub habitat is lacking from a particular tract, adjacent or connected tracts with scrub habitat are necessary for food and burrow sites when resources are scarce in the frontal dunes, and are essential to beach mouse populations during and immediately after hurricanes. Trapping data suggests that beach mice occupying the scrub following hurricanes recolonize the frontal dunes once vegetation and some dune structure have recovered (Swilling et al. 1998; Sneckenberger 2001). Similarly, when frontal dune habitat is lacking from a tract and a functional pathway to frontal dune habitat does not exist, beach mice may not be able to attain the resources necessary to expand the population and reach the densities necessary to persist through the harsh summer season or the next storm. Functional pathways may allow for natural behavior such as dispersal and exploratory movements, as well as gene flow to maintain genetic variability of the population within fragmented or isolated areas. To that end, contiguous tracts or functionally connected patches of suitable habitat are essential to the long-term conservation of beach mice.

A lack of suitable burrow sites may be a consequence of habitat degradation. Beach mice use burrows to avoid predators, protect young, store food, and serve as refugia between foraging bouts and during periods of rest. Beach mice have been shown to select burrow sites based on a suite of abiotic and biotic factors. A limitation in one or more factors may result in a shortage of suitable sites and the availability of potential burrow sites in each habitat may vary seasonally. Beach mice tend to construct burrows in areas with greater plant cover, less soil compaction, steep slopes, and higher elevations above sea level (Lynn 2000; Sneckenberger 2001). These factors are likely important in minimizing energy costs of burrow construction and maintenance while maximizing the benefits of burrow use by making a safe and physiologically efficient refuge. Similar to food resources, this fluctuation in availability of burrow sites suggests that a combination of primary, secondary and scrub dune habitat is essential to beach mice at the individual level.

Predation

Beach mice have a number of natural predators including coachwhip (*Masticophis flagellum*) and corn snakes (*Elaphe guttata guttata*), pygmy rattlesnake (*Sistrurus miliarius*), and Eastern diamondback rattlesnake (*Crotalus adamanteus*), short-eared (*Asio flammeus*) and great-horned owls (*Bubo virginianus*), great blue heron (*Ardea herodias*), northern harrier (*Circus cyaneus*), red fox (*Vulpes vulpes*), gray fox (*Urocyon cinereoargenteus*) skunk (*Mephitis mephitis*), weasel (*Shallela frenata*), and raccoon (*Procyon lotor*) (Blair 1951; Bowen 1968; Holler 1992; Novak 1997; Moyers et al. 1999; VanZant and Wooten 2003). Predation in beach mouse populations that have sufficient recruitment and habitat availability is natural and not a concern. However, predation pressure from natural and non-native predators may result in the extirpation of small, local populations of beach mice.

Free-roaming and feral pets are believed to have a devastating effect on beach mouse persistence (Bowen 1968, Linzey 1978) and are considered to be the main cause of the loss of at least one population of beach mice (Holliman 1983). Cat tracks have been observed in areas of low trapping success for beach mice (Moyers et al. 1999). The PHVA for the ABM indicated that if each population had as few as one cat which ate one mouse a day, rapid extinction occurred in over 99 percent of all iterations (Taylor-Holzer 2005).

In response to increasing depredation of sea turtle nests and shorebird nests/young by coyote, fox, hogs, and raccoon, multi-agency cooperative effort have been initiated and are ongoing throughout Florida, in particular on public lands. These programs also benefit beach mice.

Hurricanes

Hurricanes are known to affect beach mouse population densities in various habitats. Mechanisms for effects include direct mortality of individuals, relocation/dispersal, and subsequent effects of habitat alterations (that impact such factors as forage abundance/production and substrate elevation). Habitat impacts can be widespread, encompassing the range of the subspecies.

The impact of hurricanes on plant communities temporarily affects food availability, and hence can limit population densities in impacted habitats soon after storms. Observations indicate that Hurricane Opal (a Category 3 storm in November 1995) caused a decrease in one population of ABM by 30 percent (Swilling et al. 2000). However, population densities in scrub habitat typically increased following hurricanes (Swilling et al. 2000; Sneckenberger 2001). Five months post-storm, “densities (individuals/km) were up to 7.5 times greater in scrub areas than in frontal dune grids” (Sneckenberger 2001). Impacts of the storm may have been apparent as long as 17 months after the storm when scrub densities remained triple those of frontal dunes (Sneckenberger 2001). Similar results were found for CBM at Grayton Beach State Park. When frontal and primary dunes sustained extensive damage during Hurricane Opal in 1995, beach mice were captured behind what remained of primary dune habitat (Moyers et al. 1999). By 1998, however, primary dunes and the immediate habitat inland appeared to support higher numbers of beach mice.

In addition to the overall change in post Hurricane Opal distribution of ABM, the average percent of newly marked individuals increased from 14 percent for the three trapping periods

before the storm to an average of 26.7 percent for the same interval post hurricane (Swilling et al. 1998). The average for the three trapping periods immediately following was even higher, at 42.7 percent of the individuals captured. This increased presence of new individuals reflected increased reproduction (Swilling et al. 1998). A statistical analysis of the data indicated that the number of females exhibiting signs of reproduction was significantly higher than normal (18.9 percent higher). Similar results were also found at Topsail Hill Preserve State Park. Four to five months following Hurricane Opal, all female CBM captured were pregnant or lactating (Moyers et al. 1999). Trapping six months after the hurricane, 52 percent of captured CBM were new unmarked beach mice.

Although hurricanes can significantly alter CBM habitat and population densities in certain habitats, some physical effects may benefit the subspecies. Hurricanes are probably responsible for maintaining coastal dune habitat upon which beach mice depend through repeated cycles of destruction, alteration, and recovery of dune habitat. Hurricanes may function to break up population subgroups and force population mixing (Holler et al. 1999). The resultant breeding between members of formerly isolated subgroups increases genetic heterogeneity and could decrease the probability of genetic drift and bottlenecks.

Genetic viability

Selander et al. (1971) conducted an electrophoretic study on 30 populations of *P. polionotus*, including populations of beach mouse subspecies. Based on 30 allozyme loci, they estimated that the level of allozyme variation found in beach mouse populations was at least 40 percent lower than the level of variation in nearby inland populations. This work indicates that beach mouse populations already have lower genetic variability before inbreeding, bottleneck events, or founder effects that may occur in a reintroduced population. Lower levels of heterozygosity has been linked to less efficient feeding, fewer demonstrations of social dominance and exploratory behavior, and smaller body size (Smith et al. 1975; Garten 1976; Teska et al. 1990). Research focused on inbreeding depression in old-field mice (including one beach mouse subspecies), determined that the effects of inbreeding negatively influenced factors such as litter size, number of litters, and juvenile survivorship (Lacy et al. 1995).

In 1995, the Service contracted with Auburn University to conduct genetic analysis in CBM (Wooten and Holler 1999) of: 1) post-re-establishment gene structure in CBM; 2) if feasible, the historical relationship of St. Andrews Beach Mouse (SABM) from Crooked Island relative to CBM from Shell Island and SABM from St. Joseph Peninsula.

Results of the work found: 1) founder effects were observed in the Grayton Beach population (fixation of alleles common to the donor population and allele frequency shifts); 2) incongruity in number and size of several alleles was observed between Grayton Beach and Shell Island; 3) overall genetic divergence between the donor and re-established population was moderate; 4) genetic differences between Topsail Hill Preserve State Park and other CBM sites were higher than expected given the spatial proximity; 5) Topsail Hill Preserve State Park appears to be a reservoir for unique variation within the remaining populations of CBM; and 6) the overall relatedness estimated for Grayton State Park suggested that any mating would involve close relatives (Wooten and Holler 1999).

Wooten and Holler (1999) recommended management of CBM based on genetics by managing the Grayton Beach population for genetic characteristics; however, additional genetic analyses

would be needed. Although they recommended relocation of CBM to Grayton Beach from Shell Island should be continued; subsequent translocation work (VanZant and Wooten 2003) indicated that translocations should not be conducted if the population carrying capacity was reached.

Beachfront Lighting

Artificial lighting increases the risk of predation and influences beach mouse foraging patterns and natural movements as it increases their perceived risk of predation. Foraging activities and other natural behaviors of beach mice are influenced by many factors. Artificial lighting alters behavior patterns causing beach mice to avoid otherwise suitable habitat and decreases the amount of time they are active (Bird et al. 2004). The presence of vegetative cover reduces predation risk and perceived predation risk of foraging beach mice, and allows for normal movements, activity, and foraging patterns. Foraging in sites with vegetative cover is greater and more efficient than in sites without cover (Bird 2002). Beach mice have also been found to select habitat for increased percent cover of vegetation, and decreased distance between vegetated patches (Smith 2003).

Wildlife lighting is recommended for development projects on Walton County shorelines. These are light sources that emit long wavelength light (greater than 580 nanometers). These long-wavelength light sources include low pressure sodium vapor lamps or less, incandescent bug lamps, amber and red LEDs (light emitting diodes), true red neon, and some color-filtered compact fluorescent lamps. All lamps must be housed in a full cut off or fully shielded fixture. Fixtures should be mounted as low in elevation (height) for the needed purpose.

Analysis of the species/critical habitat likely to be affected

Aspects of the beach nourishment encompass primary and secondary dune habitats. Suitable habitat for the CBM occurs on all these habitats, as well as on lands to the north, east and west. Trapping and tracking surveys for CBM have occurred within the State Park properties. Suitable habitat for the CBM occurs within the entire beach nourishment area. Portions of the beach nourishment placement are located seaward of areas designated as critical habitat for the CBM. In addition, beach access sites for equipment and vehicles and possibly staging storage are within designated critical habitat for the CBM. The Action Area includes areas within the geographic range occupied by the subspecies at the time of listing, provides essential connectivity between public lands, and provides habitat for natural movements, behaviors, and long-term persistence of CBM.

The Action Area includes all habitat within two CBM critical habitat units – Grayton, and Deer Lake Units (refer to **Species/critical habitat description** for a detailed description of units). Beach mouse habitat within the critical habitat units provides the primary constituent elements necessary to sustain the essential life history functions of the subspecies. These include: primary and secondary dunes, generally dominated by sea oats, that despite occasional temporary impacts and reconfiguration from tropical storms and hurricanes, provide abundant food resources, burrow sites, and protection from predators; scrub dunes, generally dominated by scrub oaks, that provide food resources and burrow sites, and provide elevated refugia during and after intense flooding due to rainfall and/or hurricane induced storm surge; and, functional, unobstructed habitat connections that facilitate genetic exchange, dispersal, natural exploratory movements, and recolonization of locally extirpated areas.

ENVIRONMENTAL BASELINE

Status of the species within the Action Area

The Action Area for the beach nourishment project encompasses approximately 1.5 to 2 acres (beach access or storage areas) of CBM habitat. Actual placement of material on CBM habitat is not anticipated. While no long-term formal trapping surveys for CBM have been conducted within the Action Area, various trapping and tracking efforts have been conducted at Topsail Hill State Preserve State Park, Grayton Beach State Park, Stallworth County Park, WaterColor (private) and WaterSound (private). The CBM habitat within the Action Area provides habitat for use on a permanent basis, natural movements and behavior, refugia during storm events, and recolonization. This area is essential to the conservation of the species.

The effects of the 2004-2005 hurricanes and subsequent post-storm activities (armoring) on the habitat are still depressing beach mouse populations. Based on these data, we would anticipate that CBM are found in suitable habitat but in reduced numbers throughout the Action Area. Areas with recovering or intact dune habitat remain especially important habitat for the CBM.

Factors affecting species environment within the Action Area

The greatest threat to the beach mouse in the Action Area is habitat loss from storm events, pedestrian trespass across the beach mouse habitat (including critical habitat), and to some degree predation by cats and other non-native species. The discussion of hurricane impacts to sea turtles also applies for beach mice. Impacts to the beach mouse from hurricanes are similar to sea turtles where habitat is either altered severely by overwash, covered by sand or washed away. Depending on the intensity and frequency of the storm event, and habitat recovery efforts recovery of beach mice varies. Immediately after a storm supplemental feeding with sunflower seeds helps during the period when the surviving dune plants overcome the effects from the storm (being covered by sand or burning from salt spray, standing water, etc.).

The armoring of the shoreline that took place post Hurricane Dennis in 2005 has led to the direct and indirect loss of CBM habitat. The construction of shoreline armoring prevents the dynamics of the coastline from forming and reforming dune habitats and creates barriers to CBM movement for foraging, reproduction, and dispersal. In addition, following immediate post-storm response protecting the remaining dunes from vehicle and pedestrian traffic is needed while determining the appropriateness for replacing lost vegetation. Dune habitat restoration and maintenance is an important component of beach mouse conservation. Providing a healthy and continuous dune system assures mouse population stability. Integral to this is keeping beach goers off the dunes and replanting as necessary when impacts occur or are observed.

Feral and domestic cats may have the greatest impact of the predators. The domestic cat *Felis catus* is not native to North America and is considered a separate species from its wild ancestral species, *Felis silvestris*. Cats are hunters, retaining this behavior from their ancestors. However, wildlife in the western Hemisphere did not evolve in the presence of a small, abundant predator like the domestic cat, and thus did not develop defenses against them. Cats were introduced to North America a few hundred years ago.

While cats may instinctively hunt wildlife, it is clear that they are not adapted to life in the wild as are our native wild cats like the bobcat, panther, and mountain lion. Outdoor domestic cat populations are most commonly found in and around human settlements; most do not survive without direct or indirect support by humans. They are in this way very different from native predators.

Free-ranging pet and feral cats prey on small mammals, birds, and other native wildlife. In the U.S., on a nationwide basis, cats kill over a billion small mammals and hundreds of millions of birds each year. Worldwide, cats are second only to habitat destruction in contributing to the extinction of birds. Cats have been documented to take beach mice, sea turtle hatchlings, shorebirds, and migratory birds. A significant issue in the recovery of beach mice is predation by free-ranging pet and feral cats. Beach mice have a number of natural predators including snakes, owls, herons, and raccoons. Predation is part of the natural world. However, predation pressure from both natural and non-native predators may result in the extirpation of small, local populations of beach mice in a very short time.

Individual pet owners can be at fault by allowing their pet cats to roam freely. Individuals or groups contribute to the adverse effects by providing food for feral cats. Placing food in or adjacent to undeveloped areas frequently creates cat colonies. Supplemental feeding of feral cats results in high densities of cats because food is not a limiting factor. The presence of feral cat trap, neuter and release (TNR) group(s) in coastal Walton County has exacerbated the impacts to beach mice from cats. Cat tracks are routinely observed in beach and dune habitats. These TNR programs have not proven themselves to control or reduce the population of feral cats (Hatley and Ankerson 2003; The Wildlife Society 2006; American Bird Conservancy 1999). In fact, the programs encourage the "dropping off" of unwanted pets.

In addition, cats spread diseases to native wildlife including rabies, feline immunodeficiency virus, and feline leukemia, to name a few. Cats also spread zoonotic diseases (animal diseases that are naturally communicable to humans) such as rabies, ringworm, cat scratch disease, or toxoplasmosis by contact with cat feces or cat bites or scratches (Humane Society of the U.S. 2002).

Other Actions

Other activities have affected the conservation of CBM in the Action Area and required consultation with the Service. These are located within and outside of the Action Area and are important in the Service's overall evaluation of the subspecies current status **(Table 11)**.

Table 11. Previous biological opinions within the Action Area completed for Choctawhatchee beach mouse.

PROJECT	YEAR	IMPACT (Habitat/critical habitat/individuals)
Stallworth Preserve Development	1995	7 acres
WaterColor and WaterSound Developments	2000	7.6 acres

PROJECT	YEAR	IMPACT (Habitat/critical habitat/individuals)
FWS scientific collecting permit	2004-2005	1 beach mouse per 400 trap-nights per area
FEMA beach berms post hurricane Ivan emergency consultation	2005	Consultation not complete
Western Lake Reopening consultation	2006	2.7 acres annually for five years
Alligator Lake emergency Opening	2007	0.5 mile
Eastern Lake emergency opening	2007	0.5 mile
FEMA FL emergency berm programmatic	2007	75 miles

EFFECTS OF THE ACTION

Factors to be considered

Aspects of the beach nourishment project activities would occur within CBM habitat including designated critical habitat that is used by beach mice year round. The activities include the storage of equipment, work vehicles, or materials and creation, expansion, or use of beach access points for the dune, berm, and beach fill project. The work is anticipated to be conducted beginning in late 2008 to early 2009 and continue for up to six to nine months. While most effects would be expected to be temporary, long-term and permanent impacts from the activities could include the loss of beach mice from excavation or compaction of dune habitat and degradation and fragmentation of CBM habitat including critical habitat. Short-term and temporary impacts could include loss of foraging habitat and altering beach mouse movement and dispersal activities.

There are typically different "levels" of access sites needed for a beach nourishment project. The primary access is a "lay-down" yard, where pipe is delivered and stored and storage trailers, and other equipment and materials are stored. These are typically big paved parking lots, so that the contractor's trucks can access the area to drop off and pick up equipment. There's typically a beach access at that point to get the pipe and equipment onto the beach and that access is usually at least 50-ft wide (the pipes are frequently 40- to 50-ft sections).

“Intermediate areas" are used at about the quarter points of the project length. These are used for the fuel tank, welding equipment, and other items or systems that get used a couple of times a day.

Then there are access points to allow project vehicles and trucks on and off the beach. Based on previous projects, it would be expected to have single-vehicle entry points with most of these at existing established beach accesses.

Analyses for effects of the action

Impacts to beach mice are expected to occur from some aspects of the project activities. The activities are expected to directly or indirectly adversely affect CBM and/or their designated critical habitat. The work will occur on public and/or private lands.

Proximity of action: Some aspects of the beach nourishment project activities would occur directly in CBM habitat. The storage or staging of pipe and other equipment, and vehicles, use or creation of beach access points and placement of pipe and beach fill could occur in habitat occupied or used by the beach mouse. Beach mice spend their entire life cycle within the coastal dune system.

Distribution: The storage or staging of pipe and other equipment and vehicles and use of beach access points that could occur in habitat occupied or used by CBM.

Timing: The timing of the activities would directly and indirectly impact beach mice and their habitat depending on the season. Beach mice reproduce year round with more mice being produced in the late winter and early spring. Impacts could include but would not be limited to disrupting mice seeking mates, constructing nest burrows, foraging for food, caring for their young and young mice leaving the nest burrow dispersing into new habitat.

Nature of the effect: The effects of the activities may include the temporary loss of habitat including the loss of a few beach mice from excavation of habitat for beach access and reduction of beach mouse activity including feeding, reproduction, dispersal and population expansion, and movement from loss or alteration of habitat. Activities that decrease the amount or quality of dune habitat or movement could affect beach mice by reducing the amount of available habitat and fragmenting the habitat.

Duration: The project may take 6 to 9 months to complete depending on the project length, weather, and other factors (equipment mobilization and break downs, availability of fuel, lawsuits, etc.). Project work could take as little as 6 months and as long as the projected 9 months. Beach mouse habitats would remain disturbed until the project is completed and the habitats are restored. Following initial beach nourishment maintenance activities could occur every eight to ten years. Thus, impacts related to the subject activities would be expected to occur no more often than every eight to ten years. However, while not anticipated, work could occur annually in response to emergency events such as hurricanes.

Disturbance frequency: Depending on the nourishment frequency this could result in impacts to beach mice and their habitats at any time during the year on a minimum cycle of every eight to ten years.

Disturbance intensity and severity: If the projected material retention is realized impacts would occur for about 6 to 9 months every eight to ten years albeit a response to a storm event. The area of direct project impacts encompasses less than .06 percent of the CBM's range. The intensity is likely to be minimal and confined to beach access areas and the severity slight as few if any mice would be lost and impacted dune habitats are quickly restored.

The staging and storage of equipment and materials and beach access points could occur within habitat occupied or used by CBM and within designated critical habitat for the CBM. Beach mice are permanent inhabitants of the coastal ecosystem conducting all their life cycles in this environment. While the current status of CBM is unknown, their general distribution is known.

The Action Area consists of the Gulf beachfront including the wet and dry unvegetated beach, developing foredunes and interdunal swales, and areas that were formerly primary or secondary dunes. Beach nourishment project work would not occur on existing vegetated primary or secondary dunes. However, construction of or expansion of an existing beach access could be located through scrub, secondary, or primary dunes. Beach mice would generally be found inhabiting stable primary, secondary, and scrub dunes on a permanent basis with other habitats being used periodically on a daily or seasonal basis for feeding and movement. Some of these areas also include CBM designated critical habitat. The primary constituent elements for CBM critical habitat include the following.

1. A contiguous mosaic of primary, secondary and scrub vegetation and dune structure, with a balanced level of competition and predation and few or no competitive or predaceous nonnative species present, that collectively provide foraging opportunities, cover, and burrow sites.

2. Primary and secondary dunes, generally dominated by sea oats, that, despite occasional temporary impacts and reconfiguration from tropical storms and hurricanes, provide abundant food resources, burrow sites, and protection from predators.

3. Scrub dunes, generally dominated by scrub oaks, that provide food resources and burrow sites, and provide elevated refugia during and after intense flooding due to rainfall and/or hurricane induced storm surge.

4. Functional, unobstructed habitat connections that facilitate genetic exchange, dispersal, natural exploratory movements, and recolonization of locally extirpated areas.

5. A natural light regime within the coastal dune ecosystem, compatible with the nocturnal activity of beach mice, necessary for normal behavior, growth and viability of all life stages.

Direct and Indirect Impacts

Direct impacts are effects of the action on the species occurring as the project is implemented -- during the construction of the dune, berm, and beach fill project. The beach nourishment project may provide beneficial effects for CBM by creating a wider beach and berm that would provide storm protection to the landward habitat of CBM. Also, the planting of the dunes and/or berms would accelerate habitat restoration of CBM habitat (food source and burrow habitat). Direct loss of individual beach mice may occur during the creation or expansion of beach access points when heavy equipment clears the habitat and packs the sand. In general, the length of time between project maintenance work is expected to be sufficient for beach mouse habitat to be restored. Thus, it is not anticipated that the beach nourishment project activities would result in permanent beach mouse habitat destruction (including critical habitat). However, habitat for

CBM within the Action Area including designated critical habitat that provides food or cover may be temporarily destroyed or altered from the activities.

Indirect effects are a result of a proposed action that occur later in time and are reasonably certain to occur. The indirect effect of the nourishment activities would be newly created or expanded existing beach access points that act as barriers to beach mouse movement for foraging, or population expansion or dispersal. Maintaining the connectivity among habitats is vital to persistence of beach mice recovery. Recovery actions needed to assure the connectivity include restoration and maintenance of the dune system following project completion.

For the Service to determine if the project impacts on proposed critical habitat would be an adverse modification, we must determine if the impact on the habitat appreciably diminishes the capability of the critical habitat to satisfy essential requirements of beach mice with designated critical habitat. The long-term maintenance of the beach mouse populations in the project areas could be compromised if the dune, berm, and beach fill project activities occur too frequently resulting in a long-term barrier to mice movement. However, our evaluation indicates the impacts to critical habitat should be temporary in nature based on past history of similar type (nourishment) projects. In addition, the area to be directly affected would be a small percentage of the overall critical habitat and would not be expected to reduce the carrying capacity of the recovery units.

Species' response to a proposed action

This biological opinion is based on effects that are anticipated to CBM (all life stages) as a result of the temporary physical disturbance of beach mouse habitat from the dune, berm, and beach fill activities. The project may provide benefits for CBM through storm protection of habitat and acceleration of habitat restoration. However, some beach mice (all life stages) may be lost during the initial construction or expansion of beach accesses where heavy equipment destroys dune habitat and compacts the sand within the access corridor. Any mice that survive the initial construction may move outside of the disturbed area and construct burrows elsewhere in the vicinity. Following access construction, a bare gap of sand could form a barrier to limit beach mouse movement within the area altering regular movement patterns. These impacts are expected to be limited to the construction phase of the project (up to 9 months). As the life span of a beach mouse is estimated to be approximately 9 months, the loss of individual mice or the temporary loss of habitat could affect several generations of beach mice, but because beach mice can reproduce rapidly (every 26 days), colonization or recolonization of the restored habitat would be expected within several months/generations.

While beach mice have evolved to adapt to catastrophic weather events, additional factors such as surrounding development pressure and non-native predators may affect the species' ability to recover from the loss of individuals. However, the temporary loss of the habitat itself is not expected to permanently impact the populations as only about 0.06 percent of the habitat within the project areas would be temporarily impacted. Therefore, while a few mice may be lost initially and temporary impacts to dune habitats may occur, the function and conservation role of the remaining beach mouse habitat including habitat designated as critical habitat is not expected to be altered.

PIPING PLOVER

Action Area

The Project and Action Area for piping plovers is the 13.5 miles of shoreline proposed for nourishment in Walton County (**Figure 2**). The project fill site is located in the GOM in four reaches (segments) demarcated by the following FDEP monuments: R -41 to R-64, R-67 to R-72, R-78 to R-98, and R-105.5 to R-127. It begins at MLW along the GOM and includes intertidal areas of the GOM and coastal dune lakes, wrack lines, ephemeral pools, inlets, and the upper sandy beach with sparse or no vegetation and coastal dune lakes sand and mud flats habitat as well as any overwash areas that occur adjacent or connecting the GOM and the coastal dune lakes.

STATUS OF THE SPECIES/CRITICAL HABITAT

Species/critical habitat description

The piping plover is a small, pale sand-colored shorebird, about seven inches long with a wingspan of about 15 inches (Palmer 1967). On January 10, 1986, the piping plover was listed as endangered in the Great Lakes watershed and threatened elsewhere within its range, including migratory routes outside of the Great Lakes watershed and wintering grounds (Service 1985). Piping plovers were listed principally because of habitat destruction and degradation, predation, and human disturbance. Protection of the species under the Act reflects the species' precarious status range-wide. Three separate breeding populations have been identified, each with its own recovery criteria: the northern Great Plains (threatened), the Great Lakes (endangered), and the Atlantic Coast (threatened) (**Figure 16).** The piping plover winters in coastal areas of the U.S. from North Carolina to Texas, and along the coast of eastern Mexico and on Caribbean islands from Barbados to Cuba and the Bahamas (Haig and Elliott-Smith 2004). Information from observation of color-banded piping plovers indicates that the winter ranges of the breeding populations overlap to a degree.

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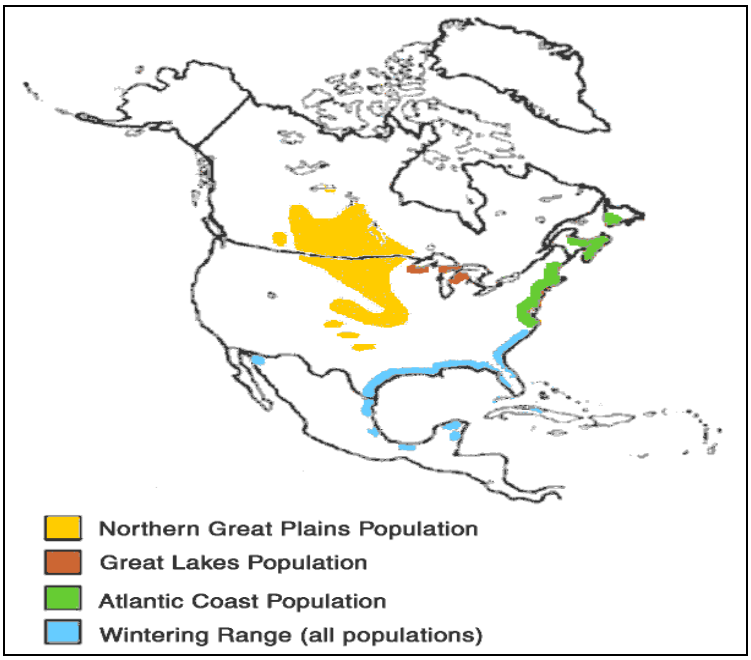

Figure 16. Range of piping plovers.

Natural protection: Cryptic coloration is a primary defense mechanism for this species; nests, adults, and chicks all blend in with their typical beach surroundings. Piping plovers on wintering and migration grounds respond to intruders (pedestrian, avian and mammalian) usually by squatting, running, and flushing (flying).

Foraging/food: Behavioral observation of piping plovers on the wintering grounds suggests that they spend the majority of their time foraging (Nicholls and Baldassarre 1990a; Drake 1999a, 1999b). Feeding activities may occur during all hours of the day and night (Staine and Burger 1994; Zonick 1997), and at all stages in the tidal cycle (Goldin 1993; Hoopes 1993). Wintering plovers primarily feed on invertebrates such as polychaete marine worms, various crustaceans, fly larvae, beetles, and occasionally bivalve mollusks (Bent 1929; Cairns 1977; Nicholls 1989; Zonick and Ryan 1996). They peck these invertebrates on top or just beneath the surface.

Feeding areas: Plovers forage on moist substrate features such as intertidal portions of ocean beaches, washover areas, mudflats, sand flats, algal flats, wrack lines, sparse vegetation, and shorelines of coastal ponds, lagoons, ephemeral pools and adjacent to salt marshes (Gibbs 1986; Zivojnovich 1987; Nichols 1989; Nicholls and Baldassarre 1990a; Nicholls and Baldassarre 1990b; Coutu et al. 1990; Hoopes et al. 1992; Loegering 1992; Goldin 1993; Elias-Gerken 1994; Wilkinson and Spinks 1994; Zonick 1997; Service 2001a). Studies have shown that the relative importance of various feeding habitat types may vary by site (Gibbs 1986, Coutu et al. 1990; McConnaughey et al. 1990; Loegering 1992; Goldin 1993; Hoopes 1993). Cohen et al. (2006) documented more abundant prey items and biomass on sound island and sound beaches than the ocean beach.

Habitat: Wintering piping plovers appear to prefer coastal habitat that include sand flats adjacent to inlets or passes, sandy mud flats along prograding spits (areas where the land rises with respect to the water level), ephemeral pools, and overwash areas as foraging habitats. These substrate types have a richer infauna than the foreshore of high energy beaches and often attract large numbers of shorebirds (Cohen et al. 2006). Wintering plovers are dependent on a mosaic

of habitat patches and move among these patches depending on local weather and tidal conditions (Nicholls and Baldassarre 1990a). Drake (1999b) monitored the movement of 48 piping plovers in south Texas for one season. She found, using 95 percent of the documented locations, that these birds had a mean home range of 3,117 acres. Drake (1999b) also noted that the mean linear distance moved per individual bird was 2 miles for the fall through the spring of 1997-1998. Observations suggest that this species exhibits a high degree of wintering site fidelity (Drake et al. 2001; Stucker and Cuthbert 2006).

Migration: Plovers depart their breeding grounds for their wintering grounds from July through late August, but southward migration extends through November. Piping plovers use habitats in the Florida from July 15 through May 15. Both spring and fall migration routes of Atlantic Coast breeders are believed to occur primarily within a narrow zone along the Atlantic Coast (Service 1996). Some mid-continent breeders travel up or down the Atlantic Coast before or after their overland movements (Stucker and Cuthbert 2006). Use of inland stopovers during migration is also documented (Pompei and Cuthbert 2004). Information from observation of color-banded piping plovers indicates that the winter ranges of the breeding populations overlap to a significant degree. Therefore, the source breeding population of a given wintering individual cannot be determined in the field unless it has been banded or otherwise marked. Confirmed sightings from all three breeding populations have been documented in the Florida panhandle.

While piping plover migration patterns and needs remain poorly understood and occupancy of a particular habitat may involve shorter periods relative to wintering, information about the energetics of avian migration indicates that this might be a particularly critical time in the species' life cycle. The possibility of lower survival rates for Atlantic Coast piping plovers breeding at higher latitudes (based on relationships between population trends and productivity) suggest that migration stress may substantially affect survival rates of this species (Hecht 2006). The pattern of both fall and spring counts at many Atlantic Coast sites demonstrates that many piping plovers make intermediate stopovers lasting from a few days up to one month during their migrations (Noel et al. 2005; Stucker and Cuthbert 2006). In addition, this species exhibits a high degree of intra- and inter-annual wintering site fidelity (Nicholls and Baldassarre 1990a; Drake et al. 2001; Noel et al. 2005; Stucker and Cuthbert 2006).

The Service has designated critical habitat for the piping plover on three occasions. Two of these designations protected different breeding populations of the piping plover. Critical habitat for the Great Lakes breeding population was designated May 7, 2001 (66 FR 22938, Service 2001a), and critical habitat for the northern Great Plains breeding population was designated September 11, 2002 (67 FR 57637, Service 2002). The Service designated critical habitat for wintering piping plovers on July 10, 2001 (66 FR 36038, Service 2001b). Wintering piping plovers may include individuals from the Great Lakes and northern Great Plains breeding populations as well as birds that nest along the Atlantic coast. The three separate designations of piping plover critical habitat demonstrate diversity of constituent elements between the two breeding populations as well as diversity of constituent elements between breeding and wintering populations.

Designated wintering piping plover critical habitat originally included 142 areas [the rule states 137 units; this is in error] encompassing about 1,793 miles of mapped shoreline and 165,211 acres of mapped areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas.

Since the designation of wintering critical habitat, 19 units (TX- 3,4,7-10, 14-19, 22, 23, 27,28, and 31-33) in Texas have been vacated and remanded back to the Service for reconsideration by Court order (Texas General Land Office v. U.S. Department of Interior (Case No. V-06-CV-00032)). The Courts vacated and remanded back to the Service for reconsideration, four units in North Carolina (Cape Hatteras Access Preservation Alliance v. U.S. Department of Interior (344 F. Supp. 2d 108 (D.D.C. 2004)). The four critical habitat units vacated were NC-1, 2, 4, and 5, and all occurred within Cape Hatteras National Seashore (CAHA). On June 12, 2006, the Service proposed to amend and re-designate these four units as critical habitat for wintering piping plover (71 FR 33703, Service 2006a). On May 15, 2008, the USFWS proposed a revised designation of critical habitat which would add areas to units NC-1 and NC-4 (USFWS 2008d). A total of 119 designated critical habitat units and 110,461 acres remain designated.

The primary constituent elements for piping plover wintering habitat are those biological and physical features that are essential to the conservation of the species. The primary constituent elements are those habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support these habitat components. These areas typically include those coastal areas that support intertidal beaches and flats and associated dune systems and flats above annual high tide (Service 2001a). PCEs of wintering piping plover critical habitat include sand or mud flats or both with no or sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting piping plovers (Service 2001a). Important components of the beach/dune ecosystem include surf-cast algae, sparsely vegetated back beach and salterns, spits, and washover areas. Washover areas are broad, unvegetated zones, with little or no topographic relief, that are formed and maintained by the action of hurricanes, storm surge, or other extreme wave action. The units designated as critical habitat are those areas that have consistent use by piping plovers and that best meet the biological needs of the species. The amount of wintering habitat included in the designation appears sufficient to support future recovered populations, and the existence of this habitat is essential to the conservation of the species. Additional information on each specific unit included in the designation can be found at 66 FR 36038 (Service 2001a).

Life history

Piping plover breeding activity begins in mid-March when birds begin returning to their nesting areas (Coutu et al. 1990; Cross 1990; Goldin 1990; MacIvor 1990; Hake 1993). Plovers are known to begin breeding as early as one year of age (MacIvor 1990; Haig 1992); however, the percentage of birds that breed in their first adult year is unknown. Piping plovers generally fledge only a single brood per season, but may renest several times if previous nests are lost.

Demographic models for piping plovers indicate that even small declines in adult and juvenile survival rates will cause very substantial increases in extinction risk (Melvin and Gibbs 1994; Amirault et al. 2005). Furthermore, insufficient protection of non-breeding piping plovers and their habitat has the potential to quickly undermine the progress toward recovery achieved at other sites. For example, a banding study conducted between 1998 and 2004 in Atlantic Canada found lower return rates of juvenile (first year) birds to the breeding grounds than was documented for Massachusetts (Melvin and Gibbs 1996, cited in Appendix E, Service 1996), Maryland (Loegering 1992), and Virginia (Cross 1996) breeding populations in the mid-1980s and very early 1990s. This is consistent with failure of the Atlantic Canada population to

increase in abundance despite very high productivity (relative to other breeding populations) and extremely low rates of dispersal to the U.S. over the last 15 plus years (Amirault et al. 2005). Simply stated, this suggests that maximizing productivity does not ensure population increases. Management must focus simultaneously on all sources of stress on the population within management control (predators, off road vehicles (ORVs), etc.). Drake et al. (2001) evaluated winter piping plover habitat use in Texas and determined they have relatively small home-ranges and high survivorship from arrival in fall through spring departure. Cohen et al. (2006) experienced 100 percent winter survival of radio-tagged birds in a study conducted in North Carolina from December 2005 to March 2006. They speculate their high survival rate was attributed to plovers food availability much of the day as well as the low occurrence of days below freezing and infrequent wet weather.

Piping plovers live an average of five years, although studies have documented birds as old as 11 (Wilcox 1959) and 15 years.

Population dynamics

Northern Great Plains Population

The Northern Great Plains plover breeds from Alberta to Manitoba, Canada and south to Nebraska; although some nesting has recently occurred in Oklahoma. Currently the most westerly breeding piping plovers in the United States occur in Montana and Colorado.

Nesting occurs on sand flats or bare shorelines of rivers and lakes, including sandbar islands in the upper Missouri River system, and patches of sand, gravel, or pebbly-mud on the alkali lakes of the northern Great Plains. Breeding surveys in the early 1980s reported 2,137 to 2,684 adult plovers in the northern Great Plains/Prairie region (Haig and Oring 1985). In 1991, 2,032 adult plovers were observed in the U.S. portion of the northern Great Plains (Haig and Plissner 1993). The number declined to 1,599 in 1996 (Plissner and Haig 1997), a reduction of 21 percent from 1991. Part of this reduction may be an artifact of increased numbers of plovers nesting in Canada in 1996 due to high water levels in the U.S. (Plissner and Haig 1997). Overall in both the U.S. and Canadian portion of the northern Great Plains, 3,469 adult piping plovers were observed in 1991; 3,286 were observed in 1996; and 2,953 were observed in 2001 (Ferland and Haig 2002). The 2001 figure includes 1,291 breeding pairs.

The northern Great Plains is the largest of the three breeding populations (2006 data report 4,698 birds including the 2,962 in the U.S. (Ryba 2007)). The 2006 International Census reported a substantial increase since 2001 in both the U.S. and Canadian portion of the northern Great Plains breeding population.

The decline of piping plovers on rivers in the Northern Great Plains has been largely attributed to the loss of sandbar island habitat and forage base due to dam construction and operation. While piping plovers do nest on shorelines of reservoirs created by the dams, reproductive success is often low and reservoir habitat is not available in many years due to high water levels or vegetation. Dams operated with steady constant flows allow vegetation to grow on potential nesting islands, making these sites unsuitable for nesting. Population declines in alkali wetlands are attributed to wetland drainage, contaminants, and predation.

Great Lakes Population

The Great Lakes plovers once nested on Great Lakes beaches in Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin, and Ontario. Russell (1983) reviewed historical records to estimate the pre-settlement populations of the plover throughout this range. While estimates may be high for some Great Lakes states, no other historic estimates are available. Total population estimates ranged from 492 to 682 breeding pairs in the Great Lakes region; Michigan alone may have had the most with as many as 215 pairs. When listed, the Great Lakes population numbered only 17 known breeding pairs that nested in northern Michigan. Gradual increases in this population have been documented since listing and these birds are now known to have expanded to the south and west (USFWS 2003). Twenty-nine breeding pairs were observed in 2001 (Ferland and Haig 2002). As of 2007, there were an estimated 63 nesting pairs (Dingledine 2008, *in litt*.).

Great Lakes piping plovers nest on wide, flat, open, sandy or cobble shoreline with very little grass or other vegetation. Reproduction is adversely affected by human disturbance of nesting areas and predation by foxes, gulls, crows and other avian species. Shoreline development, such as the construction of marinas, breakwaters, and other navigation structures, has adversely affected nesting and brood rearing.

Atlantic Coast Population

The Atlantic Coast piping plover breeds on coastal beaches from Newfoundland and southeastern Quebec to North Carolina. Historical population trends for the Atlantic Coast piping plover have been reconstructed from scattered, largely qualitative records. Nineteenth-century naturalists, such as Audubon and Wilson, described the piping plover as a common summer resident on Atlantic Coast beaches (Haig and Oring 1987). However, by the beginning of the 20th Century, egg collecting and uncontrolled hunting, primarily for the millinery trade, had greatly reduced the population, and in some areas along the Atlantic Coast, the piping plover was close to extirpation. Following passage of the Migratory Bird Treaty Act (40 Stat. 775; 16 U.S.C. 703-712) in 1918, and changes in the fashion industry that no longer exploited wild birds for feathers, piping plover numbers recovered to some extent (Haig and Oring 1985).

Available data suggest that the most recent population decline began in the late 1940s or early 1950s (Haig and Oring 1985). Reports of local or statewide declines between 1950 and 1985 are numerous, and many are summarized by Cairns and McLaren (1980) and Haig and Oring (1985). While Wilcox (1939) estimated more than 500 pairs of piping plovers on Long Island, New York, the 1989 population estimate was 191 pairs (see Table 4, USFWS 1996). There was little focus on gathering quantitative data on piping plovers in Massachusetts through the late 1960s because the species was commonly observed and presumed to be secure. However, numbers of piping plover breeding pairs declined 50 to 100 percent at seven Massachusetts sites between the early 1970s and 1984 (Griffin and Melvin 1984). Piping plover surveys in the early years of the recovery effort found that counts of these cryptically colored birds sometimes went up with increased census effort, suggesting that some historic counts of piping plovers by one or a few observers may have underestimated the piping plover population. Thus, the magnitude of the species decline may have been more severe than available numbers imply.

The Atlantic Coast population has increased from 790 pairs since listing to a preliminary estimate of 1,887 pairs in 2007 (USFWS 2008)(final 2006 estimate of 1,749 pairs, USFWS 2006b). Population growth has been greatest in the New England and New York-New Jersey recovery units, with a more modest and recent increase in the Southern unit and an even smaller

increase in Atlantic Canada. Periodic rapid declines in abundance of breeding pairs at the level of the recovery unit, including a 68 percent decline in the southern half of the Virginia barrier island chain and North Carolina between 1995 and 2001, illustrate continued population vulnerability.

Status and distribution

Non-breeding (migrating and wintering)

Piping plovers migrate through and winter in coastal areas of the U.S. from North Carolina to Texas and in portions of Mexico and the Caribbean. Birds from the three breeding populations overlap in their use of migration and winter habitat. In Florida, the majority of wintering birds on the Gulf Coast are likely to be from the northern Great Plains population, although individuals from the Great Lakes and Atlantic populations have been documented. The majority of the birds using the Atlantic Coast are believed to be from the Atlantic breeding population. Repeated sightings for >8 years of banded Great Lakes birds have documented their use of the coast of the Carolinas, Georgia (Noel et al. 2005), Alabama (Stucker and Cuthbert 2006) and Florida's Atlantic Coast (Leary 2007).

In 2001, 2,389 piping plovers were located during a winter census, accounting for only 40 percent of the known breeding birds recorded during a breeding census (Ferland and Haig 2002). About 89 percent of birds that are known to winter in the U.S. do so along the Gulf Coast (Texas to Florida), while eight percent winter along the Atlantic Coast (North Carolina to Florida). Four range-wide population surveys have been conducted for the piping plover; the 1991 (Haig and Plissner 1992), the 1996 (Plissner and Haig 1997), the 2001 (Ferland and Haig 2002) and the 2006. The 2006 International Census results have not yet been published. These four surveys were completed to help determine the species distribution and to monitor progress towards recovery. **Table 12** provides a summary of the results of the four International wintering censuses. Total numbers have fluctuated over time with some areas experiencing increases and others decreases. Fluctuations are predominately due to the location, quality, and extent of suitable non-breeding habitat that may vary over time due to regional rainfall and anthropogenic hydrologic manipulation and disturbance. Fluctuations could also represent unequal survey efforts or localized conditions during surveys. The increased numbers of birds counted in Texas in 2006 may reflect a shift of birds away from areas such as the Chandeleur Islands in Louisiana that were negatively impacted by Hurricane Katrina in 2005 (Cobbs 2006). The increase in the 2006 numbers from the Caribbean is due to increased survey efforts (Maddock 2006).

Table 12. Results of the 1991, 1996, 2001, and unofficial 2006 International Piping Plover Wintering Census.

Location	**1991**	**1996**	**2001**	**2006**
North Carolina	20	50	87	84
South Carolina	51	78	78	82
Georgia	37	124	111	212
Florida	551	375	416	414
-Atlantic	*70*	*31*	*111*	*unk*
-Gulf	*481*	*344*	*305*	*unk*
Alabama	12	31	30	29
Mississippi	59	27	18	78
Louisiana	750	398	511	224

Location	1991	1996	2001	2006
Texas	1,904	1,333	1,042	2,158
Puerto Rico	0	0	6	?
U.S. Total	**3,935**	**2,416**	**2,299**	**~3,281**
Mexico	27	16	Not surveyed	76
Caribbean	40	83	90	378
GRAND TOTAL	**3,451**	**2,515**	**2,389**	**3,735**
% of Breeding Census	62.9%	42.4%	40.2%	unknown

The status of piping plovers on winter and migration grounds is difficult to assess, but threats to piping plover habitat used during winter and migration identified by the Service during its designation of critical habitat continue to affect the species. Unregulated motorized and pedestrian recreational use, inlet and shoreline stabilization projects, beach maintenance and nourishment, and pollution affect most winter and migration areas. Conservation efforts at some locations have likely resulted in the enhancement of wintering habitat.

The 2004 and 2005 hurricane seasons affected a substantial amount of habitat along the Gulf Coast. Habitats such as those along Gulf Islands National Seashore have benefited from increased washover events which created optimal habitat conditions for piping plovers. On the flip side, hard shoreline structures are put into place throughout the species range to prevent such shoreline migration (see *Factors Affecting Species Environment within the Action Area*). The Chandeleur Islands, a north-south oriented chain of low-lying islands, located approximately 62 miles east of the city of New Orleans, Louisiana, were impacted by hurricanes Lili (2002), Ivan (2004), Dennis (2005) and Katrina (2005), the strongest and closest in proximity to the Chandeleurs) (USGS 2005). Early estimates are that Hurricane Katrina removed about 85 percent of the sand from the beach and dunes of the Chandeleur Islands. It is unknown how much sand is likely to return under natural conditions to rebuild these barrier islands (Williams 2006). The Chandeleur Island Chain was used consistently by piping plovers and was designated critical habitat in 2001.

The Service is aware of the following site-specific conditions that affect the status of several habitats piping plover use while wintering and migrating, including critical habitat units. In Texas, one critical habitat unit was afforded greater protection due to the acquisition of adjacent upland properties by the local Audubon chapter. In another unit in Texas, vehicles were removed from a portion of the beach decreasing the likelihood of automobile disturbance to plovers. In Florida, land acquisition has been initiated within portions of one critical habitat unit in the panhandle. Exotic plant removal is occurring in another Florida critical habitat unit in South Florida that threatens to invade suitable piping plover habitat. The Service remains in a contractual agreement with the USDA for predator control within limited coastal areas in the panhandle, including portions of some critical habitat units. Continued removal of potential terrestrial predators is likely to enhance survivorship of wintering and migrating piping plovers. In North Carolina, one critical habitat unit was afforded greater protection when the local Audubon chapter agreed to manage the area specifically for piping plovers and other shorebirds following the relocation of the nearby inlet channel.

Several projects have resulted in formal consultation for piping plovers or their designated critical habitat in Florida (**Table 13**). Emergency consultation for beach nourishment at Navarre

Beach resulted in supplying the permittee with avoidance and minimization measures to lessen the impacts to optimal piping plover habitat that may have been created by the hurricane. Emergency consultations with the Corps for berm placement post Hurricane Ivan, resulted in similar guidance. These projects are complete; however, final consultation is not yet complete. A few consultations have resulted in formal consultation for piping plovers or their designated critical habitat in Northwest Florida. The Service has completed a statewide programmatic consultation in draft form with the Corps for emergency berm repair.

Table 13. Biological opinions issued for all projects that had adverse impact to the piping plovers on non-breeding grounds in Florida.

SPECIES Piping plover	YEAR	PROJECT ACTIVE YES/NO
East Pass re-opening	2001	Completed
Amend BO for south jetty extension in Ponce De Leon Navigation Inlet	2003	Completed
Terminal groin and nearshore breakwater on south end of Amelia Island, Nassau, FL	2004	Completed
Eglin AFB INRMP	2007-2011	Completed
Pensacola Beach beach nourishment original Amd. 1	2002-2005	Initial completed & hurricane recovery completed
Navarre beach nourishment emergency consultation and Amd. 1-6	2005	Project completed, consultation not completed
Eglin Santa Rosa Island Programmatic	2005-2007	Completed
Tyndall AFB INRMP	2007-2011	Completed
St. Joseph Peninsula beach restoration	2007	Consultation complete, project started
Alligator Point beach nourishment	2007	Consultation complete, project cancelled
NAS Pensacola pass dredging and spoil placement	2007	Consultation ongoing
FEMA emergency berm repair for Florida coast	2008	Consultation complete
Eglin AFB nourishment	2008	Consultation complete, project on hold until 2010.
Perdido Key beach nourishment	2008	Consultation complete, project not started.

Recovery criteria

Northern Great Plains Population (Service 1994)

1. Increase the number of birds in the U.S. northern Great Plains states to 2,300 pairs.

2. Attain recovery objective of 813 pairs amongst 4 Provinces for Prairie Canada (Goossen et al. 2002).
3. Secure long term protection of essential breeding and wintering habitat.

Great Lakes Population (Service 2003)

1. At least 150 pairs (300 individuals), for at least 5 consecutive years, with at least 100 breeding pairs (200 individuals) in Michigan and 50 breeding pairs (100 individuals) distributed among sites in other Great Lakes states.
2. Five-year average fecundity within the range of 1.5-2.0 fledglings per pair, per year, across the breeding distribution, and ten-year population projections indicate the population is stable or continuing to grow above the recovery goal.
3. Protection and long-term maintenance of essential breeding and wintering habitat is ensured, sufficient in quantity, quality, and distribution to support the recovery goal of 150 pairs (300 individuals).
4. Genetic diversity within the population is deemed adequate for population persistence and can be maintained over the long-term.
5. Agreements and funding mechanisms are in place for long-term protection and management activities in essential breeding and wintering habitat.

Atlantic Coast Population (Service 1996)

1. Increase and maintain for 5 years a total of 2,000 breeding pairs, distributed among 4 recovery units.
2. Verify the adequacy of a 2,000 pair population of piping plovers to maintain heterozygosity and allelic diversity over the long term.
3. Achieve a 5-year average productivity of 1.5 fledged chicks per pair in each of the 4 recovery units described in criterion 1, based on data from sites that collectively support at least 90 percent of the recover unit's population.
4. Institute long-term agreements to assure protection and management sufficient to maintain the population targets and average productivity in each recovery unit.
5. Ensure long-term maintenance of wintering habitat, sufficient in quantity, quality, and distribution to maintain survival rates for a 2,000-pair population.

Threats to Piping Plovers

Predation

Predation has been identified as a major factor limiting piping plover reproductive success but the impact predation has on piping plovers while on migration or wintering grounds is unknown. Substantial evidence exists that human activities are affecting types, numbers, and activity patterns of predators, thereby exacerbating natural predation. Non-native species such as feral cats are considered significant predators on some sites (Goldin et al. 1990; Post 1991). Humans have also indirectly influenced predator populations; for instance, human activities abetted the expansions in the populations and/or range of other species such as gulls (Drury 1973; Erwin 1979). Strauss (1990) found that the density of fox tracks on a beach area was higher during periods of more intensive human use. Predatory birds also are relatively common during their fall and spring migration and there is a possibility they may occasionally take piping plovers.

Weather

Piping plover habitats (breeding and non-breeding) are dependent on natural forces although storms and severe cold weather are believed to take their toll on piping plovers. After an intense snowstorm swept the entire North Carolina coast in late December 1989, high mortality of many coastal bird species was noted (Fussell 1990). Piping plover numbers decreased significantly from about 30 to 40 birds down to 15 birds. While no dead piping plovers were found, circumstantial evidence suggests that much of the decrease was mortality (Fussell 1990). Hurricanes may also result in direct mortality or habitat loss, and if piping plover numbers are low enough or if total remaining habitat is very sparse relative to historical levels, population responses may be impaired even through short-term habitat losses. Wilkinson and Spinks (1994) suggest that, in addition to the unusually harsh December 1989 weather, low plover numbers seen in South Carolina in January 1990 (11 birds, compared with more than 50 during the same time period in 1991 to 1993) may have been influenced by effects on habitat and food availability caused by Hurricane Hugo which came ashore there in September 1989. Hurricane Elena struck the Alabama Coast in September 1985 and subsequent surveys noted a reduction of foraging intertidal habitat on Dauphin and Little Dauphin Islands (Johnson and Baldassarre 1988). Birds were observed foraging at Sand Island, a site that was used little prior to the hurricane.

Vehicles

Vehicles significantly degrade piping plover habitat or disrupt normal behavior patterns. Vehicular and/or pedestrian disturbance that reduces plover use and/or impairs their foraging efficiency on soundside tidal flats is particularly injurious. Multiple studies have shown that bay tidal flats have relatively high indices of arthropod abundance compared with other microhabitats, and that piping plovers select these habitats in greater proportion than their availability (Loegering and Fraser 1995; Cross and Terwilliger 2000; Elias et al. 2000; Houghton et al. 2005). Zonick (2000) found that off road vehicle (ORV) density negatively correlated with abundance of roosting plovers on the ocean beach. Cohen et al. (in press) found that piping plovers appear to show preference of foraging and roosting in areas with no ORV disturbance. Studies elsewhere (Wheeler 1979) demonstrate adverse effects of ORV driving on soundside beaches on the abundance of infauna essential to piping plover foraging requirements.

Recreational Activities

Pedestrian and non-motorized recreational activities can be a source of both direct mortality and harassment of piping plovers. There are a number of potential sources for pedestrians on the beach, including those individuals driving and subsequently parking on the beach, those originating from off-beach parking areas (hotels, motels, commercial facilities, beachside parks, etc.), and those from beachfront and nearby residences. Essentially, the magnitude of threats to coastal species is particularly significant because vehicles extend impacts to remote stretches of beach where human disturbance would be very slight if access were limited to pedestrians only. Human recreation on coastal habitats can cause adverse impacts on dune formation, vegetation, and the invertebrate and vertebrate fauna.

Elliott and Teas (1996) found a significant difference in actions between piping plovers encountering pedestrians and those not encountering pedestrians. Piping plover not encountering

pedestrians spend proportionately less time in active non-foraging behavior. This study suggests that interactions with pedestrians on beaches cause birds to shift their activities from calorie acquisition to calorie expenditure. In winter and migration sites, human disturbance continues to decrease the amount of undisturbed habitat and appears to limit local piping plover abundance (Zonick and Ryan 1996). The disturbance distance for wintering and migrating western snowy plovers in a California study was 98.4 feet for pedestrians and pets, but a higher proportion of pets than pedestrians disturbed plovers (Lafferty 2001).

During spring, summer, and fall months in Florida, recreational boaters find barrier island washover areas and peninsular tips attractive landing spots to spend the day, which may prove an increasing issue for piping plovers especially during migration months. This is particularly true on weekends and holidays.

Dogs

The presence of pets increases disturbance to wintering and migrating piping plovers. Pedestrians have been observed walking their dogs through congregations of feeding shorebirds and encouraging their dogs to chase the birds. Noncompliant pet owners who allow their dogs off leash have the potential to flush piping plovers and these flushing events may be more prolonged than those associated with pedestrians or pedestrians with dogs on leash. A study conducted on Cape Cod, Massachusetts found that the average distance at which piping plovers were disturbed by pets was 150 feet, compared with 75 feet for pedestrians. Furthermore, the birds reacted to the pets by moving an average of 187 feet, compared with 82 feet when the birds were reacting to a pedestrian, and the duration of the disturbance behavior stimulated by pets was significantly greater than that caused by pedestrians (Hoopes 1993). Disturbance also reduces the time migrating shorebirds spend foraging (Burger 1991) and has been implicated as a factor in the long-term decline of migrating shorebirds at staging areas (Pfister et al. 1992).

Viruses

Preliminary reports suggested West Nile virus was a potential threat on the northern Great Plains population in 2003 or 2004, but a case has yet to be confirmed (Dingledine 2006). Shorebird testing throughout the U.S. for Avian Flu is ongoing. One piping plover was captured and swabbed in Florida in December 2006. Results are undetermined with ongoing research.

Oil Spills

Oil spills pose a threat to piping plovers throughout their life cycle. Oiled plovers have been reported from Matagorda Island National Wildlife Refuge, Texas (Service 1996). Four piping plovers have been reported in the Jacksonville, Florida area with greased undersides (Leary 2007). No known oil spill was reported in the area. It is possible they became greased while roosting in wrack that accumulated remnant oil from some offshore activity. Impacts are undetermined.

Exotic vegetation

In Florida, 39-64 percent of the non-indigenous plant species considered to be most invasive by the Florida Exotic Pest Plant Council may actually alter the ecosystems that they invade through changes in such properties as geomorphology, hydrology, biogeochemistry, and disturbance

(Gordon 1998). Like many invasive species, coastal exotic plants reproduce and spread quickly and exhibit dense growth habits, often outcompeting native plant species. Crowfootgrass (*Dactyloctenium aegyptium*) grows invasively along portions of the Florida coastline and it forms thick bunches or mats that may change the vegetative structure of coastal plant communities and alter shorebird habitat. The exotic Australian pine (*Casuarina equisetifolia*) also changes the vegetative structure of the community. Because shorebirds prefer foraging in open areas where they are able to see potential predators and because tall trees provide good perch sites for avian predators, Australian pines may impact shorebirds by limiting the availability of optimal foraging habitat.

Habitat Loss/Degradation

Important components of ecologically sound barrier beach management include perpetuation of natural dynamic coastal formation processes. Man-made structures along the shoreline or manipulation of natural inlets upset the dynamic processes and result in habitat loss or degradation (Melvin et al. 1991). Throughout the range of migrating and wintering piping plovers, inlet and shoreline stabilization, inlet dredging, and beach maintenance and renourishment activities continue to constrict natural coastal processes. Dredging of inlets can affect spit formation adjacent to inlets, while jetties can cause widening of islands and subsequent growth of vegetation on inlet shores. Over time, both result in loss of plover habitat. Additional investigation is warranted to determine the extent to which these disturbance factors affect wintering plovers on a cumulative nature.

Analysis of the species/critical habitat likely to be affected

The proposed action has the potential to adversely affect wintering and migrating piping plovers and their habitat from all three populations within the proposed project area and Action Area. The Atlantic Coast nesting population of piping plover is a component of the entity listed as threatened which encompasses all breeding piping plovers (Great Plains and Atlantic) except the Great Lakes breeding population. As reported by Haig et al. (2005), results of the 2001 Plover Breeding Census indicate an 8.4 percent increase from 1991 census, but only a 0.2 percent increase since 1996. Regional trends suggest that since 1991, numbers of breeding birds increased on the Atlantic Coast by 78 percent and by 80 percent in the Great Lakes. The 2006 International Census reported a substantial increase since 2001 in both the U.S. and Canadian portion of the northern Great Plains breeding population.

Florida has 34 piping plover designated critical habitat units, comprising approximately 26 percent of its coastline. The 34 units include approximately 68 miles of federal shoreline, 120 miles of State shoreline and 24 miles of shoreline in private ownership (including non-profit organizations). This equates to approximately 212 miles of shoreline in Florida designated as critical habitat for the piping plover. No critical habitat is located within the Action Area. Coastal projects, which include beach nourishment, jetty extensions, and inlet dredging activities that affect the conservation of piping plovers wintering or migrating in northwest Florida are included in the Service's evaluation of the species current status.

ENVIRONMENTAL BASELINE

Walton County coastal beaches and connected coastal lakes are part of a complex and dynamic coastal system that continually respond to inlets, tides, waves, erosion and deposition, longshore

sediment transport, and depletion, fluctuations in sea level, and weather events. The location and shape of the coastline and coastal dune outlets perpetually adjusts to these physical forces. Winds move sediment across the dry beach forming dunes and the island interior landscape. The natural communities contain plants and animals that are subject to shoreline erosion and deposition, salt spray, wind, drought conditions, and sandy soils. Vegetative communities include foredunes, primary and secondary dunes, interdunal swales, sand pine scrub, and maritime forests. During storm events, overwash into the coastal lakes are common, depositing sediments on the interior of the lakes, clearing vegetation and increasing the amount of open, sandflat habitat ideal for shoreline dependent shorebirds. However, the protection or persistence of these important natural land forms, processes, and wildlife resources is often in conflict with long-term, large-scale beach stabilization projects and their indirect effects, i.e., increases in residential development, infrastructure, and public recreational uses, and preclusion of overwash which limits the creation of open sand flats preferred by piping plovers.

Status of the species within the action area

Piping plover habitat within the Action Area occurs within an area affected by dynamic coastal processes and ongoing human uses. Suitable piping plover habitat appears to be present at and near Draper Lake, Alligator Lake, and Eastern Lake outfall areas and lake side sand and mud flats and along ocean shoreline. The number of piping plovers within the Action Area during the winter or migration is difficult to assess. Regular surveys have not been conducted for non-breeding (including migrating and overwinterng) plovers within the Action Area. Surveyors report no piping plovers in the project area during either the 2001 or 2006 International Piping Plover Census (Ferland and Haig 2002; Service 2006 Recovery Plan).

The known distribution of the piping plover in Florida is a result of occasional statewide cursory surveys combined with sporadic localized surveys that provide better estimates on abundance and seasonal use in those specific areas depending on the strength of the surveys. Currently the International Plover Winter Census as summarized in **Table 12** remains the only consistent winter survey effort for piping plovers on a statewide basis (Ferland and Haig 2002). Relative to abundance and relying on the results of the International Plover Winter Census, Florida ranks in the top third of eight southeastern states on which wintering piping plovers depend. The section above "*Status and Distribution: non-breeding (migrating and wintering*)" explains the limitations in the data collected during the International Census survey window with regard to locating all sites and exact numbers of plovers in specific locations. By their nature, the habitat features that piping plovers depend on are in a constant state of change thereby making it difficult to document the exact status of piping plovers in the Action Area on any given year at any given site.

We use the results of the following survey effort to demonstrate the limitations of relying on just the results of the International Plover Winter Census or any short term, one day or season survey effort for a species dependent on dynamic habitats. In 2006, the Service and the American Bird Conservancy funded the Apalachicola Riverkeeper to collect shorebird abundance and distribution data throughout Franklin County, Florida. A biologist for the Apalachicola Riverkeeper, Bradley Smith, collected survey data from August 2006, through May 2007. He attempted to visit each primary site at least twice monthly. He visited Phipps Preserve, an area known for its historic plover use, twenty-four times with surveys occurring August 15, 2006, through May 1, 2007. Numbers of piping plover recorded ranged from zero to a high of 47 piping plovers on two different days (**Figure 17**). The 2006 International Plover Winter Census

reports 17 piping plovers on Phipps Preserve. Given that piping plovers evolved in a dynamic system, and that they are dependent upon these ever-changing features for their survival and conservation it is important that sites that experience these natural processes where plover habitat may come and go, are protected.

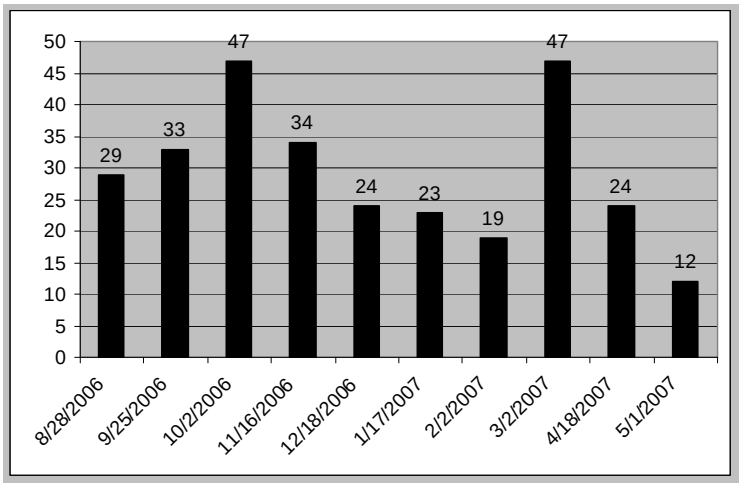

Figure 17. Piping plover sightings reported from Phipps Preserve, Franklin County, FL, from August 2006 through May 1, 2007.

Factors affecting species environment within the action area

A number of ongoing anthropogenic and natural factors may affect the species addressed in these biological opinions. Many of these effects have not been evaluated with respect to biological impacts on the species. In addition, some are interrelated and the effects of one cannot be separated from others. Known or suspected factors affecting the species addressed in these biological opinions are discussed below.

Most threats discussed above ***(****see threats: Status and Distribution section****)*** are threats seen throughout piping plover habitat in the entire Action Area. Depending on the local land codes, land ownership and enforcement capabilities, some threats are more pronounced in some areas than others.

Predation

Mammalian and avian predators are relatively common within the action area. In 1997, a multi-agency predator control partnership formed with US Department of Agriculture (USDA). The partnership has proven benefits for coastal species such as beach mice and shorebird and sea turtle nests. No depredation of piping plover during winter or migration has been noted, but would be difficult to document.

Pedestrian Use of the Beach

There are a number of potential sources of pedestrians, including those individuals driving and subsequently parking on the beach, those originating from off-beach parking areas (hotels, motels, commercial facilities, beachside parks, etc.), and those from beachfront and nearby

residences. The effect of pedestrian traffic on roosting piping plovers on the Gulf beach side is unknown but evidence exists that pedestrian traffic affects wintering piping plovers. Lack of their visibility on the Gulf beaches may be a result of high pedestrian use. When approached, piping plovers typically flush to avoid close contact with humans *(see Life History section for more detail).* There are no closures areas within the Action Area for foraging and roosting piping plovers.

Dogs

Leashed dogs are a permitted activity on Walton County beaches between 3:00 p.m and 9:00 a.m. Dogs are restricted from State Park lands. On private and public lands, violations probably occur but enforcement is difficult because of the limited number of County and Park staff. Dogs running freely on beaches are potential predators of piping plovers and can harass migrating and wintering adults. The extent of the effects that free-running dogs have on piping plovers within the Action Area is unknown *(see Life History section for more detail).*

Vehicle Impacts

Walton County permits recreational beach driving in the Town of Grayton along approximately 600 feet of beachfront. The Tourist development Council collects trash along the beachfront. Vehicles can significantly degrade piping plover habitat and disrupt normal behavior patterns of the birds. Two studies show piping plovers avoidance of areas with vehicle use *(see Life History section for more detail).* Two sections of Walton County beaches are closed to vehicle use due to beach erosion.

Increasing Trend of Berm Placement and Nourishment Projects in Response to Storm Events

In the wake of an apparent increasing trend in episodic storm events, managers of lands under public, private and county ownership chose to protect coastal structures using emergency storm berms usually followed by nourishment activities. Berm placement and beach nourishment place substantial amounts of sand along the Gulf beaches in hopes of preventing what otherwise would be considered "natural processes" of overwash and island migration.

Past and ongoing stabilization projects along the northwest Florida coastline have fundamentally altered the naturally dynamic coastal processes that create and maintain beach strand habitats (**Figure 18**). Hard shoreline stabilization structures such as jetties and groins interrupt littoral drift, while artificially created berms and nourishment prevent overwash. These structures prevent natural shoreline migration. Such stabilization has encouraged residential and commercial development and associated infrastructure along otherwise ephemeral and/or flood prone habitats. The subsequent development has forestalled formation of highly productive piping plover overwash habitats and eliminated connectivity of piping plover oceanfront and bayside roosting and foraging habitats. The results of these projects have essentially forced public lands and some undeveloped private lands into becoming an oasis for endangered species such as the piping plover as well as other non-listed species. Of concern is the increasing trend of public lands applying these same actions. **Figure 18** shows the results of the 2006 International Plover Winter Census. It does not seem a coincidence that the areas populated with piping plovers in this snapshot survey are the areas that are not artificially stabilized and developed and preclude natural successional stages and processes from occurring. While shoreline hardening projects are installed to protect existing structures they further prevent

natural shoreline processes. A similar pattern is seen throughout Florida (ABC and FWS unpublished data 2007). Recreational pressures are heavy on both the natural and unnatural lands, so it appears to be more a habitat component that makes the difference in areas selected for use by piping plovers.

Seven miles of Walton County shorelines within the Action Area were bermed in 2004. Approximately ten miles had artificial dunes constructed in 2005. The intentions of both efforts were to protect structures from eroding shorelines.

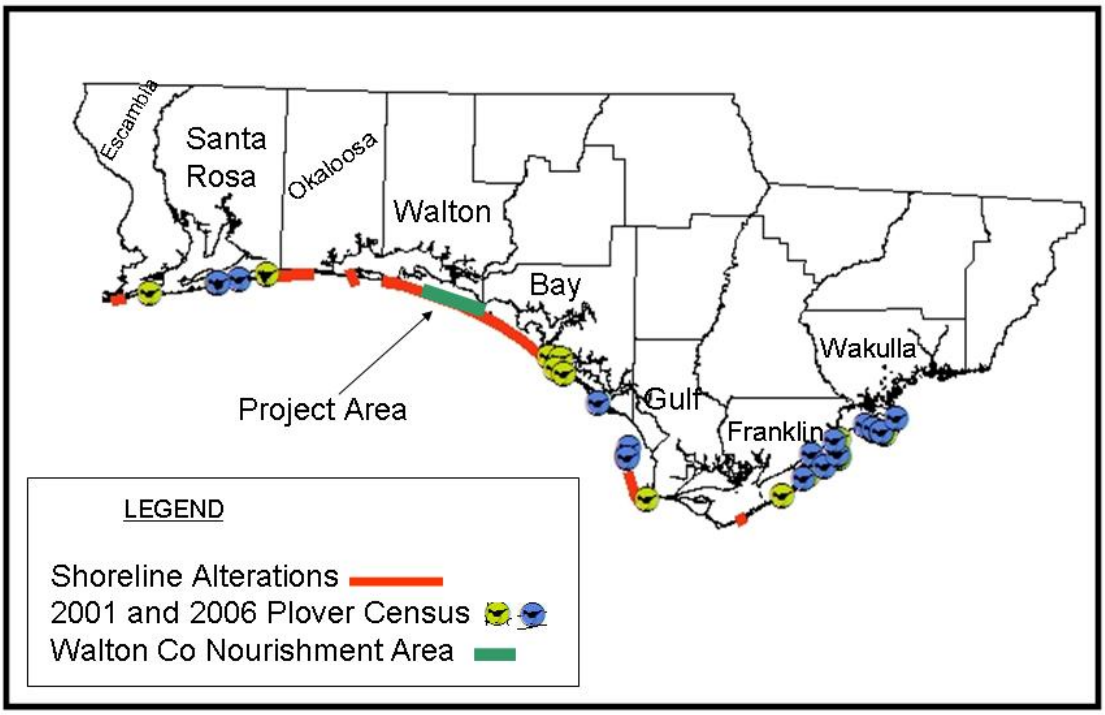

Figure 18. Comparison of shoreline stabilization projects (beach nourishment, hardening) and 2001 and 2006 piping plover census data.

Intraspecific and Interspecific Shorebird Competition

Historically, prior to high human densities and beach hardening projects, approximately 825 miles of coastline and parallel bayside flats (unspecified amount) of habitat occurred in Florida. This provided an unspecified amount of optimal foraging habitat for many shorebird species depending on the cumulative successional stages of the coastline. To date, approximately thirty-five percent of the coastline remains where coastal dynamics are allowed to function in Florida. As coastal functions are prohibited, formations of habitat appealing to different bird species dependent on these processes become more and more concentrated into the remaining optimal areas for foraging and roosting. It is likely they are, or will be, forced to forage and roost in less optimal areas.

Up to 24 shorebird species migrate or winter along the Atlantic Coast and almost 40 species of shorebirds occur during migrational and wintering periods in the GOM region (Helmers 1992). Continual degradation and loss of habitat needed by migrating and wintering shorebirds elevates the risk of increased pressure on remaining food supplies. Food limitations potentially increase intraspecies and interspecies competition and could result in eventual mortality. Shorebirds require maximum fat reserves to complete migrations. Birds with less than maximum fat reserves could be expected to show reduced survivorship. Piping plovers are part of this overall shorebird niche that may be forced to compete with the other 24 to 40 species of shorebirds dependent on Florida coastline habitats for some part of their life cycle. Shorebird species numbers are universally declining. The complexities of a shorebird life cycle make it difficult to determine what role the loss of 65 percent of habitat has played in this overall decline but it is likely significant.

EFFECTS OF THE ACTION

Factors to be considered

The proposed activity includes dune restoration, berm construction, and beach fill over approximately 13.5 miles of eroding shoreline. The proposed project is the first major nourishment of this shoreline segment. It intends to raise the beach berm and widen the beach providing storm protection and increasing recreational space. The proposed project occurs within habitat that appears suitable for piping plover use. The Corps expects construction to begin late 2008 or early 2009, with completion six to nine months later. This coincides with the piping plovers migration and wintering period (July 15 through May 15). Short-term and temporary impacts to piping plovers will occur if the birds are roosting and feeding in the area during a migration stopover. The deposition of sand will temporarily deplete the intertidal food base and temporarily disturb roosting birds during project construction. The tilling to loosen compaction of the sand required to minimize sea turtle impacts may affect any wrack that has accumulated on the “new” beach. This impacts feeding and roosting habitat for piping plovers, since they often use wrack.

The geomorphic characteristics of barrier islands, peninsulas, beaches, dunes, overwash fans, and inlets are critical to a variety of natural resources and influence a beach’s ability to respond to wave action, including storm overwash and sediment transport. However, the protection or persistence of these important natural land forms, processes, and wildlife resources is often in conflict with long-term, large-scale beach stabilization projects and their indirect effects, i.e., increases in residential development, infrastructure, and public recreational uses, and preclusion of overwash, especially into coastal dune lakes and creation of spit formations on which piping plovers thrive.

The manufactured dunes, berms and beach fill will partially impede overwash into the connected coastal dune’s lake sides, thereby causing successional advances in the habitat that will minimize sand flat formation and therefore its use by piping plovers in the project area. The proposed nourishment project will completely impede any overwash potential for at least two, coastal dune lakes (Allen Lake and Oyster Lake) that are close to the Gulf shoreline but not currently connected. Residential houses separate the Lakes from the Gulf. No specific conservation measures were provided by the applicant that would minimize the impacts of the project to the piping plover. The project design, which leaves necessary gaps lacking fill for most coastal dune

lake outlet areas, will allow some overwash into the lakes to continue, thereby minimizing impacts to potential piping plover habitat.

Proximity of action: Lack of regular surveys along most of the project area makes it difficult to measure the amount of piping plovers actually using the Gulf beach within the project area. Regardless, we expect short-term impacts by direct disturbance during construction and temporary loss of food base along the Gulf shoreline. The footprint of the proposed action does not occur within any critical habitat units for wintering piping plover. We expect the indirect effects of the action, alterations of the natural processes of overwash, to occur throughout the project area where-ever coastal dune lakes occur within the Project Area. There are 8 lakes intermittently connected to the Gulf and two that are unnaturally restricted.

Distribution: The Corps proposes project construction activities on the GOM shoreline between FDEP reference monuments Reach (R) -41 to R-64, R-67 to R-72, R-78 to R-98, and R-105.5 to R-127 within Walton County. We expect direct and indirect impacts to migrating and wintering piping plover along lake side habitat and washover areas that, but for the project, would exist in the future. We expect indirect impacts to piping plover and optimal piping plover roosting and foraging habitat in the Action Area from increased human disturbance (vehicles, dog walking, and pedestrian traffic).

Timing: The timing of the dune, berm, and beach fill project may occur completely or partially during the migration and wintering period for piping plovers (July 15-May 15). We expect indirect effects to occur later in time.

Nature of the effect: The effects to piping plover are direct, indirect and long term. We anticipate changes to plover habitat in morphology due to the elimination or reduction of potential for washover into dune lakes due to the presence of the constructed beach. A decrease in survival of birds on migrating or wintering grounds due to lack of optimal habitat contribute to decreased survival rates, decreased productivity on the breeding grounds, and therefore increased vulnerability to any of the three piping plover populations.

In addition, we expect increased recreational use inside the project area to affect the shoreline by reducing the value of the beaches because of direct disturbance to foraging and roosting piping plovers. We expect short-term impacts from disturbance during project construction. Activities that impact or alter the use of optimal habitat or increase disturbance to the species may decrease the survival and recovery potential of the piping plover.

Duration: The activities associated with the dunes, berm, and beach fill project are a one-time occurrence and expect completion within 6 to 9 months. The Corps expect to begin in late 2008 and early 2009 and complete the project in late 2009 to 2010. We expect long term, if not permanent, alteration of the natural coastal processes.

We expect permanent increased recreational pressures within the Action Area due to the expansion of the beach.

Disturbance frequency: We expect short-term disturbance from construction activities. We expect long-term effects of sand placement and the impact of increased disturbance within the Action Area on the piping plover. Most nourishment activities and effects are expected to cycle

every 8 to 10 years but Walton County is generally an accreting beach. Nourishment activities are expected to occur less often than normal for this reason.

Disturbance intensity and severity: We anticipate construction activities to have short-term and temporary effects on the piping plover populations. We anticipate piping plovers located within the construction area to move outside of the construction zone due to disturbance. We anticipate project construction to indirectly effect shoreline morphology and lake side shoreline dynamics by reducing the creation of piping plover habitat. Permanent impacts to less than 3,186 feet of optimal and temporary impacts of 13.5 miles of less optimal piping plover habitat are expected.

Analyses for Effects of the Action

Direct effects

Direct effects are those direct or immediate effects of a project on the species or its habitat. The construction window (i.e., disposal of sand) will extend through approximately one piping plover migration and winter season. Heavy machinery and equipment (e.g., trucks and bulldozers operating on project area beaches, the placement of the dredge pipeline along the beach, and sand disposal) may adversely affect migrating and wintering piping plovers in the project area by disturbance and disruption of normal activities such as roosting and feeding, and possibly forcing birds to expend valuable energy reserves to seek available habitat elsewhere.

Burial and suffocation of invertebrate species will occur during each nourishment and renourishment cycle. Impacts will affect the entire 13.5 miles along the Project Area, as well as at some downdrift areas. Timeframes projected for benthic recruitment and re-establishment following beach nourishment are between 6 months to 2 years. Depending on actual recovery rates, impacts will occur even if nourishment activities occur outside the plover migration and wintering seasons.

Indirect effects

The proposed project includes construction of berm, dunes, and beach fill along 13.5 miles of GOM shoreline as protective elements against shoreline erosion to protect man-made infrastructure. Indirect effects of reducing potential for the formation of optimal habitats, especially along shorelines that are susceptible to overwash, pose a critical concern for piping plovers with respect to survival and recovery.

Eventually the inter-tidal zone along the beach front will re-establish and provide some feeding habitat for piping plovers but these feeding areas are considered substantially inferior to natural overwash habitat that is highly likely to form to a greater extent within sections of the project area absent the proposed project. The plover's rapid responses (bird occurred within 6 months) to habitats formed by washovers from the hurricanes in 2004-2005 in the Florida panhandle at Gulf Islands National Seashore, and similar observations of their preferences for overwash habitats at Phipps Preserve and Lanark Reef in Franklin County, Florida, and elsewhere in their range, demonstrate the importance of overwash created habitats for wintering and migrating piping plovers. The proposed project will perpetuate and contribute to the widespread activities that prevent the formation of these preferred early successional overwash habitats. These disturbance factors warrant additional investigation to determine the extent to which they cumulatively affect wintering plovers.

At the same time that the proposed project limits the creation of optimal foraging and roosting habitat, it increases the attractiveness of these beaches and increases recreational pressures within the project area. The draft biological assessment provided by the applicant states that the "proposed beach restoration project is a protective measure that reduces the risk of storm damage to upland property. At the same time, a healthy and wide beach provides increased recreational opportunities to the county's citizens, promotes tourism and increases revenue streams to local businesses….". Recreational activities that potentially adversely affect plovers include disturbance by unleashed pets, increased pedestrian use (walking, sunbathing, beach driving) and reduction of foraging habitat from deliberate removal of wrack (beach cleaning and raking), often seen as unattractive to beach goers.

We expect landowners and local governments to initiate construction of new infrastructure or upgrade existing facilities, such as buildings or parking areas adjacent to the project area. Long-term impacts include a decrease in use of habitat due to increased disturbance levels and preclusion of the creation of additional recovery habitat.

Species response to the proposed action

The Service bases this biological opinion on anticipated direct and indirect effects to piping plovers (wintering and migrating) as a result of dune, berm, and beach fill construction which restricts the formation of habitat that plovers consider optimal for foraging and roosting. In the context of migrating and wintering piping plovers, we anticipate that approximately 3,186 feet (estimated from Taylor Engineering permit drawings and the Services' Geographical Imaging System (GIS)) of lake side habitat, its associated mud and sand flat area, and an unspecified number of piping plovers will be impacted by habitat loss if the lake sides are restricted from future overwash processes. Foraging on suboptimal habitat on the non-breeding grounds by migrating and wintering piping plovers may reduce the fitness of individuals.

The Service anticipates adverse affects throughout the project area from increased recreational pressure resulting in increased disturbance to roosting and foraging piping plovers from levels of human presence significantly greater than those currently experienced.

Elliott and Teas (1996) found a significant difference in actions between piping plovers encountering pedestrians and those not encountering pedestrians. Piping plover encountering pedestrians spend proportionately more time in non-foraging behavior. This study suggests that interactions with pedestrians on beaches cause birds to shift their activities from calorie acquisition to calorie expenditure. In winter and migration sites, human disturbance continues to decrease the amount of undisturbed habitat and appears to limit local piping plover abundance (Zonick and Ryan 1996).

The presence of pets increases disturbance to wintering and migrating piping plovers. A study conducted on Cape Cod, Massachusetts, found that pets disturbed piping plovers by an average distance of 150 feet, compared with 75 feet from pedestrians. Furthermore, the birds reacted to the pets by moving an average of 187 feet, compared with 82 feet when the birds reacted to a pedestrian. The duration of the disturbance behavior stimulated by pets was significantly greater than that caused by pedestrians (Hoopes 1993). Disturbance also reduces the time migrating shorebirds spend foraging (Burger 1991). Pfister et al. (1992) implicate disturbance as a factor in the long-term decline of migrating shorebirds at staging areas. While piping plover migration

patterns and needs remain poorly understood and occupancy of a particular habitat may involve shorter periods relative to wintering, information about the energetics of avian migration indicates that this might be a particularly critical time in the species' life cycle.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed project are not considered in this opinion because they require separate consultation pursuant to section 7 of the Endangered Species Act.

The majority of the land within the Action Area is privately owned and is close to build out. It is reasonably certain to expect that coastal development, human occupancy and recreational use along the Gulf Coast of Florida, including Walton County, will increase in the future until build out occurs. Redevelopment along with new developments following the hurricane seasons of 2004 and 2005 occurs as allowed by local zoning standards and state and federal permitting. It is unknown how much influence a nourished beach contributes to the development and recreational use of the shoreline. Any projects that are within endangered or threatened species habitat will require section 7 or 10 permitting from the Service.

CONCLUSION

Sea Turtles

After reviewing the current status of the loggerhead, green, leatherback, and Kemp's ridley sea turtles, the environmental baseline for the Action Area, the effects of the proposed sand placement activities, and the cumulative effects, it is the Service's biological opinion that the project, as proposed, is not likely to jeopardize the continued existence of the loggerhead, green, leatherback, or Kemp's ridley sea turtles. No critical habitat has been designated for any of the sea turtle species in the continental United States; therefore, none will be affected.

The conservation of the five loggerhead nesting subpopulations is essential to the recovery of the loggerhead sea turtle. Each individual subpopulation is necessary to conserve genetic and demographic robustness, or other features necessary for long-term sustainability of the entire population. Thus, maintenance of viable nesting in each subpopulation contributes to the overall population. This project is within the Florida panhandle subpopulation.

There is approximately 1,400 miles of available sea turtle nesting habitat in the southeastern U.S and 234 miles in the panhandle. Of this available nesting habitat, project impacts will occur on 1.0 percent of the nesting habitat statewide and 6.0 percent of the nesting habitat in the panhandle.

Choctawhatchee Beach Mouse

After reviewing the current status of the CBM, the environmental baseline for the Action Area, the effects of beach nourishment and associated activities, and the cumulative effects, it is the Service's biological opinion that the project, as proposed, is not likely to jeopardize the continued existence of the CBM and is not likely to destroy or adversely modify designated critical habitat for the CBM.

As discussed in the Effects of the Action section of this opinion, we would not expect the carrying capacity of CBM habitat within the Action Area to be reduced. Beach mouse habitat will continue to provide for the biological needs of the subspecies as demonstrated below:

1. A contiguous mosaic of beach mouse habitats will be provided within the Action Area during and after project construction.

2. No permanent loss of beach mouse habitat will occur within the Action Area from the project construction or maintenance.

3. Impacts to beach mouse habitat will be restored within the Action Area after project completion.

Temporary impacts are expected to be limited to the construction/maintenance phase of the project and habitat restoration period following the project which could be expected to be completed within six to nine months. As the life span of a beach mouse is estimated to be approximately 9 months, the temporary impacts of the proposed action may effect several generations of PKBM, but because the subspecies can reproduce rapidly (every 26 days) colonization or recolonization of the restored habitat would be expected within several months.

While a few beach mice may be lost, beach mice recover well from population size reductions (Wooten 1994) given sufficient habitat is available for population expansion after the bottleneck occurs. While we remain concerned for the current low numbers of CBM remaining since the 2004 and 2005 storm seasons, the habitat appears to be recovering and some increase in populations have occurred. Therefore, for this project we do not consider the potential loss of individuals to be significant.

Also, we would not anticipate that the temporary loss of the critical habitat would alter or affect the remaining critical habitat in the Action Area for CBM to the extent that it would appreciably diminish the habitat's capability to provide the intended conservation role for the subspecies in the wild.

Piping Plover

After reviewing the current status of the wintering population of the northern Great Plains, the Great Lakes and the Atlantic Coast piping plover, the environmental baseline for the berm, dune and beach fill project and associated construction activities, and the cumulative effects, it is the Service's biological opinion that implementation of the project, as proposed, is not likely to jeopardize the continued existence of non-breeding piping plover. Specific rationale for the non-jeopardy determination for each population is provided below. As noted previously, the overall status of the listed entity is stable, if not increasing.

Of greatest concern is the reliance that piping plovers have on the remaining 35 percent of Florida's coastal shoreline where the natural coastal processes are allowed to function. In these natural areas, piping plover habitat conceivably comes and goes as a function of storm events and associated tides, winds, elevation, and vegetational succession. The best we can hope for is a balance between suitable and unsuitable piping plover habitat remaining in Florida as there is little opportunity to expand the amount of habitat available for future conservation of the species. The amount available today appears sufficient to sustain the species but it is unknown if it is

sufficient to conserve the species into perpetuity. The remaining habitat in Florida available today for piping plover use where coastal processes are allowed to function are still subjected to threats, especially human disturbance, coastal highways, military missions, dredge disposal and nourishment projects. Increased management to minimize such impacts to piping plover in these areas is the best defense we may have to conserve the species.

The proposed project would directly affect 13.5 miles of Gulf beach shoreline temporarily and indirectly affect less than 3,186 feet (0.60 mile) of subsequent mud and sand flats by precluding natural development of additional habitat within the Project Area. An unspecified amount of piping plovers are probably using the Gulf shoreline and lake side sand and mud flats of the Action Area, at least temporarily during migration or winter months.

Ferland and Haig (2002) calculated from the 2001 International Plover Census results that 57 percent of piping plover sites contained 1-10 birds, 36 percent contain 11-50, and less than 8 percent contain more than 50 piping plovers. At the moment, this area appears to be of minimal importance with regard to piping plovers since they remain undocumented within the project area. It is difficult to determine how the preclusion of the creation of additional recovery habitat will affect the species.

On winter and migration sites, human disturbance continues to decrease the amount of undisturbed habitat and appears to limit local piping plover abundance (Zonick and Ryan 1996). It is unknown what the carrying capacity may be within the project area with removal of human disturbance, but it is believed to be greater than its current use. Foraging on optimal, but disturbed habitat, on the non-breeding grounds by migrating and wintering piping plovers may reduce the fitness of individuals, which will have an unknown affect on the listed entity.

Florida's shoreline equates to approximately 825 miles, of which, 211 are designated critical habitat for piping plovers. Permanent impacts to less than 3,186 feet (0.60 mile) of optimal and temporary impacts to 13.5 miles of less optimal piping plover habitat represents less than 0.07 percent and 1.6 percent, respectively, of shoreline in Florida. For the reasons stated above, this leads us to conclude that implementation of the project, with the temporary loss of 13.5 miles of coastal shoreline and the partial loss of 3,186 feet of lake side sand and mud flats and harassment of an unspecified amount of piping plovers would not appreciably affect the survival and recovery of the piping plover from the Atlantic Coast and Great Plains population.

The Great Lakes population of piping plovers is a separate listed entity, classified as endangered. Piping plovers from this population may occur within the Action Area during the non-breeding season. This population is currently increasing, but remains at very low levels. The current number, if any, of the Great Lakes piping plovers using the Action Area during migration and over winter is unknown. Assuming a worst case scenario of a fully diminished coastal dune lake sides and GOM shoreline habitat, less suitable for piping plover use, this may result in the incidental take of individuals. However, coupled with continued intensive management in the breeding range of the Great Lakes population, the lack of known use in this area, a reasonable portion of the population's repeated use of Georgia's mostly protected coastline, and the status of the listed entity rangewide, we conclude that implementation of the proposed project would not appreciably affect the survival and recovery of the piping plover from the Great Lakes population.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be implemented by the Corps so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the permittee must report the progress of the action and its impacts on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

Sea Turtles

The Service expects that no more than 13.5 miles of highly eroded shoreline where sea turtles nest could be affected as a result of the beach nourishment. The Service expects the incidental take of sea turtles will be difficult to detect for the following reasons (**Table 9**):

(1) turtles nest primarily at night and all nests are not located because
  [a] natural factors, such as rainfall, wind, and tides may obscure crawls; and
  [b] human-caused factors, such as pedestrian and vehicular traffic, may obscure crawls, and result in nests being destroyed because they were missed during a nesting survey and egg relocation program;
(2) the total number of hatchlings per undiscovered nest is unknown;
(3) the reduction in percent hatching and emerging success per relocated nest over the natural nest site is unknown;
(4) an unknown number of females may avoid the project beach and be forced to nest in a less than optimal area;
(5) lights may misdirect an unknown number of hatchlings and cause death; and
(6) escarpments may form and cause an unknown number of females from accessing a suitable nesting site.

However, the level of take of these species can be expected by the disturbance and changes to suitable turtle nesting beach habitat because: (1) turtles nest within the project site; (2) the dune, berm, and beach fill will likely occur during a portion of the nesting season; (3) the project will modify the incubation substrate, beach slope, and sand compaction; and (4) artificial lighting will deter and/or misdirect nesting females and hatchlings during and following beach nourishment.

Take is expected to be in the form of:

(1) harm in the destruction of all nests that may be constructed and eggs that may be deposited and missed by a nest survey and egg relocation program within the boundaries of the proposed project during the sea turtle nesting season from May 1 through October 31;
(2) harm in the destruction of all nests deposited from October 31 through April 30 when a nest survey and egg relocation program is not required to be in place within the boundaries of the proposed project;
(3) harm in the reduced hatching success due to egg mortality during relocation and adverse conditions at the relocation site;
(4) harassment in the form of disturbing or interfering with female turtles attempting to nest within the construction area or on adjacent beaches as a result of construction activities;
(5) harassment by the misdirection of hatchling turtles on beaches adjacent to the construction area as they emerge from the nest and crawl to the water as a result of project lighting;
(6) harassment in the behavior modification of nesting females due to escarpment formation within the project area during a nesting season, resulting in false crawls or situations where they choose marginal or unsuitable nesting areas to deposit eggs; and
(7) harm in the destruction of nests from escarpment leveling within a nesting season when such leveling has been approved by the Service.

The level of take can be monitored with the use of standardized sea turtle nesting surveys (**Table 14**).

Table 14. How the monitoring of incidental take for the proposed project will be monitored if the specific individuals cannot be determined based on the best available commercial and scientific information.

SPECIES	CRITICAL HABITAT	HABITAT	Monitoring
Loggerhead, Green, Leatherback, and Kemp's Ridley sea turtles	None	13.5 miles	Statewide Nesting Beach Survey protocol

Choctawhatchee Beach Mouse

The Service expects that no more than 1.5 acres of suitable CBM habitat could be affected as a result of the beach nourishment. The Service expects incidental take of beach mice would be difficult to detect for the following reasons (**Table 15**):

(1) an unknown number of beach mice may be injured, crushed or buried during beach access use and remain entombed in the sand;
(2) beach mice are nocturnal, small and finding a dead or injured mouse is unlikely because of predation and scavengers, and
(3) changes in essential beach mouse life behaviors may not be detectable in standardized monitoring surveys.

However, the following level of take of beach mice can be expected by the loss of habitat that is fragmented temporarily for use as construction beach accesses because: (1) CBM are known to inhabit the project area; (2) are found year round in the project area; and (3) creation or expansion of beach access corridors could fragment CBM habitat.

The incidental take is expected to be in the form of:
(1) harm or harassment to all beach mice occupying the beach access points;
(2) harassment of beach mice from disturbance of foraging opportunities within the access areas during the construction period;
(3) harassment of beach mice from temporary loss of foraging and burrow habitat; and
(4) harassment of beach mice from temporary restriction of movement across access areas.

To assess the effects of the impacts to beach mice, the success of habitat restoration can be monitored (**Table 15**).

Table 15. The amount of CBM habitat that will be affected by the project and the monitoring of incidental take for the proposed project.

SPECIES	CRITICAL HABITAT	HABITAT	MONITORING
CBM	Temporary impacts at beach access points covering 0.83 acre (2 accesses, storage, or staging sites)	Temporary impacts at beach access points covering 1.5 acres (9 accesses, storage, or staging sites)	Beach access habitat restoration success monitoring

Piping Plovers

The Service anticipates that directly and indirectly an unspecified amount of piping plovers and 13.5 miles of GOM shoreline and 0.60 mile of coastal dune lake side shoreline potentially used by piping plovers could be taken in the form of harm and harassment as a result of this proposed action; however, incidental take of piping plovers will be difficult to detect for the following reasons:

(1) Harassment to the level of harm may only be apparent on the breeding grounds the following year; and
(2) dead plovers may be carried away by waves or predators.

The level of take of this species can be anticipated by the proposed activities because (**Table 16**):

(1) Piping plovers probably migrate and winter in the Action Area;

(2) the placement of the constructed beach is expected to affect the coastal mainland morphology and prevent early successional stages, thereby precluding the maintenance and creation of additional recovery habitat;
(3) increased levels of pedestrian and dog disturbance is expected; and
(4) a temporary reduction of food base will occur.

Table 16. The amount of piping plover roosting and foraging habitat that will be affected by the project and the monitoring of incidental take for the proposed project.

SPECIES	CRITICAL HABITAT	HABITAT AFFECTED	MONITORING
Piping plover	N/A	13.5 miles of shoreline and 0.60 mile of coastal dune lakes shoreline habitat affected by physical alterations; in addition to 13.5 miles affected by increased human disturbance	Surveys/ educational and restrictive measures applied

EFFECT OF THE TAKE

Sea Turtles

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the loggerhead, green, leatherback, or Kemp's ridley sea turtle species. Critical habitat has not been designated in the project area; therefore, the project will not result in destruction or adverse modification of critical habitat for any of the sea turtle species.

Incidental take of nesting and hatchling sea turtles is anticipated to occur during project construction and during the life of the project. Take will occur on nesting habitat consisting of the length of the beach where the beach nourishment is placed.

Choctawhatchee Beach Mouse

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to CBM. The Service has determined that the project would not result in destruction or adverse modification of designated critical habitat for the CBM.

Incidental take of CBM is anticipated to occur during the construction of the beach nourishment. The take will occur during project construction where beach access points are expanded or created and where equipment is staged or stored within beach mouse habitat.

Piping Plover

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the piping plover species or destruction or adverse modification of its critical habitat. Incidental take of piping plovers is anticipated to occur along 13.5 miles of GOM shoreline and 0.60 mile of shoreline along coastal dune lakes during and following the life of the project.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of nesting and hatchling loggerhead, green, leatherback, and Kemp's Ridley sea turtle, CBM, and non-breeding piping plover in the proposed dune, berm and beach fill project within the Action Area.

1. Conservation Measures included in the permit application/project plans that provides for planting of the created dunes shall be implemented (unless revised below in the Term and Conditions) in the proposed project.

2. Beach quality sand suitable for sea turtle nesting, successful incubation, and hatchling emergence, beach mouse burrow construction and piping plover food prey species substrate shall be used for the project.

3. If the project is conducted during the sea turtle nesting season the eggs shall be relocated to minimize sea turtle nest burial, crushing of eggs, or nest excavation.

4. Construction equipment and materials shall be stored in a manner that will minimize impacts to sea turtles, CBM, and piping plover to the maximum extent practicable.

5. The beach nourishment project report must provide all sea turtle nesting activity for the initial nesting season and for a minimum of two additional nesting seasons. Monitoring of nesting activity shall include daily surveys.

6. Immediately after completion of the project and prior to the next three nesting seasons, beach compaction shall be monitored and tilling shall be conducted as required to reduce the likelihood of impacting sea turtle nesting and hatching activities.

7. Immediately after completion of the project and prior to the next three nesting seasons, monitoring shall be conducted to determine if escarpments are present and escarpments shall be leveled to reduce the likelihood of impacting sea turtle nesting and hatching activities.

8. The County shall minimize disturbance to optimal piping plover feeding and roosting habitat.

9. Vegetated habitat at each of the beach access points shall be protected to the maximum extent practicable and shall be delineated by fence or other suitable material to ensure vehicles and equipment transport stay within the access corridor.

10. Expanded or newly created beach access shall be restored to dune habitat within 3 months following project completion. The habitat restoration shall consist of restoring the beach and dune topography and planting with appropriate native dune vegetation (*i.e.*, native to coastal dunes in the respective county and grown from plant stock from that region of Florida). All dune restoration and planting shall be designed and conducted to minimize impacts to sea turtles, CBM and piping plover.

11. All vegetation planting on the newly constructed dunes shall be designed and conducted to minimize impacts to sea turtles, beach mice and non breeding piping plovers.

12. Sand fence installation shall occur outside the sea turtle nesting season and utilize the design approved by the Service and FWC.

13. The contractors performing the project work shall install and maintain predator proof trash receptacles at all public beach access points to minimize the potential for attracting predators of sea turtles, beach mice, and piping plover.

14. Lighting associated with the project night work shall be minimized to reduce the possibility of disrupting and disorienting nesting and/or hatchling sea turtles, nocturnal movements of CBM, and piping plover roosting activities.

15. Pre and post-project surveys of all artificial lighting visible from the beach fill shall be completed. This information shall be provided to the Service and FWC.

16. The contractors performing the project shall fully understand and correctly implement the sea turtle, beach mice, and non-breeding piping plover protection measures detailed in this incidental take statement.

17. Upon locating a sea turtle, CBM, or piping plover harmed or destroyed as a direct or indirect result of the project, notification shall be made to the Service and FWC.

18. A report describing the actions taken to implement the terms and conditions of this incidental take statement shall be submitted to the Service within 60 days of completion of the proposed work for each year when the activity has occurred.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Corps shall ensure that the permittee complies with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

Proposed work

1. In accordance with 62B-41.007, Florida Administrative Code, all fill material placed on the beach or in the dunes or berm shall be analogous to that which naturally occurs within the project location or vicinity in quartz to carbonate ratio, color, median grain size and median sorting. Specifically, such material shall be predominately of carbonate, quartz or similar material with a particle size distribution ranging between 0.062 mm and 4.76 mm (classified as sand by either the Unified Soil Classification System or the Wentworth classification). The material shall be similar in color and grain size distribution (sand grain frequency, mean and median grain size, and sorting coefficient) to the material in the existing coastal system at the disposal site and shall not contain:

    a. greater than five percent, by weight, silt, clay, or colloids passing the #230 sieve; greater than five percent, by weight, fine gravel retained on the #4 sieve;
    b. coarse gravel, cobbles, or material retained on the 3/4 inch sieve in a percentage or size greater than found on the native beach;

c. construction debris, toxic material or other foreign matter; and not result in cementation of the beach.

These standards shall not be exceeded in any 1,000 square foot section, extending through the depth of the nourished beach. If the natural beach exceeds any of the limiting parameters listed above, then the fill material shall not exceed the naturally occurring level for that parameter.

2. The project may occur during the sea turtle nesting season except on publicly owned conservation lands such as state or federal parks and areas where such work is prohibited under land management plans or local land use codes.

3. The permittee shall ensure that the contractors conducting the work provide predator proof trash receptacles for the construction workers. All contractors and their employees shall be briefed on the importance of not littering and keeping the project area trash and debris free. Predator proof trash receptacles shall be installed and maintained at all access points, eating areas, and rest-room areas.

4. A meeting between representatives of the contractor, the Service, the FWC, and the permitted sea turtle surveyor and other species surveyors as appropriate prior to the commencement of work on this project must be held. At least 10 business days advance notice must be provided prior to conducting this meeting. This will provide an opportunity for explanation and/or clarification of the sea turtle, CBM, and piping plover protection measures as well as additional guidelines when construction occurs during the nesting season such as storing equipment, minimizing driving, and follow up meetings during construction.

5. Reports on all sea turtle nesting activity shall be provided for the initial nesting season and for a minimum of two additional nesting seasons. Monitoring of sea turtle nesting activity in the seasons following construction shall include daily surveys and any additional measures authorized by the Service and FWC.

Protection of Species

1. The project may occur during the sea turtle nesting season (May 1 through October 31) if not prohibited by state or federal park land management plans or local land use codes.

2. If any portion of the project occurs in the sea turtle nesting season, nesting surveys shall be initiated 70 days prior or by May 1 whichever is later. Nesting surveys must continue through the end of the project or through August 31 whichever is earlier. If nests are constructed in areas where they may be affected by the project activities, eggs must be relocated per the requirements listed below:

   2a. Sea turtle nesting surveys and egg relocations will only be conducted by persons with prior experience and training in these activities and who is duly authorized to conduct such activities through a valid permit issued by FWC, pursuant to FAC 68E-1. Nesting surveys must be conducted daily between sunrise and 9 a.m. (this is for all time zones). The contractor shall not initiate work until daily notice has been received from the sea turtle permit holder that the morning survey has been completed. Surveys must be

performed in such a manner so as to ensure that construction activity does not occur in any location prior to completion of the necessary sea turtle protection measures.

2b. Only those sea turtle nests that may be affected by project activities shall be relocated. Nests requiring relocation must be moved no later than 9 a.m. the morning following deposition to a nearby self-release beach site in a secure setting where artificial lighting will not interfere with hatchling orientation. Relocated nests shall not be placed in organized groupings; must be randomly staggered along the length and width of the beach in settings that are not expected to experience daily inundation by high tides or known to routinely experience severe erosion and egg loss, or subject to artificial lighting. Nest relocations in association with construction activities shall cease when construction activities no longer threaten nests.

2c. Sea turtle nests deposited where project activities have ceased or will not occur for 70 days shall be marked and left *in situ* unless other factors threaten the success of the nest. The turtle permit holder shall install an on-beach marker at the nest site and/or a secondary marker at a point landward as possible to assure that future location of the nest will be possible should the on-beach marker be lost. A series of stakes and highly visible survey ribbon or string shall be installed to establish a 10-foot radius around the nest. No activity shall occur within this area nor will any activities occur which could result in impacts to the nest. Nest sites shall be inspected daily to assure nest markers remain in place and the nest has not been disturbed by the project activities.

3. During the sea turtle nesting season, the contractor shall not extend the beach fill more than 500 feet along the shoreline between dusk and the following day until the daily nesting survey has been completed and the beach cleared for fill advancement. If the 500 feet is not feasible for the project, an agreed upon distance shall be decided on during the preconstruction meeting. Once the beach has been cleared and the necessary nest relocations have been completed, the contractor is allowed to proceed with the placement of fill during daylight hours until dusk at which time the 500-foot length limitation shall apply.

4. Immediately after completion of the project and prior to April 15 for 3 subsequent years, sand compaction shall be monitored in the area of beach fill in accordance with a protocol agreed to by the Service, the FWC, and the applicant. At a minimum, the protocol provided under 4a and 4b below shall be followed. If tilling is required, the area shall be tilled to a depth of 24 inches. All tilling activity must be completed prior to April 15.

   Each pass of the tilling equipment shall be overlapped to allow more thorough and even tilling. If the project is completed during the nesting season, tilling shall not be performed in areas where nests have been left in place or relocated. (NOTE: The requirement for compaction monitoring can be eliminated if the decision is made to till regardless of post-construction compaction levels. Additionally, out-year compaction monitoring and remediation are not required if placed material no longer remains on the dry beach.) A report on the results of the compaction monitoring must be submitted to the Service's Panama City Ecological Service Office field office, 1601 Balboa Avenue, Panama City, FL 32405 prior to any tilling actions being taken.

   4a. Compaction sampling stations shall be located at 500-foot intervals along the project area. One station must be at the seaward edge of the dune/bulkhead line (when material

is placed in this area), and one station shall be midway between the dune line and the high water line (normal wrack line).

4b. At each station, the cone penetrometer shall be pushed to a depth of 6, 12, and 18 inches three times (three replicates). Material may be removed from the hole if necessary to ensure accurate readings of successive levels of sediment. The penetrometer may need to be reset between pushes, especially if sediment layering exists. Layers of highly compact material may lie over less compact layers. Replicates shall be located as close to each other as possible, without interacting with the previous hole and/or disturbed sediments. The three replicate compaction values for each depth shall be averaged to produce final values for each depth at each station. Reports shall include all 18 values for each transect line, and the final 6 averaged compaction values.

4c. If the average value for any depth exceeds 500 pounds per square inch (psi) for any two or more adjacent stations, then that area shall be tilled immediately prior to the following dates listed above.

4d. If values exceeding 500 psi are distributed throughout the project area but in no case do those values exist at two adjacent stations at the same depth, then consultation with the Service shall be required to determine if tilling is required. If a few values exceeding 500 psi are present randomly within the project area, tilling shall not be required.

4e. Tilling shall occur landward of the wrack line and avoid all vegetated areas three (3) square feet or greater with a three (3) square foot buffer around the vegetated areas.

5. Visual surveys for escarpments along the project area shall be made immediately after completion of the project and prior to April 15 for 3 subsequent years. Escarpments that interfere with sea turtle nesting or that exceed 18 inches in height for a distance of 100 feet shall be leveled and the beach profile reconfigured to minimize scarp formation.

   If the project is completed during the sea turtle nesting and hatching season, escarpments may be required to be leveled immediately, while protecting nests that have been relocated or left in place. Surveys for escarpments shall be conducted weekly. Results of the surveys shall be submitted within one month to the Service's appropriate Field Office prior to any action being taken during the nesting season. The Service shall be contacted immediately if subsequent reformation of escarpments that interfere with sea turtle nesting or that exceed 18 inches in height for a distance of 100 feet occurs during the nesting and hatching season to determine the appropriate action to be taken. If it is determined that escarpment leveling is required during the nesting or hatching season, the Service will provide a brief written authorization that describes methods to be used to reduce the likelihood of impacting existing nests. An annual summary of escarpment surveys and actions taken shall be submitted to the Service Panama City, Florida Field Office. (NOTE: Out-year escarpment monitoring and remediation are not required if placed material no longer remains on the beach).

6. Staging areas for construction equipment shall be located off the beach to the maximum extent practicable from May 1 to October 31.

7. Nighttime storage of construction equipment not in use shall be off the beach to minimize disturbance to sea turtle nesting and hatching activities. In addition, all construction pipes

that are placed on the beach shall be located as far landward as possible without compromising the integrity of the existing or reconstructed dune system. Temporary storage of pipes shall be off the beach to the maximum extent possible. Temporary storage of pipes on the beach shall be in such a manner so as to impact the least amount of nesting habitat and shall not compromise the integrity of the dune systems. Pipes placed parallel to the dune shall be five to ten feet away from the toe of the dune.

8. Direct lighting of the beach and nearshore waters shall be limited to the immediate construction area and shall comply with safety requirements from May 1 to October 31.

9. Lighting on offshore or onshore equipment must be minimized through reduction, shielding, lowering, and appropriate placement to avoid excessive illumination of the waters surface and nesting beach while meeting all Coast Guard, EM 385-1-1, and OSHA requirements. Light intensity of lighting plants must be reduced to the minimum standard required by OSHA for General Construction areas, in order not to misdirect sea turtles. Shields must be affixed to the light housing and be large enough to block light from all lamps from being transmitted outside the construction area (**Figure 19)**.

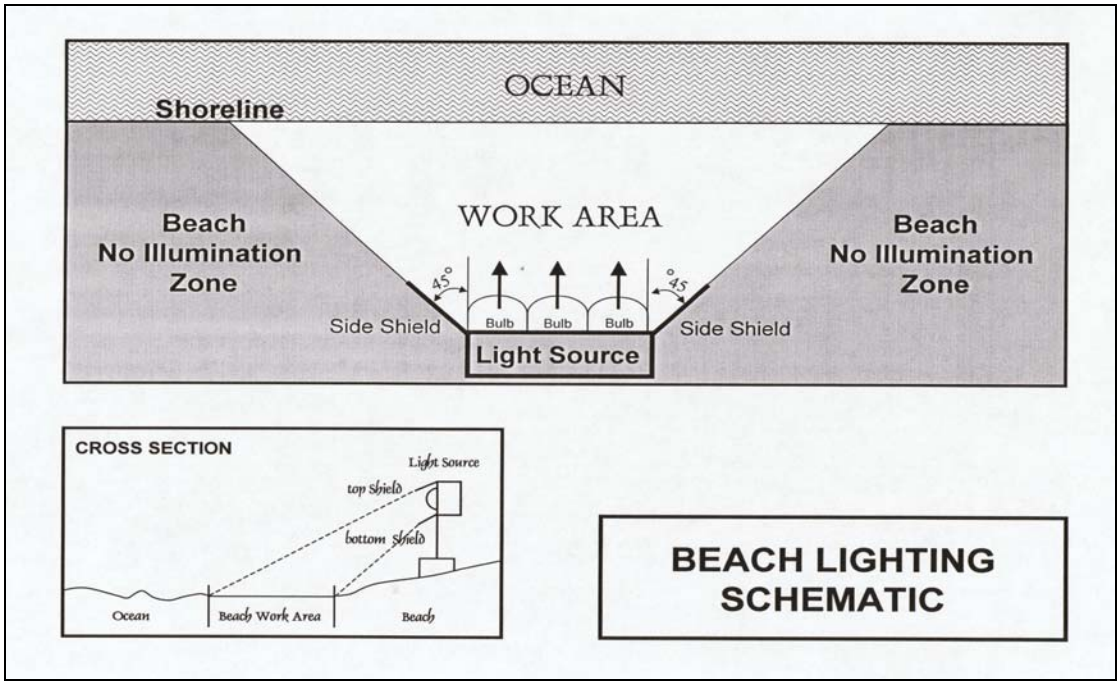

Figure 19. Beach lighting schematic.

10. A survey of all artificial lighting visible from the project beach shall be conducted before and after the project since there is no lighting ordinance in place. The survey shall use standard techniques (**Appendix 1**).

    The surveys shall document all lighting visible from the pre-project beach and then the post-project beach. The surveys shall document all lighting visible from the un- or previously nourished beach and then the nourished beach by May 15 following the nourishment work and again by June 15, July 15, August 15, and September 15 of that nesting season. For each light source visible, it must be documented that the property owner(s) have been notified of the problem light with recommendations for correcting the light. Recommendations must be

in accordance with the Florida Model Lighting Ordinance for Marine Turtle Protection FAC 62B55. A summary report of each survey including documentation of property owner notification shall be submitted to the Service's Panama City Florida Field Office by the 1st of the following month; and a final summary report provided by December 15 of that year. After the final report is completed, a meeting shall be set up with the FWC and the Service to discuss the survey report and documented sea turtle disorientations.

Dune Planting

1. Dune vegetation planting may occur during the sea turtle nesting season (May 1 through October 31) under the following conditions.

   1a. Daily early morning sea turtle nesting surveys shall be conducted during the period from May 1 through October 31. Nest surveys shall only be conducted by personnel with prior experience and training in nest surveys. Surveyors must have a valid FWC permit. Nest surveys shall be conducted daily between sunrise and 9 a.m. (all times). No dune planting activity shall occur until after the daily turtle survey and nest conservation and protection efforts have been completed.

   1b. Nesting surveys shall be initiated 70 days prior to dune planting activities or by May 1, whichever is later and by March 1. Nesting surveys shall continue through the end of the project or through August 31, whichever is earlier. Hatching and emerging success monitoring shall involve checking nests beyond the completion date of the daily early morning nesting surveys.

   1c. Any nests deposited in the dune planting area not requiring relocation for conservation purposes shall be left in situ. The turtle permit holder shall install an on-beach marker at the nest site and/or a secondary marker at a point as far landward as possible to assure that future location of the nest will be possible should the on-beach marker be lost. A series of stakes and highly visible survey ribbon or string shall be installed to establish an area of 3-foot radius surrounding the nest. No planting or other activity shall occur within this area nor will any activities occur which could result in impacts to the nest. Nest sites shall be inspected daily to assure nest markers remain in place and the nest has not been disturbed by the planting activity.

   1d. If a nest is disturbed or uncovered during planting activity, the contractor, permittee or the permittee's contractors shall cease all work and immediately contact the responsible turtle permit holder. If a nest(s) cannot be safely avoided during planting, all activity within the affected project site shall be delayed until hatching and emerging success monitoring of the nest is completed.

   1e. All dune planting activities shall be conducted by hand and only during daylight hours.

   1f. All dune vegetation shall consist of coastal dune species native to the local area; (i.e., native to coastal dunes in the respective county and grown from plant stock from that region of Florida) (**Appendix 2**). Seedlings shall be at least 1 inch by 1 inch with a 2.5-inch pot. Planting shall be on 18-inch centers throughout the created dune; however, 24-inch centers may be acceptable depending on the acreage of the area to be planted and the

size of the plants. Vegetation shall be planted with an appropriate amount of fertilizer and anti-desiccant material for the plant size.

1g. No use of heavy equipment (trucks) shall occur on the dunes or seaward for planting purposes. A lightweight (ATV type) vehicle, with tire pressures of 10 psi or less may be operated on the beach.

2. Sand fencing or other dune restoration material placed in the project area shall be installed outside of the main portion of sea turtle nesting season (June 1 through October 31) in accordance with the following conditions:

2a. A maximum of 10 foot- long spurs of parallel fence spaced at a minimum of 7 feet apart shall be installed on a northeast or southwest (diagonal) alignment depending on where it is installed **(Figure 20).**

2b. Upon site inspection by the Service, FDEP, or the FWC, if it is determined that the fence adversely impacts nesting or hatchling turtles, the fence shall be removed or repositioned, as appropriate.

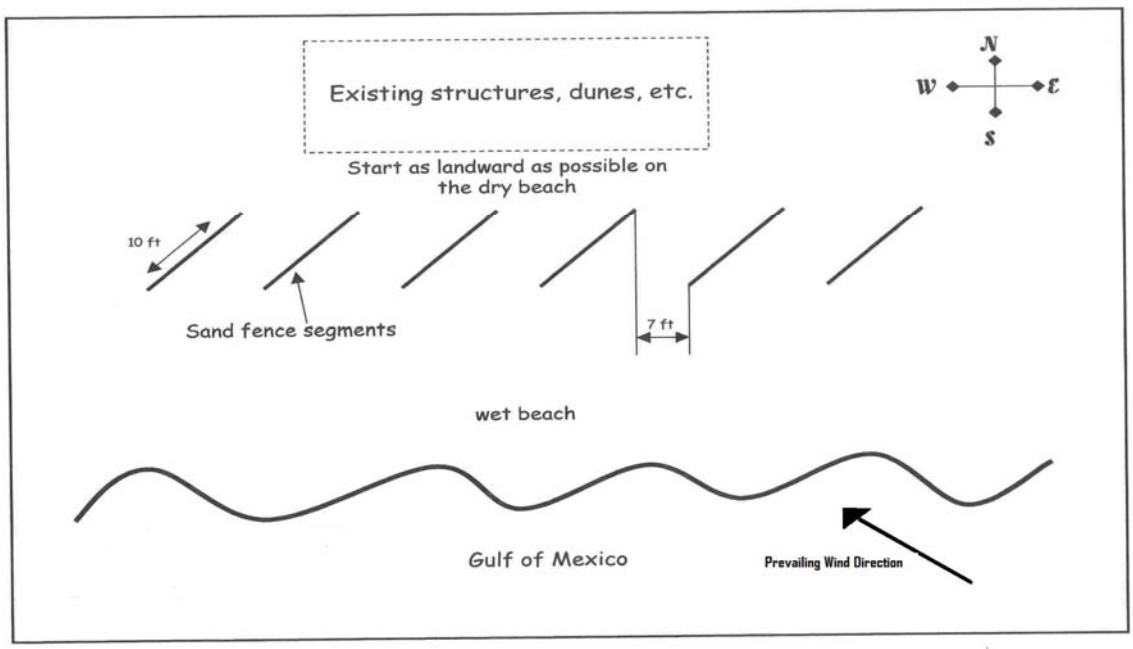

Figure 20. Dune restoration fence alignment.

Protection of Beach Mice

1. Beach mouse habitat shall be avoided when selecting sites for equipment, pipes, vehicle storage and staging to the maximum extent practicable. Suitable beach mouse habitat constitutes the primary dunes (characterized by sea and other grasses), secondary dunes (similar to primary dunes, but also frequently includes such plants as woody goldenrod, false rosemary, and interior or scrub dunes (often dominated by scrub oaks and yaupon holly).

2. Equipment shall be excluded in the area between 5 to 10 feet seaward of the existing dune toe or 10 percent of the beach width (for projects occurring on narrow eroded beach segments) seaward of the dune toe in areas of occupied beach mouse habitat. The toe of the dune is where the slope breaks at the seaward foot of the dune (**Figure 21**).

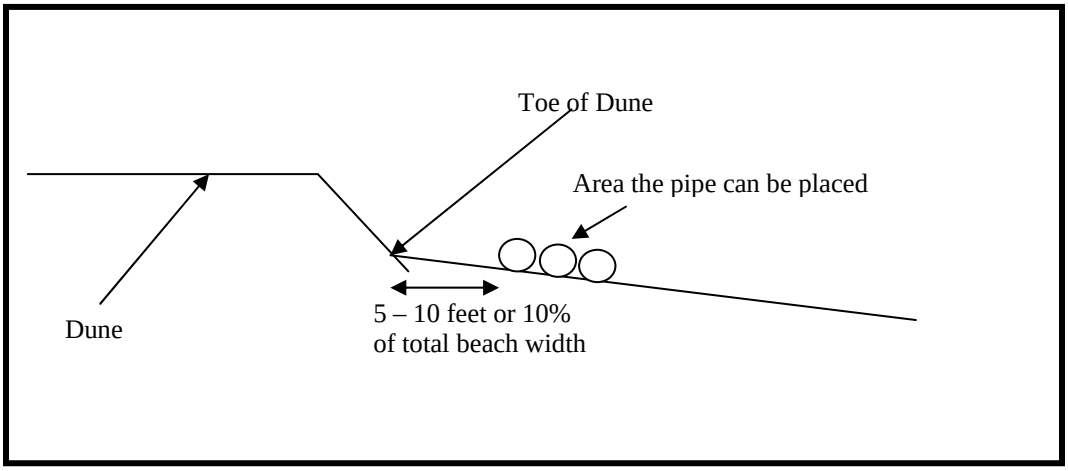

Figure 21. Placement of pipe in areas where there are existing dunes.

3. Existing beach access points shall be used for vehicle and equipment beach access to the maximum extent practicable. These accesses shall be delineated by post and rope or other suitable material to ensure vehicles and equipment transport stay within the access corridor. The topography at the accesses shall be fully restored to pre-project work configuration following project completion. Equipment and material staging/storage areas for the project shall be located outside of vegetated dune habitat. Parking areas for construction crews shall be located as close as possible to the work sites, but outside of vegetated dunes to minimize impacts to existing habitat and the need to transport workers along the beachfront.

4. The creation of new or expansion of existing beach accesses for vehicles and equipment within beach mouse habitat consisting of vegetated dunes shall be delineated by post and rope or other suitable material to ensure vehicles and equipment transport stay within the access corridor. The access points must be as follows:

   a) No more than 25 feet wide for vehicles;
   b) No more than 50 feet wide for equipment.

5. New or expanded beach accesses that impact vegetated dunes must be replanted within 3 months following project completion. The habitat restoration must consist of restoring the dune topography and planting with at least three species of appropriate native dune vegetation (i.e., native to coastal dunes in the respective county and grown from plant stock from that region of Florida) (**Appendix 2**). Seedlings must be at least 1 inch by 1 inch with a 2.5-inch pot. Planting must be on 18-inch centers throughout the created dune; however, 24-inch centers may be acceptable depending on the area to be planted. Vegetation must be planted with an appropriate amount of fertilizer and anti-desiccant material, as appropriate, for the plant size. No sand stabilizer material (coconut matting or other material) must be used in the dune restoration. The plants may be watered without installing an irrigation

system. In order for the restoration to be considered successful 80 percent of the total planted vegetation is documented to survive six months following planting of vegetation. If the habitat restoration is unsuccessful, the area must be replanted following coordination with the Service.

Protection of Piping Plovers

1. **The permittee shall implement Term and Conditions "1a-b", or "Protection of Piping Plovers prior, during, and after the project 2a-i:"**

   1a. Annually, the applicant shall contribute at least **$3,100** for each mile or **$0.60** per linear foot of berm, dune, or beach fill constructed per life of the project*. The Service will specify where the funds shall be deposited once project is initiated. The funds will be used towards the management and monitoring of piping plovers and their habitat on public or private lands which have a demonstrated use or potential use by piping plovers. Management may include but not be limited to posting and roping important use areas, enforcement of pet ordinances, and protection of closed off areas. Monitoring may assist in summarizing the status of plovers and their habitat. Trends in areas used by piping plovers may also be assessed in portions of Florida depending on data collected as funding allows.* These funds are to be used to minimize potential impacts to areas that may be used by piping plover that may be displaced permanently or temporarily by the project.

   *Given the randomness of storm events and the unknowns associated with defining the "life" of the project, we will specify that at least **two** years of funding shall be required from the applicant regardless of the state of the project and no more than 10 years of funding will be required. The "life" of the project is defined by the applicant's contractor as the point where only 50% of the original placement volume remains.

   1b. To preserve piping plover feeding and roosting habitat, the mechanical removal of natural organic material (wrack) shall be prohibited year-around along the shoreline. This has been identified as important foraging and roosting habitat by piping plovers as well as an abundance of other shorebirds on the winter and migration grounds as well. Trash and litter may be manually removed. Exceptions apply when health of humans may be affected such as with red tide events. Protection of wrack will help to offset the impacts of shorebird habitat directly or indirectly by the proposed project and ensuing human disturbance.

OR

2. **Protection of piping plover prior, during, and after the project.**

   2a. Prior to construction, survey and map onto aerial photography, throughout the Action Area, optimal non-breeding piping plover habitat (low lying areas, washover passes, inlets, ephemeral ponds, lagoons, and mud and sand flats). The applicant will work with the Service to integrate piping plover habitat features into the project design when possible.

2b. Avoid berm and dune construction within public lands such as county access areas and State Park lands.

2c. Poles or pier pilings occurring within 200 feet of piping plover habitat shall be retro-fit to reduce avian predation.

2d. Conduct surveys for non-breeding piping plover in the **Project** area (includes connected coastal dune lake shorelines daily starting two weeks prior to project initiation for the duration of the berm, dune, and beach fill construction period between July 15 and May 15 (10 months of the year). Submit daily piping plover survey results to the Service's Panama City Florida Field Office with maps documenting the locations of piping plovers (with GPS coordinates or latitude and longitude coordinates) if seen during this survey period. Negative data shall also be reported.

2e. Conduct bi-monthly surveys for piping plovers in the **Action** areas (includes Walton County beaches, State Park lands, and connected coastal dune lake shorelines) from July 15 through May 15 of each year (10 months of the year) beginning two weeks post construction and continuing for the duration of the project*. Maintain information in a database (e.g. Access or Excel). Report negative and positive survey data and the amount and type of recreational use documented. Record piping plover locations with a Global Positioning System (GPS), habitat type used (intertidal area, mid-beach, etc), and observed behavior (foraging, roosting, etc). Incorporate all information collected into the database. Guidelines for conducting surveys are included in **Appendix 3.** Submit yearly piping plover survey results (datasheets and database) to the Service's Panama City Florida Filed Office with maps documenting the locations of piping plovers (with GPS coordinates or latitude and longitude coordinates) when seen. Negative data (i.e., no plovers seen) shall also be reported.

Conduct at least one of the bi-monthly shorebird surveys April through October on a weekend to document the amount of recreational pressure potentially occurring along the shoreline.

*Given the randomness of storm events and the unknowns associated with defining the "life" of the project, we will specify that at least **two** years of surveys shall be required from the applicant regardless of the state of the project and no more than 10 years of surveys will be required. The "life" of the project is defined by the applicant's contractor as the point where only 50% of the original placement volume remains.

2f. To preserve piping plover feeding and roosting habitat, the mechanical removal of natural organic material (wrack) shall be prohibited year-around along the shoreline. This has been identified as important foraging and roosting habitat by piping plovers as well as an abundance of other shorebirds on the winter and migration grounds as well. Trash and litter may be manually removed. Exceptions apply when health of humans may be affected such as with red tide events. Protection of wrack will help to offset the impacts of shorebird habitat directly or indirectly by the proposed project and ensuing human disturbance.

2g. Annually, Walton County staff shall notify holders of beach driving permits to drive their vehicles just above or just below the primary "wrack" line.

2h. At approximately every mile of beach, a "Disturbance-Free Zone" at least a one half acre area shall be posted and roped off where potential bird roosting and feeding could occur (not into the tidal area and allowing enough space for walkers to cross) **OR** at least one half acre area adjacent to **3** coastal dune lake outlets shall be posted and roped off where potential bird roosting and feeding could occur. These areas shall remain rope off year around for the duration of the project*.

2i. Walton County shall post, where appropriate, at each beach access points, the provisions of the County Dogs on the Beach Permit Requirements. Annually a notice shall be placed in the local paper informing in this same regard. A copy of the published notice should be mailed to the USFWS. Warnings and citations should be issued when appropriate to minimize harassment of piping plovers and other shorebirds.

2j. Walton County shall restrict, and enforce this restriction, the use of all fireworks on the Walton front beaches adjacent to the roped and posted areas as discussed in Terms and Conditions 2h.

Reporting

1. A report describing the actions taken to implement the terms and conditions of this incidental take statement shall be submitted to the Service's Panama City Florida Field Office by January 15 of the following year of completing the proposed work for each year when the activity has occurred. This report will include the dates of actual construction activities, names and qualifications of personnel involved in piping plover surveys and sea turtle nest surveys and relocation activities (separate the nest surveys for nourished and non-nourished areas), descriptions and locations of self-release beach sites, nest survey and relocation results and the information outlined in **Table 17.**

2. Upon locating a sea turtle adult, hatchling, or egg, CBM, or a piping plover harmed or destroyed as a direct or indirect result of the project, notification shall be made to the Service's Law Enforcement Office at (352) 429-1037 and the Panama City Field Office at (850) 769-0552. The FWC Sea Turtle Stranding and Salvage Network by Pager: 1-800-241-4653, ID#274-4867 and/or Wildlife Alert 1-888-404-3922 shall also be notified. Care shall be taken in handling injured turtles or eggs to ensure effective treatment or disposition, and in handling dead specimens to preserve biological materials in the best possible state for later analysis.

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Table 17. Sea turtle nesting data required for annual reports.

CHARACTERISTIC	PARAMETER	MEASUREMENT	VARIABLE
Nesting Success	False crawls - number	Visual assessment of all false crawls	Number and location of false crawls in nourished areas and non nourished areas: any interaction of the turtle with obstructions, such as groins, seawalls, or scarps, should be noted.
	False crawl - type	Categorization of the stage at which nesting was abandoned	Number in each of the following categories: emergence-no digging, preliminary body pit, abandoned egg chamber.
	Nests	Number	The number of sea turtle nests in nourished and non nourished areas should be noted. If possible, the location of all sea turtle nests must be marked on map of project, and approximate distance to sea walls or scarps measured using a meter tape. Any abnormal cavity morphologies should be reported as well as whether turtle touched groins, seawalls, or scarps during nest excavation
		Lost Nests	The number of nests lost to inundation, erosion or the number with lost markers that could not be found.
	Lighting Impacts	Disoriented sea turtles	The number of disoriented hatchlings and adults must be documented and reported in accordance with existing FWC protocol for disorientation events.
Reproductive Success	Emergence & hatching success	Standard survey protocol	Numbers of the following: unhatched eggs, depredated nests and eggs, live pipped eggs, dead pipped eggs, live hatchlings in nest, dead hatchlings in nest, hatchlings emerged, disoriented hatchlings, depredated hatchlings

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. Walton County should consider measures to limit coastal development that would exacerbate coastal erosion and require storm protection in the future;

2. The Applicant should consider purchasing land for shorebird conservation which could include locations where natural shoreline processes can occur unimpeded. These might include not only undeveloped areas, but the potential "buy-out" of developments in areas that are sparsely developed and have high potential habitat value (*e.g.*, proximity to feeding areas, prone to coastal dune outlets, etc.).

3. In order to comply with the MBTA[a] and potential for this project to impact nesting shorebirds, the Corps grant Applicant should follow FWC's standard guidelines to protect against impacts to nesting shorebirds during implementation of this project during the periods from February 15-August 31.

4. Additional dune walkovers and parking areas should be constructed where appropriate to protect dune habitats at beach access points.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

The Migratory Bird Treaty Act (MBTA)

The Fish and Wildlife Service will not refer the incidental take of piping plover for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703-712), if such take is in compliance with the terms and conditions specified here.

REINITIATION NOTICE

This concludes formal consultation on the proposed action. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take shall cease pending reinitiation.

The above findings and recommendations constitute the report of the Department of the Interior. If you have any questions about this opinion, please contact Lorna Patrick of this office at extension 229.

Sincerely,

Janet Mizzi
Deputy Field Supervisor

[a] The Migratory Bird Treat Act (MBTA) implements various treaties and conventions between the U.S., Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory bird. Under the provisions of the MBTA it is unlawful "by any means or manner to pursue, hunt, take, capture or kill any migratory bird except as permitted by regulations issued by the Fish and Wildlife Service. The term "take" is not defined in the MBTA, but the Service has defined it by regulation to mean to pursue, hunt, shoot, wound, kill, trap, capture or collect any migratory bird, or any part, next or egg or any migratory bird covered by the conventions or to attempt those activities.

cc:
Nicole Adimey, FWS, Jacksonville, FL
Robbin Trindell, FWC, Office of Protected Species Management, Tallahassee, FL
John Himes, FWC, Non-game Program, PC, FL
Brad Pickel, Seahaven Consulting, Beaufort, SC
South Walton County Tourist Development Council, Santa Rosa Beach, FL
Michael Trudnak, Taylor Engineering, Inc, Jacksonville, FL
FDEP, Beaches and Coastal Systems, Tallahassee, FL
Ken Graham, FWS, Ecological Services, Atlanta, GA (electronic version only)
Anne Hecht, FWS, Piping Plover Coordinator, Sudbury, MA (final version only)

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APPENDIX 1

Assessments: Discerning Problems caused by Artificial Lighting

Excerpt from:
Understanding, Assessing, and Resolving Light-Pollution Problems on Sea Turtle Nesting Beaches
Florida Wildlife Research Institute Technical Report TR-2
Revised 2003

Assessments: Discerning Problems caused by Artificial Lighting

WHAT ARE LIGHTING INSPECTIONS?

During a lighting inspection, a complete census is made of the number, types, locations, and custodians of artificial light sources that emit light visible from the beach. The goal of lighting inspections is to locate lighting problems and to identify the property owner, manager, caretaker, or tenant who can modify the lighting or turn it off.

WHICH LIGHTS CAUSE PROBLEMS?

Although the attributes that can make a light source harmful to sea turtles are complex, a simple rule has proven to be useful in identifying problem lighting under a variety of conditions:

An artificial light source is likely to cause problems for sea turtles if light from the source can be seen by an observer standing anywhere on the nesting beach.

If light can be seen by an observer on the beach, then the light is reaching the beach and can affect sea turtles. If any glowing portion of a luminaire (including the lamp, globe, or reflector) is directly visible from the beach, then this source is likely to be a problem for sea turtles. But light may also reach the beach indirectly by reflecting off buildings or trees that are visible from the beach. Bright or numerous sources, especially those directed upward, will illuminate sea mist and low clouds, creating a distinct glow visible from the beach. This “urban skyglow" is common over brightly lighted areas. Although some indirect lighting may be perceived as nonpoint-source light pollution, contributing light sources can be readily identified and include sources that are poorly directed or are directed upward. Indirect lighting can originate far from the beach.

Although most of the light that sea turtles can detect can also be seen by humans, observers should realize that some sources, particularly those emitting near-ultraviolet and violet light (e.g., bug-zapper lights, white electric-discharge lighting) will appear brighter to sea turtles than to humans. A human is also considerably taller than a hatchling; however, an observer on the dry beach who crouches to the level of a hatchling may miss some lighting that will affect turtles. Because of the way that some lights are partially hidden by the dune, a standing observer is more likely to see light that is visible to hatchlings and nesting turtles in the swash zone.

HOW SHOULD LIGHTING INSPECTIONS BE CONDUCTED?

Lighting inspections to identify problem light sources may be conducted either under the purview of a lighting ordinance (see Appendix H and the section below on sea turtle lighting ordinances) or independently. In either case, goals and methods should be similar.

GATHER BACKGROUND INFORMATION

Before walking the beach in search of lighting, it is important to identify the boundaries of the area to be inspected. For inspections that are part of lighting ordinance enforcement efforts, the jurisdictional boundaries of the sponsoring local government should be determined. It will help to have a list that includes the name, owner, and address of each property within inspection area so that custodians of I problem lighting can be identified. Plat maps or aerial photographs will help surveyors orient themselves on heavily developed beaches.

PRELIMINARY DAYTIME INSPECTIONS

An advantage to conducting lighting inspections during the day is that surveyors will be better able to judge their exact location than they would be able to at night. Preliminary daytime inspections are especially important on beaches that have restricted access at night. Property owners are also more likely to be available during the day than at night to discuss strategies for dealing with problem lighting at their sites.

A disadvantage to daytime inspections is that fixtures that are not directly visible from the beach will be difficult to identify as problems. Moreover, some light sources that can be seen from the beach in daylight may be kept off at night and thus present no problems. For these reasons, daytime inspections are not a substitute for nighttime inspections. I Descriptions of light sources identified during daytime inspections should be detailed enough so that anyone can locate the lighting. In addition to a general description of each luminaire (e.g., HPS floodlight directed seaward at top northeast corner of the building at 123 Ocean Street), photographs or sketches of the lighting may be necessary. Descriptions should also include an assessment of how the specific lighting problem can be resolved (e.g., needs turning off; should be redirected 90° to the east). These detailed descriptions will show property owners exactly which luminaires need what remedy.

NIGHTTIME INSPECTIONS

Surveyors orienting themselves on the beach at night will benefit from notes made during daytime surveys. During nighttime lighting inspections, a surveyor walks the length of the nesting beach looking for light from artificial sources. There are two general categories of artificial lighting that observers are likely to detect:

1. **Direct lighting**. A luminaire is considered to be direct lighting if some glowing element of the luminaire (e.g., the globe, lamp [bulb], reflector) is visible to an observer on the beach. A source not visible from one location may be visible from another farther down the beach. When direct lighting is observed, notes should be made of the number, lamp type (discernable by color; Appendix A), style of fixture (Appendix E), mounting (pole, porch, etc.), and location (street address, apartment number, or pole identification number) of the luminaire(s). If exact locations of problem sources were not determined during preliminary daytime surveys, this should be done during daylight soon after the nighttime survey. Photographing light sources (using long exposure times) is often helpful.

2. **Indirect lighting**. A luminaire is considered to be indirect lighting if it is not visible from the beach but illuminates an object (e.g., building, wall, tree) that is visible from the beach. Any object on the dune that appears to glow is probably being lighted by an indirect source. When possible, notes should be made of the number, lamp type, fixture style, and mounting of an indirect-lighting source. Minimally, notes should be taken that would allow a surveyor to find the lighting during a follow-up daytime inspection (for instance, which building wall is illuminated and from what angle?).

WHEN SHOULD LIGHTING INSPECTIONS BE CONDUCTED?

Because problem lighting will be most visible on the darkest nights, lighting inspections are ideally conducted when there is no moon visible. Except for a few nights near the time of the full moon, each night of the month has periods when there is no moon visible. Early-evening lighting inspections (probably the time of night most convenient for inspectors) are best conducted during the period of 2-14 days following the full moon. Although most lighting problems will be visible on moonlit nights, some problems, especially those involving indirect lighting, will be difficult to detect on bright nights.

A set of daytime and nighttime lighting inspections before the nesting season and a minimum of three additional nighttime inspections during the nesting-hatching season are recommended. The first set of day and night inspections should take place just before nesting begins. The hope is that managers, tenants, and owners made aware of lighting problems will alter or replace lights before they can affect sea turtles. A follow-up nighttime lighting inspection should be made approximately two weeks after the first inspection so that remaining problems can be identified. During the nesting-hatching season, lighting problems that seemed to have been remedied may reappear because owners have been forgetful or because ownership has changed. For this reason, two midseason lighting inspections are recommended. The first of these should take place approximately two months after the beginning of the nesting season, which is about when hatchlings begin to emerge from nests. To verify that lighting problems have" been resolved, another follow-up inspection should be conducted approximately one week after the first midseason inspection.

WHO SHOULD CONDUCT LIGHTING INSPECTIONS?

Although no specific authority is required to conduct lighting inspections, property managers, tenants, and owners are more likely to be receptive if the individual making recommendations represent a recognized conservation group, research consultant, or government agency. When local ordinances regulate beach lighting, local government code-enforcement agents should conduct lighting inspections and contact the public about resolving problems.

WHAT SHOULD BE DONE WITH INFORMATION FROM LIGHTING INSPECTIONS?

Although lighting surveys serve as a way for conservationists to assess the extent of lighting problems on a particular nesting beach, the principal goal of those conducting lighting inspections should be to ensure that lighting problems are resolved. To resolve lighting problems, property managers, tenants, and owners should be give the information they need to make proper alterations to light sources. This information should include details on the location and description of problem lights, as well as on how the lighting problem can be solved. One should also be prepared to discuss the details of how lighting affects sea turtles. Understanding the nature of the problem will motivate people more than simply being told what to do.

MONITORING SEA TURTLE BEHAVIOR

In part, the behavior of nesting sea turtles and their hatchlings on the beach can be monitored by studying the tracks they leave in the sand. This evidence can reveal how much and where nesting occurs and how well oriented hatchlings are as they attempt to find the sea from their nest. Monitoring this behavior is one way to assess problems caused by artificial lighting, but it is no substitute for a lighting inspection program as described above. Many lighting problems may affect sea turtles and cause mortality without their leaving conspicuous track evidence on the beach.

SEA TURTLE NESTING

On many beaches, sea turtle biologists make early morning surveys of tracks made the previous night in order to gather information on nesting. With training, one can determine the species of sea turtles nesting, the success of their nesting attempts, and where these attempts have occurred. These nesting surveys are one of the most common assessments made of sea turtle populations.

Because many factors affect nest-site choice in sea turtles, monitoring nesting is a not a very sensitive way to assess lighting problems. However, changes that are observed in the distribution or species composition of nesting can indicate serious lighting problems and should be followed with a program of lighting inspections if one is not already in place.

HATCHLING ORIENTATION

Although hatchlings are more sensitive to artificial lighting than are nesting turtles, the evidence they leave behind on the beach is less conspicuous. Evidence of disrupted sea-finding in hatchlings (hatchling disorientation) can vastly under represent the extent of a lighting problem; however, this evidence can be useful in locating specific problems between lighting inspections. There are two ways one can use hatchling-orientation evidence to help assess lighting problems:

HATCHLING-ORIENTATION SURVEYS

Of the two methods, hatchling-orientation surveys, which involve measuring the orientation of hatchling tracks at a sample of sites where hatchlings have emerged, provide the most accurate assessment. Because the jumble of hatchling tracks at most emergence sites is often too confused to allow individual tracks to be measured, simple measures of angular range (the width that the tracks disperse) and modal direction (the direction that most hatchlings seem to have gone) are substituted. If the sampling of hatchling emergence sites does not favor a specific stretch of beach or a particular time of the lunar cycle, data from these samples can be an accurate index of how well hatchlings are oriented (Witherington et al., 1996).

HATCHLING-DISORIENTATION REPORTS

Although many cases of hatchling disorientation go unnoticed, some are observed and reported. The evidence of such events includes numerous circling tracks, tracks that are directed away from the ocean, or the carcasses of hatchlings that have succumbed to dehydration and exhaustion. Because reporters often discover this evidence while conducting other activities, such as nesting surveys, the events reported often include only the most conspicuous cases. Although these reports have a distinct coverage bias, they can still yield valuable information.

Hatchling-disorientation reports can help researchers immediately identify light-pollution problems. Although not every hatchling that is misled by lighting may be observed and reported, each report constitutes a 'documented event. When reports are received by management agencies or conservation groups, action can be taken to correct the light-pollution problem at the specific site recorded in the report. To facilitate the gathering of this information, standardized report forms should be distributed to workers on the beach who may discover evidence of hatchling disorientation. The following is a list of information that should be included on a standardized hatchling-disorientation report form:

1. Date and time (night or morning) that evidence was discovered.
2. Observer's name, address, telephone number, and affiliation (if any). The reporter may need to be contacted so that information about the event can be verified and the site can be located.
3. Location of the event and the possible light sources responsible. Written directions to the locations should be detailed enough to guide a person unfamiliar with the site. The reporter should judge which lighting may have caused the sea-finding disruption, a decision that may involve knowledge about lighting that was on during the previous night and the direction(s) of the tracks on the beach. If possible, the type of lighting responsible should be identified (e.g. a high pressure sodium street light).
4. The number of hatchlings of each species involved in the event. Unless carcasses or live hatchlings are found, the species and numbers involved will be an estimate.
5. Additional notes about the event.

Excerpted from: Witherington, B.E., and R.E. Martin. 2003. Understanding, Assessing, and Resolving Light-Pollution Problems on Sea Turtle Nesting Beaches. 3rd ed. Rev. Florida Fish and Wildlife Research Institute. St Petersburg, FL. http://research.myfwc.com/engine/download_redirection_process.asp?file=tr-2_3101.pdf&objid=2156&dltype=article

APPENDIX 2

Species Plant List for Coastal Dune and Beaches in Walton County, FL

Species Plant List for Coastal Dune and Beaches in Walton County, Florida

Scientific Name	Common Name	Height	Container	Primary & Secondary Dune	Inter-dunal	Scrub dune
Trees						
Magnolia grandiflora	Southern Magnolia	60'-90'*	1gTP,3gTP,D			X
Osmanthus americanus	Wild Olive	70'*	1gTP,3gTP,D			X
Pinus clausa	Sand Pine	20'*	1gTP,3gTP,D			X
Pinus elliottii	Slash Pine	80'-100'*	1gTP,3gTP,D			X
Quercus geminata	Sand Live Oak	30'*	1gTP,3gTP,D			X
Quercus myrtifolia	Myrtle Oak	40'*	1gTP,3gTP,D			X
Quercus virginiana maritima	Sand Live Oak	40'-50'*	1gTP,3gTP,D			X
Medium to Large Shrubs & Small Trees						
Callicarpa americana	Beautyberry	5'	1gTP,TB,D			X
Erythrina herbacea	Eastern Coralbean	4' (25')	1gTP,TB,D	X		X
Ilex vomitoria	Yaupon Holly	20'	1gTP,TB,D			X
Iva frutescens	Marsh-Elder	11'	1gTP,TB,D		X	
Rhus copallina	Winged Sumac	10' (30')	1gTP,TB,D		X	X
Serenoa repens	Saw Palmetto	10' (30')	1gTP,TB,D			X
Small Shrubs & Ground Covers						
Schizachyrium scoparium (formerly maritimum)	Bluestem		LT,TB	X		
Asclepias humistrata	Sandhill Milkweed		LT,TB			X
Bignonia capreolata	Cross Vine		LT,TB			X
Cakile constricta	Sea Rocket		LT,TB	X		
Ceratiola ericoides	Seaside Rosemary		LT,TB			X
Chryosoma pauciflosculosa	Seaside Goldenrod		LT,TB	X		X
(T) Chrysopsis gossypina cruiseana	Cruise's Golden Aster		LT,TB	X		X
Conradina canescens	Beach Heather		LT,TB	X		X
Cyperus sp.	Sedge		LT,TB		X	
Heterotheca subaxillaris	Aster (Camphor weed)		LT,TB	X		X
Hydrocotyle bonariensis	Pennywort		LT,TB	X	X	X
Ipomoea pes-caprae	Railroad Vine		LT,TB	X		
Ipomoea imperati (formerly stolonifera)	Beach Morning Glory		LT,TB	X		
Licania michauxii	Gopher Apple		LT,TB			X
Panicum amarum	Beach Grass		LT,TB	X		
(E) Polygonella macrophylla	Large-leavedJointweed		LT,TB			X
Tradescantia ohiensis	Spiderwort		LT,TB			X
Uniola paniculata	Sea Oats		LT,TB	X		

T & E = State of Florida protected plant. Planting is stongly encouraged to help recover the species. Make sure the nursery you purchase the plant from is in the Association of Florida Native Plants; they follow all State regulations to grow and sell protected species.

*****Trees living in coastal dunes do not reach "normal heights." They tend to be stunted and "pruned" by the wind, sand, and salt spray. Plant small specimens preferably in protected areas such as on the landward side of the dunes.

APPENDIX 3

Piping and Snowy Plover Non-breeding Season Survey Guidelines

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Piping and Snowy Plover Non-breeding Season Survey Guidelines*

June 2007

*In coordination with the Florida Fish and Wildlife Conservation Commission, we recommend these guidelines for conducting piping and snowy plover non-breeding season surveys. These guidelines combine the survey protocol from the International Piping Plover Census and the International Shorebirds Survey (ISS). Please note that these guidelines only pertain to routine plover population monitoring and that a separate set of guidelines may be recommended for the purposes of evaluating potential project impacts.

1. Sites should be selected based on geographic features, suitability of habitat, and ability for you to adequately and consistently survey the site.

2. We have prepared a survey form for your use (enclosed). We also have the form in an Excel file if you need it. Let us know.

3. Monitoring should be conducted July 15 through May 15 which mostly follow ISS census dates listed below. The ISS schedule usually results in three surveys per month. If this is not feasible, try to do at least two surveys per month on the ISS census dates. Surveys should be conducted on ISS dates plus or minus 2 days (example: a survey scheduled for the 15th could be conducted on any day from the 13th through the 17th.)

Spring Migration	Fall Migration	Winter
February 25	July 15	October 15
March 5	July 25	October 25
March 25	August 5	November 5
April 5	August 15	November 15
April 15	August 25	November 25
April 25	September 5	December 5
May 5	September 15	December 15
May 15	September 25	December 25
	October 5	January 5
		January 15
		January 25
		February 5
		February 15

4. To the extent possible, surveys should be conducted when birds are feeding. The best time is at low tide, but surveys can also be conducted on a falling or rising tide provided that the feeding areas are not completely covered. During high tide, birds will be roosting. Although piping plovers often roost near feeding areas, the birds will be much more difficult to locate.

5. If conducting the surveys by ATV or vehicle, driving speeds should be limited to 5 mph (8 kph) so that birds may be more easily observed. Avoid driving on feeding areas (e.g., flats) during low tides and avoid driving over the wrack line or areas of dense seaweed which provide food and cover for shorebirds.

6. Do not drive on the upper beach, in the dunes, or over beach vegetation.

7. If beach scarps or high tides require driving above the high tide line, avoid those areas with known sea turtle nests or shorebird breeding areas (combined nesting seasons for turtles and shorebirds are from February through October 31).

8. Avoid conducting surveys during poor weather conditions (e.g., high winds, rain).

9. Negative data is as important as positive data. Indicate when you have surveyed and no birds were observed.

10. Although piping and snowy plovers are the target species for the surveys, any additional observations of other species will help us to identify shorebird concentration areas and management needs.

11. The FWS and the FWC would appreciate receiving copies of your survey data. Please provide the information to the following individuals:

Patty Kelly
U.S. Fish and Wildlife Service
1601 Balboa Avenue
Panama City, FL 32405
(850) 769-0552 x228
Fax (850) 763-2177
Patricia_Kelly@fws.gov

John Himes
Florida Fish and Wildlife Conservation Commission
3911 Highway 2321
Panama City, FL 32409-1658
(850) 265-3676
Fax (850) 747-5690
John.Himes@MyFWC.com

Above all, have fun and please try and minimize disturbance to the birds!

Piping Plover and Snowy Plover Survey Results in FL Panhandle

Surveyor(s) name:_____ **Date:**_____

_____ **start GPS**_____ **end GPS**_____

Ownership if known: public_____ **private**_____

Time surveyed: from _____ **to** _____ **Temperature:** _____ **C°**___ **or F°** ___

Tide stage: low_____ **Mid**_____ **High** _____ **(rising**____**/falling**____**)**

Disturbance: Number of people on beach_____ **Number of dogs leashed**_____**unleashed**_____

# of Piping plovers seen: _____

Circle location: dunes foredune mid-beach tidal zone bay shoreline mudflat other_____

Bands seen: Right Leg_____Left Leg_____ GPS_____

Bands seen: Right Leg_____Left Leg_____ GPS_____

# of Snowy plovers seen: _____

Circle location: dunes foredune mid-beach tidal zone bay shoreline mudflat other_____

Bands seen: Right Leg_____Left Leg_____ GPS_____

Bands seen: Right Leg_____Left Leg_____ GPS_____

Bands seen: Right Leg_____Left Leg_____ GPS_____

Bands seen: Right Leg_____Left Leg_____ GPS_____

# of Red Knots seen: _____

Circle location: dunes foredune mid-beach tidal zone bay shoreline mudflat other_____

Bands seen: Right Leg_____Left Leg_____ GPS_____

Bands seen: Right Leg_____Left Leg_____ GPS_____

Other Species Seen:	Number:	Comments:
Black-bellied Plover		
American Golden Plover		
Wilson's Plover		
Semipalmated Plover		
Killdeer		
American Oystercatcher		
Greater Yellowlegs		
Lesser Yellowlegs		
Solitary Sandpiper		
Willet		
Spotted Sandpiper		
Whimbrel		
Marbled Godwit		
Ruddy Turnstone		
Sanderling		
Semipalmated Sandpiper		
Western Sandpiper		
Least Sandpiper		
White-rumped Sandpiper		
Baird's Sandpiper		
Pectoral Sandpiper		
Dunlin		
Stilt Sandpiper		
Peep sp.		
Short-billed Dowitcher		
Long-billed Dowitcher		
Other:		

Please send copies to: Patty Kelly, USFWS, 1601 Balboa Avenue, Panama City, FL 32405 or fax to 850/763-2177 (Ph: 850/769-0552) and John Himes FWCC, 3911 Highway 2321, Panama City, FL 32409 or fax 850/747-5690 (Ph: 850/265-3676). Thank You.

Panama City FO:L.Patrick:lap:bs:9-29-08:850-769-0552x229:c:Server/Public/Lorna/Walton County beach nourishment/Walton Co beach nourishment Project final BO 9-29-08.doc

EA-APPENDIX B

SECTION II

Coordination Documents for the Selected Federal Plan

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF:

CESAM-PD-EC 23 July 2004

MEMORANDUM FOR RECORD

SUBJECT: Walton County Shore Protection Feasibility Environmental Coordination Meeting

1. On 29 June 2004, an interagency meeting was held at the Walton County, Tourist Development Council facility in Santa Rosa Beach, Florida. The purpose of the meeting was to initiate environmental coordination with the interagency team involved in the permitting and environmental compliance processes for the Walton County Shore Protection Feasibility Study. The meeting's primary objects were to identify and discuss environmental issues and opportunities, permitting issues, and environmental compliance requirements associated with the proposed Walton County project. In attendance were representatives from the U.S. Army Corps of Engineers (USACE), Walton County, U.S. Fish and Wildlife Service (FWS), Florida Department of Environmental Protection (DEP), and Florida Fish and Wildlife Conservation Commission (FWCC). It should be noted that representatives from the U.S. National Marine Fisheries Service were invited to attend. Communications with the Habitat Conservation Division expressed that the project did not raise issues that would require their representation. Representatives from the Protected Resources Division did not respond. The meeting agenda and attendance list are attached.

2. A summary of Walton County's proposed shore protection plan was presented by Brad Pickel. Walton County has approximately 26 miles of shoreline and contains a number of areas exhibiting excessive beach erosion and deterioration of the dunes and bluffs. Although the County has approximately 26 miles of shoreline, the proposed actions will not encompass the entire shoreline. The project would be comprised of smaller reaches of beach nourishment and/or dune and bluff restoration. Each of the problem areas have their own unique characteristics that require different approaches and will be treated on a case-by-case basis. The project is separate from and in addition to the existing beach nourishment project currently being pursued for Destin and the western end of Walton County.

3. Projects such as this present certain problems that must be overcome as well as opportunities providing advantages to the project. Some of the problems identified throughout the discussion specific to this project include issues associated with the dune lakes existing along Walton County's shoreline. These areas provide excellent habitat for nesting shorebirds and special attention must be given towards assuring that any nourishment or restoration activities will not interfere with their normal water fluctuation. Walton County contains six miles of State Park lands and concerns have been expressed pertaining to project end points adjacent to this

property. All activities that impact State Park lands should be coordinated with officials from the parks. This situation can be turned into a positive situation by offering the State Park Service opportunity to participate in the shore protection project. Other opportunities exist to take advantage of existing data such as beach sediment data, beach profile surveys, and aerial photography. These types of data have been collected through DEP and independent contracts and available to this project.

4. The meeting was next directed to environmental issues concerning potential borrow sites. An issue was raised by DEP that any potential borrow sources in the vicinity of East Pass should be avoided and would likely result in permitting problems. Other features to be aware of during sand search operations are the presence of offshore limestone ridges. These known features provide habitat for a variety of species and possibly soft corals. Efforts should be made to avoid these areas as potential borrow sites. In addition to the limestone ridges a required search for known authorized artificial reefs must be conducted in the vicinity of potential borrow areas and should be avoided. Sediment quality is another major issue when determining a borrow source. Comprehensive sediment suitability analysis will be required including grain size, color, and compaction characteristics. DEP expressed that it would beneficial if they would be involved in the sediment QA/QC process early on in the project and before submittal of the WQC application. Benthic resource assessments of potential borrow sites would also be expected as well as post-borrow monitoring for determination of benthic recovery rates. If a hopper dredge will be used to harvest borrow materials, the activities should adhere to conditions and recommendations specified in the regional biological opinion conducted by NMFS for the use of hopper dredges.

5. Environmental issues concerning beach placement was another important topic of discussion. As with the borrow sites, a comprehensive sediment compatibility analysis will be required. In addition to grain size, color, etc., special attention should be given to suitability for sea turtles, shorebirds and beach mice. Efforts should be made to create "turtle friendly" design profiles to minimize scarping, overwash, and ponding. The proper Section 7 coordination must be conducted pertaining to sea turtles, beach mice, manatees, shorebirds and Gulf sturgeon. If any beach/dune placement activities occur during sea turtle nesting season, a formal consultation will be necessary.

Dune restoration design should take into consideration existing beach mice habitat and shorebird nesting habitat. Dune creation is not always beneficial towards providing shorebird nesting areas. In some cases the creation of dunes has covered up lower elevated sandy areas providing preferred nesting conditions for many shorebirds. Consideration should be taken to assure that such a situation is avoided. Dune reconstruction should also attempt to achieve, as much as possible, a contiguous dune line to allow for beach mice migration along the shoreline. Any beach and/or dune restoration activities must be cognizant of the natural processes supporting the local dune lakes. Existing permit applications for the dune-lake outfall projects are currently incomplete. Possible adverse impacts from these projects to the lakes, wetlands, dunes, beach and Gulf (water quality) have not yet been sufficiently addressed.

Another important issue discussed was the identification of storm water outfalls within proposed action areas. If there are any existing storm water outfalls within the project areas, the

environmental documents should address their impacts and the possibility of their removal. Other issues that should be addressed in the feasibility phase of this project include formation of a sea turtle lighting plan and identifying staging areas that minimize second hand impacts.

6. The Walton County project also presents some environmental opportunities that can act to create positive impacts. Such opportunities include re-establishment of coastal dune vegetation, providing and maintaining sea turtle nesting habitat, enhancement of beach mice habitat, and the protection and regulation of the sensitive habitats of the dune lakes. This project will provide overall stabilization of the Walton County shoreline, providing greater stability and maintenance to the existing regional environment.

7. Several permitting issues were identified and should be kept in consideration during all phases of the project. Such issues include maintaining coastal lake outfalls, identification and modification of storm water outfalls that affect the beach system, sand suitability, and sea turtle lighting requirements. Given that this project will likely be composed of several smaller beach nourishment and/or dune reconstruction activities, it is anticipated that permitting may be done on a case-by-case basis. Beach restoration projects should be submitted as Joint Coastal Permit applications. Dune restorations may be included in these applications, especially if the sand is dredged from the Gulf or an inlet. However, stand-alone dune restoration projects that don't involve sand dredged from the Gulf or an inlet should be submitted as Coastal Construction Control Line Permit applications.

8. The final topic of discussion dealt with the NEPA process that should be conducted for the Walton County projects, specifically whether the project would require an EA or EIS. The FWS is not viewing this project as one that would require an EIS. Although the project area encompasses some 26 miles of shoreline, the activities will be comprised of smaller beach nourishment and/or dune restoration that will be conducted on a case-by-case basis. The group in attendance felt that given the project characteristics, low level of controversy, and precedent set by other local beach projects that an EA would be the appropriate level of environmental documentation for Walton County. However, an EA must adequately address the cumulative impacts of the entire project and may be subject to future change into an EIS should any major issues and controversy arise.

9. Please address any questions or concerns pertaining to this meeting to Mr. Larry Parson at (251) 690-3139 or larry.e.parson@sam.usace.army.mil.

/Lp/

Larry E. Parson CESAM-PD-EC
USACE, Coastal Environment Team

CF:

Curtis Flakes - CESAM-PD
Kenneth Day - CESAM-PD-E
Susan Rees - CESAM-PD-EC
Elaine Baxter - CESAM-PD-FP
Tim Caldwell - CESAM-PM-CM
Brad Pickel - Walton County
Lorna Patrick – FWS
Robbin Trindell – Florida FWCC
Marty Seeling - Florida DEP, BBWR
Jamie Christoff - Florida DEP, BBWR
Philip Flood - Florida DEP
Ralph Clark - Florida DEP
Mark Thompson - NMFS, Habitat Conservation Division
Stephania Bolden - NMFS, Protected Resources Division

AGENDA

WALTON COUNTY SHORE PROTECTION ENVIRONMENTAL COORDINATION MEETING

WALTON COUNTY TOURIST DEVELOPMENT COUNCIL

TUESDAY, 29 JUNE 2004

- Walton County – Proposed Shore Protection Plan
- Problems and Opportunities
- Environmental Issues (Borrow Sites)
- Environmental Issues (Placement Sites)
- Environmental Opportunities
- Permitting Issues
- EA vs. EIS

Walton County Shore Restoration Feasibility
Environmental Coordination Meeting
29 June 2004

	Name	Affiliation	Phone
1	Larry Parson	USACE	(251) 690-3139
2	Phil Flood	DEP	850/457-1262 x168
3	Ralph Clark	DEP - Beaches	850/487-4469 ext 174
4	Brad Picker	WC TDC	(850) 267-1216 x131
5	Lorna Patrick	USFWS	(850) 769-0552 x229
Conferenced by phone 6	Marty Seeling	DEP	(850) 487-4469 x10
Conferenced by phone 7	Jamie Christoff	DEP	(850) 487-4469 x12
8	Robbin Trindell	FWC	(850) 922-4330
9			
10			

Attachment 2 – Attendance List

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

January 12, 2010

Coastal Environment Team
Planning and Environmental Division

Ms. Lorna Patrick
U.S. Department of Interior
Fish and Wildlife Service
1601 Balboa Avenue
Panama City, Florida 32405-3721

Dear Ms. Patrick:

The U.S. Army Corps of Engineers (Corps), Mobile District is seeking Federal authorization to conduct a hurricane and storm damage reduction project for Walton County, Florida. Walton County is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet as illustrated in the enclosed biological assessment (BA). This area and the adjacent waters support federally protected species under the Service's purview such as sea turtles (loggerhead, green, leatherback, and Kemp's ridley), piping plover, West Indian manatee, and the Choctawhatchee beach mouse (CBM). Gulf sturgeon and associated critical habitat also exists within the project limits but fall under the purview of the National Marine Fisheries Service and will not be considered under this BA. Based on our evaluation of the selected Federal plan described in the BA, it is our assessment that the actions may have an adverse affect on sea turtles, piping plovers, and CBM. Upon further consideration of a previous biological opinion (BO) issued for the local Walton County Beach Nourishment Project, SAJ-2007-5152 (IP-DEB)/FWS 2008-F-0060 Walton County, Florida, BO, October 2, 2008, it is the U.S. Fish and Wildlife Service's opinion that the effects of the proposed activities are not likely to jeopardize the continued existence of these species and not likely to destroy or adversely modify designated critical habitat for the CBM.

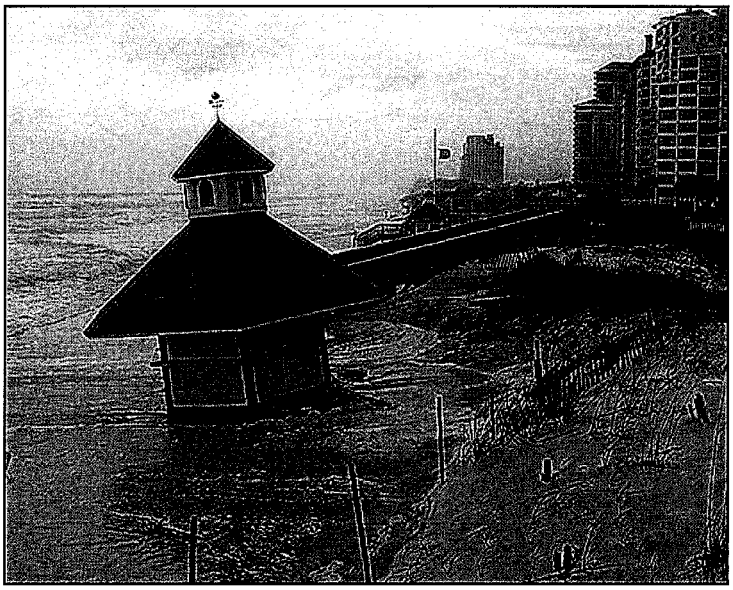
Based on the above determinations, a formal consultation is being requested under Section 7 of the Endangered Species Act. Please find the enclosed BA associated with the proposed action. Please address any questions or concerns to Mr. Larry Parson at (251) 690-3139 or email at larry.e.parson@usace.army.mil.

Sincerely,

Jennifer L. Jacobson
Chief, Coastal Environmental Team

Enclosure

BIOLOGICAL ASSESSMENT
FOR
WALTON COUNTY, FLORIDA HURRICANE AND STORM DAMAGE REDUCTION PROJECT
WALTON COUNTY, FLORIDA



January 2010

Biological Assessment (BA)
Walton County, Florida
Hurricane and Storm Damage Reduction Project

The U.S. Army Corps of Engineers, Mobile District (Corps) is seeking Federal authorization to conduct a hurricane and storm damage reduction project for Walton County, Florida. Walton County's shoreline located in the Florida's panhandle is receding; the protective dunes and high bluffs are being destroyed by hurricane and storm forces that are occurring more frequently than before. During the late 1990s, the area endured several strong hurricanes resulting in extensive shoreline erosion (Taylor Engineering, 2003). In 2004, the area was affected severely by Hurricane Ivan (Sep 04) and early into the 2005 hurricane season it was impacted by Hurricanes Arlene (June 05) and Dennis (July 05). The impacts of these storms to property and infrastructure are considerable and can possibly be reduced through a beach restoration and stabilization project, which also includes environmental restoration opportunities associated with the beach and dune system.

A feasibility study was authorized by a resolution of both the United States Senate and House of Representatives, which reads as follows:

Resolution Adopted July 15, 2002, by The United States Senate:

> *"Resolved by the Committee on Environment and Public Works of the United States Senate, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and related improvements in Walton County, Florida, in the interest of protecting and restoring the environmental recourses on and behind the beach, including the feasibility of providing shoreline and erosion protection and related improvements consistent with the unique characteristics of the existing beach sand, and with consideration of the need to develop a comprehensive body of knowledge, information, and data on coastal area changes and processes as well as impacts from federally constructed projects in the vicinity of Walton County, Florida.*

Resolution Adopted July 24, 2002, by The United States House of Representatives:

> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and environmental restoration and protection in the vicinity of Walton County, Florida.*

The non-Federal sponsor is the Walton County Board of Commissioners. Their central point of contact is the Director of Beach Management for the Walton County Tourist Development Council (TDC).

Project Location

Walton County is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet (Figure 1). The western two-thirds of Walton County are comprised of a coastal peninsula extending from the mainland, and the eastern third is comprised of mainland beaches. Choctawhatchee Bay lies north of the peninsula. Walton County includes 11.9 miles of state-designated critically eroding areas and three State of Florida park areas that cover approximately six miles of the 26-mile shoreline.

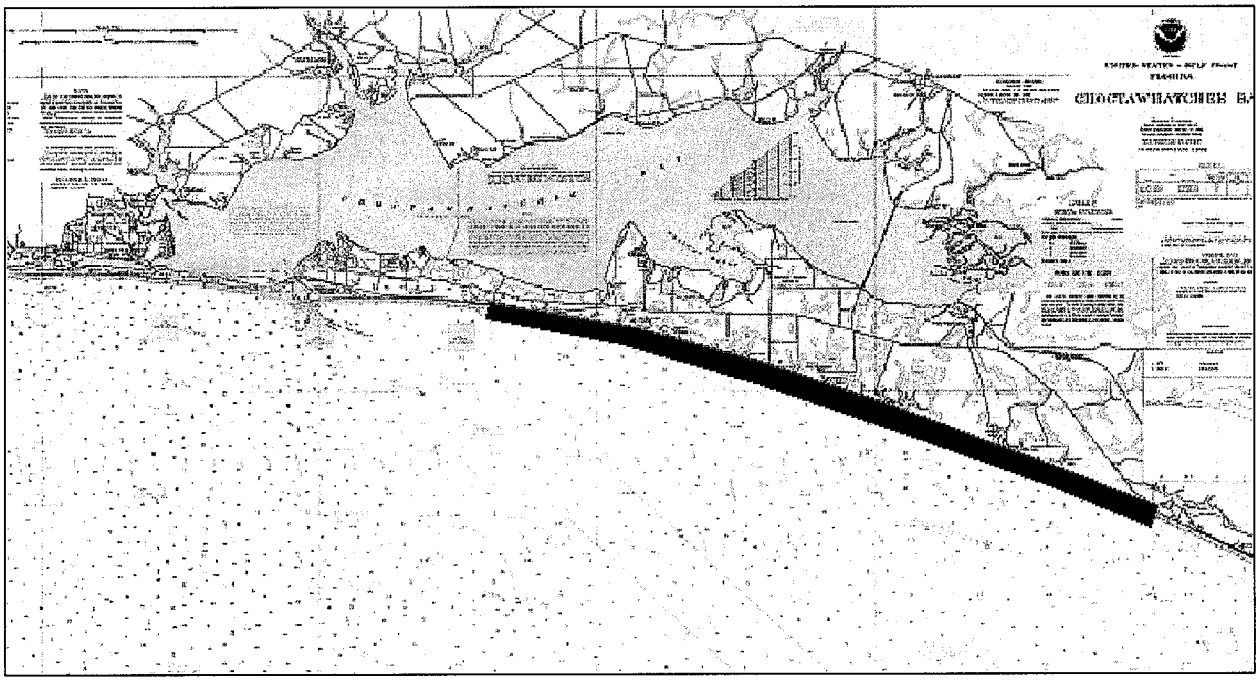


Figure 1. Location of Walton County project area

Project Description

The Walton County upland cross-section is defined by dune elevations ranging from +9.5 to + 33 feet NAVD88 and a natural berm elevation of +5.5 feet NAVD88. The study region was divided into five study reaches based on structural development and state park areas as illustrated in Figure 2. The historical and 2004 beach surveys were used to develop 11 representative profiles which characterize the existing condition for the five study reaches. The representative profiles were identified based on similarity in shape of the upper beach profile (dune height and width, berm width, foreshore beach slope, and profile volume) and shape of the offshore profile.

The tentatively selected plan recommended for construction consists of the five construction reaches. The project will be composed of a 50-foot berm width, a 25-foot

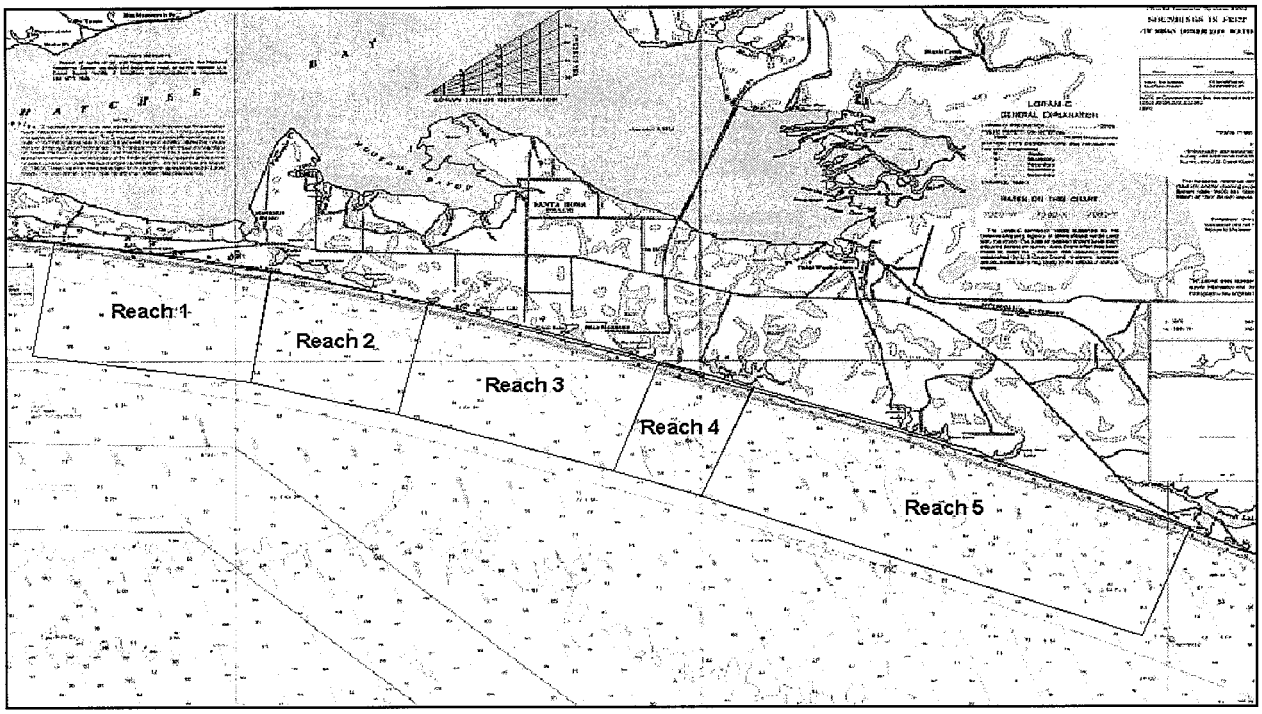


Figure 2. Location of the 5 construction reaches within the project area.

berm and an additional 25 feet of advanced nourishment in all construction reaches. The project will also feature added dune width in all construction reaches of either 10 or 30 feet. The modeling efforts predicted necessary the beach fill requirements to be 3,350,000 cubic yards (cy) for initial construction. Re-nourishments will be on a 12-year cycle with predicted volumes to be approximately 2,000,000 cy. Approved borrow sources lie offshore within the State of Florida waters. The typical cross-sections for the selected plan illustrated in Figure 3. When dune construction is complete, the dune will be planted with at least three species of dune vegetation to create a dune that matches the surrounding natural dune patterns in the area. Upon reconstruction immediate steps will be taken to plant and stabilize the dune for rapid stabilization. This will be accomplished through the use of sand fences and dune plants. The dune plants will be planted to cover 60-80% of the total area. The vegetation will consist of local dominant species that populate nearby natural dune systems. The selection of the dune vegetation will consist of species that are most widely used for dune restoration and are readily available from local nurseries and suppliers. The selection will be coordinated with local experts familiar with dune ecosystems in the immediate area. Species being considered are:

- sea oats *(Uniola paniculata)*
- bitter panic grass *(Panicum ararum)*
- sea rocket *(Cakile constricta)*
- beach morning glory *(Ipomoea imperati)*
- railroad vine *(Ipmea pes-caprae)*
- blue stem *(Schizachyrium scoparium)*
- blanket flower *(Gaillardi pulchella)*

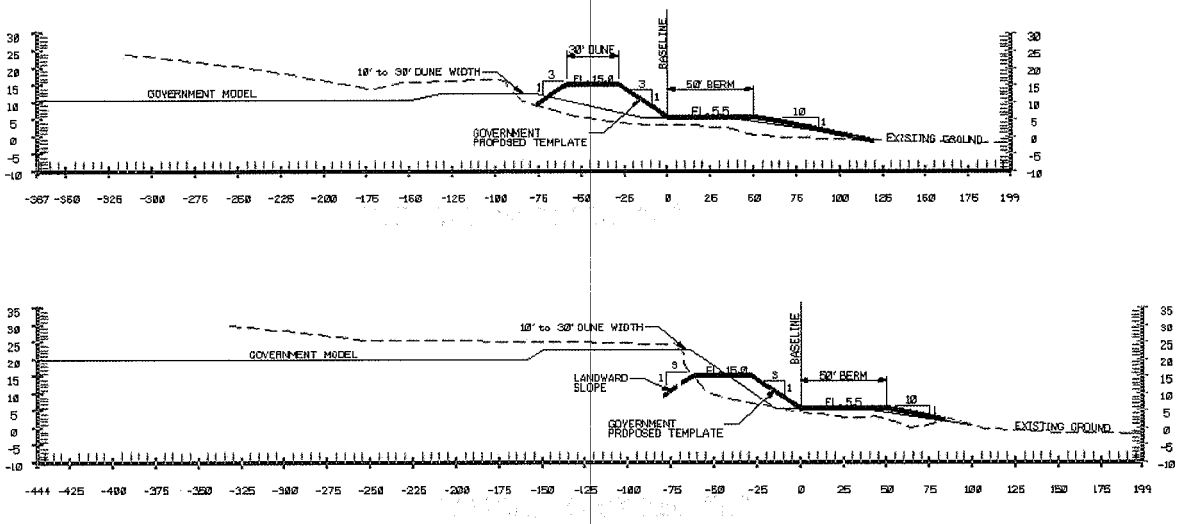


Figure 3. Selected plan typical cross sections to be constructed

Borrow Areas

Recent offshore studies to include geological and geophysical interpretation to identify a suitable offshore borrow area has been performed by Taylor Engineering, Inc. (2003) in the Walton County Destin Beach Management Feasibility Study Final Report under contract to the local sponsor, which conducted investigations on the East Pass area southwest of Destin and the eastern most end of Okaloosa County and the westernmost end of Walton County. Subsequent investigations looked at the entire coastline to assess locations with sufficient quantities for borrow development for the initial beach placement and future re-nourishments.

A large scale reconnaissance level geophysical, lithological and granulomteric investigation was undertaken off Walton County, Florida. Sub-bottom profiles were used initially to locate prospective core locations to identify high quality sand sources for beach nourishment. Vibracores and selected seismic records were interpreted in an attempt to confirm the presence and quality of sand off Walton County.

The proposed borrow area sediments are typically well sorted medium sand (1-2 phi) with some 10,000,000 cubic yards proven by the geotechnical investigations. This volume covers the selected Federal plan placement and the four planned subsequent re-nourishments for the next 50 years. The borrow area is centrally located and offers the best source for now and in the future. Based on the extensive geotechnical investigations, this borrow site has been demonstrated to be the most suitable source, located offshore East Pass, has sand of color, size, and composition generally similar to that of the native beach. All materials used for beach nourishment will be excavated by hopper dredge, transported to the placement area offshore and pumped into the beach template. Small

bulldozers will be used on land to shape the material to the prescribed template. Required Section 7 coordination for the borrow area has been initiated with the National Marine Fisheries Service, Protected Species Division.

Previous Coordination

It should be recognized that the local sponsor proceeded with pursuing a beach restoration plan of their own. Their local project area lays the length of Walton County. The proposed local plan includes a berm design that on average exhibits a construction profile that has a 207-ft wide berm measured from the existing 9.5 ft NAVD contour with a 10-ft wide dune crest. The sponsor's local proposed plan view and profiles are larger than and totally encompass the selected Federal plan described above. Subsequently, the County has already completed the process of applying for the state WQC/CZC. They have also initiated and completed formal consultation for threatened and endangered species as required by the Endangered Species Act (ESA) resulting in the following biological opinion (BO): Walton County Beach Nourishment Project, SAJ-2007-5152 (IP-DEB)/FWS 2008-F-0060 Walton County, Florida, BO, October 2, 2008. Other related coordinations included the Regional Biological Opinion (RBO) for Dredging of Gulf of Mexico Navigation Channels and Sand Mining Areas Using Hopper Dredges by COE Galveston, New Orleans, Mobile, and Jacksonville Districts (Consultation Number F/SER/2000/01287) dated November 19, 2003 and amendments.

Description of Listed Species

There are several environmental concerns that must be addressed in order to achieve environmental compliance for both permitting and National Environmental Protection Act (NEPA). All efforts will be made to conduct the dredging and sand placement during the most desirable environmental windows to the maximum extent practicable to provide protection of species and habitats while accomplishing project objectives.

The project area is host to a variety of wildlife on the State and Federal protected species list presented in Table 1. Of particular concern in the proposed project vicinity are the:

- Atlantic loggerhead turtle *(Caretta caretta caretta)*
- Atlantic green turtle *(Chelonia mydas mydas)*
- Kemp's ridley turtle *(Lepidochelys kempi)*
- Leatherback turtle *(Dermochelys coriacea)*
- Gulf sturgeon *(Acipenser oxyrinchus desotoi)*
- West Indian manatee *(Trichechus manatus floridanus)*
- Choctawhatchee Key beach mouse *(Peromystus polionotus allophrys)*
- piping plover *(Charadvius melundus)*

Table 1. State and Federal Listed Species

Common Name	Scientific Name	State	Federal
Fish			
Gulf sturgeon	*Acipenser oxyrhynchus desotoi*	SSC	n/a
salt marsh topminnow	*Fundulus jenkinsi*	SSC	n/a
Reptiles			
American alligator	*Alligator mississipiensis*	SSC	T (s/a)
Atlantic loggerhead turtle	*Caretta caretta caretta*	T	T
Leatherback turtle	*Dermochelys coriacea*	E	E
Atlantic green turtle	*Chelonia mydas mydas*	E	E
Kemp's ridley	*Lepidochelys kempi*	E	E
Birds			
snowy plover	*Charadrius alexandrinus tenuirostris*	T	SSC
piping plover	*Charadrius melodus*	T	T
Arctic peregrine falcon	*Falco peregrinus tundrius*	E	T
American oystercatcher	*Haematopus palliatus*	SSC	n/a
bald eagle	*Haliaeetus leucocephalus*	T	T
brown pelican	*Pelecanus occidentalis*	SSC	n/a
least tern	*Sterna antillarum*	T	n/a
Mammals			
Choctawhatchee beach mouse	*Peromystus polionotus allophrys*	E	E
West Indian manatee	*Trichechus manatus*	E	E

State listings are taken from the Florida Fish and Wildlife Conservation Commission or as with plants Florida Department of Agriculture. Federal listings are taken from the United States Fish and Wildlife Service. E = Endangered; T = Threatened; T (s/a) = Threatened due to similarity in appearance; SSC = Species of Special Concern; UR = Under review; n/a = information not available or no designation listed

Atlantic Loggerhead Sea Turtle

The loggerhead sea turtle is a medium to large turtle. Adults are reddish-brown in color and generally 31 to 45 inches in shell length with the record set at more than 48 inches. Loggerheads weigh between 170 and 350 pounds with the record set at greater than 500 pounds. Young loggerhead sea turtles are brown above and whitish, yellowish, or tan beneath, with three keels on their back and two on their underside.

Loggerhead sea turtles occur throughout the temperate and tropical regions of the Atlantic, Gulf of Mexico, Pacific, and Indian Oceans. This species may be found hundreds of miles out to sea, as well as in inshore areas, such as bays, lagoons, salt marshes, creeks, and the mouths of large rivers. In shallow Florida lagoons, loggerheads were found during the morning and evening, leaving the area during mid-day when temperatures reached 87° F. At dusk, turtles moved to a sleeping site and remained there until morning, possibly in response to changes in light or water temperature (Nelson 1986).

Loggerhead turtles are essentially carnivores, feeding primarily on sea urchins, sponges, squid, basket stars, crabs, horseshoe crabs, shrimp, and a variety of mollusks. Their strong beak-like jaws are adapted for crushing thick-shelled mollusks. Although loggerhead sea turtles are primarily bottom feeders, they also eat jellyfish and mangrove leaves obtained while swimming and resting near the sea surface. Presence of fish species, such as croaker, in stomachs of stranded individuals may indicate feeding on the by-catch of shrimp trawling (Landry 1986). Caldwell et al. (1955) suggest that the willingness of the loggerhead to consume any type of invertebrate food permits its range to be limited only by the presence of cold water.

As loggerheads mature, they travel and forage through nearshore waters until their breeding season, when they return to the nesting beach areas. The majority of mature loggerheads appear to nest on a two or three year cycle. Major nesting beaches for loggerheads include the Sultanate of Oman, southeastern United States, and eastern Australia. From a global perspective, the southeastern U.S. nesting aggregation is of paramount importance to the survival of the species and is second in size only to the nesting aggregation on Masirah Island, Oman. This species nests within the U.S. from Texas to Virginia, although the major nesting concentrations are found along the Atlantic cost of Florida, Georgia, South Carolina, and North Carolina. About 80 percent of all loggerhead nesting in the southeastern U.S. occurs in six Florida counties (Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties). Total estimated nesting in the U.S. is approximately 50,000 to 70,000 nests per year. Nesting in the northern Gulf outside of Florida occurs primarily on the Chandeleur Islands in Louisiana and to a lesser extent on adjacent Ship, Horn, and Petit Bois Islands in Mississippi.

Loss or degradation of suitable nesting habitat may be the most important factor affecting the nesting population in northern Gulf of Mexico. Overall the loss of nesting beaches, hatchling disorientation from artificial light, drowning in fishing and shrimping

trawls, marine pollution, and plastics, and styrofoam have led to the decline of loggerheads.

Loggerhead sea turtles are considered turtles of shallow water. Juvenile loggerheads are thought to utilize bays and estuaries for feeding, while adults prefer waters less than 165 feet deep (Nelson 1986). Aerial surveys suggests that loggerheads (benthic immatures and adults) in U.S. waters are distributed in the following proportions: 54% in the southeast U.S. Atlantic, 29% in the northeast U.S. Atlantic, 12% in the eastern Gulf of Mexico, and 5% in the western Gulf of Mexico. During aerial surveys of the Gulf of Mexico, the majority (97 percent) of loggerheads were seen off the east and west coasts of Florida (Fritts 1983). Most were observed around mid-day near the surface, possibly related to surface basking behavior (Nelson 1986). Although loggerheads were seen off the coast of Alabama, Mississippi, and Louisiana, they were 50 times more abundant in Florida than in the western Gulf. The majority of the sightings were in the summer (Fritts et al. 1983). An individual tagged in Perdido Bay, Alabama was recaptured one year later only about a mile from the original capture site. In another case, a loggerhead had moved from Perdido Bay, Alabama into Pensacola Bay, Florida over a several month period.

Loggerheads are frequently observed near offshore oil platforms, natural rock reefs, and rock jetties along the Gulf Coast. Large numbers of stranded turtles were observed inshore of such areas (Rabalais and Rabalais 1980). Fishermen reported sightings of large turtles near the Gulf Coast. In a recent tracking study, loggerheads spent more than 90 percent of the time underwater, tended to avoid colder water, and spent much of the time in the vicinity of oil and gas structures, such as those found offshore of Mississippi and Alabama.

Green Sea Turtle

The green sea turtle is mottled brown in color. The name is derived from the greenish fat of the body. The carapace is light or dark brown. It is sometimes shaded with olive, often with radiating mottled or wavy dark markings or large dark brown blotches. This species is considered medium to large in size for sea turtles with an average length of 36 to 48 inches. The record was set at about 60 inches in length. Its weight ranges from about 250 to 450 pounds with the record at more than 650 pounds. The upper surfaces of young green turtles are dark brown, while the undersides are white.

Although green sea turtles are found worldwide, this species is concentrated primarily between the 35° North and 35° South latitudes. Green sea turtles tend to occur in waters that remain warmer than 68° F; however, there is evidence that they may be buried under mud in a torpid state in waters to 50° F (Ehrhart 1977; Carr et al. 1979).

This species migrates often over long distances between feeding and nesting areas (Carr and Hirth 1962). During their first year of life, green sea turtles are thought to feed mainly on jellyfish and other invertebrates. Adult green sea turtles prefer an herbivorous diet frequenting shallow water flats for feeding (Fritts et al. 1983). Adult turtles feed primarily on seagrasses, such as *Thalassia testudinum*. This vegetation provides the

turtles with a high fiber content and low forage quality (Bjorndal 1981a). Caribbean green sea turtles are considered to be nutrient-limited, resulting in low growth rate, delayed sexual maturity, and low annual reproductive effort. This low reproductive effort makes recovery of the species slow once the adult population numbers have been severely reduced (Bjorndal 1981). In the Gulf of Mexico, principal foraging areas are located in the upper west coast of Florida. Nocturnal resting sites may be a considerable distance from feeding areas, and distribution of the species is generally correlated with grassbed distribution, location of resting beaches, and possibly ocean currents (Hirth 1971).

Major nesting areas for green sea turtles in the Atlantic include Surinam, Guyana, French Guyana, Costa Rica, the Leeward Islands, and Ascension Island in the mid-Atlantic. Historically in the U. S., green turtles have been known to nest in the Florida Keys and Dry Tortugas. Yet, these turtles primarily nest on selected beaches along the coast of eastern Florida, predominantly Brevard through Broward Counties. However, they probably nested along the Gulf Coast before their decline. In the southeastern U.S., nesting season is roughly June through September. Nesting occurs nocturnally at 2, 3, or 4-year intervals. Only occasionally do females produce clutches in successive years. Estimates of age at sexual maturity range from 20 to 50 years (Balazs 1982; Frazer and Ehrhart 1985) and they may live over 100 years. Immediately after hatching, green turtles swim past the surf and other shoreline obstructions, primarily at depths of about 8 inches or less below the water surface, and are dispersed both by vigorous swimming and surface currents. The whereabouts of hatchlings to juvenile size is uncertain. Green turtles tracked in Texas waters spent more time on the surface, with fewer submergences at night than during the day, and a very small percentage of the time was spent in the Federally maintained navigation channels. The tracked turtles tended to utilize jetties, particularly outside of them, for foraging habitat (Renaud et. Al. 1993).

Most green turtle populations have been depleted or endangered because of direct exploitation or incidental drowning in trawl nets. A major factor contributing to the green turtle's decline worldwide is commercial harvest for eggs and meat. In Florida, the nesting population was nearly extirpated within 100 years of the initiation of commercial exploitation. Fibropapillomatosis, a disease of sea turtles characterized by the development of multiple tumors on the skin and internal organs, is also a mortality factor and has seriously impacted green turtle populations in Florida, Hawaii, and other parts of the world. These tumors interfere with swimming, eating, breathing, vision, and reproduction, and turtles with heavy tumor burdens become severely debilitated and die. Other threats include loss or degradation of nesting habitat from coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and incidental take from commercial fishing operations.

Leatherback Sea Turtle

The leatherback sea turtle is the largest of all sea turtles. It may reach a length of about 7 feet and weigh as much as 1600 pounds. The carapace is smooth and is colored gray, green, brown and black. The plastron is yellowish white. Juveniles are black on top and white on the bottom.

This species is highly migratory and is the most pelagic of all sea turtles (NMFS and USFWS 1992). They are commonly found along continental shelf waters. Leatherback turtles' range extends from Cape Sable, Nova Scotia, south to Puerto Rico and the U.S. Virgin Islands. Leatherbacks are found in temperate waters while migrating to tropical waters to nest (Ross 1981). Distribution of this species has been linked to thermal preference and seasonal fluctuations in the Gulf Stream and other warm water features (Fritts et al. 1983). General decline of this species is attributed to exploitation of eggs (Ross 1981).

Leatherback sea turtles are omnivorous. Leatherbacks feed mainly on pelagic soft-bodied invertebrates such as jellyfish and tunicates. Their diet may also include squid, fish, crustaceans, algae, and floating seaweed. Highest concentrations of these prey animals are often found in upwelling areas or where ocean currents converge. They will also ingest plastic bags and other plastic debris, which are commonly generated by oil drilling rigs and production platforms in coastal Florida, Alabama, Mississippi, and Louisiana (Fritts et al. 1983).

Nesting of leatherback sea turtles is nocturnal with only a small number of nests occurring in the United States in the Gulf of Mexico (Florida) from April to late July (Pritchard 1971; Fuller 1978; Fritts et al. 1983). Leatherbacks prefer open access beaches possibly to avoid damage to their soft plastron and flippers. Unfortunately, such open beaches with little shoreline protection are vulnerable to beach erosion triggered by seasonal changes in wind and wave direction. Thus, eggs may be lost when open beaches undergo severe and dramatic erosion. The Pacific coast of Mexico supports the world's largest known concentration of nesting leatherbacks. There is very little nesting in the United States (Gunter 1981).

Disturbance of the nesting grounds is the most serious threat to leatherback sea turtles. Although the flesh of this sea turtle is not eaten, the population has been threatened by egg-harvesting in countries such as Malaysia, Surinam, the Guianas, the west coast of Mexico, Costa Rica, and in several Caribbean islands. Leatherbacks were killed in the past for the abundant oil they yield, which was used for oil lamps and for caulking wooden boats. Ingesting plastic bags and other plastic wastes are another cause of death for leatherbacks turtles. The sea turtles confuse plastic wastes with one of their favorite foods jellyfish. When swallowed, plastics can clog a turtle's throat, esophagus, and intestines.

Kemp's ridley turtle

The Kemp's ridley occurs mainly in coastal areas of the Gulf of Mexico and the northwestern Atlantic Ocean with occasional individuals reaching European waters. Adults of this species are generally confined to the Gulf of Mexico, although some adults are sometimes found on the east coast of the U.S. Females return to their nesting beach about every other year with nesting occurring from April into July and usually limited to the western Gulf of Mexico. The mean clutch size for this species is about 100 eggs per nest and an average of 2.5 nests per female per season.

Benthic immature turtles have been found along the eastern seaboard of the U.S. and in the Gulf of Mexico. In Gulf, studies suggest that immature turtles stay in shallow, warm, nearshore waters in the northern Gulf until cooling waters force them offshore or south along the Florida coast (Renaud 1995). Little is known of the movements of the post-hatching stage (pelagic stage) within the Gulf. Studies have indicated that this stage varies from 1 to 4 or more years and the benthic immature stage lasts about 7 to 9 years. The maturity age of this species is estimated to be 7 to 15 years. Of the seven extant species of sea turtles, the Kemp's ridley has declined to the lowest population level. However, recent studies have indicated that increased nesting activities and suggest that the decline in ridley population has stopped and the population is now increasing. A period of steady increase in the benthic immature turtles has been occurring since 1990 and suggests a result of increased hatchling production and survival rates of the immature turtles. The increased survival of immature individuals is believed to be in part a result of the use of turtle exclusion devices (TEDs) in the commercial shrimping fleets. Future threats to the species include interaction with fishery gear; marine pollution; destruction of foraging habitat; illegal poaching; and impacts to nesting beaches associated with rising sea level, development, and tourism pressure.

Gulf Sturgeon

The National Marine Fisheries Service (NMFS) and FWS listed the Gulf sturgeon as a threatened species on September 30, 1991 and designated critical habitat areas as defined by the Federal Register Vol. 68, No. 53. For purposes of this project consultation, Gulf sturgeon fall under the jurisdiction of the NMFS. A formal consultation with NMFS regarding the effects of the proposed action on Gulf sturgeon and subsequent potential modification to Gulf sturgeon critical habitat has been initiated and will not be considered further in this Biological Assessment (BA).

West Indian Manatee

The West Indian manatee, also known as the Florida manatee, is a federally-listed endangered aquatic mammal protected under the ESA. Manatees inhabit both salt and fresh water and can be found in shallow (5 ft to usually <20 ft), slow-moving rivers, estuaries, saltwater bays, canals, and coastal areas (FWS, 1991) throughout their range. On occasion, manatees have been observed as much as 3.7 miles off the Florida

Gulf coast. The West Indian manatee is herbivorous and eats aquatic plants, such as hydrilla, eelgrass, and water lettuce.

During the cooler months between October and April, Florida manatees concentrate in areas of warmer water. Manatees are thermally stressed at water temperatures below 18°C (64.4°F); therefore, during winter months, when ambient water temperatures approach 20°C (68°F), manatee population confines itself to the coastal waters of the southern half of peninsular Florida and to springs and warm water industrial outfalls as far north as southeast Georgia. Manatees also winter in the St. Johns River near Blue Spring State Park. Severe cold fronts have been known to kill manatees when the animals did not have access to warm water refuges. During summer months, they may migrate as far north as coastal Virginia on the east coast and the Louisiana coast on the Gulf of Mexico and appear to choose areas based on an adequate food supply, water depth, and proximity to fresh water. Annual migratory circuits of some individuals through the intracoastal waterway of the Atlantic Coast are 1,700 km round trips at seasonal travel rates as high as 50 km/day.

Manatee population trends are poorly understood, but deaths have increased steadily. The population of manatees in Florida has been estimated to be at least 1,865 individuals. In the last decade, yearly mortality in Florida has averaged nearly 150 animals a year. A large percent of mortality is due to collisions with watercrafts, especially of calves. Another closely related factor in their decline has been the loss of suitable habitat through incompatible coastal development, particularly destruction of sea grass beds by boating facilities.

Piping Plover

The piping plover is a small, pale-colored North American shorebird. The bird's light sand-colored plumage blends in with the sandy beaches and shorelines that are its primary habitat. It weighs 1-2 ounces (43-63 grams) and is 6-6 ½ inches (17-18 centimeters) long. During the breeding season the legs are bright orange and the short stout bill is orange with a black tip. There are two single dark bands, one around the neck and one across the forehead between the eyes. Plumage and leg color help distinguish this bird from other plovers. The female's neck band is often incomplete and is usually thinner than the male's neck band. In winter, the bill turns black, the legs remain orange but pale, and the black plumage bands on the head and neck are lost. Chicks have speckled gray, buff, and brown down, black beaks, orange legs, and a white collar around the neck. Juveniles resemble wintering adults and obtain their adult plumage the spring after they fledge

Historically, piping plovers bred across three geographic regions. These regions include: the United States and Canadian Northern Great Plains from Alberta to Manitoba and south to Nebraska; the Great Lakes beaches; and the Atlantic coastal beaches from Newfoundland to North Carolina. Currently, piping plovers live in an area similar to their historical range, although the numbers of those breeding in the Great Lakes region have decreased significantly since the 1930s. The Great Lakes breeding population is now found mainly in Michigan, with one pair nesting in Wisconsin. Generally, piping

plovers favor open sand, gravel, or cobble beaches for breeding. Breeding sites are generally found on islands, lake shores, coastal shorelines, and river margins.

Birds from all three populations build their nests in the north but spend the winter along the south Atlantic and Gulf coasts, sometimes arriving as early as mid-July. Since the three populations are indistinguishable from one another, while on their overlapping wintering grounds, all plovers are classified as threatened in their wintering areas.

Piping plovers winter in coastal areas of the United States from North Carolina to Texas. They also winter along the coast of eastern Mexico and on Caribbean islands from Barbados to Cuba and the Bahamas. Information from observation of color-banded piping plovers indicate that the winter range of the three breeding populations overlap, to a significant degree. Therefore, the source breeding population of a given wintering individual cannot be accurately determined in the field, without having marked the individual. The 1996 census numbers reflect the following: Great Lakes – approximately 32 breeding pairs (all but one of these pairs are in Michigan); Northern Great Plains (including the Canadian Prairie region) – approximately 1,398 breeding pairs; and the Atlantic Coast – approximately 1372 breeding pairs.

Piping plovers begin arriving on the wintering grounds in early July, with some late nesting birds arriving in September. A few individuals can be found on the wintering grounds throughout the year, but sightings are rare in June and early July. Migration is poorly understood, but most piping plovers probably migrate non-stop to wintering grounds.

Piping plovers feed along beaches and intertidal mud and sand flats. Primary prey for piping plovers includes worms, various crustaceans, insects, and occasionally bivalve mollusks. Many of the coastal beaches traditionally used by piping plovers for nesting, feeding, and roosting have been lost to commercial, residential, and recreational developments. Also, developments near beaches provide food that attracts increased numbers of predators, such as raccoons, skunks, and foxes. Water level manipulation along the major rivers may also lead to loss of breeding habitat. In order to recover the piping plover and remove it from the endangered species list, threats to reproductive success at breeding grounds must be addressed. Availability of quality foraging and roosting habitat in the regions where this species winters is necessary in order to insure that an adequate number of adults survive to migrate back to breeding sites and successfully nest. Piping plovers often nest on beaches where people like to live and enjoy the shoreline. Their nests accidentally get stepped on or crushed by people and vehicles. The presence of people also may cause the birds to desert the nest, exposing eggs or chicks to the hot sun and predators. Interruption of feeding may stress juvenile birds during critical periods in their life cycle. Pets, especially dogs, may harass or kill the birds.

Critical habitat for the piping plover is identified on the attached map in the vicinity of the project area. The primary constituent elements essential for the conservation of the wintering plovers are those habitat components that support foraging, roosting, sheltering and the physical features necessary to maintaining the natural processes that support these habitat components. The primary constituent elements are

found in geologically dynamic coastal areas that support or have the potential to support intertidal beaches and flats and associated dune systems. Important components of intertidal flats include sand and or mud flats with no or sparse emergent vegetation.

Choctawhatchee Beach Mouse.

The Choctawhatchee beach mouse (CBM), a federally listed endangered species, inhabits the coastal dune communities along portions of the northern Gulf coast. This endemic subspecies once had a historic range from East Pass in Okaloosa County to Shell Island in Bay County. Today, only three main populations exist in Topsail Hill State Preserve and Grayton Beach State Recreation Area in Walton County, and Shell Island in Bay County. The FWS designated all three areas as critical habitat for the CBM. In Walton County, Topsail Hill State Preserve comprises about 200 acres of critical habitat along 2.7 miles of coastline. Critical habitat within Grayton Beach State Recreation Area consists of 67 acres along 1.7 miles of coastline. The Florida Department of Environmental Protection manages these areas. The population at Grayton Beach State Recreation Area exists only as a result of a translocation program in cooperation with the Florida Fish and Wildlife Conservation Commission (FWCC) and the Florida Department of Environmental Protection.

Beach mouse habitat is restricted to mature coastal barrier sand dunes along the Gulf. Optimal beach mouse habitat should have: (1) high maximum elevation of coastal sand dunes; (2) relatively great differences between maximum dune height and minimum interdunal elevation; (3) close proximity of forest; (4) a sparse ground cover, and (5) relatively low cover of sea oats. Early research suggested that the frontal dune system was a significant habitat component utilized by the beach mice. However, new research suggests that scrub dune habitat serves an invaluable role in the persistence of the beach mouse population. Therefore, habitat components considered critical for beach mice extend from the frontal dune landward to the transition from scrub habitat to maritime forest. Within the rows of dunes paralleling the shoreline towards the scrub habitat are three microhabitats including the frontal dune (primary), interdunal areas (secondary), and inland dunes (scrub). The primary, secondary, and scrub dune habitat is utilized for burrow sites, food resources, cover, and high-elevation refuge from storm events. The food plants most utilized by beach mice are beach grass and sea oats; however, they may eat invertebrates when seed sources are scarce in the late winter or early spring (USFWS, 1992).

Beach mice are burrow-inhabiting animals occupying either old burrow of ghost crabs or digging their own burrows. Burrows are located mainly on the lee side of the primary, secondary, and scrub dunes where vegetation provides suitable cover. As many as 20 burrows may be found within their home range, suggesting that they are semi-nomadic. Each burrow may be used for various purposes (refuge, nesting, food storage, etc.) at different periods of time. Beach mice are nocturnal, spending the day sleeping in their burrows and foraging at night.

Critical habitat receives protection under section 7 of the ESA through the prohibition against destruction or adverse modification of critical habitat with regard to

actions carried out, funded, or authorized by a Federal agency. Critical habitat determinations are based on the best scientific data available and consider those physical and biological features (primary constituent elements) that are essential to the conservation of the species, and that may require special management considerations and protection.

The FWS issued in the Federal Register a proposed rule for revising designated critical habitat for the Perdido Key (PKM) and CBM. The primary constituent elements of critical habitat for the PKM and CBM are the habitat components that provide: (1) a contiguous mosaic of primary, secondary, and scrub vegetation and dune structure, with a balanced level of competition and predation and few or no competitive or predaceous non-native species present, that collectively provide foraging opportunities, cover, and burrow sites, (2) Primary and secondary dunes, generally dominated by sea oats, that, despite occasional temporary impacts and reconfiguration from tropical storms and hurricanes, provide abundant food resources, burrow sites, and protection from predators, (3) scrub dunes, generally dominated by scrub oaks, that provide food resources and burrow sites, and provide elevated refugia during and after intense flooding due to rainfall and/or hurricane-induced storm surge, (4) functional, unobstructed habitat connections that facilitate genetic exchange, dispersal, natural exploratory movements and re-colonization of locally extirpated areas, and (5) a natural light regime within the coastal dune ecosystem, compatible with the nocturnal activity of beach mice, necessary for normal behavior, growth, and viability of all life stages. The Perdido Key beach mouse is located in critical habitat units (1) Gulf State Park Unit, (2) West Perdido Key Unit, and (3) Perdido Key State Park Unit.

Effects of Proposed Action

Sea Turtles

The effects of beach nourishment and impacts on nesting sea turtles has been extensively documented and indicate that, in nesting success rates may decrease the year following beach placement as a result of escarpments, altered beach profiles, and sand compaction. Post-placement monitoring has shown an increase in abandoned nest attempts on altered beaches compared to that of unnourished beaches as well as increases water inundation during the beach equilibration process. This suggests that a post-placement decline in nesting is a result from variation in the beach profile than beach compaction and escarpment formation. Other studies, however, have shown that sediment used for the nourishment of some beaches in Florida exhibited little or no impediments to nesting sea turtles and that the physical characteristics of the placed sediment did not cause excessive scarp formation and limit their ability to nest across the beach. Minimal post-placement effects can be achieved by using compatible beach material and innovative design methods. For this particular project, the sand dredged from the borrow area and placed on the beach or nearshore matches closely with the native beach sand. However, there will likely be some potential impacts resulting from altering the profile and equilibration process. Changes in beach slope as well as the

development of escarpments may develop along the mean high water line as the constructed beach adjusts from a construction profile to a natural beach profile

Though the equilibration process and subsequent escarpment formation are features of most beach projects, management techniques can be implemented to reduce the impact of escarpment formations. For completed sections of beach during beach construction operations, and for subsequent three years following as the construction profile approaches a more natural profile, visual surveys for escarpments would be performed. Escarpments that are identified prior to or during the nesting season that interfere with sea turtle nesting (exceed 18 inches in height for a distance of 100 ft.) can be leveled to the natural beach for a given area for these three subsequent years. If it is determined that escarpment leveling is required during the nesting or hatching season, actions should be taken as directed by the FWS.

It likely that pipeline equipment will be used to place the material on the beach and if conducted within the nesting season, may act as an impediment to nesting females and/or hatchlings. Nesting females may either encounter the pipe and false crawl, or nest in front of the pipeline in a potentially vulnerable area to erosion and water inundation. This problem can easily be avoided by conducting the beach placement outside of the turtle nesting window.

The presence of artificial lighting on or within the vicinity of nesting beaches has shown to be detrimental to the nesting process both for the nesting females and emerging hatchlings. Lighting on beaches tends to deter sea turtles emerging from the sea to nest and the sea-finding process of hatchlings during the nest emergence. The impact of light on nesting females and hatchlings can be minimized by reducing the number and wattage of light sources or by modifying the direction of light sources through shielding, redirection, elevational modifications, etc. During construction, all lighting will be minimized to the maximum extent practicable while maintaining compliance with all Corps, OSHA, and Coast Guard requirements.

All efforts will be made to conduct the proposed dredging and placement activities outside of the sea turtle nesting window. Additionally, the conservation measures and recommendations specified in the RBO for Dredging of Gulf of Mexico Navigation Channels and Sand Mining Areas Using Hopper Dredges will be followed to the maximum extent practicable. However, it is inevitable that some of the placed sand will remain on the beach during subsequent nesting seasons. Given these considerations it was initially determined that the proposed action may adversely affect sea turtles. However, after considering the findings of the BO issued for the local plan which is larger than and totally encompasses the selected Federal plan, it is the FWS's opinion that the effects of the proposed activities are not likely to jeopardize the continued existence of the loggerhead, green, leatherback, or Kemp's ridley sea turtles.

West Indian Manatee

Manatees may be occasionally found in the shallow waters of the project area during the warmer months of the year. Given their slow-moving and low visibility

nature, it is possible that manatees could wander into close proximity of the dredging and placement operations. To minimize contact and potential injury to manatees, the Manatee Construction Conservation Measures as specified by the FWS letter dated August 31, 2006 will be strictly observed. In addition, there will be NMFS approved observers on board all hopper dredge operations. By adhering to these measures and recommendations, the proposed action may affect but not likely to adversely affect manatees.

Piping Plovers

The beach placement proposed during this action may actually enhance beach habitat and even potentially restore lost habitat in the long term. However, short-term impacts to foraging and roosting habitat may occur during beach construction operations. Since piping plovers do not nest in Florida, construction activities will not impact breeding and nesting activities. Wintering habitat for roosting and foraging may be impacted; however, project construction limits will avoid areas designated as critical habitat to the maximum extent practicable. Direct short-term foraging habitat losses may occur during the placement of sediment on the beach and associated construction operations. Since only a small portion of the foraging habitat is directly affected at and around the discharge site, adjacent habitat is still available and the overall direct loss of foraging habitat will be minimal and short-term. However, the placement of sediment on the beach may temporarily impact foraging, sheltering, and roosting habitat and; therefore, it was initially determined that the beach and dune placement activities may adversely affect piping plovers. However, after considering the findings of the BO issued for the local plan which is larger than and totally encompasses the selected Federal plan, it is the FWS's opinion that the effects of the proposed activities are not likely to jeopardize the continued existence of non-breeding piping plover.

Choctawhatchee Beach Mouse (CBM)

The direct dune and beach placement is adjacent to designated critical habitat for the CBM. The placement of sediment directly on the beach and seaward of the toe of the existing primary dune line would not generally impact existing habitat. Pipeline routes for beach construction will be avoided for identified primary constituent elements for critical habitat. Considering that much of the mature coastal barrier sand dunes and scrub dune habitat on the Gulf and Atlantic coasts of Florida have been lost and populations of beach mice have declined as a result, the development of new habitat or enhancement of existing habitat is beneficial to the recovery goals of beach mice. Dune restoration activities allows for the availability of materials for the natural formation and growth of primary and secondary dunes. Such processes would help in the development of new beach mouse habitat and may aid in the enhancement and expansion of existing populations by stabilizing and enhancing existing dune communities with available sand and associated aeolian transport processes. This in turn promotes natural recruitment of native dune vegetation that contributes to the primary constituent elements for critical habitat by providing food resources for beach mice.

With these considerations in mind and the uncertainties associated with the direct beach placement and location of the dune building processes it was initially determined that the action may adversely affect the CBM and designated critical habitat. However, after considering the findings of the BO issued for the local plan which is larger than and totally encompasses the selected Federal plan, it has been determined that the effects of the proposed activities are not likely to jeopardize the continued existence of the CBM and is not likely to destroy or adversely modify designated critical habitat for the CBM.

Conclusions

Based upon the findings of this BA, the following determinations have been made:

Sea Turtles – All efforts will be made to conduct the proposed dredging and placement activities outside of the sea turtle nesting window. The conservation measures and recommendations specified in the RBO for Dredging of Gulf of Mexico Navigation Channels and Sand Mining Areas Using Hopper Dredges will be followed to the maximum extent practicable. During construction, all lighting will be minimized to the maximum extent practicable while maintaining compliance with all Corps, OSHA, and Coast Guard requirements. After placement of material on the beaches and prior to April 15 for three (3) subsequent years, if placed sand still remains on the beach, compaction testing will be performed in accordance with a accepted protocols to determine if tilling is necessary. Tilling may be conducted in lieu of compaction testing.

Because it is inevitable that some of the placed sand will remain on the beaches during subsequent nesting seasons was initially determined that the proposed action may adversely affect sea turtles. However, after considering the findings of the BO (SAJ-2007-5152 (IP-DEB)/FWS 2008-F-0060) issued October 2, 2008 for the local plan which is larger than and totally encompasses the selected Federal plan, it is the Fish and Wildlife Service's opinion that the effects of the proposed activities are not likely to jeopardize the continued existence of the loggerhead, green, leatherback, or Kemp's ridley sea turtles.

West Indian Manatee - To minimize contact and potential injury to manatees, the Manatee Construction Conservation Measures as specified by the FWS letter dated August 31, 2006 will be strictly observed. In addition, there will be NMFS approved observers on board all hopper dredge operations. By adhering to these measures and recommendations, the proposed action may affect but not likely to adversely affect manatees.

Piping Plover - The placement of sediment on the beach may temporarily impact foraging, sheltering, and roosting habitat and therefore was initially determined that direct beach placement of sediment may adversely affect piping plovers. However, after considering the findings of the BO issued for the local plan which is larger than and totally encompasses the selected Federal plan, it is the Fish and Wildlife Service's opinion that the effects of the proposed activities are not likely to jeopardize the continued existence of non-breeding piping plover.

Choctawhatchee beach mouse - Direct beach placement and dune restoration of compatible sand may enhance existing habitat or establish new habitat for beach mice. It was initially determined that the action may adversely affect the Perdido Key beach mouse or designated critical habitat. However, after considering the findings of the BO issued for the local plan which is larger than and totally encompasses the selected Federal plan, it is the Fish and Wildlife Service's opinion that the effects of the proposed activities are not likely to jeopardize the continued existence of the CBM and is not likely to destroy or adversely modify designated critical habitat for the CBM.

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DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

January 15, 2010

Coastal Environment Team
Planning and Environmental Division

Mr. Eric Hawk
National Marine Fisheries Service,
Southeast Regional Office
Protected Resources Division
263 13th Avenue South
St. Petersburg, Florida 33701

Dear Mr. Hawk:

The U.S. Army Corps of Engineers (Corps), Mobile District is seeking Federal authorization to conduct a hurricane and storm damage reduction project for Walton County, Florida. Walton County is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet as illustrated in the attached biological assessment (BA). This area and the adjacent waters support federally protected species under your agency's purview, such as sea turtles (loggerhead, green, leatherback, and Kemp's ridley) and Gulf sturgeon and its designated critical habitat. Based on our evaluation of the selected Federal plan described in the BA, it is our assessment that the actions may have an adverse affect on sea turtles and Gulf sturgeon but not likely to jeopardize their continued existence, which are covered under the Regional Biological Opinion (RBO) for Dredging of Gulf of Mexico Navigation Channels and Sand Mining Areas Using Hopper Dredges by COE Galveston, New Orleans, Mobile, and Jacksonville Districts (Consultation Number F/SER/2000/01287) dated November 19, 2003 and amendments.

Formal consultation is being requested under Section 7 of the Endangered Species Act (ESA) regarding Gulf sturgeon and its designated critical habitat for the selected Federal plan described in the enclosed BA. The local sponsor proceeded with pursuing a beach restoration plan of their own in which their proposed project is larger than and totally encompasses the selected Federal plan and uses the same borrow area. Subsequently, the County has initiated and completed formal ESA Section 7 consultation with the National Marine Fisheries Service (NMFS), Protected Resources Division concerning Gulf sturgeon critical habitat which resulted in a letter dated August 13, 2008 stating that the NMFS has determined that the proposed action is not likely to adversely affect Gulf Sturgeon critical habitat. A copy of this letter is included with this BA. The Corps is therefore requesting that consideration be given to applying that coordination to the selected Federal plan.

Please address any questions or concerns to Mr. Larry Parson at (251) 690-3139 or email at larry.e.parson@usace.army.mil.

Sincerely,

Jennifer L. Jacobson
Chief, Coastal Environmental Team

Enclosure

ESA Section 7 - Biological Assessment (BA)
Walton County, Florida
Hurricane and Storm Damage Reduction Project

The U.S. Army Corps of Engineers, Mobile District (Corps) is seeking Federal authorization to conduct a hurricane and storm damage reduction project for Walton County, Florida. Walton County's shoreline located in the Florida's panhandle is receding; the protective dunes and high bluffs are being destroyed by hurricane and storm forces that are occurring more frequently than before. During the late 1990s, the area endured several strong hurricanes resulting in extensive shoreline erosion (Taylor Engineering, 2003). In 2004 the area was affected severely by Hurricane Ivan (Sep 04) and early into the 2005 hurricane season it was impacted by Hurricanes Arlene (June 05) and Dennis (July 05). The impacts of these storms to property and infrastructure are considerable and can possibly be reduced through a beach restoration and stabilization project which also includes environmental restoration opportunities associated with the beach and dune system.

A feasibility study was authorized by a resolution of both the United States Senate and the U.S. House of Representatives, which reads as follows:

Resolution Adopted July 15, 2002, by The United States Senate:

> *"Resolved by the Committee on Environment and Public Works of the United States Senate, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and related improvements in Walton County, Florida, in the interest of protecting and restoring the environmental recourses on and behind the beach, including the feasibility of providing shoreline and erosion protection and related improvements consistent with the unique characteristics of the existing beach sand, and with consideration of the need to develop a comprehensive body of knowledge, information, and data on coastal area changes and processes as well as impacts from federally constructed projects in the vicinity of Walton County, Florida.*

> Resolution Adopted July 24, 2002, by The United States House of Representatives:

> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and environmental restoration and protection in the vicinity of Walton County, Florida.*

The non-Federal sponsor is the Walton County Board of Commissioners. Their central point of contact is the Director of Beach Management for the Walton County Tourist Development Council (TDC).

Project Location

Walton County is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet (Figure 1). The western two-thirds of Walton County are comprised of a coastal peninsula extending from the mainland, and the eastern third is comprised of mainland beaches. Choctawhatchee Bay lies north of the peninsula. Walton County includes 11.9 miles of state-designated critically eroding areas and three State of Florida park areas that cover approximately six miles of the 26-mile shoreline.

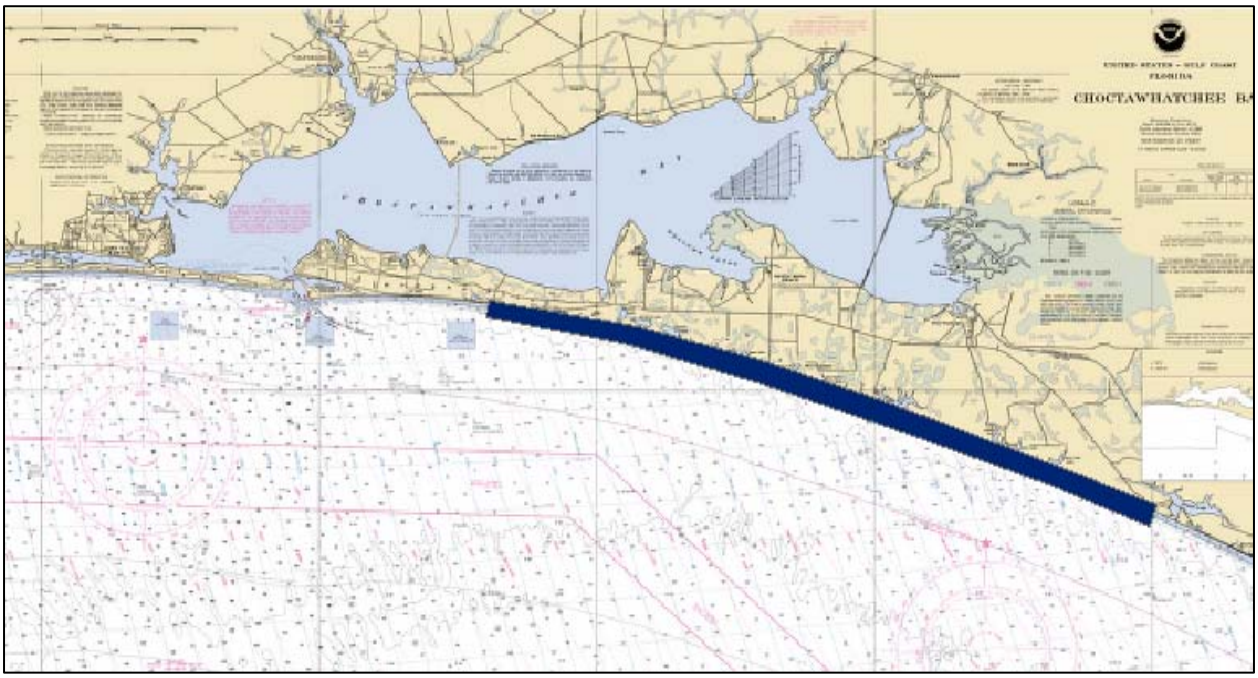

Figure 1. Location of Walton County project area

Project Description

The Walton County upland cross-section is defined by dune elevations ranging from +9.5 to + 33 feet NAVD88 and a natural berm elevation of +5.5 feet NAVD88. The study region was divided into five study reaches based on structural development and state park areas as illustrated in Figure 2. The historical and 2004 beach surveys were used to develop 11 representative profiles which characterize the existing condition for the five study reaches. The representative profiles were identified based on similarity in shape of the upper beach profile (dune height and width, berm width, foreshore beach slope, and profile volume) and shape of the offshore profile.

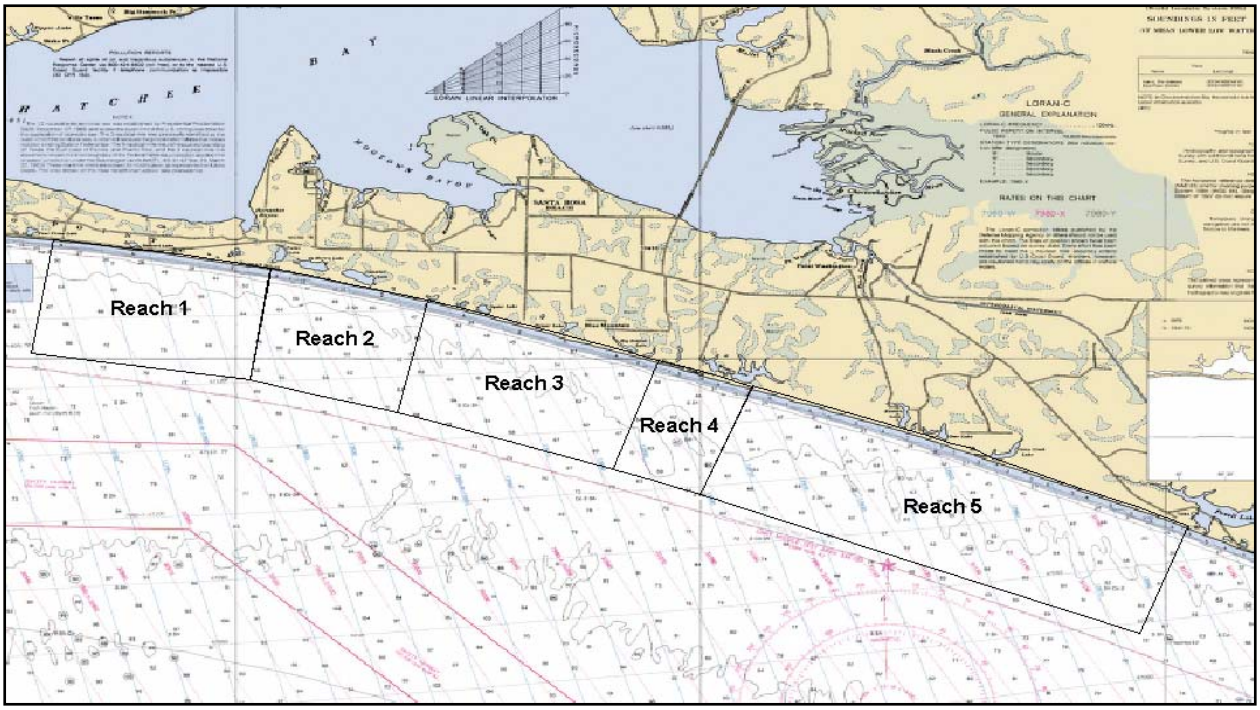

Figure 2. Location of the 5 construction reaches within the project area.

The selected plan recommended for construction consists of the five construction reaches (Figure 2). The project will be composed of a 50-foot berm width, a 25-foot berm and an additional 25 feet of advanced nourishment in all construction reaches. The project will also feature added dune width in all construction reaches of either 10 or 30 feet. The modeling efforts have predicted fill requirements of 2,400,000 cy. If this condition can be extrapolated to the predicted construction timeframe of FY11, then the necessary beach fill requirements will be 3,350,000 cy. Re-nourishments will be on a 12-year cycle with predicted volumes to be approximately 2,000,000 cy. Approved borrow sources lie offshore within the State of Florida waters. The typical cross-sections for the selected plan illustrated in Figure 3. When dune construction is complete, the dune will be planted with at least three species of dune vegetation to create a dune that matches the surrounding natural dune patterns in the area. Upon reconstruction immediate steps will be taken to plant and stabilize the dune for rapid stabilization. This will be accomplished through the use of sand fences and dune plants. The dune plants will be planted to cover 60-80% of the total area. The vegetation will consist of local dominant species that populate nearby natural dune systems. The selection of the dune vegetation will consist of species that are most widely used for dune restoration and are readily available from local nurseries and suppliers. The selection will be coordinated with local experts familiar with dune ecosystems in the immediate area.

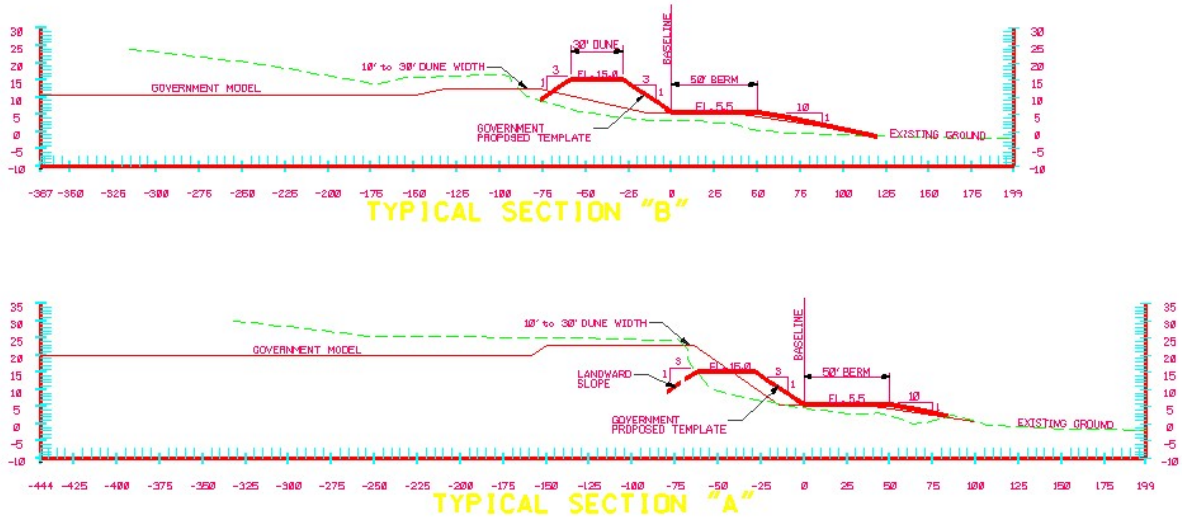

Figure 3. Selected plan typical cross sections to be constructed

Borrow Areas

Recent offshore studies to include geological and geophysical interpretation to identify a suitable offshore borrow area has been performed by Taylor Engineering, Inc. (2003) in the Walton County Destin Beach Management Feasibility Study Final Report under contract to the local sponsor, which initially concentrated on the East Pass area southwest of Destin and the eastern most end of Okaloosa County and the westernmost end of Walton County. Subsequent investigations looked at the entire coastline to assess locations with sufficient quantities for borrow development for the initial beach placement and future re-nourishments.

A large scale reconnaissance level geophysical, lithological and granulomteric (grain size) investigation was undertaken off Walton County, Florida. Sub-bottom profiles were used to locate prospective core locations to identify high quality sand sources for beach nourishment. Vibracores and selected seismic records were interpreted to confirm the presence and quality of sand off Walton County. The borrow area investigation locations are shown in Figure 4.

The proposed borrow area sediments are typically well sorted medium sand 0.25 - 0.50 mm (1-2 phi). Monitoring of the borrow discharges will be a constant requirement for compliance with color and grain size criteria. Borrow area B-4 shown on Figure 4 is the borrow site that was selected with some 10,000,000 cubic yards proven by these initial investigations. This volume covers the recommended locally preferred plan placement and the four planned subsequent re-nourishments for the next 50 years. The B-4 borrow area is most centrally located and offers the best source for the initial project construction and future re-nourishments. Based on the extensive geotechnical investigations, this borrow site has been demonstrated to be the most suitable source and has sand of color, size, and composition generally similar to that of the native beach. All materials used for beach nourishment will be excavated by hopper dredge, transported to the placement area offshore and pumped into the beach template. Small bulldozers will be used on land to shape the material to the prescribed template.

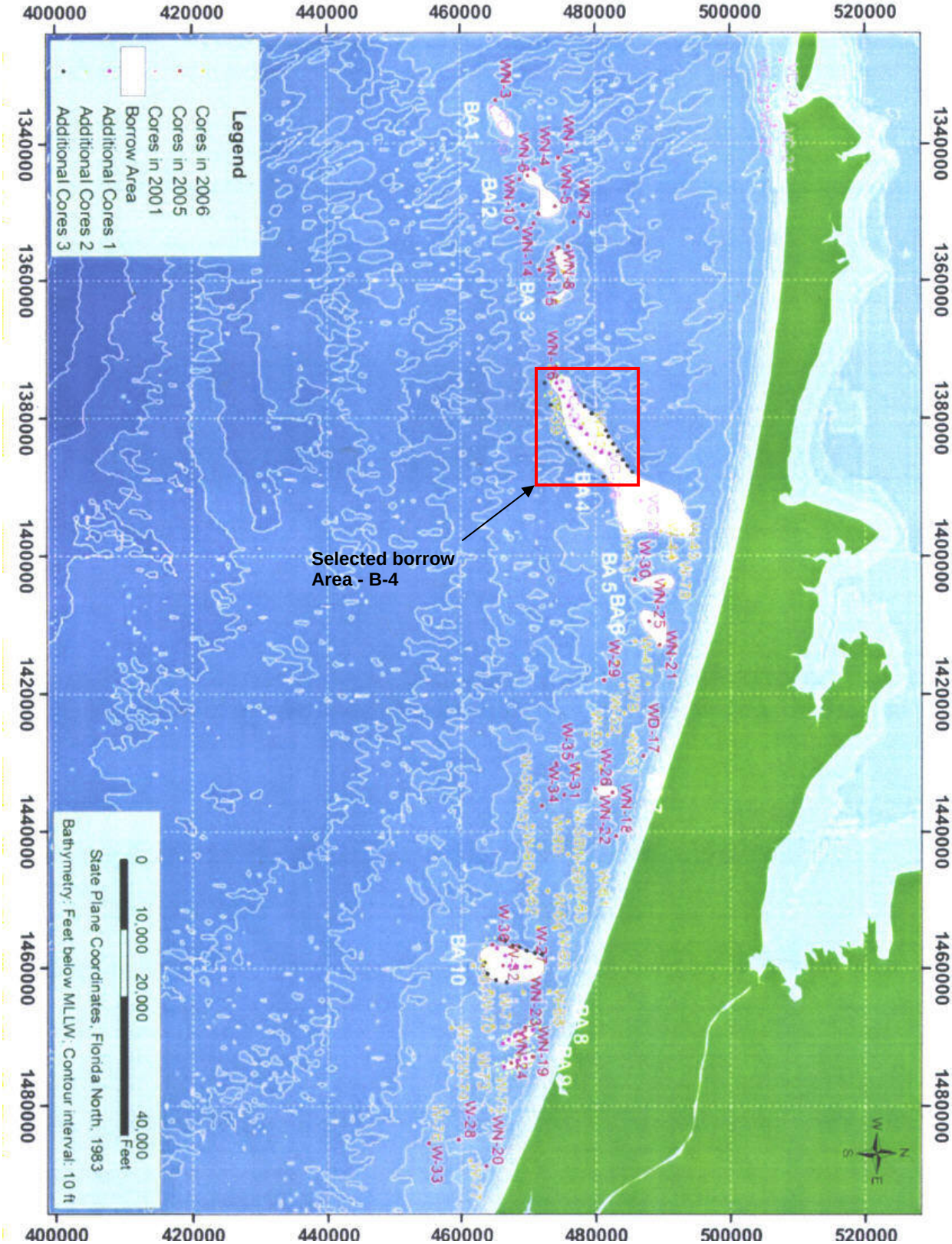

Figure 4. Borrow area investigation locations and selected borrow site.

Previous Coordination

It should be recognized that the local sponsor proceeded with pursuing a beach restoration plan of their own. Their local project area lays the length of Walton County. The proposed local plan includes a berm design that on average exhibits a construction profile that has a 207-ft wide berm measured from the existing 9.5 ft NAVD contour with a10-ft wide dune crest. The sponsor's local proposed plan view and profiles are larger than and totally encompass the selected Federal plan described above. Subsequently, the County has initiated and completed formal ESA Section 7 consultation with the National Marine Fisheries Service (NMFS), Protected Resources Division concerning Gulf sturgeon critical habitat, which resulted in a letter dated August 13, 2008 stating that the NMFS has determined that the proposed actions will not impact sediment quality or migratory pathways, and effect to prey abundance and water quality will be insignificant. It was therefore concluded that the proposed action is not likely to adversely affect Gulf Sturgeon critical habitat. A copy of this letter is enclosed with this BA.

Other related coordinations, which cover sea turtles and Gulf sturgeon, are included in the Regional Biological Opinion (RBO) for Dredging of Gulf of Mexico Navigation Channels and Sand Mining Areas Using Hopper Dredges by COE Galveston, New Orleans, Mobile, and Jacksonville Districts (Consultation Number F/SER/2000/01287) dated November 19, 2003 and associated amendaments.

Description of Listed Species

There are several environmental concerns that must be addressed in order to achieve environmental compliance for both permitting and National Environmental Protection Act (NEPA). The NMFS lists the following species under their purview as either threatened and/or endangered that may occur within the area:

Marine Mammals
E-blue whale - (*Balaenoptera musculus*)
E- finback whale - (*Balaenoptera physalus*)
E-humpback whale - (*Megaptera novaeangliae*)
E- sei whale - (*Balaenoptera borealis*)
E- sperm whale - (*Physeter macrocephalus*)

Turtles
T- green sea turtle - (*Chelonia mydas*)
E- hawksbill sea turtle - (*Eretmochelys imbricate*)
E- Kemp's ridley sea turtle - (*Lepidochelys kempii*)
E- leatherback sea turtle - (*Dermochelys coriacea*)
T- loggerhead sea turtle - (*Caretta caretta*)

Fish
T- Gulf sturgeon- (*Acipenser oxyrinchus*)

Federally protected species, such as the blue whale, finback whale, humpback whale, sei whale, and sperm whale are not considered in this BA as these species are unlikely to be found in or near the project area. Of particular concern in this BA are the species of sea turtles identified in the RBO (green, loggerhead, and Kemp's ridley) that could potentially be affected by hopper dredging operations and the Gulf sturgeon and its designated critical habitat (Unit 11). A description of these species are included below.

Loggerhead Sea Turtle

The loggerhead sea turtle is a medium to large turtle. Adults are reddish-brown in color and generally 31 to 45 inches in shell length with the record set at more than 48 inches. Loggerheads weigh between 170 and 350 pounds with the record set at greater than 500 pounds. Young loggerhead sea turtles are brown above and whitish, yellowish, or tan beneath, with three keels on their back and two on their underside.

Loggerhead sea turtles occur throughout the temperate and tropical regions of the Atlantic, Gulf of Mexico, Pacific, and Indian Oceans. This species may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, and the mouths of large rivers. In shallow Florida lagoons, loggerheads were found during the morning and evening, leaving the area during mid-day when temperatures reached 87° F. At dusk, turtles moved to a sleeping site and remained there until morning, possibly in response to changes in light or water temperature (Nelson 1986).

Loggerhead turtles are essentially carnivores, feeding primarily on sea urchins, sponges, squid, basket stars, crabs, horseshoe crabs, shrimp, and a variety of mollusks. Their strong beak-like jaws are adapted for crushing thick-shelled mollusks. Although loggerhead sea turtles are primarily bottom feeders, they also eat jellyfish and mangrove leaves obtained while swimming and resting near the sea surface. Presence of fish species such as croaker in stomachs of stranded individuals may indicate feeding on the by-catch of shrimp trawling (Landry 1986). Caldwell et al. (1955) suggest that the willingness of the loggerhead to consume any type of invertebrate food permits its range to be limited only by the presence of cold water.

As loggerheads mature, they travel and forage through nearshore waters until their breeding season, when they return to the nesting beach areas. The majority of mature loggerheads appear to nest on a two or three year cycle. Major nesting beaches for loggerheads include the Sultanate of Oman, southeastern United States, and eastern Australia. From a global perspective, the southeastern U.S. nesting aggregation is of paramount importance to the survival of the species and is second in size only to the nesting aggregation on Masirah Island, Oman. This species nests within the U.S. from Texas to Virginia, although the major nesting concentrations are found along the Atlantic cost of Florida, Georgia, South Carolina, and North Carolina. About 80 percent of all loggerhead nesting in the southeastern U.S. occurs in six Florida counties (Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties). Total estimated nesting in the U.S. is approximately 50,000 to 70,000 nests per year. Nesting in the northern Gulf outside of Florida occurs primarily on the Chandeleur Islands in Louisiana and to a lesser extent on adjacent Ship, Horn, and Petit Bois Islands in Mississippi (Ogren 1977).

Ogren (1977) reported a historical reproductive assemblage of sea turtles, which nested seasonally on remote barrier beaches of eastern Louisiana, Mississippi, and Alabama.

Loss or degradation of suitable nesting habitat may be the most important factor affecting the nesting population in northern Gulf of Mexico. Overall the loss of nesting beaches, hatchling disorientation from artificial light, drowning in fishing and shrimping trawls, marine pollution, plastics, and styrofoam have led to the decline of loggerheads.

Loggerhead sea turtles are considered turtles of shallow water. Juvenile loggerheads are thought to utilize bays and estuaries for feeding, while adults prefer waters less than 165 feet deep (Nelson 1986). Aerial surveys suggest that loggerheads (benthic immatures and adults) in U.S. waters are distributed in the following proportions: 54% in the southeast U.S. Atlantic, 29% in the northeast U.S. Atlantic, 12% in the eastern Gulf of Mexico, and 5% in the western Gulf of Mexico. During aerial surveys of the Gulf of Mexico, the majority (97 percent) of loggerheads was seen off the east and west coasts of Florida (Fritts 1983). Most were observed around mid-day near the surface, possibly related to surface basking behavior (Nelson 1986). Although loggerheads were seen off the coast of Alabama, Mississippi, and Louisiana, they were 50 times more abundant in Florida than in the western Gulf. The majority of the sightings were in the summer (Fritts et al. 1983). An individual tagged in Perdido Bay, Alabama was recaptured one year later only about a mile from the original capture site. In another case, a loggerhead had moved from Perdido Bay, Alabama into Pensacola Bay, Florida over a several month period (Nelson 2002).

Loggerheads are frequently observed near offshore oil platforms, natural rock reefs, and rock jetties along the Gulf Coast. Large numbers of stranded turtles were observed inshore of such areas (Rabalais and Rabalais 1980). Fishermen reported sightings of large turtles near the Gulf Coast. In a recent tracking study, loggerheads spent more than 90 percent of the time underwater, tended to avoid colder water, and spent much of the time in the vicinity of oil and gas structures, such as those found offshore of Mississippi and Alabama.

Green Sea Turtle

The green sea turtle is mottled brown in color. The name is derived from the greenish fat of the body. The carapace is light or dark brown. It is sometimes shaded with olive, often with radiating mottled or wavy dark markings or large dark brown blotches. This species is considered medium to large in size for sea turtles with an average length of 36 to 48 inches. The record was set at about 60 inches in length. Its weight ranges from about 250 to 450 pounds with the record at more than 650 pounds. The upper surfaces of young green turtles are dark brown, while the undersides are white.

Although green sea turtles are found worldwide, this species is concentrated primarily between the 35° North and 35° South latitudes. Green sea turtles tend to occur in waters that remain warmer than 68° F; however, there is evidence that they may be buried under mud in a torpid state in waters to 50° F (Ehrhart 1977; Carr et al. 1979).

This species migrates often over long distances between feeding and nesting areas (Carr and Hirth 1962). During their first year of life, green sea turtles are thought to feed mainly on jellyfish and other invertebrates. Adult green sea turtles prefer an herbivorous diet frequenting shallow water flats for feeding (Fritts et al. 1983). Adult turtles feed primarily on seagrasses, such as *Thalassia testudinum*. This vegetation provides the turtles with a high fiber content and low forage quality (Bjorndal 1981a). Caribbean green sea turtles are considered by Bjorndal (l981b) to be nutrient-limited, resulting in low growth rate, delayed sexual maturity, and low annual reproductive effort. This low reproductive effort makes recovery of the species slow once the adult population numbers have been severely reduced (Bjorndal 1981). In the Gulf of Mexico, principal foraging areas are located in the upper west coast of Florida (Hirth 1971). Nocturnal resting sites may be a considerable distance from feeding areas, and distribution of the species is generally correlated with grassbed distribution, location of resting beaches, and possibly ocean currents (Hirth 1971).

Major nesting areas for green sea turtles in the Atlantic include Surinam, Guyana, French Guyana, Costa Rica, the Leeward Islands, and Ascension Island in the mid-Atlantic. Historically in the U.S., green turtles have been known to nest in the Florida Keys and Dry Tortugas. Yet, these turtles primarily nest on selected beaches along the coast of eastern Florida, predominantly Brevard through Broward Counties. However, they probably nested along the Gulf Coast before their decline. In the southeastern U.S., nesting season is roughly June through September. Nesting occurs nocturnally at 2, 3, or 4-year intervals. Only occasionally do females produce clutches in successive years. Estimates of age at sexual maturity range from 20 to 50 years (Balazs 1982; Frazer and Ehrhart 1985) and they may live over 100 years. Immediately after hatching, green turtles swim past the surf and other shoreline obstructions, primarily at depths of about 8 inches or less below the water surface, and are dispersed both by vigorous swimming and surface currents (Balzas 1980). The whereabouts of hatchlings to juvenile size is uncertain. Green turtles tracked in Texas waters spent more time on the surface, with fewer submergences at night than during the day, and a very small percentage of the time was spent in the Federally maintained navigation channels. The tracked turtles tended to utilize jetties, particularly outside of them, for foraging habitat (Renaud et. Al. 1993).

Most green turtle populations have been depleted or endangered because of direct exploitation or incidental drowning in trawl nets (King 1981). A major factor contributing to the green turtle's decline worldwide is commercial harvest for eggs and meat. In Florida, the nesting population was nearly extirpated within 100 years of the initiation of commercial exploitation (King 1981). Fibropapillomatosis, a disease of sea turtles characterized by the development of multiple tumors on the skin and internal organs, is also a mortality factor and has seriously impacted green turtle populations in Florida, Hawaii, and other parts of the world. These tumors interfere with swimming, eating, breathing, vision, and reproduction, and turtles with heavy tumor burdens become severely debilitated and die. Other threats include loss or degradation of nesting habitat from coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and incidental take from commercial fishing operations.

Kemp's ridley turtle

The Kemp's ridley occurs mainly in coastal areas of the Gulf of Mexico and the northwestern Atlantic Ocean with occasional individuals reaching European waters. Adults of this species are generally confined to the Gulf of Mexico, although some adults are sometimes found on the east coast of the U.S. Females return to their nesting beach about every other year with nesting occurring from April into July and usually limited to the western Gulf of Mexico. The mean clutch size for this species is about 100 eggs per nest and an average of 2.5 nests per female per season.

Benthic immature turtles have been found along the eastern seaboard of the U.S. and in the Gulf of Mexico. In Gulf, studies suggest that immature turtles stay in shallow, warm, nearshore waters in the northern Gulf until cooling waters force them offshore or south along the Florida coast (Renaud 1995). Little is known of the movements of the post-hatching stage (pelagic stage) within the Gulf. Studies have indicated that this stage varies from 1 to 4 or more years and the benthic immature stage lasts about 7 to 9 years (Schmid and Witzell 1997). The maturity age of this species is estimated to be 7 to 15 years.

Of the seven extant species of sea turtles, the Kemp's ridley has declined to the lowest population level. However, recent studies have indicated that increased nesting activities and suggest that the decline in ridley population has stopped and the population is now increasing (USFWS 2000). A period of steady increase in the benthic immature turtles has been occurring since 1990 and suggests a result of increased hatchling production and survival rates of the immature turtles. The increased survival of immature individuals is believed to be in part a result of the use of turtle exclusion devices (TEDs) in the commercial shrimping fleets. Future threats to the species include interaction with fishery gear; marine pollution; destruction of foraging habitat; illegal poaching; and impacts to nesting beaches associated with rising sea level, development, and tourism pressure.

Gulf Sturgeon

The NMFS and U.S. Fish and Wildlife Service (FWS) listed the Gulf sturgeon as a threatened species on September 30, 1991. The Gulf sturgeon, also known as the Gulf of Mexico sturgeon, is a subspecies of the Atlantic sturgeon. It is a large fish with an extended snout, vertical mouth, and with the upper lobe of the tail longer than the lower. Adults are 180 to 240 cm (71-95 inches) in length, with adult females larger than adult males. The skin is scaleless, brown dorsally and pale ventrally and imbedded with 5 rows of bony plates.

Adult fish are bottom feeders, eating primarily invertebrates, including brachiopods, insect larvae, mollusks, worms and crustaceans. Gulf sturgeon are anadromous, with reproduction occurring in fresh water. Most adult feeding takes place in the Gulf of Mexico and its estuaries. The fish return to breed in the river system in which they hatched. Spawning occurs in areas of deeper water with clean (rock and rubble) bottoms. The eggs are sticky and adhere in clumps to snags, outcroppings, or other clean surfaces. Sexual maturity is reached between the ages of 8 and 12 years for females and 7 and 10 years for males.

Historically, the Gulf sturgeon occurred from the Mississippi River to Charlotte Harbor, Florida. It still occurs, at least occasionally, throughout this range, but in greatly reduced numbers. The fish is essentially confined to the Gulf of Mexico. River systems where the Gulf sturgeon are known to be viable today include the Mississippi, Pearl, Escambia, Yellow, Choctawhatchee, Appachicola, and Swannee Rivers, and possibly others.

Effects of Proposed Action

The RBO in November 2003 and subsequent revisions for use of hopper dredges analyzed the impacts to sea turtles and Gulf sturgeon. The effects to these species as stated in the RBO are summarized below. Also included in this section are effects of the proposed action to the designated Gulf sturgeon critical habitat.

Sea Turtles

The RBO identified three species of sea turtles described above, that could potentially be affected through use of hopper dredging operations. Hopper dredge entrainment is a documented source of sea turtle mortality. Conducting hopper dredging operations within the waters of the Gulf of Mexico, especially during turtle nesting season (April through November) or when water temperatures are above 11ºC creates an increased risk for taking sea turtles. Injuries inflicted on sea turtles from a draghead are typically fatal. Based on sea turtle life history and strandings data sited in the RBO, it would be expected that the proposed action may result in sea turtle mortality from hopper dredging activity. During operations when hydraulic cutter-head pipeline dredging equipment is being used, no effects to sea turtles are anticipated, as they are not known to impact sea turtles.

Disposal of the dredged material on the beach nearshore area is unlikely to affect sea turtles in the immediate vicinity. Sea turtles are known to be highly mobile and would be expected to exit the area during such activities. Disposal of the dredged material is a slow process that has not been shown to adversely affect sea turtles.

The conservation measures and recommendations specified in the RBO for Dredging of Gulf of Mexico Navigation Channels and Sand Mining Areas Using Hopper Dredges will be followed to the maximum extent practicable. Given these considerations it is determined that the proposed action may affect, but not likely to adversely affect sea turtles and will not jeopardize the continued existence of the species.

Gulf Sturgeon

Effects to Gulf Sturgeon resulting from the proposed dredging and nearshore disposal activities would be confined to direct impacts associated with the dredge equipment. Effects resulting from the use of hopper dredges were considered in the RBO. Mobile District will abide by the reasonable and prudent measures set forth in that opinion. Disposal of dredged material in the nearshore area is unlikely to affect Gulf sturgeon in the immediate vicinity. Sturgeons are known to be highly mobile and would be expected to exit the area during such activities. Disposal of the dredged material is a slow process that has not been shown to adversely affect

Gulf sturgeon. No effects to Gulf Sturgeon are anticipated with the use of a hydraulic cutter-head dredge, as they are not known to impact Gulf Sturgeon.

The conservation measures and recommendations specified in the RBO will be followed to the maximum extent practicable pertaining to Gulf sturgeon. It is therefore determined that if the conservation measures specified in the RBO are observed, the proposed action may affect, but not likely to adversely affect Gulf sturgeon and will not jeopardize the continued existence of the species.

Gulf Sturgeon Critical Habitat

The proposed project area falls within the designated Gulf sturgeon critical habitat. As defined by the Federal Register Vol. 68, No. 53, the proposed dredging of the navigation channel is located within Unit 11 - Florida Nearshore Gulf of Mexico. Unit 11 extends from the mean high water line seaward one nautical mile and terminates one nautical mile west of Pensacola Pass. The selected borrow area does not fall within Gulf sturgeon critical habitat, however, the direct beach placement activities will be occurring within Unit 11. Alteration of Gulf sturgeon critical habitat Unit 11 is likely to occur in areas of direct beach placement by extending the shoreline seaward.

The primary constituent elements essential for the conservation of the Gulf sturgeon are those habitat components that support foraging, riverine spawning sites, normal flow regime, water quality, sediment quality, and safe unobstructed migratory pathways.

Forage Area: Activities associated within beach placement cover epibenthic crustaceans and infaunal polychaetes in the beachfront area that serve as potential prey items for the sturgeon. The impacts are considered short-term in nature and consist of a temporary loss of benthic invertebrate populations where the shoreline extends seaward. This is believed that this will not result in a significant impact to critical habitat. Due to the fact that, before the recent hurricane activity the area was above mean high water and was not contributing to the benthic productivity of the coastal system. The project will restore the shoreline to pre-hurricane Ivan (2004) conditions and provide more suitable nesting habitat for endangered sea turtles and shorebird foraging area. The loss of Gulf bottom from beach placement area will not jeopardize the continued existence of the species. The areas immediately adjacent to the shoreline are extremely dynamic and shallow and likely not utilized by feeding sturgeon. The total area influenced by the placement of sand along the construction zones is approximately 45 acres, which falls with the extreme nearshore zone and constitutes a minute fraction of the total available forage habitat for the species in that area. It is believed the impacts to the Gulf sturgeon critical habitat would be relatively minor in nature and not result in an adverse modification.

Migratory passage: The primary migration pattern through the area would be parallel to the shoreline in the nearshore area. The proposed beach placement is occurring primarily on dry beach and immediate nearshore along an open-water shoreline and will not restrict fish migration. No significant short-term or long-term effects to migratory passage have been identified.

Sediment and water quality: This constituent element will not be significantly affected by the proposed activity. All conditions of the FDEP Water Quality Certification will be followed during construction. No long-term impacts were identified.

Normal Water Flow: Water flow patterns associated with the littoral environment will not be effected. Therefore, no effects to this constituent element will occur.

Spawning habitat: The placement areas are obviously not located in a riverine system where Gulf sturgeon spawning takes place and therefore, no impacts to this constituent element will occur.

Riverine aggregation areas: No impact

Conservation Measures

The proposed project will adhere to the reasonable and prudent measures set forth in the Regional Biological Opinion for Dredging of Gulf of Mexico Navigation Channels and Sand Mining Areas Using Hopper Dredges by COE Galveston, New Orleans, Mobile, and Jacksonville Districts (Consultation Number F/SER/2000/01287) dated November 19, 2003 and subsequent revisions. This would include screens, observers, drag head deflectors, and relocation trawling within the active dredging areas.

Conclusions

The Corps is not aware of any evidence that would change conservation measures recommended in 2003 RBO and subsequent revisions. Conducting the proposed action will implement all reasonable and prudent measures, recommendations, and conditions as specified in the RBO.

Based upon the findings of this biological assessment and measure set forth by the 2003 RBO, the Corps has found that the proposed action “may affect” the following species under the purview of the NMFS:

Loggerhead Sea Turtle - The dredging operations associated with this project may affect, but not likely to adversely affect and will not jeopardize the continued existence of the species.

Green Sea Turtle - The dredging operations associated with this project may affect, but not likely to adversely affect and will not jeopardize the continued existence of the species.

Leatherback Sea Turtle - The dredging operations associated with this project may affect, but not likely to adversely affect and will not jeopardize the continued existence of the species.

Gulf Sturgeon - May affect, but not likely to adversely affect and will not jeopardize the continued existence of the species.

Gulf Sturgeon Critical Habitat - The beach disposal areas do fall within the extreme nearshore areas of Gulf sturgeon critical habitat - Unit 11. The direct beach disposal will be restoring the historic shoreline position to pre-Hurricane Ivan dimensions. Given these considerations, it has been determined that the disposal activities associated with this project will not adversely modify designated Gulf sturgeon critical habitat.

The U.S. Army Corps of Engineers is requesting that since the local sponsor for the Federal project has already completed ESA Section 7 consultation with your agency for a local plan that is larger than and totally encompasses the selected Federal plan described herein, that consideration be given to applying that coordination to the Federal plan.

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UNITED STATES DEPARTMENT OF COMMERCE
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AUG 13 2008

F/SER31:DK

Mr. Osvaldo Collazo
Panama City Regulatory Office
Jacksonville District Corps of Engineers
1002 West 23rd Street, Suite 350
Panama City, FL 32405

RECEIVED
AUG 18 2008
JACKSONVILLE DISTRICT
USACE

Re: SAJ-2007-5152 (IP-DEB)

Dear Mr. Collazo:

This responds to your letter dated October 15, 2007, regarding the referenced U.S. Army Corps of Engineers' (COE) permit application submitted by the Walton County Board of County Commissioners. The applicant proposes to nourish 13.5 miles of beach and restore dunes along the Gulf of Mexico. The project is located in Walton County, Florida, and includes four reaches: from the Florida Department of Environmental Protection (FDEP) survey monument R-41 to R-64, from R-67 to R-72, from R-78 to R-98, and from R-105.5 to R-127. The central coordinates for the proposed fill area are latitude 30.31629°N, longitude 86.12845°W. You requested concurrence from the National Marine Fisheries Service (NMFS), pursuant to section 7 of the Endangered Species Act (ESA), with your determination that the proposed project may affect the federally-listed loggerhead, leatherback, hawksbill, Kemp's ridley, and green sea turtles, and Gulf sturgeon. You also determined that the proposed project, portions of which will occur in designated Gulf sturgeon critical habitat Unit 11 (nearshore Gulf of Mexico in Florida), may adversely modify sturgeon critical habitat. NMFS' determinations regarding the effects of the proposed action are based on the description of the action in this informal consultation. You are reminded that any changes to the proposed action may negate the findings of the present consultation and may require reinitiation of consultation with NMFS.

The intent of the Walton County beach nourishment and dune management project is to increase the storm protection function and restore the recreational capacity of the beach. The proposed project includes renourishing approximately 13.5 miles of beach over a span of four segments as described above. The total volume of sand to be placed along the beach is approximately 5,682,000 cubic yards (cy), with an average volume density of 79 cy/ft. The material will be obtained from a proposed borrow area located approximately 5 miles offshore western Walton County within a northeast/southwest-oriented ridge with water depths ranging from 70-80 ft below NAVD. The COE and applicant have not specified the dredge type to be used at this time. If a hopper dredge is to be used, the potential impacts from the hopper dredging portion of the project are covered by the incidental take statement of the regional biological opinion on hopper dredging for the Gulf of Mexico, dated November 19, 2003, and the reasonable and prudent

measures and terms and conditions of that opinion would be required to be followed for this action. The other possible dredge type to be used is a hydraulic cutterhead/pipeline dredge, the potential impacts of which will be addressed below. The borrow area contains fine- to medium-to-fine sand with less than 1 percent shell content. The grain size and composition is similar to the native beach sediment. Much of the sand placement will take place above the water level, using a berm design. A typical section will include sand placement for the dune crest, back berm, mid berm, and fore berm, all above the MHW level. The foreshore slope will be constructed from the fore berm seaward out to the existing bottom, extending a couple of hundred feet past the MHW mark. This slope is steeper than the natural slope and, between berm erosion and equilibration, is expected to adjust rapidly until it approaches a more natural slope. The bottom areas below MHW that will be covered by the initial placement and later equilibration consist of sediments similar to those on the beach, with no hardbottom habitat, corals, or seagrasses. This project is a one-time restoration that is expected, in the absence of large storm events, to maintain as much as 60 percent of the fill for a 10 year period.

Conservation measures that have been incorporated into the project description include:

1. As required by the FDEP, a minimum of a 1-foot buffer will be maintained between sediments consistent with the type removed from the borrow area and any underlying materials (e.g., mud, dark sands, or rock). This ensures that the surface sediments in the borrow area will be the same post-construction as they were pre-construction.

2. Sand dikes for purposes of turbidity control will be utilized as needed to maintain state water quality standards, as indicated by the FDEP's Bureau of Beaches and Coastal Systems.

3. Turbidity levels will be monitored twice daily at both the borrow area and the beach; if turbidity values exceed values permitted by the state, all dredging and deposition activities will be suspended until water quality meets state standards.

4. The applicant has agreed to utilize NMFS' Sea Turtle and Smalltooth Sawfish Construction Conditions to reduce the potential for impacts to listed species.

NMFS believes the following listed species may be present and affected by the proposed beach renourishment project: loggerhead, leatherback, Kemp's ridley, hawksbill, and green sea turtles, and Gulf sturgeon. NMFS has previously determined that non-hopper-type dredging activities, including hydraulic-type dredges, are not likely to adversely affect sea turtles and Gulf sturgeon. These species will likely temporarily avoid the immediate project vicinity during construction (i.e., dredging and sand pumping) due to vessel and machinery noise; however, this avoidance will not affect migration and foraging behaviors. If sea turtles or Gulf sturgeon do enter the project site during dredging activities, they are unlikely to be harmed by the hydraulic dredge. Listed species may also be affected if they were to be struck by the dredge as it transits the site or by the pipeline as it is being positioned or moved to place sand on the beach; however, due to their mobility, the likelihood of this occurring is discountable. The likelihood of creating an obstacle for turtles approaching and exiting the beach during nesting season is minimized by the perpendicular placement of the sand discharge pipe on the seafloor from the dredge to the beach,

which reduces the length of pipe necessary for renourishment. Seaward bound sea turtle hatchlings could be affected by project activities. However, this is unlikely because daily sea turtle nest surveys will be completed during nesting season and construction will not occur on any segment of the beach with active nests. In summary, NMFS believes that listed species under its purview will not be adversely affected by the proposed action. Note that this consultation does not cover onshore impacts, such as to nesting sea turtles on the beach, or sea turtle nests or hatchlings on the beach. A consultation with the U.S. Fish and Wildlife Service is required to ensure ESA compliance for onshore impacts to sea turtles.

Gulf sturgeon critical habitat was designated in 2003 (50 CFR 226.214). The portion of the beach renourishment area below MHW is located within critical habitat Unit 11. The primary constituent elements (PCEs) present in Unit 11 and essential for the conservation of Gulf sturgeon include abundant prey items, water quality, sediment quality, and safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats. Of these PCEs, NMFS believes only prey abundance and water quality may be affected. No impacts to sediment quality are expected as sediment composition at the borrow sites and on the beach are expected to be the same pre- and post-construction, and all sediments are free of contaminants. Project construction will not impede migratory pathways either during or after construction, as the project site is not located within, or adjacent to, a major river system, where construction activities could deter Gulf sturgeon from migrating between their riverine and estuarine habitats.

Gulf sturgeon could be affected by impacts to the abundance and diversity of their prey items, but these effects are expected to be insignificant, as these benthic macro-invertebrates have been found to recolonize within one year of a dredging disturbance when sediment composition and depth remain consistent. Additionally, the majority of sand placed below MHW will be in water depths less than 5 ft (1.5 meters). While Gulf sturgeon are known to occasionally forage in very shallow waters, normal foraging depths are usually deeper than 5 ft. Further, it is likely that any Gulf sturgeon in the project area will find appropriate and abundant prey in the areas adjacent to the project location, as many nearby sandy areas exist.

Effects to Gulf sturgeon from impacts to water quality are expected to be insignificant. They will be minor and temporary. Because the material from the borrow site consists of mostly sand, with only ca. 1 percent fines (similar to the existing sand), almost no turbidity is expected to ensue. Potential impacts to water quality will be further minimized by compliance with the twice-daily state water quality sampling requirement which will ensure that turbidity levels remain low. No changes to temperature, salinity, pH, hardness, oxygen content, or other water quality parameter will occur.

In summary, NMFS has determined that the project will not impact sediment quality or migratory pathways, and effects to prey abundance and water quality will be insignificant. Therefore, we conclude that the proposed action is not likely to adversely affect Gulf sturgeon critical habitat.

This concludes your consultation responsibilities under the ESA for species under NMFS' purview. Consultation must be reinitiated if a take occurs or new information reveals effects of the action not previously considered, or the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat in a manner or to an extent not previously considered, or if a new species is listed or critical habitat designated that may be affected by the identified action. We have enclosed additional information on other statutory requirements that may apply to this action, and on NMFS' Public Consultation Tracking System (PCTS) to allow you to track the status of ESA consultations.

If you have any questions regarding this ESA consultation or PCTS use, please contact Dennis Klemm, Fishery Biologist, at (727) 824-5312, or by e-mail at dennis.klemm@noaa.gov.

Sincerely,

James E. Weaver

for Roy E. Crabtree, Ph.D.
Southeast Regional Administrator

Enclosures (2)

File: 1514-22.F.1.FL
Ref: I/SER/2007/06965

PCTS Access and Additional Considerations for ESA Section 7 Consultations (Revised 5-13-2008)

Public Consultation Tracking System (PCTS) Guidance: PCTS is an online query system at **https://pcts.nmfs.noaa.gov/** that allows federal agencies and U.S. Army Corps of Engineers' (COE) permit applicants and their consultants to ascertain the status of NMFS' Endangered Species Act (ESA) and Essential Fish Habitat (EFH) consultations, conducted pursuant to ESA section 7, and Magnuson-Stevens Fishery Conservation and Management Act's (MSA) sections 305(b)2 and 305(b)(4), respectively. Federal agencies are required to enter an agency-specific username and password to query the Federal Agency Site. The COE "Permit Site" (no password needed) allows COE permit applicants and consultants to check on the current status of Clean Water Act section 404 permit actions for which NMFS has conducted, or is in the process of conducting, an ESA or EFH consultation with the COE.

For COE-permitted projects, click on "Enter Corps Permit Site." From the "Choose Agency Subdivision (Required)" list, pick the appropriate COE district. At "Enter Agency Permit Number" type in the COE district identifier, hyphen, year, hyphen, number. The COE is in the processing of converting its permit application database to PCTS-compatible "ORM." An example permit number is: SAJ-2005-000001234-IPS-1. For the Jacksonville District, which has already converted to ORM, permit application numbers should be entered as SAJ (hyphen), followed by 4-digit year (hyphen), followed by permit application numeric identifier with no preceding zeros. For example: SAJ-2005-123; SAJ-2005-1234; SAJ-2005-12345.

For inquiries regarding applications processed by COE districts that have not yet made the conversion to ORM (e.g., Mobile District), enter the 9-digit numeric identifier, or convert the existing COE-assigned application number to 9 numeric digits by deleting all letters, hyphens, and commas; converting the year to 4-digit format (e.g., -04 to 2004); and adding additional zeros in front of the numeric identifier to make a total of 9 numeric digits. For example: AL05-982-F converts to 200500982; MS05-04401-A converts to 200504401. PCTS questions should be directed to Eric Hawk at Eric.Hawk@noaa.gov. Requests for username and password should be directed to PCTS.Usersupport@noaa.gov.

EFH Recommendations: In addition to its protected species/critical habitat consultation requirements with NMFS' Protected Resources Division pursuant to section 7 of the ESA, prior to proceeding with the proposed action the action agency must also consult with NMFS' Habitat Conservation Division (HCD) pursuant to the MSA requirements for EFH consultation (16 U.S.C. 1855 (b)(2) and 50 CFR 600.905-.930, subpart K). The action agency should also ensure that the applicant understands the ESA and EFH processes; that ESA and EFH consultations are separate, distinct, and guided by different statutes, goals, and time lines for responding to the action agency; and that the action agency will (and the applicant may) receive separate consultation correspondence on NMFS letterhead from HCD regarding their concerns and/or finalizing EFH consultation.

Marine Mammal Protection Act (MMPA) Recommendations: The ESA section 7 process does not authorize incidental takes of listed or non-listed marine mammals. If such takes may occur an incidental take authorization under MMPA section 101 (a)(5) is necessary. Contact Ken Hollingshead of our NMFS Headquarters' Protected Resources staff at (301) 713-2323 for more information on MMPA permitting procedures.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
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SEA TURTLE AND SMALLTOOTH SAWFISH CONSTRUCTION CONDITIONS

The permittee shall comply with the following protected species construction conditions:

a. The permittee shall instruct all personnel associated with the project of the potential presence of these species and the need to avoid collisions with sea turtles and smalltooth sawfish. All construction personnel are responsible for observing water-related activities for the presence of these species.

b. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles or smalltooth sawfish, which are protected under the Endangered Species Act of 1973.

c. Siltation barriers shall be made of material in which a sea turtle or smalltooth sawfish cannot become entangled, be properly secured, and be regularly monitored to avoid protected species entrapment. Barriers may not block sea turtle or smalltooth sawfish entry to or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.

d. All vessels associated with the construction project shall operate at "no wake/idle" speeds at all times while in the construction area and while in water depths where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will preferentially follow deep-water routes (e.g., marked channels) whenever possible.

e. If a sea turtle or smalltooth sawfish is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle or smalltooth sawfish. Operation of any mechanical construction equipment shall cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities may not resume until the protected species has departed the project area of its own volition.

f. Any collision with and/or injury to a sea turtle or smalltooth sawfish shall be reported immediately to the National Marine Fisheries Service's Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.

g. Any special construction conditions, required of your specific project, outside these general conditions, if applicable, will be addressed in the primary consultation.

Revised: March 23, 2006
O:\forms\Sea Turtle and Smalltooth Sawfish Construction Conditions.doc

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

January 15, 2010

Coastal Environment Team
Planning and Environmental Division

Ms. Gail Carmody
U.S. Department of Interior
Fish and Wildlife Service
1601 Balboa Avenue
Panama City, Florida 32405-3721

Dear Ms. Carmody:

This letter pertains to possible conflicts with the Coastal Barrier Resources Act (CBRA) of 1982 associated with the Walton County, Florida hurricane and storm damage reduction project. CBRA was passed by the U.S. Congress to address problems caused by coastal barrier development. CBRA restricts most Federal expenditures and financial assistance that tend to encourage development, including Federal flood insurance, in the John H. Chafee Coastal Barrier Resource System. Three important goals of CBRA are to:

- minimize loss of human life by discouraging development in high risk areas;
- reduce wasteful expenditure of Federal resources; and
- protect fish and wildlife and other natural resources associated with coastal barriers.

As you are aware, the U.S. Army Corps of Engineers (Corps), Mobile District is seeking Federal authorization to conduct this hurricane and storm damage reduction project. A feasibility study was authorized by a resolution of both the United States Senate and House of Representatives, which reads as follows:

Resolution Adopted July 15, 2002, by The United States Senate:

"Resolved by the Committee on Environment and Public Works of the United States Senate, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and related improvements in Walton County, Florida, in the interest of protecting and restoring the environmental recourses on and behind the beach, including the feasibility of providing shoreline and erosion protection and related improvements consistent with the unique characteristics of the existing beach sand, and with consideration of the need to develop a comprehensive body of knowledge, information, and data on coastal area changes and processes as well as impacts from federally constructed projects in the vicinity of Walton County, Florida."

Resolution Adopted July 24, 2002, by The United States House of Representatives:

> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and environmental restoration and protection in the vicinity of Walton County, Florida."*

The non-federal sponsor is the Walton County Board of Commissioners. Their central point of contact is the Director of Beach Management for the Walton County Tourist Development Council (TDC).

The project is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet as indicated by the map included in Enclosure 1.

The study region was divided into five study reaches based on structural development and state park areas as illustrated in Enclosure 1. The project will be composed of a 50-foot berm width, a 25-foot berm and an additional 25 feet of advanced nourishment in all construction reaches. The project will also feature added dune width in all construction reaches up to 30 feet. The typical cross-sections for the selected plan are illustrated in Enclosure 1. The necessary beach fill requirements will be about 3,350,000 cubic yards (cy). Re-nourishments will be on a 12-year cycle with predicted volumes to be approximately 2,000,000 cy. Approved borrow sources lie offshore within the State of Florida waters.

In addition to providing shoreline protection, there are numerous environmental opportunities that will restore, protect, and enhance fish and wildlife resources and habitats associated with the project area. Coastal ecological resources throughout Walton County have consistently been diminished due to the high shoreline recession rates exhibited in this region (Taylor Engineering 2003). The result has been the loss of valuable habitat including sea turtle nesting habitat, shorebird foraging and roosting areas, dune habitat supporting various flora and fauna, and general beach ecosystem functions. Restoring a beach-dune system allows greater sustainability of the coastal environment once it has become established. Restoring beach habitat that supports a variety of associated flora and fauna contributes to the success and continual survival of several threatened or endangered species such as sea turtles, piping plover, and the Choctawhatchee beach mouse (CBM) as well as designated critical habit. The restoration effort will also contribute to the well being of various other flora and fauna that naturally occur along the northern Gulf region.

The storm activities of recent years have left the fragile coastal dune lakes found throughout Walton County vulnerable to future damages and catastrophic breaching. The lakes support a variety of coastal wildlife with natural communities unique to this region. Coastal dune lakes are important breeding areas for insects and crustaceans. Many birds and mammals also utilize coastal dune lakes for food and habitat. Restoring a beach-dune system in the areas adjacent to the dune lake resources will provide for continued sustainability to the fragile ecosystems of the lakes.

There is currently little beach within the project area, which reduces the capabilities of this area in supporting sea turtle nesting activities. Although, initial beach renourishment operations may have an impact on sea turtle nesting activities, the Corps believes that the long-term benefits of restoring berm width in this area will increase future opportunities towards protecting and enhancing sea turtle nesting opportunities. The enhanced berm creates additional habitat beneficial to a variety of shore birds as well as other inhabitants of the coastal environment. Wider beaches augment natural dune creation and maintenance, which will be beneficial for dune dwelling organisms and threatened and endangered species, such as the CBM and the Gulf coast lupine.

When dune construction is complete, the dune will be planted with at least three species of dune vegetation. Sand dunes are dynamic coastal features, which are formed and maintained by the accumulation of wind blown sand. The dune restoration activities will be designed to create a dune that mimics the surrounding natural dune patterns in the area. Upon reconstruction immediate steps will be taken to plant and stabilize the dune for rapid colonization. This will be accomplished through the use of sand fences and dune plants. The dune plants will be planted to cover 60-80% of the total area. Plantings will occur across the entire dune on approximate two-foot spacing. The vegetation will consist of local dominant species that populate nearby natural dune systems. The selection of the dune vegetation will consist of species that are most widely used for dune restoration and are readily available from local nurseries and suppliers. The selection will be coordinated with local environmental experts familiar with dune ecosystems in the immediate area. Dune plant species being considered are:

- sea oats *(Uniola paniculata)*;
- bitter panic grass *(Panicum ararum)*;
- sea rocket *(Cakile constricta)*;
- beach morning glory *(Ipomoea imperati)*;
- railroad vine *(Ipmea pes-caprae)*;
- blue stem *(Schizachyrium scoparium)*; and/or
- blanket flower *(Gaillardi pulchella)*.

CBRA units P32, P31A, FL-96, FL-95P, FL-94, and FL-93P fall within or are adjacent to the project area as illustrated in Enclosure 2.

Unit P32 - This unit is located at the western-most end of the project area and corresponds with project segments R1-1 thru R1-4 (Enclosure 2) which lies within a reach (segments R1-1 thru R1-10) that is not justifiable for Federal funding. Therefore, this reach is considered as part of the Locally Preferred Plan (LLP) and will be 100% funded by the non-Federal sponsor. Since no Federal funding will be used in the construction of this segment of the project, the CBRA is not applicable with this reach of the project.

Unit P31A - Located in west one third of the project, this unit for the most part, is located in an area that in not within the construction area except for the eastern-most boundary of the unit, which contains an approximate 400-ft portion of the berm and dune transition. This unit corresponds to the Topsail State Preserve. Even though the construction reach is small, it is believed that establishing the proposed beach-dune system will contribute to the overall sustainability of the fish and wildlife and various other natural resources including the dune lakes. Being that this area is a state preserve, the use of Federal funds is not likely to result in future development within this unit.

Unit FL-96 - This CBRA unit is associated with Draper Lake, one of the many coastal dune lakes in the county. The construction of the berm-dune system tapers to an end on each side (approximately 500 feet on the west side and 200 feet on the east side) of the lake outfall in order to preserve the natural breaching capabilities. The restoration of the beach-dune system adjacent to the dune lake will provide valuable shoreline stability towards preventing catastrophic breaching of the already vulnerable ecosystems supported by the dune lake. A healthy and stable beach-dune system will contribute to the protection and overall sustainability of the fish and wildlife and various other natural resources including the dune lakes.

Unit FL-95P - This unit is considered an Otherwise Protected Area (OPA) and only applies for Federal flood insurance which is not applicable to this project.

Unit FL-94 - This unit is associated with the Deer Lake Complex. The bulk of the unit is excluded from the construction reaches except for the ends on either side (approximately 600 feet on the west side and 1,000 feet on the east side). The construction of the berm-dune system tapers to an end on each side of the lake outfall in order to preserve the natural breaching capabilities. The restoration of the beach-dune system adjacent to the dune lake complex will provide valuable shoreline stability towards preventing catastrophic breaching of the already vulnerable ecosystems supported by the dune lakes. A healthy and stable beach-dune system will contribute to the overall sustainability and protection of the fish and wildlife and various other natural resources including the dune lakes. The unit is in the vicinity of Deer Lake State Park and believed that the use of Federal funds in this area is not likely to result in future development.

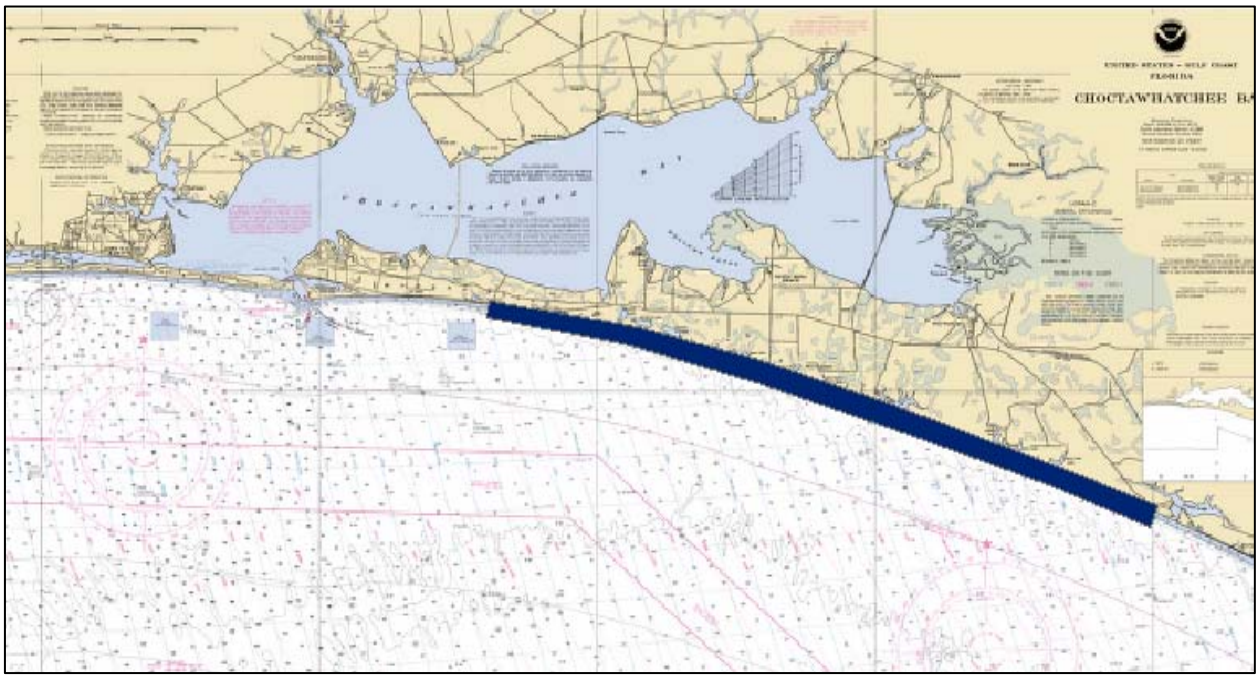
Unit FL-93P - This unit is considered an Otherwise Protected Area (OPA) and only applies for Federal flood insurance which is not applicable to this project.

The Corps believes that this project would qualify for an exemption under Section 6 Exemptions for CBRA units P31A, FL-96, and FL-94. Section 6(a)(6)(A) identifies projects relating to the study, management, protection, or enhancement of fish and wildlife resources and habitats, including recreational projects. Section 6(a)(6)(G) also exempts nonstructural projects for shoreline stabilization that are designed to mimic, enhance, or restore natural stabilization systems. The Corps is seeking your concurrence in this matter. Coordination for this effort should be directed to Mr. Larry Parson at (251) 690-3139 or email at larry.e.parson@usace.army.mil. Thank you for your assistance in this project.

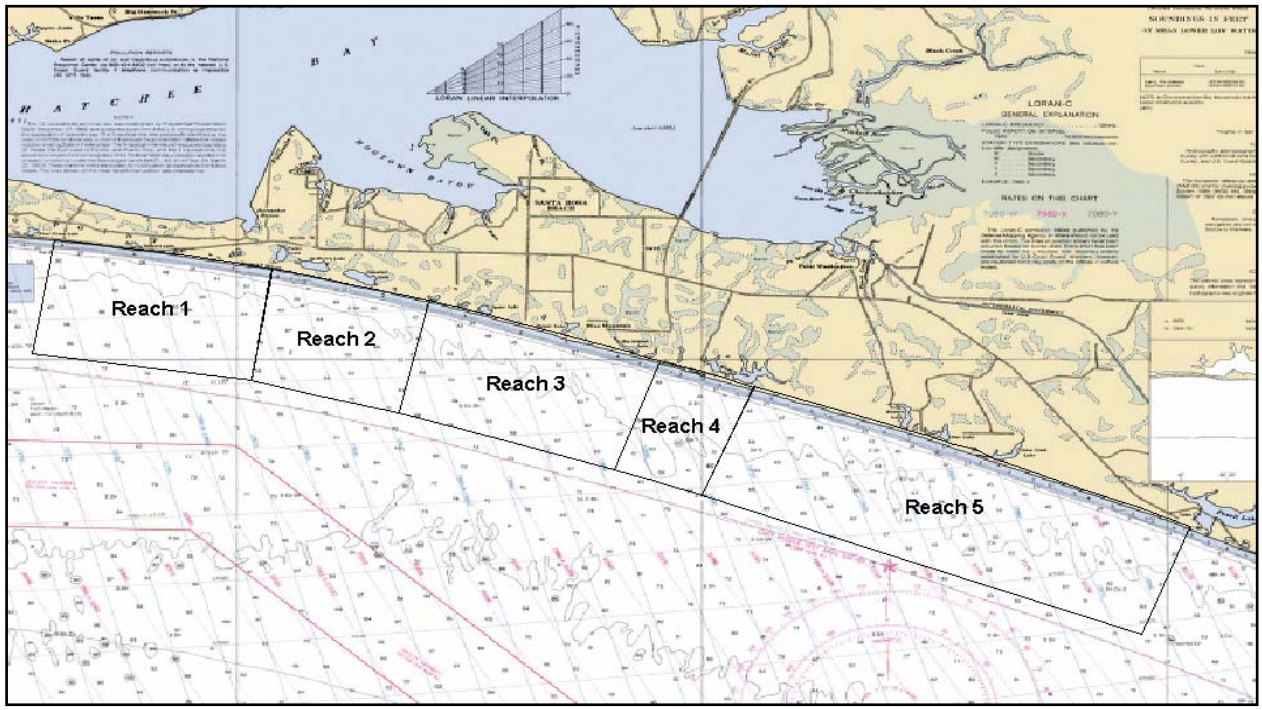
Sincerely,

Kenneth P. Bradley
Chief, Environment and Resources
Branch

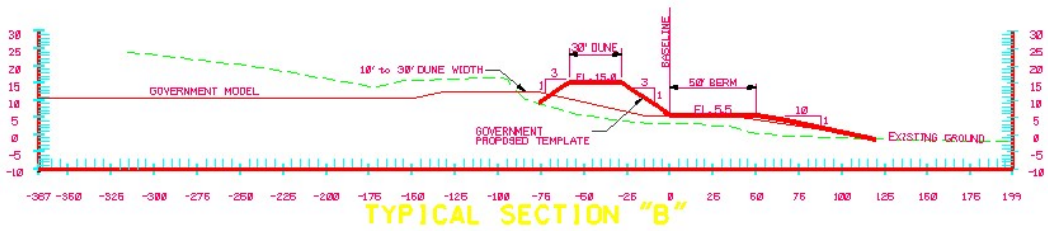
Enclosures

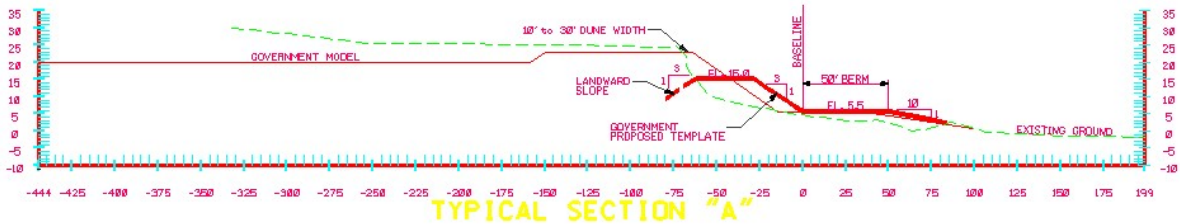


Location of Walton County project area

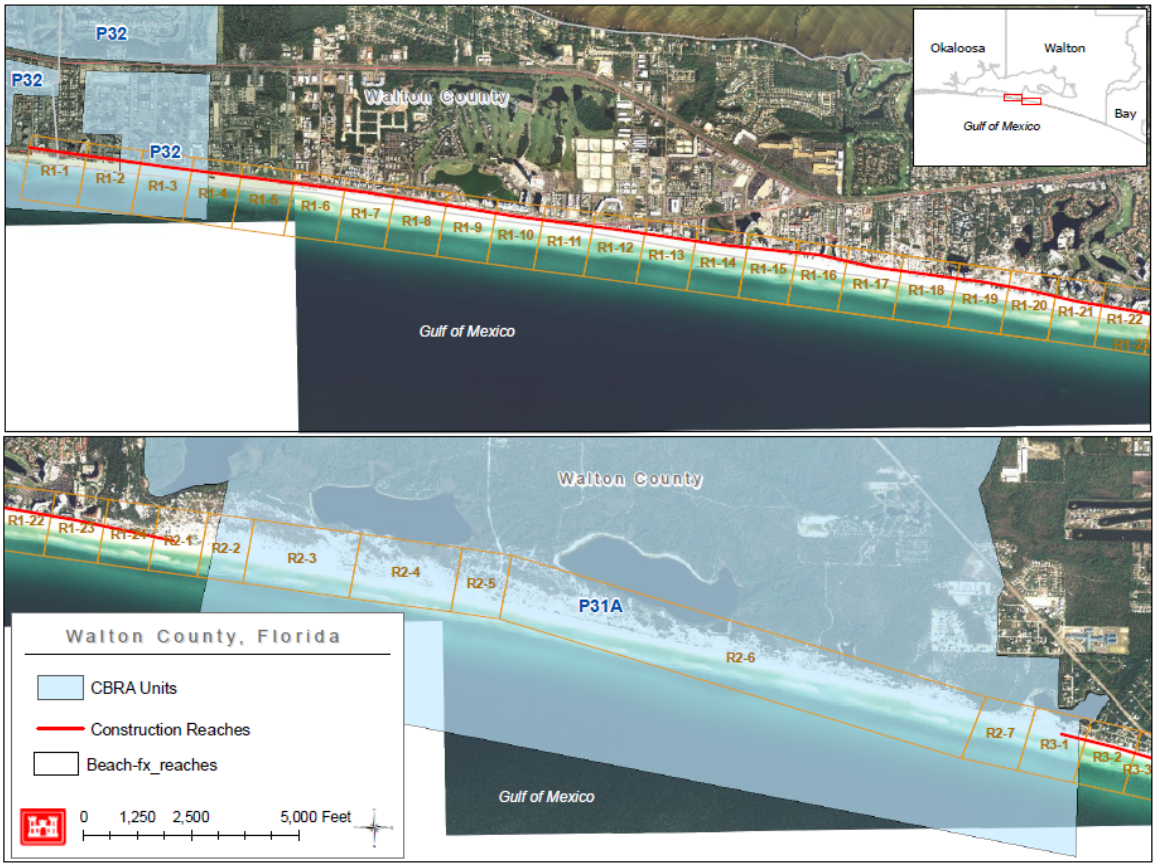


Location of the 5 construction reaches within the project area.

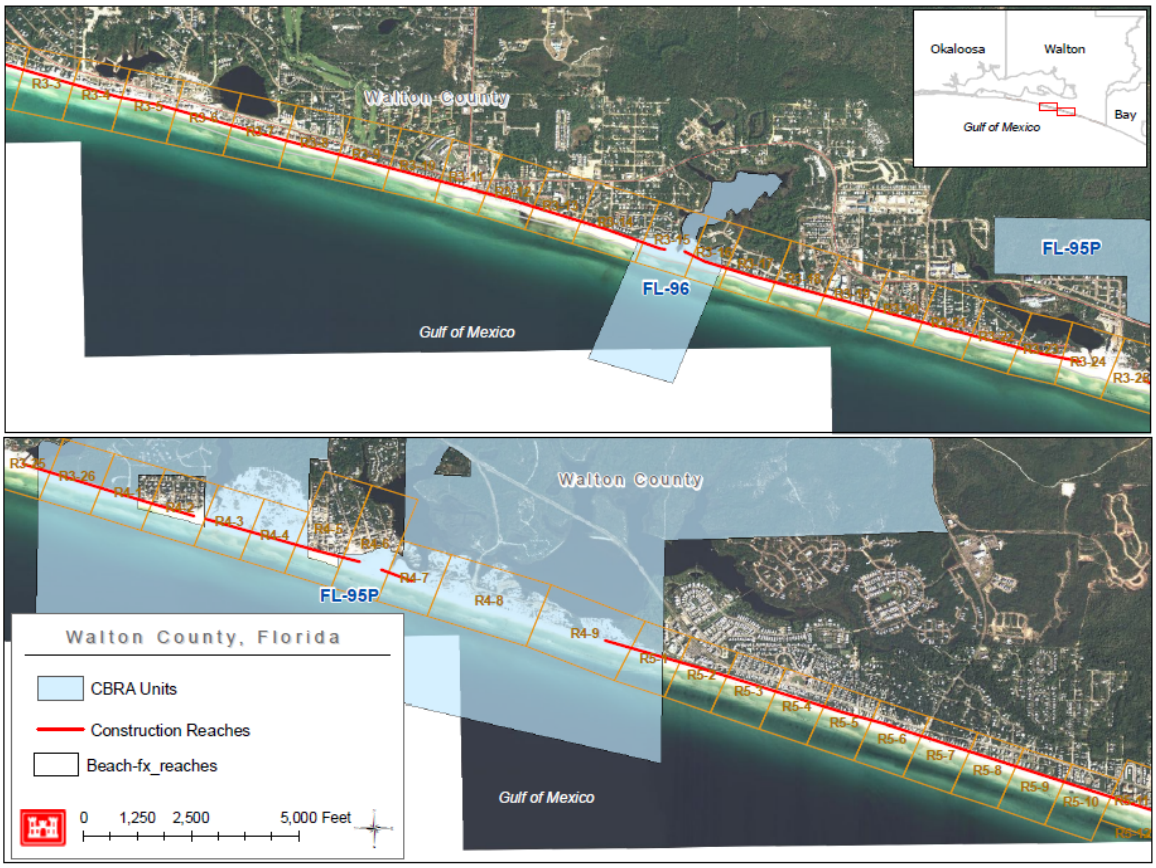




Selected plan typical cross sections to be constructed



Locations of CBRA Units P32 and P31A in relation to the project area



Locations of CBRA Units FL-96 and FL-95P in relation to the project area

Locations of CBRA Units FL-94 and FL-93P in relation to the project area

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

January 13, 2010

Coastal Environment Team
Planning and Environmental Division

Mr. Mark Thompson
National Marine Fisheries Service,
Habitat Conservation Division
Panama City Office
3500 Delwood Beach Road
Panama City, Florida 32404

Dear Mr. Thompson:

The U.S. Army Corps of Engineers (Corps), Mobile District is seeking Federal authorization to conduct a hurricane and storm damage reduction project for Walton County, Florida. Walton County's shoreline located in the Florida's panhandle is receding; the protective dunes and high bluffs are being destroyed by hurricane and storm forces that are occurring more frequently than before. During the late 1990s, the area endured several strong hurricanes resulting in extensive shoreline erosion (Taylor Engineering, 2003). In 2004, the area was affected severely by Hurricane Ivan (September 04) and early into the 2005 hurricane season it was impacted by Hurricanes Arlene (June 05) and Dennis (July 05). The impacts of these storms to property and infrastructure are considerable and can possibly be reduced through a beach restoration and stabilization project which also includes environmental restoration opportunities associated with the beach and dune system.

A feasibility study was authorized by a resolution of both the United States Senate and House of Representatives, which reads as follows:

Resolution Adopted July 15, 2002, by The United States Senate:

> *"Resolved by the Committee on Environment and Public Works of the United States Senate, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and related improvements in Walton County, Florida, in the interest of protecting and restoring the environmental recourses on and behind the beach, including the feasibility of providing shoreline and erosion protection and related improvements consistent with the unique characteristics of the existing beach sand, and with consideration of the need to develop a comprehensive body of knowledge, information, and data on coastal area changes and processes as well as impacts from federally constructed projects in the vicinity of Walton County, Florida."*

Resolution Adopted July 24, 2002, by The United States House of Representatives:

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The non-federal sponsor is the Walton County Board of Commissioners. Their central point of contact is the Director of Beach Management for the Walton County Tourist Development Council (TDC).

Project Location

Walton County is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet (Figure 1). The western two-thirds of Walton County are comprised of a coastal peninsula extending from the mainland, and the eastern third is comprised of mainland beaches. Choctawhatchee Bay lies north of the peninsula. Walton County includes 11.9 miles of state-designated critically eroding areas and three State of Florida park areas that cover approximately six miles of the 26-mile shoreline.

Project Description

The Walton County upland cross-section is defined by dune elevations ranging from +9.5 to + 33 feet NAVD88 and a natural berm elevation of +5.5 feet NAVD88. The study area was divided into five study reaches based on structural development and state park areas as illustrated in Figure 2. The selected plan recommended for construction will be composed of a 50-foot berm width, a 25-foot berm and an additional 25 feet of advanced nourishment in all construction reaches. The project will also feature added dune width in all construction reaches of either 10 or 30 feet. The predicted fill requirements for initial construction is approximately 3,350,000 cubic yards (cy). Re-nourishments will be on a 12-year cycle with predicted volumes to be approximately 2,000,000 cy. Approved borrow sources lie offshore within the State of Florida waters. The typical beach cross-sections for the selected plan are illustrated in Figure 3. When dune construction is complete, the dune will be planted with at least three species of dune vegetation to create a dune that matches the surrounding natural dune patterns in the area.

Borrow Areas

Recent offshore studies, included geological and geophysical interpretation to identify a suitable offshore borrow area, has been performed by Taylor Engineering, Inc. (2003) in the Walton County Destin Beach Management Feasibility Study Final Report under contract to the local sponsor, which initially concentrated on the East Pass area southwest of Destin and the eastern most end of Okaloosa County and the westernmost end of Walton County. Subsequent investigations looked at the entire coastline to assess locations with sufficient quantities for borrow development for the initial beach placement and future re-nourishments.

A large scale reconnaissance level geophysical, lithological and granulomteric investigation was undertaken off Walton County, Florida. Sub-bottom profiles were used to locate prospective core locations to identify high quality sand sources for beach nourishment. Vibracores and selected seismic records were interpreted to confirm the presence and quality of sand off Walton County. The borrow area investigation locations and selected borrow area are shown in Figure 4.

The proposed borrow area sediments are typically well sorted medium sand 0.25 - 0.50 mm (1-2 phi). Monitoring of the borrow discharges will be a constant requirement for compliance with color and grain size criteria. Borrow area B-4 shown on Figure 4 is the borrow site that was selected with some 10,000,000 cy proven by these initial investigations. This volume covers the recommended locally preferred plan placement and the four planned subsequent re-nourishments for the next 50 years. The B-4 borrow area is most centrally located and offers the best source for the initial project construction and future re-nourishments. Based on the extensive geotechnical investigations, this borrow site has been demonstrated to be the most suitable source, and has sand of color, size, and composition generally similar to that of the native beach. All materials used for beach nourishment will be excavated by hopper dredge, transported to the placement area offshore and pumped into the beach template. Small bulldozers will be used on land to shape the material to the prescribed template.

Analysis of Effects:

Congress defines Essential Fish Habitat (EFH) as "those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity," the designation and conservation of EFH seeks to minimize adverse effects on habitat caused by fishing and non-fishing activities. The National Marine Fisheries Service (NMFS) has identified EFH habitats for the Gulf of Mexico in its Fishery Management Plan Amendments. These habitats include estuarine areas, such as estuarine emergent wetlands, seagrass beds, algal flats, mud, sand, shell, and rock substrates, and the estuarine water column. In addition, marine areas, such as the water column, vegetated and non-vegetated bottoms, artificial and coral reefs, geologic features, continental shelf features, and the Mississippi shelf, have also been identified. **Table 1** lists the species managed by the Gulf of Mexico Fishery Management Council.

Material would be removed from the designated borrow area via hopper dredge and pumped onto the beach to create the desired template. This method is preferable in terms of turbidity reduction and minimizing the potential impact to fish and wildlife. Most of the motile benthic and pelagic fauna, such as crab, shrimp, and fish, should able to avoid the disturbed area and should recover shortly after the activity is completed. The selected borrow area is characterized as sandy bottom and does not contain any hard-bottoms, coral reefs, oyster beds, or seagrasses. No long-term direct impacts to managed species are anticipated. However, it is reasonable to anticipate some non-motile and motile invertebrate species will be physically affected through the dredging and placement operations. These species are expected to recover rapidly soon after the dredging and disposal operations are complete.

The Corps has taken extensive steps to reduce and avoid potential impacts to EFH as well as other significant area resources. The Corps will be adhering to water quality requirements under the conditions specified by the Florida Department of Environmental Protection (DEP) to further reduce impacts to EFH.

Based on the above assessment of the project in relation to impacts to fisheries resources, the overall impact to identified species is considered negligible given the relatively small area. Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (PL 94-265), we request your concurrence with our assertion that the project will not result in significant impacts to EFH.

If we can be of any further assistance to you, please call Mr. Larry Parson at (251) 690-3139 or e-mail him at larry.e.parson@usace.army.mil.

Sincerely,

Jennifer L. Jacobson
Chief, Coastal Environment Team

Enclosures

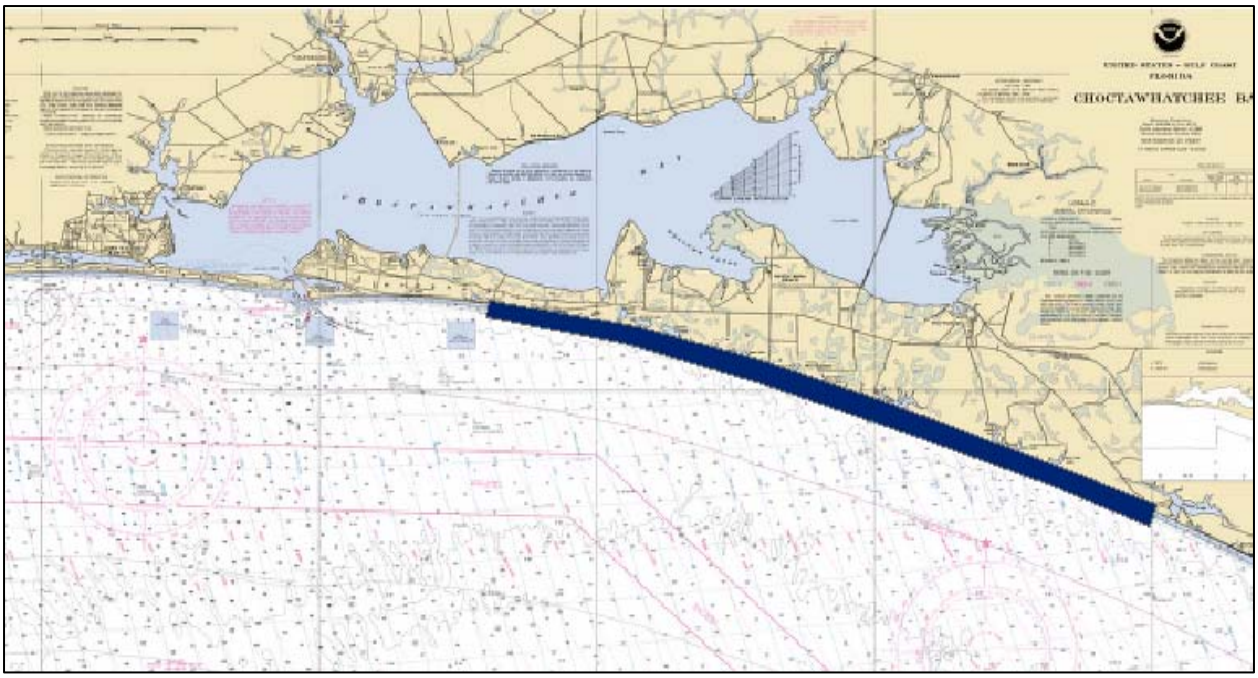

Figure 1. Location of Walton County project area

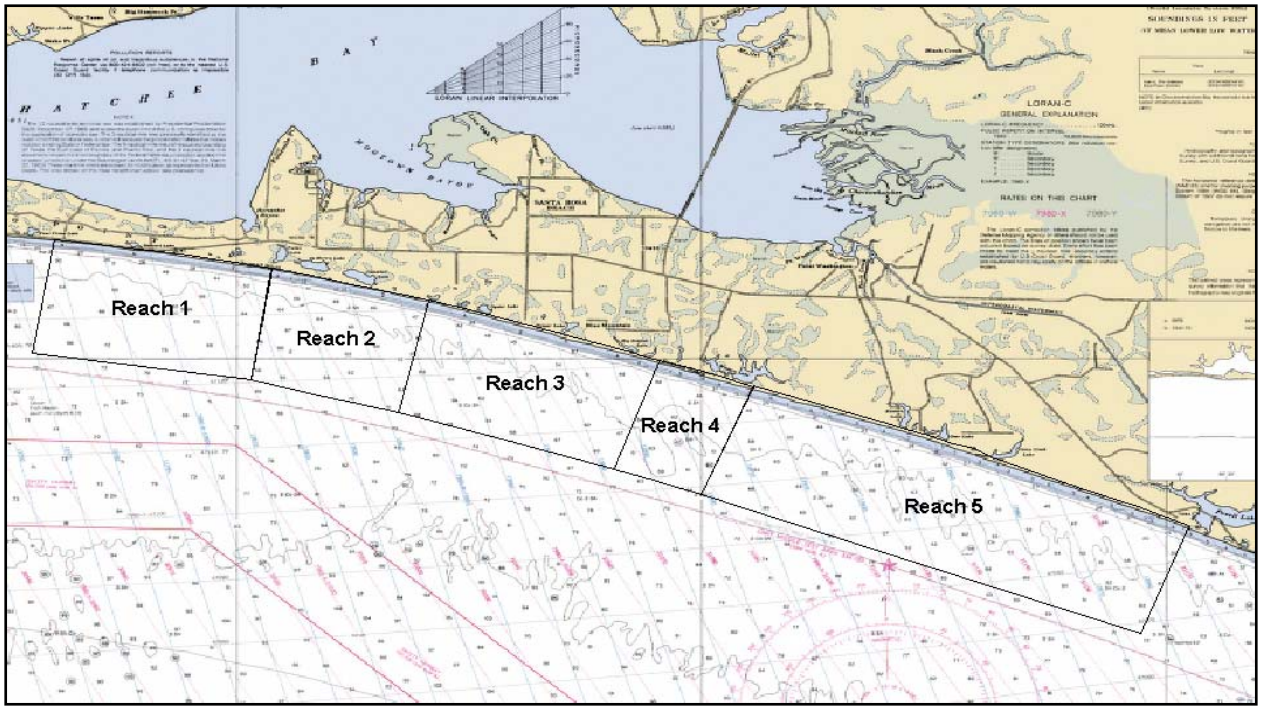

Figure 2. Location of the 5 construction reaches within the project area.

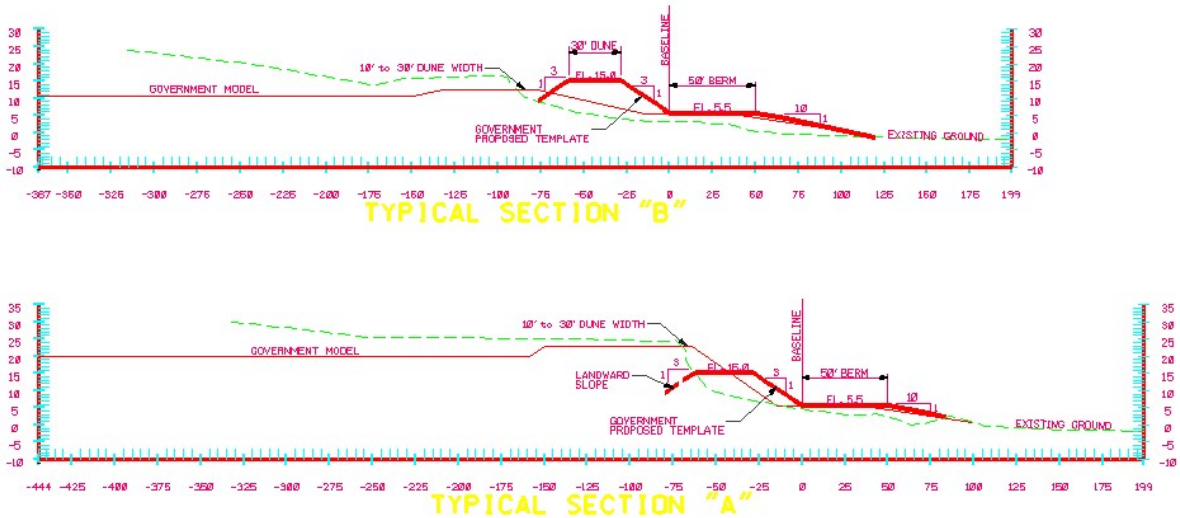

Figure 3. Selected plan typical cross sections to be constructed

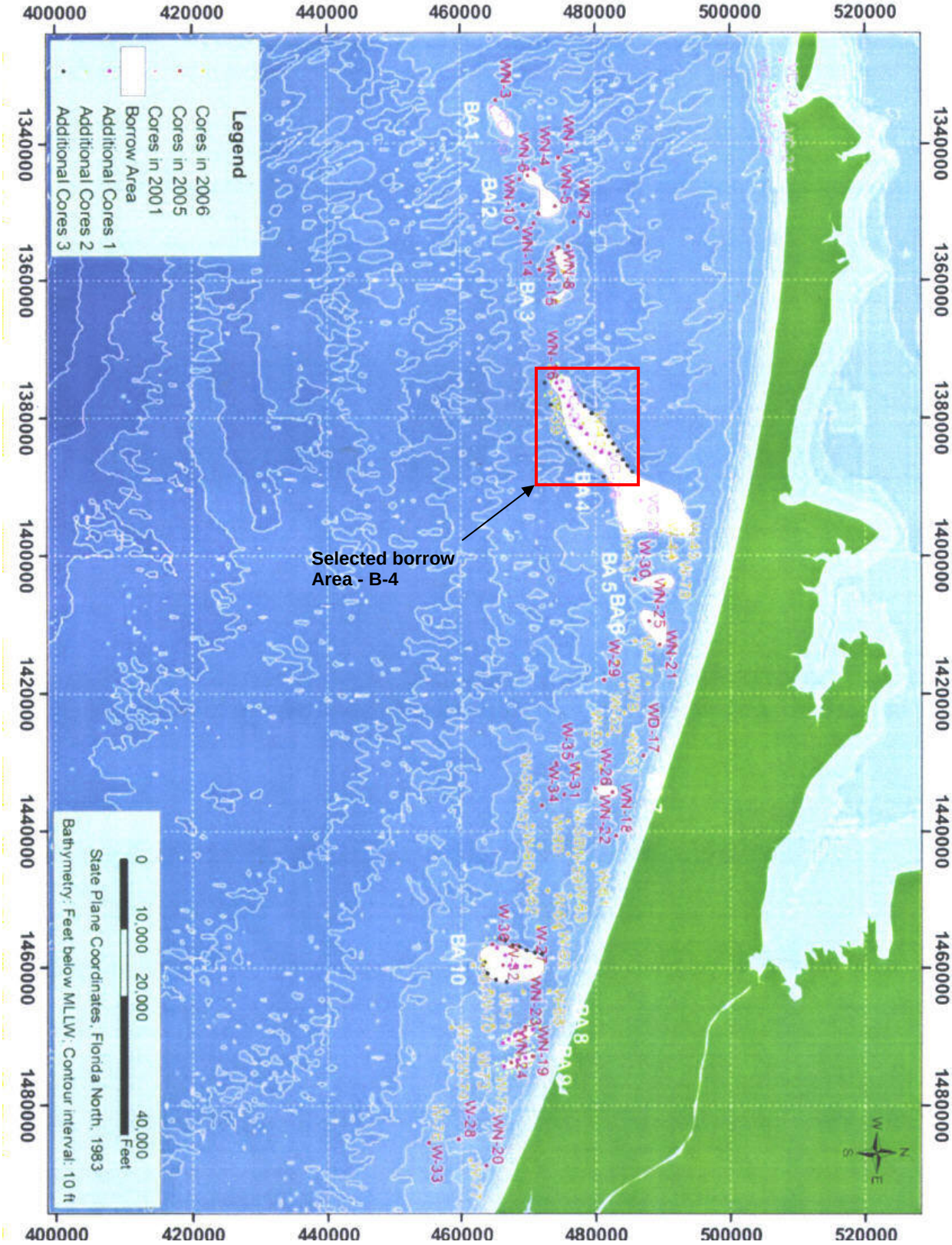

Figure 4. Borrow area investigation locations and selected borrow site.

Table 1: Fishery Management Plans and Managed Species for the Gulf of Mexico area.

GULF OF MEXICO FISHERY MANAGEMENT COUNCIL (NMFS 2008)

Shrimp Fishery Management Plan
- brown shrimp - *Farfantepenaeus aztecus*
- pink shrimp - *F. duorarum*
- royal red shrimp - *Pleoticus robustus*
- white shrimp - *Litopenaeus setiferus*

Red Drum Fishery Management Plan
- red drum - *Sciaenops ocellatus*

Reef Fish Fishery Management Plan
- almaco jack – *Seriola rivoliana*
- anchor tilefish - *Caulolatilus intermedius*
- banded rudderfish – *S. zonata*
- blackfin snapper - *Lutjanus buccanella*
- blackline tilefish - *Caulolatilus cyanops*
- black grouper- *Mycteroperca bonaci*
- blueline tilefish – *C. microps*
- cubera snapper – *L. cyanopterus*
- dog snapper – *L. jocu*
- dwarf sand perch - *Diplectrum bivittatum*
- gag grouper - *M. microlepis*
- goldface tilefish – *C. chrysops*
- goliath grouper - *Epinephelus itajara*
- gray snapper – *L. griseus*
- gray triggerfish - *Balistes capriscus*
- greater amberjack – *S. dumerili*
- hogfish - *Lachnolaimus maximus*
- lane snapper - *Lutjanus synagris*
- lesser amberjack - *S. fasciata*
- mahogany snapper – *L. mahogoni*
- marbled grouper – *E. inermis*
- misty grouper – *E. mystacinus*
- mutton snapper – *L. analis*
- Nassau grouper – *E. striatus*
- queen snapper - *Etelis oculatus*
- red hind - *Epinephelus guttatus*
- red grouper – *E. morio*
- red snapper - *L. campechanus*
- rock hind – *E. adscensionis*
- sand perch - *Diplectrum formosum*
- scamp grouper - *M. phenax*
- schoolmaster – *L. apodus*
- silk snapper – *L. vivanus*
- snowy grouper – *E. niveatus*
- speckled hind - *E. drummondhayi*
- tilefish - *Lopholatilus chamaeleonticeps*
- vermilion snapper - *Rhomboplites aurorubens*
- Warsaw grouper – *E. nigritus*
- wenchman - *Pristipomoides aquilonaris*
- yellowedge grouper *E .lavolimbatus*
- yellowfin grouper – *M. venenosa*
- yellowmouth grouper – *M. interstitialis*
- yellowtail snapper - *Ocyurus chrysurus*

Stone Crab Fishery Management Plan FL
- stone crab - *Menippe mercenaria*
- gulf stone crab – *M. adina*

Spiny Lobster Fishery Management Plan
- spiny lobster - *Panulirus argus*
- slipper lobster - *Scyllarides nodife*

Coral and Coral Reef Fishery Management Plan
- varied coral species and coral reef communities comprised of several hundred species

Coastal Migratory Pelagic Fishery Management Plan
- cobia - *Rachycentron canadum*
- king mackerel – *Scomberomorus cavalla*
- Spanish mackerel - *S. maculatus*

Table 1:

Fishery Management Plans and Managed Species for the Gulf of Mexico. (NMFS 1999)	
Shrimp Fishery Management Plan	**Red Drum Fishery Management Plan**
Brown shrimp (*Penaeus aztecus*)	Red drum (*Sciaenops oellatus*)
Pink shrimp (*P. duorarum*)	**Stone Crab Fishery Management Plan**
Royal Red Shrimp (*Pleoticus robustus*)	Stone crab (*Menippe spp.*)
White Shrimp (*P. setiferus*)	
Reef Fish Fishery Management Plan	
Black grouper (*Mycteroperca bonaci*)	Gag grouper (*M. microlepis*)
Gray snapper (*Lutjanus griseus*)	Gray triggerfish (*Balistes capriscus*)
Greater amberjack (*Seriola dumerili*)	Lane snapper (*L. synagris*)
Lesser amberjack (*S. fasciata*)	Red grouper (*Epinephelus morio)*
Red snapper (*L. campechanus*)	Scamp grouper (*M. phenax*)
Tilefish (*Lopholatilus chamaeleonticeps*)	Yellowtail snapper (*Ocyurus chrysurus*)
Vermillion snapper (*Rhomboplites aurorubens*)	
Coastal Migratory Pelagics Fishery Management Plan	
Bluefish (*Pomatomus saltatrix*)	
Dolphin (*Coryphaena hippurus*)	
Cobia (*Rachycentron canadum*)	
King mackerel (*Scomberomorus cavalla*)	
Little tunny (*Euthynnus alleteratus*)	
Spanish mackerel (*S. maculatus*)	
Spiny Lobster Fishery Management Plan	
Spiny lobster (*Panulirus argus*)	
Coral and Coral Reef Fishery Management Plan	
Varied coral species and coral reed communities	
Comprised of several hundred species	

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, AL 36628-0001

REPLY TO
ATTENTION OF

January 12, 2010

Coastal Environment Team
Planning and Environmental Division

Mr. Scott M. Stroh III
State Historic Preservation Officer
Attention: Ms. Laura Kammerer
R.A. Gray Building
500 South Bronough Street
Tallahassee, Florida 32399-0250

Dear Mr. Stroh:

The U.S. Army Corps of Engineers, Mobile District is proposing to perform beach restoration along approximately 26 miles of beaches in Walton County, Florida using an off-shore borrow area measuring 10,200 feet by 5,300 feet (approximately 1,241 acres). The beach restoration project is part of an ongoing program to reclaim beaches lost through natural erosion and recent storm events. As per requirements outlined in Section 106 of the National Historic Preservation Act, the Mobile District must consider the effects of the proposed action on historic properties.

The area of potential effect includes the deposition area along 26 miles of Walton County shoreline. The borrow source is located in open water approximately 5.8 miles south of the beach, 1.3 miles east of the Walton/Okaloosa County border. Enclosure 1 contains the tentatively selected Federal plan including maps and volumes.

The borrow area was surveyed for cultural resources in May and June of 2007 by Sonographics, Inc. in anticipation of a re-nourishment project to be undertaken by the County (Enclosure 2). The survey found no cultural resources eligible for or listed on the National Register of Historic Places (Historic Properties). The report was coordinated with your office and the results concurred with on December 11, 2008 (DHR Project File No.2008-02705-B)(Enclosure 3).

The shoreline will be reconstructed to historic dimensions. The nature of the work is such that the deposition will have no effect on historic properties. In addition, the nature of the project precludes any visual effects to historic properties.

The Mobile District has reviewed the aforementioned cultural resources survey and review by your office. Based on this information, and the nature of the project, the Mobile District, as lead Federal agency, has determined that the project will have no effect on historic properties as per 36 CFR 800.4(d)(1).

The Mobile District asks that you concur with our finding of **no historic properties affected** by the proposed action as per 36 CFR 800.4(d)(1). If you have further questions, please contact Mr. Joe Giliberti at (251)-694-4114 or via email at joseph.a.giliberti@usace.army.mil or Mr. Larry Parson at (251)-690-3139 or via email at larry.e.parson@usace.army.mil. As always, your input is valuable and greatly appreciated. Thank you for supporting the Mobile District cultural resources program.

Sincerely,

Kenneth P. Bradley,
Chief, Environment and Resources
Branch

Project Description
Walton County, Florida Hurricane and Storm Damage Reduction Project

The U.S. Army Corps of Engineers, Mobile District (Corps) is seeking Federal authorization to conduct a hurricane and storm damage reduction project for Walton County, Florida. Walton County's shoreline located in the Florida's panhandle is receding; the protective dunes and high bluffs are being destroyed by hurricane and storm forces that are occurring more frequently than before. During the late 1990s, the area endured several strong hurricanes resulting in extensive shoreline erosion (Taylor Engineering, 2003). In 2004, the area was affected severely by Hurricane Ivan (Sep 04) and early into the 2005 hurricane season it was impacted by Hurricanes Arlene (June 05) and Dennis (July 05). The impacts of these storms to property and infrastructure are considerable and can possibly be reduced through a beach restoration and stabilization project, which also includes environmental restoration opportunities associated with the beach and dune system.

A feasibility study was authorized by a resolution of both the United States Senate and House of Representatives, which reads as follows:

Resolution Adopted July 15, 2002, by The United States Senate:

> *"Resolved by the Committee on Environment and Public Works of the United States Senate, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and related improvements in Walton County, Florida, in the interest of protecting and restoring the environmental recourses on and behind the beach, including the feasibility of providing shoreline and erosion protection and related improvements consistent with the unique characteristics of the existing beach sand, and with consideration of the need to develop a comprehensive body of knowledge, information, and data on coastal area changes and processes as well as impacts from federally constructed projects in the vicinity of Walton County, Florida.*

Resolution Adopted July 24, 2002, by The United States House of Representatives:

> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and environmental restoration and protection in the vicinity of Walton County, Florida.*

The non-Federal sponsor is the Walton County Board of Commissioners. Their central point of contact is the Director of Beach Management for the Walton County Tourist Development Council (TDC).

Project Location

Walton County is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet (Figure 1). The western two-thirds of Walton County are comprised of a coastal peninsula extending from the mainland, and the eastern third is comprised of mainland beaches. Choctawhatchee Bay lies north of the peninsula. Walton County includes 11.9 miles of state-designated critically eroding areas and three State of Florida park areas that cover approximately six miles of the 26-mile shoreline.

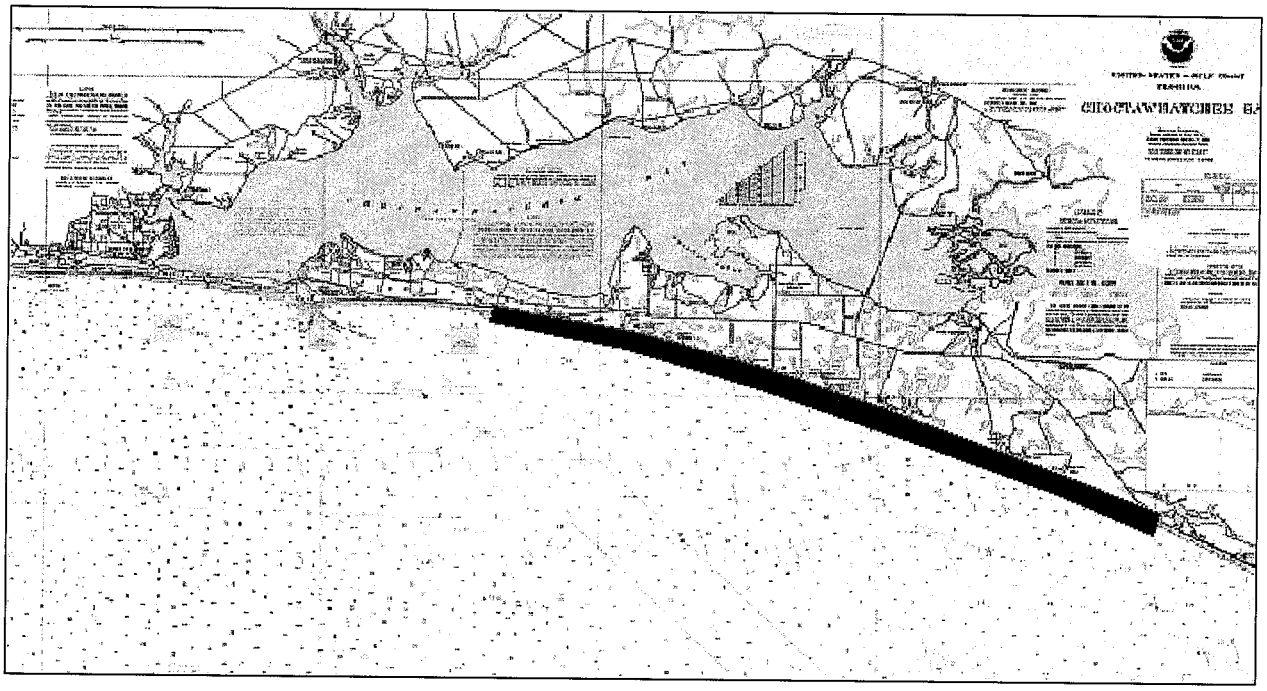

Figure 1. Location of Walton County project area

Project Dimensions

The study region was divided into five study reaches based on structural development and state park areas as illustrated in Figure 2. Representative beach profiles were identified based on similarity in shape of the upper beach profile (dune height and width, berm width, foreshore beach slope, and profile volume) and shape of the offshore profile.

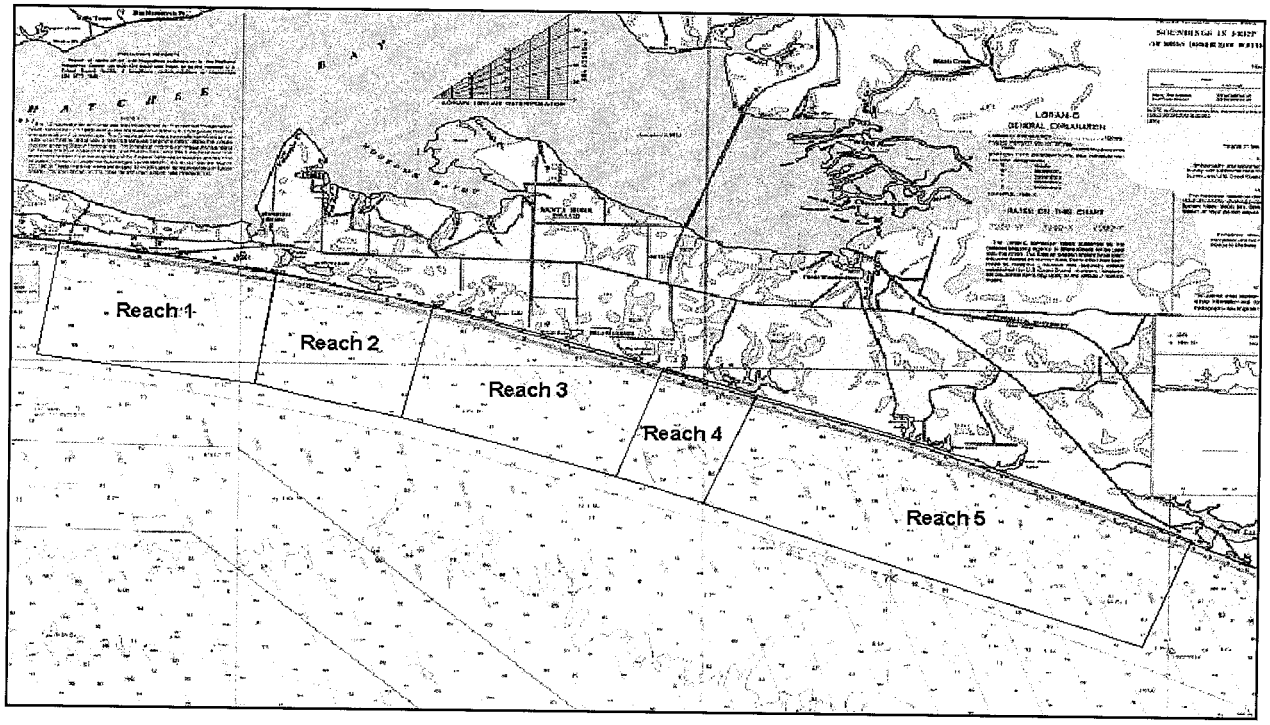

Figure 2. Location of the 5 construction reaches within the project area.

The selected plan recommended for construction consists of the five construction reaches (Figure 2). The project will be composed of a 50-foot berm width, a 25-foot berm and an additional 25 feet of advanced nourishment in all construction reaches. The project will also feature added dune width in all construction reaches of either 10 or 30 feet. The necessary beach fill requirements will be 3,350,000 cy. Re-nourishments will be on a 12-year cycle with predicted volumes to be approximately 2,000,000 cy. Approved borrow sources lie offshore within the State of Florida waters. The typical cross-sections for the selected plan illustrated in Figure 3. When dune construction is complete, the dune will be planted with at least three species of dune vegetation to create a dune that matches the surrounding natural dune patterns in the area. Upon reconstruction immediate steps will be taken to plant and stabilize the dune for rapid stabilization. This will be accomplished through the use of sand fences and dune plants. The dune plants will be planted to cover 60-80% of the total area.

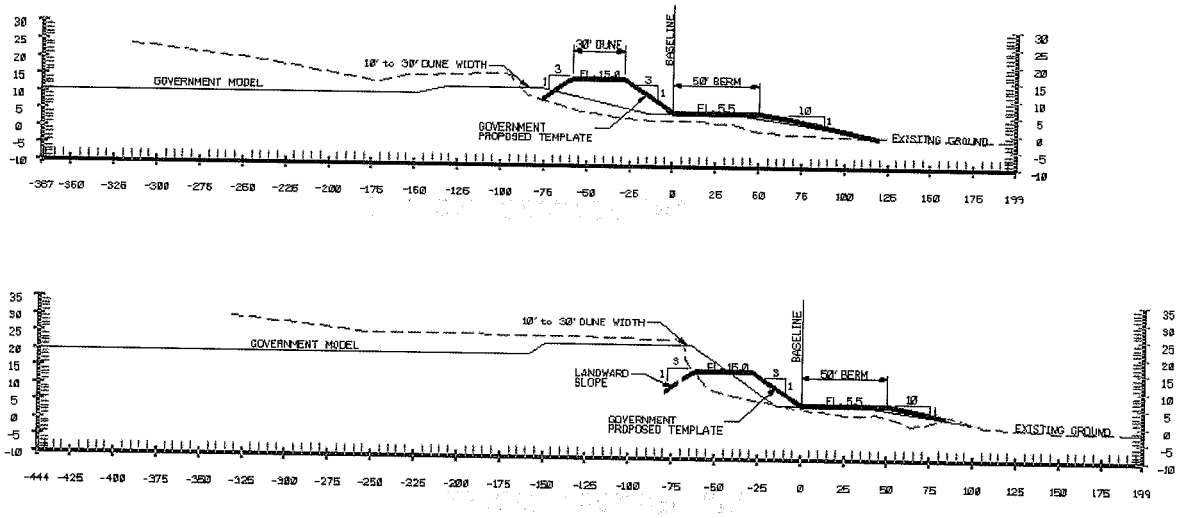

Figure 3. Selected plan typical cross sections to be constructed

Borrow Area

Recent offshore studies including geological and geophysical interpretation to identify a suitable offshore borrow area has been performed by Taylor Engineering, Inc. (2003) in the Walton County Destin Beach Management Feasibility Study Final Report under contract to the local sponsor. The investigations looked at the entire coastline to assess locations with sufficient quantities for borrow development for the initial beach placement and future re-nourishments.

A large scale reconnaissance level geophysical, lithological and granulomteric investigation was undertaken off Walton County, Florida. Sub-bottom profiles were used to locate prospective core locations to identify high quality sand sources for beach nourishment. Vibracores and selected seismic records were interpreted to confirm the presence and quality of sand off Walton County. The borrow area investigation locations are shown in Figure 4.

The proposed borrow area sediments are typically well sorted medium sand 0.25 - 0.50 mm (1-2 phi). Monitoring of the borrow discharges will be a constant requirement for compliance with color and grain size criteria. Borrow area B-4 shown on Figure 4 is the borrow site that was selected with some 10,000,000 cubic yards proven by these initial investigations. This volume covers the recommended plan placement and the four planned subsequent re-nourishments for the next 50 years. The B-4 has been demonstrated to be the most suitable source, has sand of color, size, and composition generally similar to that of the native beach. All materials used for beach nourishment will be excavated by hopper dredge, transported to the placement area offshore and pumped into the beach template. Small bulldozers will be used on land to shape the material to the prescribed template.

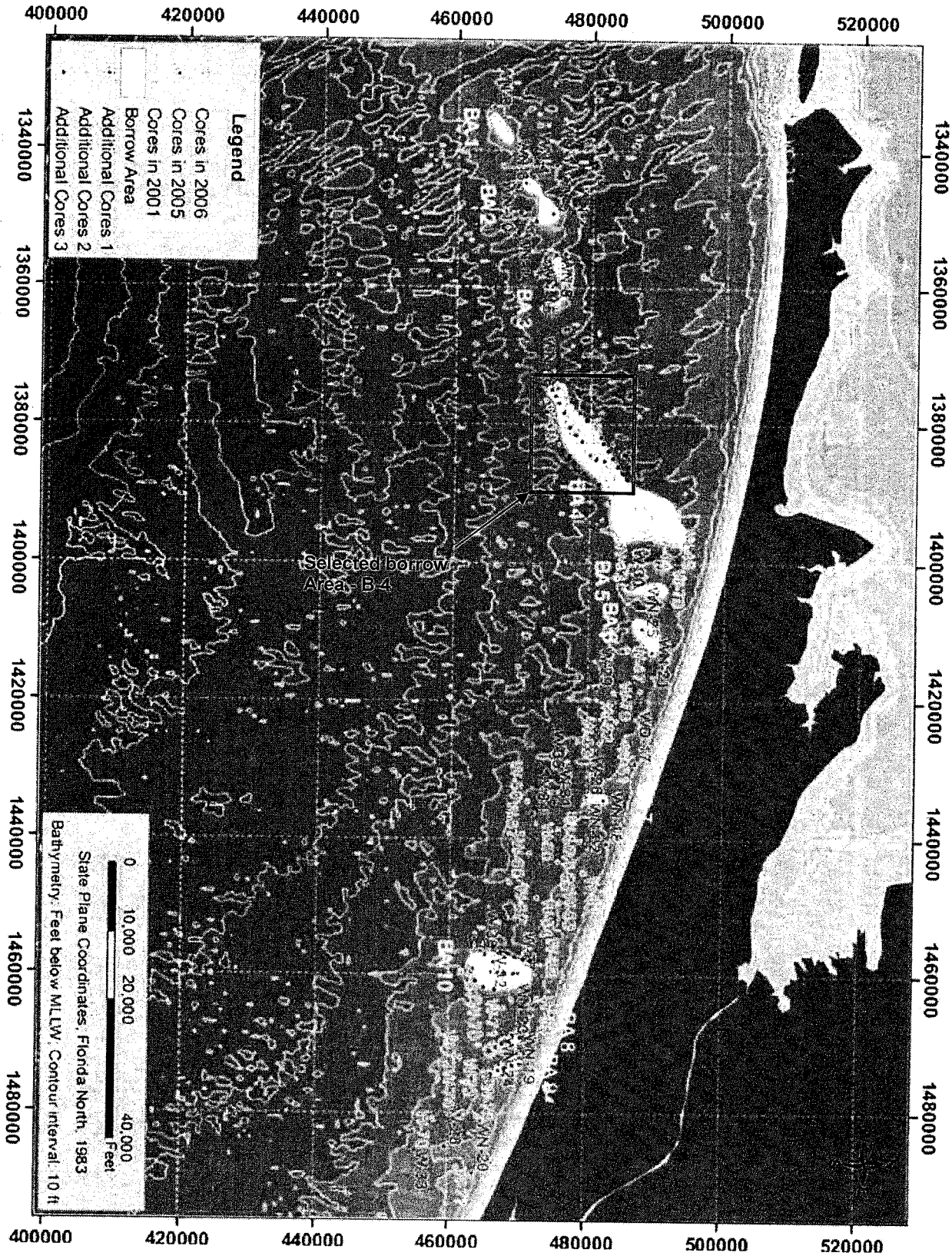

Figure 4. Borrow area investigation locations and selected borrow site.

Cultural Resources Survey Report

Enclosure 2

A Submerged Cultural Resource Remote Sensing Survey

Of A

Borrow Area

Proposed For Beach Restoration

Offshore Of

Walton County, Florida

By

Robert H. Baer
Registered Professional Archaeologist

DHR Permit No. 0607.76

Report Prepared For

Mr. Michael Trudnak, P.E.
Taylor Engineering, Inc.
9000 Cypress Green Drive, Suite 200
Jacksonville, Florida, 32256

Revised October 2008

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Appendix A: Copy 1-A-32 Permit

Appendix B: Survey Log Sheet

Appendix C: Figure 2 Fold Out

Abstract

*

Executive Summary

During the permit period 5/30/2007 - 6/30/2007 a remote sensing survey was performed of a single borrow area designated for shoreline nourishment offshore of Walton County, Florida (Figure 1). The remote sensing survey consisted of a magnetometer survey, side-scan sonar survey and a sub-bottom profile survey. The survey was performed by Sonographics, Inc. under contract with Taylor Engineering, Inc.

In the course of the survey, thirty - nine (39) magnetic anomalies, and two (2) side-scan sonar targets were recorded. The thirty - nine magnetic anomalies and two side-scan sonar targets were widely distributed over the bottom area. No concentrated pattern or scatter pattern of magnetic anomalies and side scan sonar targets were recorded that suggested the presence of shipwreck resources in the borrow area, nor did the sub-bottom profiler data indicate the presence of areas that would indicate prehistoric midden sites or other inundated habitation sites.

Based on the analysis of the remote sensing data it was the conclusion of the principal investigator that there are no sunken shipwreck resources, or other sunken cultural sites within the proposed borrow area. Based on this analysis it is the recommended that the Walton County shoreline nourishment project be authorized to proceed.

A Submerged Cultural Resource Remote Sensing Survey of a

Borrow Area

Proposed for Beach Restoration

Offshore of Walton County, Florida

Introduction

Walton County has requested a State of Florida Joint Coastal Permit and Sovereign Submerged Lands Authorization for an offshore borrow area to serve future beach nourishment operations within the county. The proposed borrow area lies in the Gulf of Mexico approximately 5.8 miles south of the Walton County shoreline and 1.3 miles east of the Walton/Okaloosa County border (Figure 1). Walton County's borrow area evaluation process included a cultural resource remote sensing survey to identify and determine if any objects within the borrow area are eligible for listing on the National Register of Historic Places (NRHP). This report presents the results of the remote sensing survey.

The remote sensing survey consisted of combined magnetometer, side-scan sonar, and sub-bottom profile surveys. The remote sensing survey complies with the National Historic Preservation Act of 1966, as amended (PL 89-665); the Archeological and Historic Preservation Act, as amended (PL 93-291); the Abandoned Shipwreck Act of 1987; the Advisory Council on Historic Preservation revised 36 CFR Part 800 Regulations; and Section 276.12, *Florida Statutes*, Chapter 1A-32 and 46 of the *Florida Administrative Code*. The State of Florida Division of Historical Resources approved the scope of work for the remote sensing survey as submitted in a Florida Bureau of Archaeological Research Permit (Chapter 1A-32) application prior to field operations; Appendix A contains Permit No. 0607.06. Field operations occurred between 5/30/2007 and 6/30/2007. The project staff, subcontracted by Taylor Engineering, Inc., included Robert H. Baer, RPA as project principal investigator and Rick Horgan as remote sensing specialist. Mr. Horgan owns and operates Sonographics Inc., Marine Geophysical Services, Wilton Manors, Florida.

Figure 1 Proposed Borrow Area Location Map

Project Location

The center of the proposed borrow area lies approximately 5.8 miles offshore Walton County and 1.3 miles east of the Walton/Okaloosa County border. Walton County lies on the northwest coast of Florida approximately 60 miles east of Pensacola, 100 miles west of Apalachicola and 115 miles southwest of Tallahassee. The county seat is De Funiak Springs. Walton County adjoins Okaloosa County to the west and Bay, Holmes and Washington Counties to the east. Figure 1 shows the position of the proposed borrow area in relation to the Walton County shoreline.

Project Research Objectives

The Submerged Cultural Resources survey aimed to identify and determine if any objects within the borrow area are eligible for listing on the National Register of Historic Places (NRHP). The survey utilized instruments specifically designed to identify shipwrecks, ferrous material, and geological anomalies such as submerged river beds and former terrestrial sites, both prehistoric and historic.

Potential for Cultural Resources in the Survey Area

The northwest Florida Gulf Coast has been settled since the middle of the seventeenth century. Pensacola, the oldest city on the northwest Florida Gulf coast, has had strategic importance since the Spanish first settled there in 1698. Pensacola and Apalachicola Bays and the barrier island estuary system that separates the Gulf of Mexico from the Florida peninsula have formed an essential commercial transit route for the Spanish, English, and later the citizens of the United States following the admittance of Florida to the Federal Union in 1845.

Over the long period of recorded history numerous ships have sunk in the waters of the northwest Florida Gulf Coast. The historic importance of the northwest Florida coastal zone is well documented. Early exploration, trade, commerce, warfare vicissitudes of weather and navigation error has generated numerous recorded shipwrecks. Due to sea level rise and the associated coastal erosion, the coastal waters also contain sites of both prehistoric and historic settlement. Based on three centuries of coastal navigation and settlement of the northwest Florida coastal zone the potential exists for the discovery of cultural materials in the proposed project area. To better understand the potential for the discovery of sunken cultural resources in the survey area a short review of northwest Florida geology, weather, and history follows. This review intends to document the importance of the Walton County coastal zone within the wider context of the northwest Florida Gulf Coast.

Archaeological Sites – Walton County Coastal Zone

Florida Master Site File Information

The State of Florida Division of Historical Resources has identified a number of archaeological master sites in the Walton County upland area and the coastal zone, including some dating between 7000 BC and 1500 AD. Older sites are found particularly along the Choctawhatchee River, its primary tributary creeks, and the littoral zone of Choctawhatchee Bay. Listed sites include Point Washington, Four Mile Point, Alaqua Bayou, Horseshoe Bayou, and Hogtown Bayou. These have occupation ranges from the Prehistoric Period to the Historic Period of settlement. Many of the Walton Coastal Zone archaeological sites in the south portion of the county contain shell middens, including the Destin Midden near the towns of Destin and Sandestin.

Environmental Background

The project area lies in the temperate region of Florida, characterized by mild winters and warm to hot summers. Associated seasonal temperatures average 54°F in winter and 81°F in summer. Walton County contains Florida's highest elevation: it rises to 345 ft near Lakewood in the northwest sector of the county. The county experiences a storm season between the months of June and October and experiences its highest annual rainfall in this period. Conversely, the months between December and February usually experience little rain. The annual average rainfall equals 57 inches. The growing season in north Florida averages 200 days as compared with 300 days in south Florida. Tidal fluctuations are moderate and average between 1.5 and 2 ft. According to a 1998 soil survey, the county has a total area of 1,338 square miles, including 90 square miles of water and 1,045 square miles of land. South Walton County has approximately 26 miles of sand beaches and associated dune systems. Approximately half of the beach and dune system lie between Choctawhatchee Bay and the Gulf of Mexico (Continental data base – facts on File 2007; Winsberg 2003:66, KH & Associates 2003).

Historic Weather Dynamics

The northwest Florida Gulf Coast is susceptible to the power of hurricanes and lesser tropical storms. Tropical storm activity in the Gulf of Mexico normally occurs during the period from June through October, reaching maximum frequency during the month of September. These common weather anomalies have affected shipping patterns in the vicinity of the survey area throughout recorded history. Thus, this study benefits from a brief summary of historic weather dynamics, including the depth and temperature of the Gulf of Mexico, the flow of the Loop Current, and the wind conditions within the unique hydrographic constraints of the wider Gulf of Mexico.

Hurricanes passing through the Gulf of Mexico generally originate in the southern Caribbean or off the west coast of Africa. The rotation of the earth sets these warm weather systems spinning counter clockwise and they create their own powerful micro weather systems. These circular rotating storms typically move across the Atlantic (west to east) or north through the Caribbean traveling along the routes of natural wind patterns. Two principal wind regimes prevail along the northwest Florida coast: southerly winds with an average annual velocity for the Walton County coastal zone of 16 – 17 kph and short lived but often strong northerly winds generally associated with winter weather conditions which may occasionally reach velocities of 38 to 40 kph. In the late winter and spring months, strong southerly winds emanate from low-pressure systems in east Texas and the plains states, often generating tornados. Wind velocities along the northwest Florida Gulf coast are generally constant throughout the year, ranging from a monthly average of 14.5 kph in September to 22.2 kph in April (Gore 1994: 102-107).

The northwest Florida Gulf coast has experienced hurricanes originating in the Atlantic and Caribbean. Hurricane Ivan, which made landfall north of Pensacola on September 16, 2004, was a serious Caribbean and Gulf Hurricane. Hurricane Katrina (2005) was the most devastating hurricane to reach the Gulf coast of the United States since the Galveston Hurricane of 1929. Katrina was an Atlantic hurricane that crossed Florida as a category 1 storm on August 25 and 26, then picked up speed and force in the warm shallow waters of the Gulf of Mexico before making landfall on the Gulf coast of Mississippi and striking New Orleans as a category 5 hurricane on August 29, 2005. In 2004, two hurricanes passed within fifty miles of the survey area; these included Hurricanes Jeanne and Francis (United States Weather Bureau Data Base 2007).

Little is known about the pattern of storms and hurricanes during the Colonial Era. However, in 1559 six vessels of the De Luna expedition to North Florida were lost in a storm in Pensacola Bay (Singer 1992: 22). Since the middle of the 19th Century at least 23 hurricanes and 28 tropical disturbances have passed within 100 miles of the survey area. Since 1990 at least one severe tropical storm or depression has crossed the northwest Florida coastal zone every five years (USWB 2006). Any serious anomaly of weather could prove fatal to a sailing vessel navigating within the confines of the Gulf of Mexico.

Geology & Barrier Island Development

Coastal geologists have classified barrier islands and coastal shorelines into a number of different categories based on their structure, geological attributes, and method of formation. Generally, all coastal barriers lie parallel to the shores that they protect. When they trend into or away from the shoreline, barrier islands may eventually develop into headlands that may form capes or gradually coalesce with the shore. The south Walton County shoreline of approximately 26 miles has a unique geological formation

and ecosystem. Approximately 13 miles of the shoreline is located between Choctawhatchee Bay and the Gulf of Mexico, and the remainder consists of dunes with a lake system that is found only in Walton County, Florida (Walton County Board of County Commissioners Report 2003).

The northwest Gulf coast and barrier island systems consist of a drowned delta that Paleo-Indians inhabited 12,000 years ago before they gradually migrated into the Florida peninsula and continental southeast. At that time, the present barrier island systems were upland regions, and the Gulf of Mexico shoreline west of the Florida peninsula extended approximately 75-100 miles seaward of the present shoreline (Milanich 1995: 17). As sea levels rose and shorelines assumed their present configuration, these prehistoric peoples withdrew to the upland regions. However, the Gulf coast shoreline continues to naturally erode, fragment, and prograde. Core analysis suggests that the northwest Florida to Texas Gulf coast was unbarred during the Middle to Late Holocene Transgression and that the present barrier island system did not originate seaward of their present locations. In other words, although the shoreline was substantially lower during the last Ice Age and inhabited during the latter stages of that period, the coastline as found today emerged from the shoals practically in place and has migrated shoreward and seaward as the result of coastal currents and other natural dynamics (Leatherman 1979: 315-16). During the Holocene Period, the late Archaic and Formative periods, native cultures of the northwest Florida and Gulf region developed and ninety percent of the archaeological sites in the present (upland) coastal zone were inhabited (Gagliano in Davis 1984: 17).

Survey Area History

The northwest Gulf coast and particularly the estuary areas and embayment areas from Apalachicola Bay to Pensacola Bay have a varied prehistoric and historic past. The native peoples who inhabited this coastal area exhibited a pattern of cultural continuity that evolved slowly over the past 10,000 years; then in the period 3000 BC, the culture of these peoples experienced a period of elaboration and diversification. This period of cultural development continued until the 16th century with the arrival of European explorers and settlers who established a permanent presence on the Gulf coast at Pensacola Bay in 1698.

The 160 miles of coastal zone between Pensacola Bay and Apalachicola Bay consist of a mixed bay and estuary system fed by rivers that flow to the southwest through the Florida peninsula. During the prehistoric period the native people that live in the Pensacola Bay-Apalachicola Bay drainage maintained contact with the cultures that lived in the lower Mississippi Valley and Central and South Georgia, most notably the people that lived in the Kolomoki Mound complex in southwest Georgia near present Blakely, Georgia. At the time of the European exploration and during the contact period the natives of the

northwest gulf were encountered by Tristan de Luna in 1559 - 60 who sailed the northwest coast before landing in Pensacola Bay (Milanich 1994: 180 – 185).

At the beginning of the European Contact period, in the 16th Century, the native populations of Florida extending north and west around the littoral of the Gulf of Mexico exhibited little cultural uniformity. According to anthropologist Vernon Knight, the native peoples of the pre-contact period exhibited a mixture of social and economic traits, from the stratified, but non agricultural Calusa of the southwest Florida coast to the partially agricultural chiefdoms of the Fort Walton and Weeden Island cultures of the northern Gulf, to the egalitarian hunter-gatherers of the Texas coast. The chiefdoms from Pensacola Bay (the Penzacola) to Apalachicola Bay (the Apalachee) became distinguished by the integration of their specialized delta horticulture into a traditional estuary oriented hunter-gatherer mixed economy. This led to a more balanced intake of nutrients and the possibility of higher and healthier population levels (Knight in Davis 1984: 199).

Spanish Colonial Period

In the early 16th Century, Spanish explorers began to investigate the northwest Florida coast. Pre-1520 voyages along the central coast of Florida include those of Diego Miruelo (1616) and Francis Hernandez de Cordova (1517). In 1519 Alonzo Alvarez de Pineda is believed to have sailed the entire coast of northwest Florida and landed in what was either Pensacola or Apalachicola Bay. Later in 1528 Panfilo de Narvaez and Alvar Nunez de Vaca entered the area in an unsuccessful attempt to trade with the natives. In 1528 Narvaez landed at what is believed to be Tampa Bay. After landing, Narvaez and a force of Spaniards marched north along the Gulf coast crossing the Withlacoochee and Suwannee rivers. After reaching an Apalachee village named Aute, Narvaez sent a lieutenant, Cabeza de Vaca, and a force of soldiers to locate the coast and the expedition ships that had been sent north from Tampa Bay. It has been suggested that Aute was near the Wakulla River which flows into the St. Marks River that in turn flows into Apalachee Bay. From the village of Aute, de Vaca and a force of soldiers were sent to locate the Gulf of Mexico, which they located a day's march to the west. Shortly thereafter Narvaez, along with de Vaca and the troops, constructed rafts at a location they named the 'Bay of Horses' and began to travel along the coast in an attempt to reach Mexico. The Spanish crossed Apalachee Bay and continued west along the littoral zone of northwest Florida. After an arduous journey in which the Spanish lost most of their party through hunger, disease and hostile Indians they eventually arrived in Vera Cruz. (Lopez – Morillas 1993: 12).

In 1559 the Tristan de Luna expedition sailed the coast of northwest Florida seeking to establish a base from which to explore a route across the southeast from the Gulf of Mexico to the Atlantic. Sailing

east along the northern gulf coast the expedition apparently missed the entrance to Mobile and Pensacola Bays then made landfall west of Apalachee Bay between Cape San Blas and present Walton County. Eventually they retraced their course to Pensacola Bay; while anchored in the bay the fleet was struck by a hurricane and nine ships were lost. The de Luna expedition failed in the attempt to traverse the southeast (Lopez – Morillas: 1993: 12).

In 1698, Andreas de Arriola was appointed the Governor of West Florida. With the establishment of the town of Pensacola, west Florida became connected by a series of missions to St. Augustine on the Atlantic coast – the Capitol of East Florida.

Walton County History

Documented European and American settlement in what is now Walton County began in the early 19th Century in the area known as the Euchee Valley generally located between present U.S. Highway 90 (Rock Hill Road), U.S. Highway 331, and the Choctawhatchee River. Another area of pioneer settlement was the Alaqua Creek basin that is now primarily located on the Eglin Air Force Reservation. Since the arrival of the Spanish in the 16th Century the rich natural resources of Choctawhatchee Bay and the Gulf of Mexico were harvested by Spanish fisherman that traveled the littoral zone of the Gulf of Mexico from Havana, Cuba, occasionally establishing fishing camps on the barrier system and in the bays and estuaries.

The first fully documented settlers of what is now Walton County were the McLendon brothers, who migrated to the area from North Carolina and settled along Bruce Creek near present Eucheeanna. The McLendons' successful homesteading influenced other North Carolinians to settle in the area. Walton County was created in 1824, shortly after the United States acquired West Florida from the Spanish. Originally Walton County consisted of 2,900 square miles, however the county lost a large portion of territory when Washington, Holmes, and Okaloosa counties were formed; the county now consists of 1,338 square miles. The first county census was carried out in 1830 and a population of 1,207 was recorded (Kimley Horn Inc., 2003).

The first settlers engaged in farming and fishing the rich natural resources of Choctawhatchee Bay. During the period of pioneer settlement the residents of the area navigated in short draft vessels out of what is now East Pass at Destin, to the port of Pensacola Bay and Escambia Bay 60 miles to the west and Apalachicola Bay 100 miles to the east. However, Pensacola became the primary port of coastal trade up to and through the era of the Civil War. Later, after the Civil War, Walton County became a prime timber growing area which supplied the timber and turpentine (naval stores) industries in Florida and the wider southeast through a widely expanding coastal trade (Walton County Historical Society).

Steamboat and barge landings on the Choctawhatchee River that included Moss Bend (Story's Landing) and Millers Ferry provided interior settlements with access to Choctawhatchee Bay and Gulf of Mexico shipping lanes. The upriver landings were often closed through low water and silting, thus Mallet's Landing and LaGrange, now Freeport were the first towns along the bay to develop as successful port communities. Present Portland where Alaqua Creek enters Choctawhatchee Bay, a few miles west of Freeport, became the site of a thriving sawmill that operated prior to and after the Civil War and was a major source of lumber production in northwest Florida (Walton County Historical Society).

During the period of the Civil War in Florida, 1861 – 1865, Walton County and the Choctawhatchee Bay area was affected by the Federal Blockade. For all practical purposes, this closed ports in the Gulf of Mexico to the normal commerce and trade that had grown over the first half of the 19th Century. There were no recorded engagements in Walton County during the five years of the Civil War, however, the Federal invasion of Pensacola in 1864 and the burning of the Port of Pensacola negatively influenced the economy of the entire northwest Gulf Region (Walton County Library Resources).

Walton County experienced an economic boom in 1884 with the completion of the Louisville & Nashville Railway line from Tallahassee to Pensacola with a link to DeFuniak Springs located in north central Walton County. This railway line opened the interior of the county to additional logging and then to the agriculture that began to flourish in the previously forested areas. The arrival of the railway decreased the amount of river traffic on the Choctawhatchee River, except for Freeport that continued to thrive as a port (Walton County Historical Society).

The beginning of what would become a flourishing tourism industry in Walton County began during the Civil War Reconstruction Era when the Florida Chautauqua opened in February of 1885 in DeFuniak Springs. The Florida Chautauqua consisted of educational and entertainment activities with a religious theme presented in a 'camp meeting' atmosphere. The Florida Chautauqua continued until the turn of the century and is credited with the bringing of the first motion pictures to Florida audiences. This advent of mass entertainment brought the end to Chautauqua in 1920 when radio and the widening Florida highway system offered other cultural opportunities for citizens and tourists alike (Walton County Historical Society).

After the Spanish American War of 1898 – 1899 additional settlers arrived in the area and the Walton County coastal zone became the site of towns that now line the 26 miles of Walton County coastline; these towns include from west to east – Destin, Sandestin, Santa Rosa Beach, Grayton Beach, Seagrove Beach and the unique architectural municipality that was incorporated as Seaside.

Historic Period Currents and Navigation

Geographically situated on the northwest Florida coast, the Walton County shoreline is strategically located at about the mid-point along the historic route of vessels departing the Mexico port of Vera Cruz for ports along the southeastern Gulf Coast or Havana, Cuba. A review of standard shipwreck resources (see below) confirms that at least a dozen vessels may have been lost in the waters offshore of Walton County or in Choctawhatchee Bay. The standard shipwreck lists document far more shipwreck sites in Apalachicola Bay to the east and Pensacola Bay to the west. However, the narrow entrance to Choctawhatchee Bay was known to be hazardous to coastal trading vessels. Due to the shallow waters in the area of the bay, navigation into the estuary was limited to shallow draft fishing vessels and coastal trading vessels. This section of the Cultural Resources Management report describes prevailing gulf currents, hazards to navigation, and a shipwreck history of the Walton County area.

The Loop Current is the primary current system in the Gulf of Mexico, utilized by Historic Era sailing vessels. This is the physical product of two major trans-Atlantic currents: the Equatorial Current and the Guiana Current. These combine and enter the Gulf of Mexico through the Yucatan Channel, north of the Yucatan Peninsula. The constriction of this narrow channel pushes masses of water into the gulf. Seasonal water mass velocities may exceed four nautical miles per hour in the summer, although they fall to a low speed of one mile per hour in the winter (Gore 1994: 67).

Once in the Gulf of Mexico the Loop Current divides into two components: a Gulf Basin component and a northern component. The Gulf Basin component arcs to the west, passing the Campeche banks, in a broad band of water 56 – 93 miles wide. This segment of the current did not provide easy navigation for sailing vessels and threatened to drive them onto the reefs and submerged rocks along the northern shoreline of the Yucatan peninsula. The northern half of the current is not of great importance to gulf shipping until a vessel attempts passage out of the gulf proper into the Straits of Florida. This segment of the Loop Current flows eastward along the northern coastline of Cuba that empties into the Florida Current separating the eastern seaboard of the Florida peninsula and the Bahamas Banks (Steinmiller 1984: 26).

The Loop Current is not a predictable physical system like the Florida Current (Gulf Stream), flowing northward in relatively the same position and at the same speed. The Loop Current is not so much a clearly defined unchangeable hydrographic entity, but rather the sum total of all the highly variable current patterns occurring offshore in the northern Gulf over a given period. Physical factors affecting the current are variations of wind, wave, and tide, along with the continual outflow of water from the Mississippi and other rivers that empty into the Gulf. Gyres may form anywhere at any time, but

only those forming in the northeastern Gulf east of the Mississippi Delta and the west coast of Florida are pertinent to this investigation. These anomalies in the current affect short term weather patterns because they transport fresh supplies of warm Gulf water into cooler, faster moving coastal currents. Such anomalies often produce storms that form and dissipate quickly, and together with high seas and darkened shorelines often proved hazardous to vessels under sail (Gore 1994:89).

Navigators in the historic period followed the Loop Current when sailing from Mexican Ports and other Gulf Ports in North America to Havana in the first leg of their return voyage to Spain. A number of such voyages have ended in shipwreck. Most notable are the Padre Island shipwrecks of 1554, located near the mouth of present Port Mansfield Channel that leads into contemporary Galveston Bay, Texas. Another representative Gulf Coast shipwreck is the *El Nuevo Constante* that foundered in shallow water off the coast of Louisiana in September, 1766. In 1980 the shipwreck site was discovered by commercial fisherman working in the offshore area (Pearson & Hoffman 1995: 1 – 7).

Area Shipwreck Research

The location of the borrow area offshore of Walton County, Florida and the long history of exploration and navigation along the northwest Florida coastal zone support the potential that historic shipwreck sites may exist in its coastal waters. Pursuant to this study, the principal investigator conducted a literature and records search to identify known shipwrecks and other historic data pertinent to the wider survey area.

The archival survey included communication with individuals and agencies at the state, county and local levels of government. The survey analyzed databases of prehistoric and historic archaeological sites that have been identified in the vicinity of the survey area. The survey focused on the documentation of activities that might have been contributing factors in the loss of vessels; such activities included exploration, colonization, agriculture, industry, trade, ship-building, commerce, warfare, transportation, and fishing.

The literature survey included the following sources: *The Encyclopedia of American Shipwrecks* (Berman 1972); *Merchant Steam Vessels of the United States 1909 – 1865* (Lyle and Holdcamper 1952); *Disasters of American Vessels, Sail and Steam 1841 – 1846* (Lockhead 1954); *Shipwrecks of the American Civil War, The Encyclopedia of Union and Confederate Naval Losses* (Schomette 1973); *Shipwrecks of the Western Hemisphere* (Marx 1971); *The Treasure Hunters Guide* (Potter 1972); *Shipwrecks of Florida* (Singer 1998); *Shipwrecks in Florida Waters* (Marx 1985). Other reference sources included the National Oceanic and Atmospheric Administration (NOAA) Historic Chart Database; The Florida State University Shipwreck Database, as well as The United States Coast Guard and recreational

boating charts of the waters of northwest Florida. Other archival charts utilized in a review of coastal waters were the Bernard Romans charts of 1775, and the Romans, *Natural History of Florida*. According to the Florida Master Site File, a number of Paleo-Indian terrestrial sites existed along the coastal zone northeast of the survey area.

Shipwrecks in the NW Florida – Walton County Coastal Waters

Shipwrecks represent the primary motivation for undertaking remote sensing surveys as part of the cultural resource assessment process. The location of some shipwrecks on the northwest Florida coast are known and documented such as the 'Six Ships of the De Luna expedition lost in a storm in Pensacola Bay in 1559 and an 'American Schooner' lost off the mouth of the Suwannee River in 1820. Potter refers to the 'The American Gulf Coast Wrecks', however, no specific locations are given. Potter does write that, "at least a dozen treasure laden vessels have been reported and rumored sunk along the American Gulf Coast" (Potter 1960: 167).

Vessels Lost Near Choctawhatchee Bay

* 1875: The *Three Sisters*, a 154 ton schooner bound from Pensacola to Apalachicola foundered in a storm before reaching port.

* 1892: The *J.P. Allen* – a schooner from Pensacola, 27 tons sand in a storm 60 miles east of Pensacola in the Gulf of Mexico.

* 1906: The *Gus Schammel*, a schooner of 42 tons, built in 1904, lost near Choctawhatchee Bay.

* 1909: The *James C. Clifford* a schooner of 377 tons abandoned 60 miles southwest of Pensacola Bay.

* 1911: The *Belle*, a side wheel schooner of 74 tons built in 1904 at Vernon, Florida was burned at pass into Choctawhatchee Bay.

* 1922: The Rollo a side-wheel schooner of 33 tons built in 1908 at Pinewood, Florida, sank in Choctawhatchee bay on March 30, 1922.

* The Miss. Becky, a 26 ton steel vessel lost in a collision off of Destin in the Gulf of Mexico.

Archival Research Summary

The above review of some credible and thorough archaeological reports indicates that the waters offshore Walton County contain very few of the known shipwreck sites off the Gulf Coast of Florida. None of the wrecks listed in the above references are found within the borrow area vicinity. Given the comprehensive nature of the above references, it is highly unlikely that the researchers overlooked any

wreck sites in the study area; thus, the current study did not conduct additional interviews. Information gained from this archival review will aid the understanding of the remote sensing survey results and will help the principal investigator determine the existence of any significant cultural resources within the study area.

Field Investigations

Magnetometer, Side-scan Sonar, Seismic Survey

Methodology

The Florida Division of Historical Resources approved the methodology and equipment for the remote sensing survey before it began. The remote sensing, magnetometer, side-scan sonar, and sub-bottom surveys of the borrow area were conducted between 5/30/2007 and 6/30/2007. The purpose of these surveys was to ascertain if any submerged cultural resources were located within the borrow area.

Magnetometer

The magnetometer survey utilized a Geometrics Model G-882 Digital Cesium System with a built in depth sensor and altimeter. The G-882 sampled the earth's magnetic field at the rate of 10 samples per second. The magnetometer delivered total field, depth, and altimeter data to a Hypack Navigation Computer. The Hypack software recorded the magnetometer tow-fish position with each incoming magnetometer reading. The surveyors monitored the display of the magnetometer throughout the survey to ensure that the equipment remained at the proper elevation. The survey collected data along straight lines spaced at 100 foot intervals.

Side-scan Sonar

The side-scan sonar survey utilized an Edge Tech Model 4200-FS digital CHIRP system. Once again, the side-scan sonar delivered imagery to the Hypack Navigation Computer, which geo-encoded it using the tow-fish position and stored it in the Edge Tech native (jsf) format. The survey followed the same tracklines as the magnetometer survey and occurred simultaneously. It collected dual frequency data at 120 kHz and 400 kHz and used a range scale of 50 m per side for a total swath of 100 m and 250% coverage.

Sub-Bottom Profiler

The sub-bottom survey utilized an Edge-Tech SB 424, which emits a high frequency CHIRP pulse. This X-Star Full Spectrum Sonar has a versatile wide-ban FM profiler that generates cross-sectional images of the seabed and collects digital normal incidence reflection data over many frequency

ranges. The tapered wave form spectrum results in images that have virtually constant resolution with depth.

Electronic Navigation

Throughout the survey, a Trimble DSM 232-L – Real Time Differential Global Positioning System (GPS) fed navigation data into the Coastal Oceanographic (Hypack) Hydrographic Data Collection and Processing System. The DSM 212-L has a differential (GPS) beacon receiver which uses the U.S. Coast Guard Differential Correction Signal to send accurate differential GPS corrections to the onboard GPS receiver. The U.S. Coast Guard Pensacola Beacon provided the differential correction signal for this survey.

The DSM-232 provides moderate precision static and dynamic position and velocity data at a rate of one reading per second. Accounting for the differential correction, it has an accuracy of approximately 1 meter. All data references the Florida State Plane Traverse Mercator – Projection Coordinate System, North Zone (NAD 83).

Survey Area Parameters

Figure 1 shows the position of the borrow area, centered approximately 5.8 miles offshore Walton County. The borrow area has a roughly rectangular shape and measures approximately 10,200 ft (1.9 miles) by 5,300 ft (1.0 miles). The average water depth in the borrow area equals 70 ft.

Figure 2 shows the remote sensing tracklines and the positions of the 39 magnetic anomalies and 2 side-scan sonar targets. Side-scan target S1 corresponds to magnetometer anomaly M5 and side-scan target S2 corresponds to magnetometer anomaly M39. Table 1 presents pertinent data associated with each magnetometer anomaly. The table includes latitude, longitude, easting, and northing data, along with the intensity of each anomaly and an estimated ferrous weight. Estimated weights were computed using formula and techniques from the *Geometrics Applications Manual for Portable Magnetometers* by Sheldon Brenier (1973). Figures 3 – 5 show images of side-scan sonar target S1, and Figures 6 – 8 show images of S2.

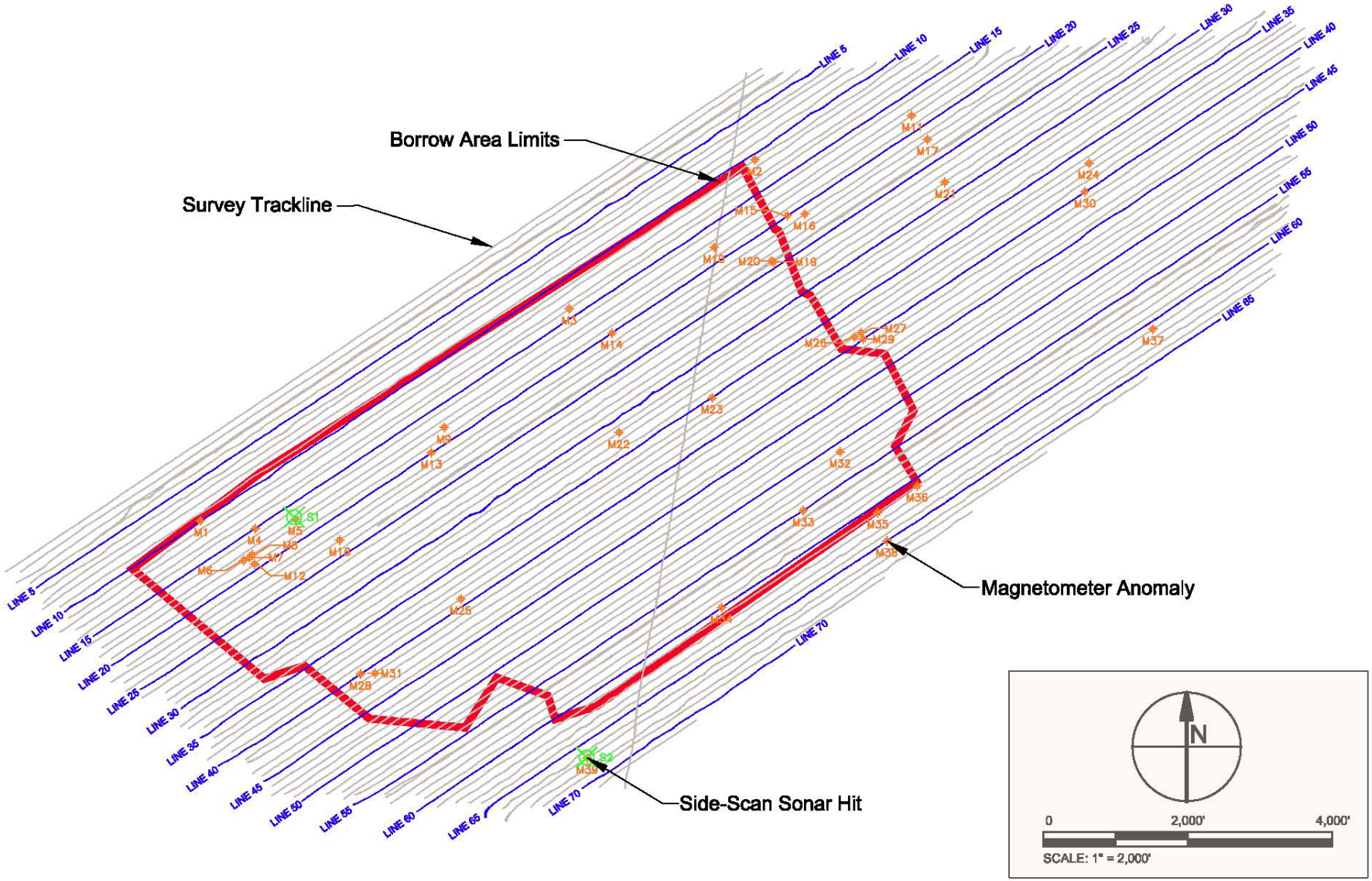

Figure 2 Seismic Tracklines with Magnetometer and Side-Scan Sonar Hits

Table 1 Magnetometer Survey Results

Number	Location (ft-NAD83, FL-N)		Survey Line No.	Intensity (gammas)	Range (ft)	Horizontal Range (ft)	Estimated Mass (lb)
	Easting	Northing					
M1	1371724.120	475229.610	10	13.0	28	13	250
M2	1379397.450	480217.850	11	23.0	26	9	350
M3	1376827.890	478156.820	14	16.0	31	23	400
M4	1372475.520	475122.080	15	7.4	15	0	24
M5, S1	1373035.190	475251.600	17	25.1	35	32	500
M6	1372324.000	474681.600	18	1.1	18	0	5
M7	1372394.500	474724.900	18	1.1	19	0	9
M8	1372444.300	474761.000	18	0.2	14	18	0
M9	1375092.700	476516.330	18	1.5	30	22	42
M10	1378831.820	479006.050	18	1.3	16	0	10
M11	1381567.590	480829.520	18	1.1	23	0	14
M12	1372467.860	474635.210	19	1.0	14	0	3
M13	1374918.530	476170.220	20	2.0	21	0	19
M14	1377418.640	477825.400	20	1.0	24	10	12
M15	1379842.650	479443.980	20	0.1	25	14	23
M16	1380085.530	479465.370	21	1.0	21	0	10
M17	1381788.350	480499.520	22	1.0	13	0	2
M18	1373651.390	474961.920	23	1.2	15	0	5
M19	1379651.540	478807.810	24	0.2	17	0	10
M20	1379622.550	478815.690	24	3.0	22	0	28
M21	1382025.100	479905.930	28	1.0	19	0	8
M22	1377515.530	476447.230	32	2.0	30	11	55
M23	1378802.230	476930.560	35	0.1	23	20	14
M24	1384019.470	480173.670	37	2.0	16	0	9
M25	1375325.700	474149.060	39	1.0	24	0	12
M26	1380776.830	477771.410	39	1.1	16	0	6
M27	1380865.480	477829.810	39	1.1	10	0	8
M28	1373939.230	473112.100	40	2.2	29	15	46
M29	1380893.830	477737.390	40	3.1	11	0	4
M30	1383967.320	479775.770	40	0.3	35	26	109
M31	1374136.850	473123.070	41	2.0	11	0	2
M32	1380577.750	476184.750	51	1.0	17	0	7
M33	1380068.420	475371.510	55	0.2	25	0	22
M34	1378938.070	474031.320	60	0.2	26	0	27
M35	1381097.910	475343.880	61	3.0	32	16	87
M36	1381644.310	475714.210	61	2.2	26	0	29
M37	1384907.870	477876.720	61	1.0	16	0	27
M38	1381224.030	474951.970	65	3.3	11	0	5
M39, S2	1377074.960	471949.970	67	4.0	31	12	119

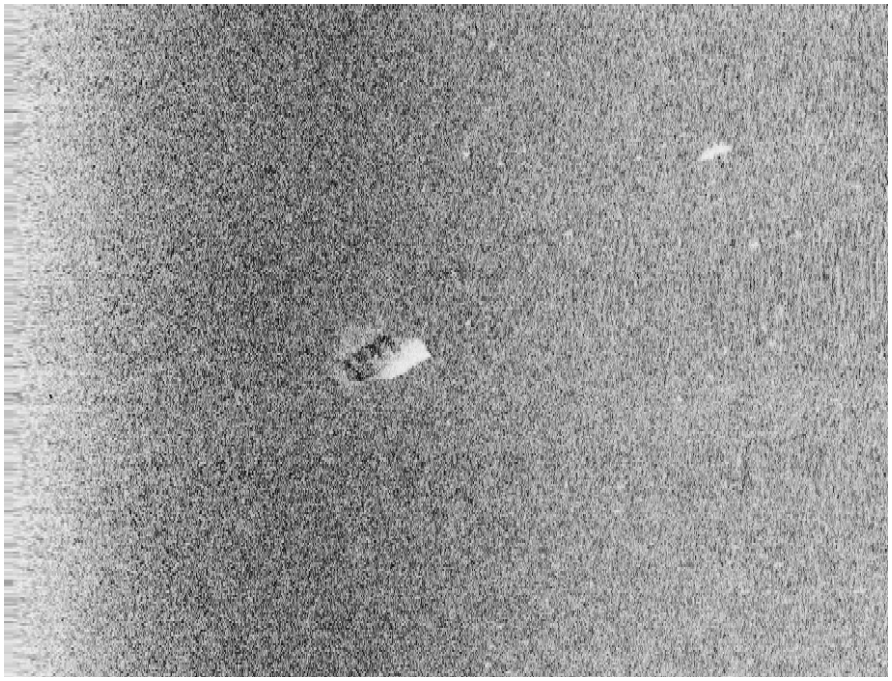

Figure 3 Sonar Target S1 at Range 62 ft on Survey Line 16NE, Heading 054T, Sweeping Left to Right

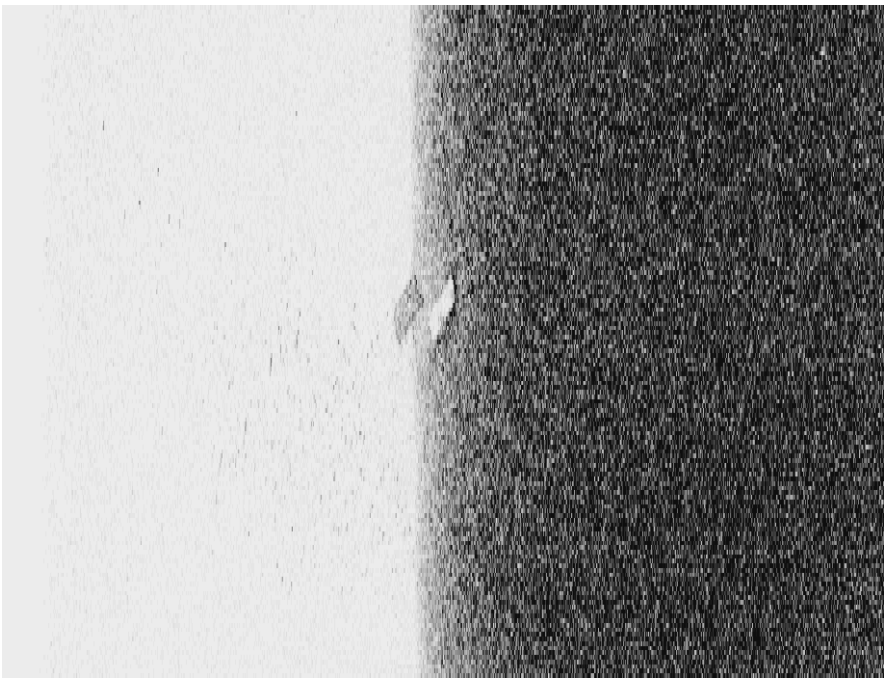

Figure 4 Sonar Target S1 at Range 16 ft on Survey Line 17SW, Heading 234T, Sweeping Left to Right. Image is zoomed with water column not removed as target was almost under the towfish. The top of the target appears suspended. However, very faint supports are visible on two corners. Small fish are visible in the water column, apparently attracted to this target.

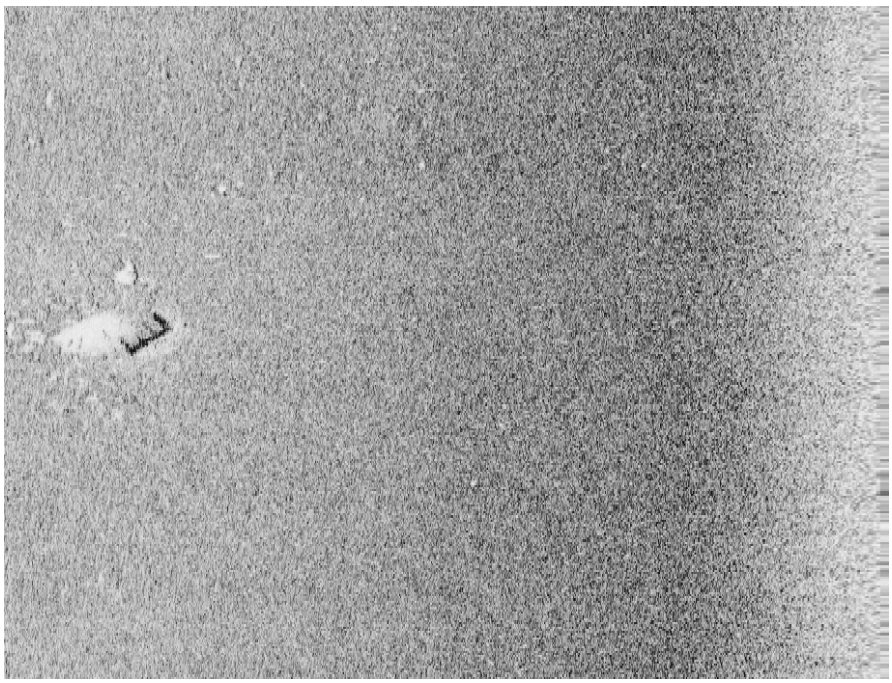

Figure 5 Sonar Target S1 at Range 127 ft on Survey Line 18NE, Heading 054T, Sweeping Right to Left

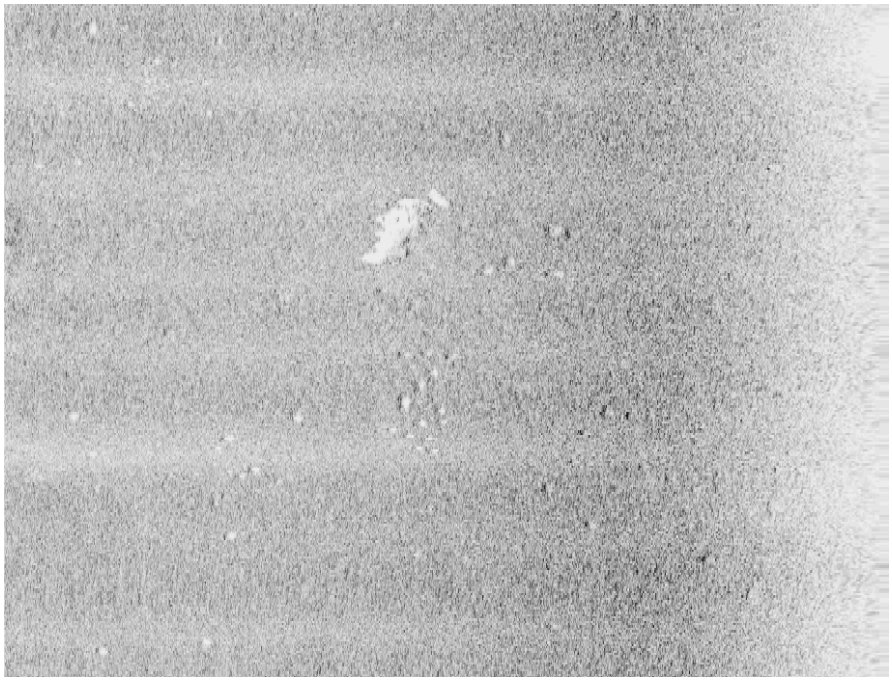

Figure 6 Sonar Target S2 at Range 80 ft on Survey Line 66SW, Heading 251T, Sweeping Left to Right. Note holes (targets with white in front) in the seafloor. These are unique to the area surrounding this target. They likely are habitat for creatures attracted to this target.

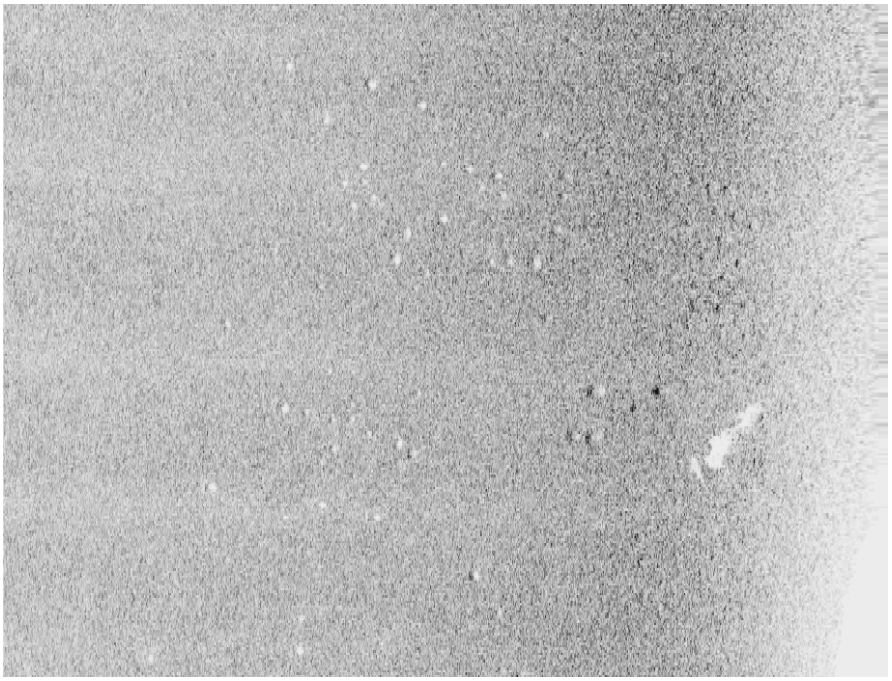

Figure 7 Sonar Target S2 at Range 24 ft on Survey Line 67NE, Heading 049T, Sweeping Left to Right.

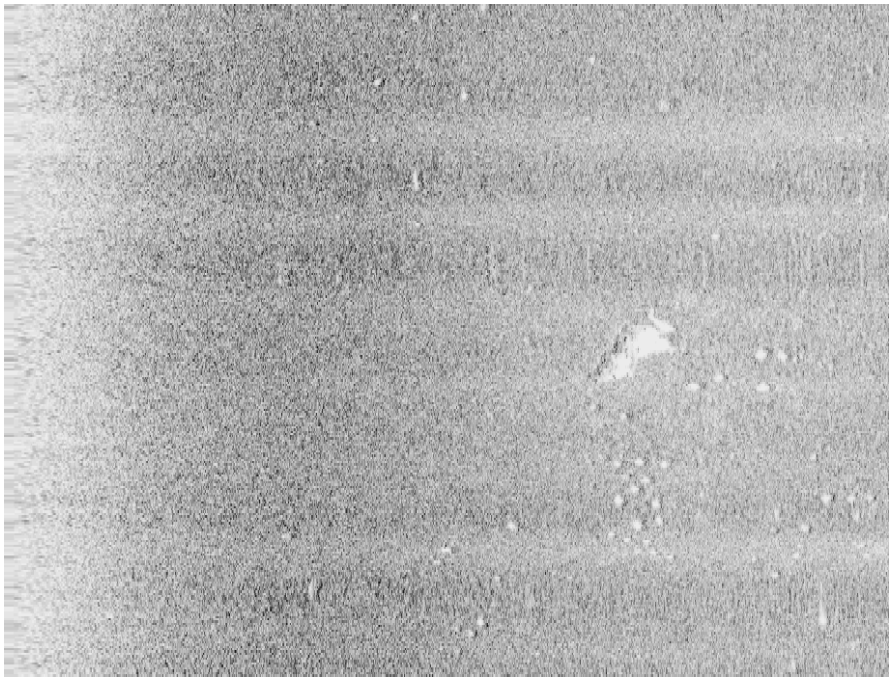

Figure 8 Sonar Target S2 at Range 105 ft on Survey Line 68SW, Heading 250T, Sweeping Right to Left.

Data Analysis

Following the investigation in the field, the survey team conducted initial data analysis of the recorded magnetometer data, side-scan sonar data, and sub-bottom profile data, and then submitted everything to the principal investigator. The role of the principal investigator was to determine the absence or presence of anomaly patterns and side-scan sonar images that would indicate the possibility of sunken cultural resources in the borrow area.

Sub-Bottom Profile Data

The principal investigator reviewed all of the sub-bottom profile data for geologic structures such as prehistoric creek and river beds that might include features that suggest aboriginal habitation sites. The data revealed no evidence of any such sites and no indication of shell midden material on the seabed. The side-scan sonar data, which would have registered such material, confirmed its absence in the project area.

Survey Results

Magnetometer and Side-Scan Sonar Survey

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Discussion

The remote sensing survey identified 39 magnetic anomalies and 2 side-scan sonar targets within the survey area. The anomalies primarily lie isolated from other anomalies, have low intensity and weight, and do not suggest the existence of any object of significance. Two exceptions warrant further analysis; the side-scan sonar target S1 and the cluster of anomalies including M4 – M8 and M-12 in the southwest corner of the proposed borrow area and the cluster of anomalies including M26, M27, and M29 just outside the borrow area boundary to the northeast suggest the possibility of submerged cultural resources. Note that side-scan sonar target S2 and the associated magnetic anomaly M39 lie approximately 600 ft outside of the borrow area and, thus, were excluded from further analysis.

Analysis

The first of the two areas identified for further analysis lies in the southwest corner of the proposed borrow area and contains magnetometer anomalies M4, M5, M6, M7, M8, M12, and side-scan sonar target S1. Although located in close proximity to one another, anomalies M6, M7, M8, and M12 each have very low intensity suggesting a submerged mass of no more than 9 ferrous pounds. However, magnetometer anomaly M5 recorded high intensity and has a computed mass of approximately 500

ferrous pounds. Figures 3 – 5 contain images from the associated side-scan sonar target S1. The article in these figures exhibits low relief and modest weight. It measures approximately 8 ft by 5 ft and appears to be acoustically transparent except for its rectangular top and bottom surfaces. It likely derives from local fishing activity and conforms to a ferrous object such as a steel fish trap.

The second of the two areas identified for further analysis lies just outside the proposed borrow area to the northeast but close enough to the boundary to potentially affect dredging activities. The cluster contains magnetic anomalies M26, M27, and M29. Each of these has very low intensity suggesting a submerged mass of no more than 8 ferrous pounds. Since the borrow area lies in a well populated coastal zone near a well used pass (East Pass), the low weight and low intensity ferrous anomalies are likely related to modern fishing and boating activities and have no historical significance.

Conclusions and Recommendations

The principal investigator concludes after an analysis of the remote sensing data that no shipwreck resources exist in the survey area. This conclusion is supported by the relatively few clusters of anomalies in the borrow area and the widely dispersed pattern of the remaining anomalies. Further, the lack of side-scan images does not suggest the presence of any raised area that would indicate inundated midden sites from a prehistoric terrestrial environment. The principal investigator recommends that the borrow area be utilized for the proposed beach re-nourishment project.

While this study did not identify any significant cultural resources, significant shipwrecks can go unrecognized even with the application of modern remote sensing methods. If any project activities encounter significant cultural resources, all work should cease at the site and the project state and/or federal agencies should be contacted.

Project Curation

All project records will be maintained by Taylor Engineering Inc, Jacksonville, Florida as well as in the archives of the Florida Division of Historical Resources, Tallahassee, Florida.

References

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Davis, David D. (1984) *Perspectives on Gulf Coast Prehistory*. Gainesville: University of Florida Press.

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Singer, Stephen (1992) *Shipwrecks of Florida*. Sarasota: Pineapple Press.

Winsberg, Morton D. (2003) Florida Weather. Gainesville: University of Florida Press.

Reports

Kimley Horn Assoc., Evaluation Appraisal report, Walton County, Florida.

Other Sources

Continental data Base – Facts on File

United States Weather Bureau

Walton County Florida Chamber of Commerce

Walton County Florida Historical Society

Appendix – A

Permit: 1-A-32 Correspondence

FLORIDA DEPARTMENT OF STATE
Kurt S. Browning
Secretary of State
DIVISION OF HISTORICAL RESOURCES

June 05, 2007

Robert H. Baer
Taylor Engineering, Inc.
9000 Cypress Green Drive, Ste. 200
Jacksonville, Florida, 32256

Re: 1A-32 Archaeological Research Permit Number 0607.76
Walton County Sand Survey

Dear Mr. Baer:

Please find the enclosed 1A-32 Archaeological Research permit. In an effort to streamline the permitting process, the permit format and conditions have changed, so please read the document carefully. In particular, please note that there are six lines for your initials under General Condition 3 and that there is a line for the land manager's (if applicable) signature.

To execute this permit, please send the signed permit to the Bureau of Archaeological Research, Permit Administrator, at the address below. If you have any questions about the permit process or about requirements, please contact me at (850) 245-6301 or via email at rjwheeler@dos.state.fl.us. Please refer to the permit number in all such contacts.

Sincerely,

Ryan J. Wheeler, Ph.D.
Chief, Bureau of Archaeological Research

FLORIDA DEPARTMENT OF STATE
Kurt S. Browning
Secretary of State
DIVISION OF HISTORICAL RESOURCES

ARCHAEOLOGICAL RESEARCH PERMIT

Permit No. 0607.76 Field Begin Date: 5/30/2007 Field End Date: 6/30/2007

PERMITTEE/AUTHORIZED ENTITY:
Taylor Engineering, Inc.
c/o Robert H. Baer
9000 Cypress Green Drive, Ste. 200
Jacksonville, Florida 32256

Report/Artifact Due Date: 6/30/2007
Project: Walton County Sand Survey

This permit is issued under the authority of Chapters 267.031 (1) and 267.12, Florida Statutes (F.S.) and Rule 1A-32, Florida Administrative Code (F.A.C.), and is administered by the Florida Bureau of Archaeological Research (BAR), Florida Division of Historical Resources (DHR).

ACTIVITY DESCRIPTION:
Submerged remote sensing survey for archaeological resources, pursuant to Rule 1A-46, F.A.C.

LOCATION DESCRIPTION:
offshore Walton County, FL
DEP, Sovereignty Submerged Lands

GENERAL CONDITIONS:

1. The Principal Investigator listed above or another qualified archaeologist designated by the applicant shall be responsible for all archaeological investigations, production of a final report, and be on site during all fieldwork.

2. A copy of this permit shall be provided to the land managing agency (when applicable) and field personnel shall carry a copy during fieldwork.

3. The permittee shall (initial each item as indicated):
   a. prepare a final report that meets standards and guidelines required by Rule 1A-46, F.A.C., including the necessary Florida Master Site File forms; RHB
   b. inform the BAR permit administrator that a report has been completed and submitted to the Division of Historical Resources; or submit a copy of the final report to the BAR permit administrator; _____
   c. provide proper curation and conservation of recovered artifacts and other recovered site materials until such time as those artifacts and other site materials are conveyed to the BAR for curation; _____
   d. convey all artifacts and related materials obtained from state-owned or controlled land to the BAR permit administrator for permanent curation or processing for loan; RHB

e. convey copies of all notes, maps, photographs, videotapes, and other field records pertaining to research conducted under this permit to the BAR permit administrator following completion of the project DAB;

f. and not remove from a stable environment artifacts and materials which the permit recipient is unable to properly curate and conserve before conveying to BAR. DAB

4. The effective field investigation dates are subject to receipt of permission from the land management agency and, in some instances, State/Federal dredge-and-fill permitting programs. Those agencies may also require work performance conditions relevant to their natural resource management and permitting responsibilities. A representative of the land managing agency (if one exists) will need to sign this permit document prior to BAR executing this permit (see page 3).

5. Unless approved in writing by BAR, no work beyond that described in the "ACTIVITY DESCRIPTION" and attached to your application shall be performed.

6. This permit is valid for up to one year following the requested report due date. Requests for approval for amendments to fieldwork, fieldwork end date and report/artifact due date are required during this time. Such requests may be made and approved by phone, email, or in writing during this time and do not require amendments to this document.

7. In any release of information, including public presentations, media contacts, and the final written report, there shall be acknowledgement that the portion of the project involving state-owned and controlled land was conducted under the terms of an archaeological research permit issued by the Florida Department of State, Division of Historical Resources, Bureau of Archaeological Research.

8. If Unmarked Human Burials are discovered, permit recipient shall comply with the provisions of 872.05, F.S., and when appropriate, Rule 1A-44, F.A.C. Specifically, upon discovery of unmarked human remains, all activities that might further affect those remains shall be halted and the remains protected from further disturbance until an appropriate course of action has been determined by the local medical examiner or by the State Archaeologist, as appropriate.

9. In issuing this permit, the State assumes no liability for the acts, omissions to act or negligence of the permittee, its agents, servants or employees; nor shall this permittee exclude liability for its own acts, omissions to act or negligence to the State.

10. The permittee, unless the permittee is an agency of the State, agrees to assume all responsibility for, indemnify, defend and hold harmless the Division of Historical Resources from and against any and all claims, demands, or liabilities, or suits of any nature whatsoever arising out of, because of, or due to any act or occurrence of omission or commission arising out of the permittee's operations pursuant to this permit and shall investigate all claims at its own expense. In addition, the permittee hereby agrees to be responsible for any injury or property damage resulting from any activities conducted by the permittee.

11. The parties hereto agree that the permittee, its officers, agents and employees, in performance of this permit, shall act in the capacity of an independent contractor and not as an officer, employee, or agent of the State.

The undersigned, as representative of the Permittee/Authorized Entity, understands and accepts the terms of this 1A-32 Archaeological Research Permit.

Robert H Bay _____ Date: 6/14/2007

Signature

The undersigned, as representative of the land managing agency for the managed area/state property described in the "LOCATION DESCRIPTION" section of this document, hereby permits the activity described above.

_____ Date: _____

n/a

Title: _____

This permit will not become effective until it has been executed by the Chief of BAR. Before BAR can execute this permit, the Permittee must have a land management representative (if applicable) sign in the space provided above. Please send the signed permit to the Permit Administrator at the address above.

A copy of the executed permit will be sent to you prior to commencing fieldwork.

Executed in Tallahassee, Florida

STATE OF FLORIDA
DEPARTMENT OF STATE

_____

RJW/apw

Ryan J. Wheeler, Ph.D.
Chief, Bureau of Archaeological Research

Date of Issue_____

Enclosures:
Rule 1A-46, F.A.C.
BAR Collections and Curation Guidelines
How to Package Documents, Florida Master Site File

Copies furnished to:

Appendix – B

Master Site File Form

Ent D (FMSF only)___/___/___

Survey Log Sheet

Florida Master Site File
Version 4.1 1/07

Survey # (FMSF only) _____

Consult *Guide to the Survey Log Sheet* for detailed instructions.

Identification and Bibliographic Information

Survey Project (name and project phase) **Walton County Sand Survey**

Report Title (exactly as on title page) **A Submerged Cultural Resource Remote Sensing Survey of a Borrow Area Proposed For Beach Restoration Offshore of Walton County, Florida**

Report Author(s) (as on title page– individual or corporate; last names first) **Robert H. Baer, Registered Professional Archaeologist**

Publication Date (year) **4/20/08** Total Number of Pages in Report (count text, figures, tables, not site forms) **28 pages**

Publication Information (Give series and no. in series, publisher and city. For article or chapter, cite page numbers. Use the style of *American Antiquity*.)
N/A

Supervisor(s) of Fieldwork (whether or not the same as author(s); last name first) **Robert Baer, RPA**

Affiliation of Fieldworkers (organization, city) **Taylor Engineering, Jacksonville, FL, 32256**

Key Words/Phrases (Don't use the county, or common words like *archaeology, structure, survey, architecture*. Limit each word or phrase to 25 haracters.)
Choctawhatchee Bay, Choctawhatchee River, Freeport, McLendon Brothers

Survey Sponsors (corporation, government unit, or person who is directly paying for fieldwork)
Name **Mr. Michael Trudnak, P.E.**
Address/Phone **Taylor Engineering 9000, Cypress Creek Drive, Jacksonville, Fl, 32256 (904) 256 - 1342**

Recorder of *Log Sheet* **Robert H. Baer, RPA** Date *Log Sheet* Completed **04/20/08**

Is this survey or project a continuation of a previous project? **X No** ☐ Yes: Previous survey #(s) (FMSF only) _____

Mapping

Counties (List each one in which field survey was done - do not abbreviate; use supplement sheet if necessary) **Walton County, Florida**

USGS 1:24,000 Map(s) : Map Name/Date of Latest Revision (use supplement sheet if necessary): **N/A**

Description of Survey Area

Dates for Fieldwork: **Start 5/30/0 End 6/30/07** Total Area Surveyed (fill in one) 640 hectares 1585 acres

Number of Distinct Tracts or Areas Surveyed 1

If Corridor (fill in one for each): **N/A**
Width _____ meters _____ feet Length _____ kilometers _____ miles

Survey Log Sheet

Survey # _____

Research and Field Methods

Types of Survey (check all that apply): **X archaeological** ❑ architectural ❑ historical/archival **X underwater** ❑ other: _____

Preliminary Methods (✓ Check as many as apply to the project as a whole.)

❑ Florida Archives (Gray Building)
❑ Florida Photo Archives (Gray Building)
❑ Site File property search
❑ Site File survey search
❑ other (describe) _____

X library research- *local public*
❑ library-special collection - *nonlocal*
❑ Public Lands Survey (maps at DEP)
X local informant(s)

❑ local property or tax records
❑ newspaper files
❑ literature search
❑ Sanborn Insurance maps

X other historic maps
❑ soils maps or data
❑ windshield survey
❑ aerial photography

Archaeological Methods (✓ Check as many as apply to the project as a whole.)

❑ Check here if **NO** archaeological methods were used.

❑ surface collection, controlled
❑ surface collection, uncontrolled
❑ shovel test-1/4"screen
❑ shovel test-1/8" screen
❑ shovel test 1/16"screen
❑ shovel test-unscreened
❑ other (describe): _____

❑ other screen shovel test (size: ____)
❑ water screen (finest size: ____)
❑ posthole tests
❑ auger (size: ____)
❑ coring
❑ test excavation (at least 1x2 M)

❑ block excavation (at least 2x2 M)
❑ soil resistivity
X magnetometer
X side scan sonar
X sub-bottom profiler

Historical/Architectural Methods (✓ Check as many as apply to the project as a whole.)

X Check here if NO historical/architectural methods were used.

❑ building permits
❑ commercial permits
❑ interior documentation
❑ other (describe): _____

❑ demolition permits
❑ exposed ground inspected
❑ local property records

❑ neighbor interview
❑ occupant interview
❑ occupation permits

❑ subdivision maps
❑ tax records
❑ unknown

Scope/Intensity/Procedures **N/A** _____

Survey Results (cultural resources recorded)

Site Significance Evaluated? ❑ Yes **X No** If *Yes*, circle NR-eligible/significant site numbers below.

Site Counts: Previously Recorded Sites **N/A** _____ Newly Recorded Sites **N/A** _____

Previously Recorded Site #'s with Site File Update Forms (List site #'s without "8." Attach supplementary pages if necessary) **N/A** _____

Newly Recorded Site #'s (Are you sure all are originals and not updates? Identify methods used to check for updates, i.e., researched Site File records. List site #'s without "8." Attach supplementary pages if necessary.) **N/A** _____

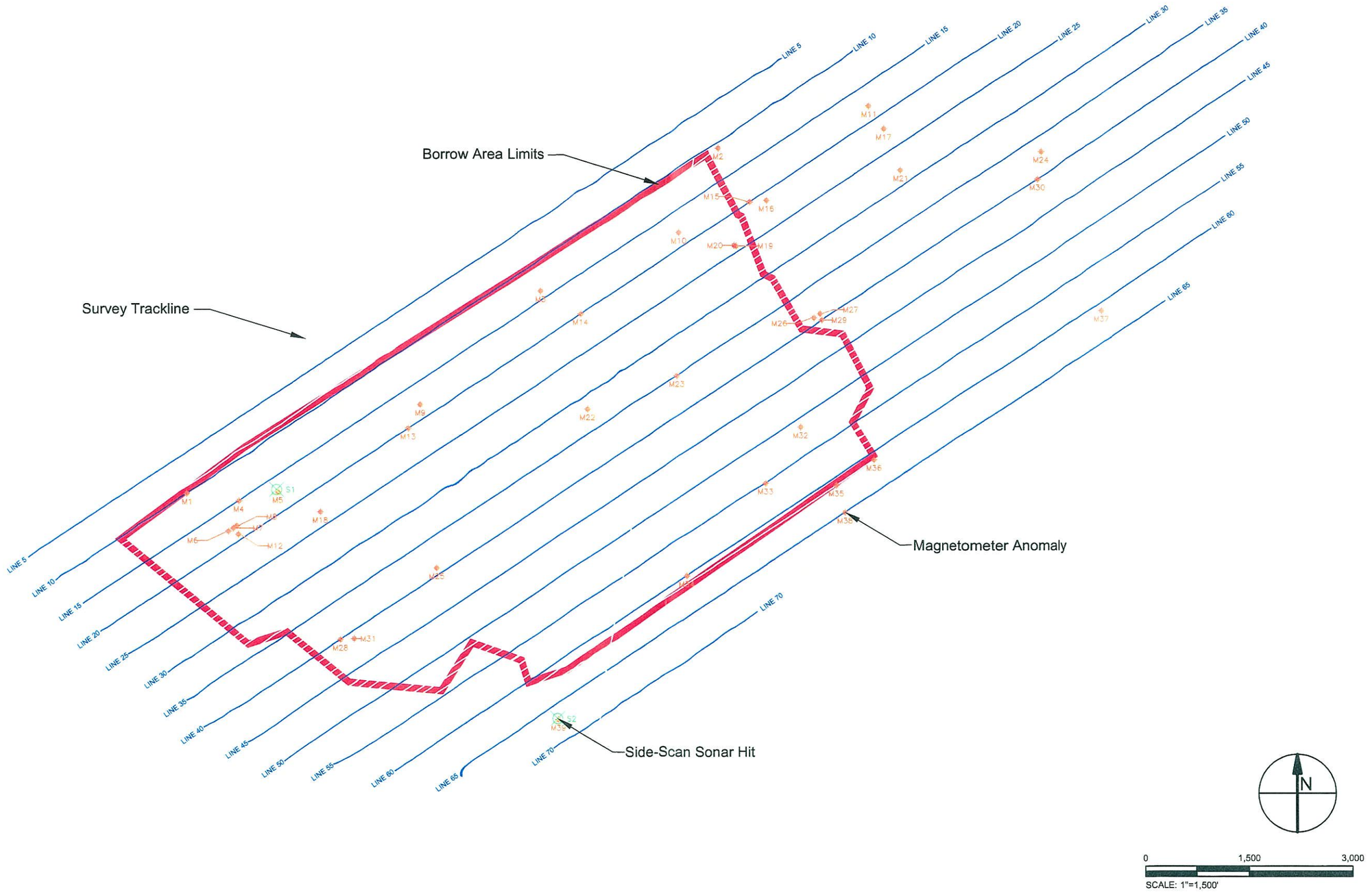
Site Form Used: ❑ Site File Paper Form **X Smart Form II Electronic Recording Form**

REQUIRED: ATTACH PLOT OF SURVEY AREA ON PHOTOCOPIES OF USGS 1:24,000 MAP(S)

DO NOT USE SITE FILE USE ONLY DO NOT USE

Appendix – C

Figure B - Fold Out



PROJECT	C2005-085
DRAWN BY	JCH
SHEET	1 of 1
DATE	OCT 2008

Figure 2
Seismic Tracklines with Magnetometer & Side-scan Hits
Walton County, Florida

TAYLOR ENGINEERING INC.
10151 Deerwood Park Blvd., Bldg. 300, Suite 300
Jacksonville, Florida 32256
CERTIFICATE OF AUTHORIZATION # 4815

Coordination Letter for Local Project

C 2007-009

FLORIDA DEPARTMENT OF STATE
Kurt S. Browning
Secretary of State
DIVISION OF HISTORICAL RESOURCES

Mr. Michael Trudnak
Taylor Engineering, Inc.
10151 Deerwood Park Blvd., Bldg. 300, Suite 300
Jacksonville, Florida 32256

December 11, 2008

Re: DHR Project File No.: 2008-02705-B / Received by DHR: April 28, 2008
Additional Information Received: October 30, 2008
1A-32 Permit No.: 0607.006
A Submerged Cultural Resource Remote Sensing Survey of a Borrow Area Proposed for Beach Renourishment Offshore of Walton County, Florida

Dear Mr. Trudnak:

We note that in May and June 2007, Sonographics, Inc. (SI) conducted the above referenced survey for Taylor Engineering, Inc. in anticipation of a request by the Florida Division of Historical Resources (DHR) for a cultural resource assessment survey. Our office proceeded to review this report with the expectation that Taylor Engineering, Inc. will be engaging in permitting processes that will require this office to comment on possible adverse impacts tot cultural resources listed or eligible for listing in the National Register of Historic Places, or otherwise of historical, architectural, or archaeological significance. We recommend at the time such actions are taken, a copy of this letter be forwarded to the permitting agency(ies) with the application. This may eliminate the permitting agency(ies) from having to submit an application to the Division of Historical Resources for review, or, if applications are forwarded to the Division with this letter, it would facilitate our review.

SI identified thirty-nine magnetic anomalies and two side-scan sonar targets within the surveyed area during the investigation. SI determined that none of the anomalies within the proposed borrow area appears to represent significant cultural resources.

SI determined that the proposed sand borrow activities are unlikely to affect cultural resources. SI recommends no further investigation of the project area.

Based on the information provided, our office concurs with these determinations and finds the submitted report complete and sufficient in accordance with Chapter 1A-46, *Florida Administrative Code.*

For any questions concerning our comments, please contact April Westerman, Historic Preservationist, by electronic mail at amwesterman@dos.state.fl.us, or by phone at (850) 245-6333. We appreciate your continued interest in protecting Florida's historic properties.

Sincerely,

Frederick P. Gaske, Director, and
State Historic Preservation Officer

XC: Louis Tesar, Bureau of Archaeological Research

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF

January 15, 2010

Coastal Environment Team
Planning and Environmental Division

Ms. Gail Carmody
U.S. Department of Interior
Fish and Wildlife Service
1601 Balboa Avenue
Panama City, Florida 32405-3721

Dear Ms. Carmody:

As you are aware, the U.S. Army Corps of Engineers (Corps), Mobile District is seeking Federal authorization to conduct a hurricane and storm damage reduction project for Walton County, Florida. The project is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet as indicated by the map included in Enclosure 1.

The study region was divided into five study reaches based on structural development and state park areas as illustrated in Enclosure 1. The project will be composed of a 50-foot berm width, a 25-foot berm and an additional 25 feet of advanced nourishment in all construction reaches. The project will also feature added dune width in all construction reaches of either 10 or 30 feet. The typical cross-sections for the selected plan are illustrated in Enclosure 2. When dune construction is complete, the dune will be planted with at least three species of dune vegetation to create a dune that matches the surrounding natural dune patterns in the area. The necessary beach fill requirements will be 3,350,000 cubic yards (cy). Re-nourishments will be on a 12-year cycle with predicted volumes to be approximately 2,000,000 cy. Approved borrow sources lie offshore within the State of Florida waters. The non-federal sponsor is the Walton County Board of Commissioners. Their central point of contact is the Director of Beach Management for the Walton County Tourist Development Council.

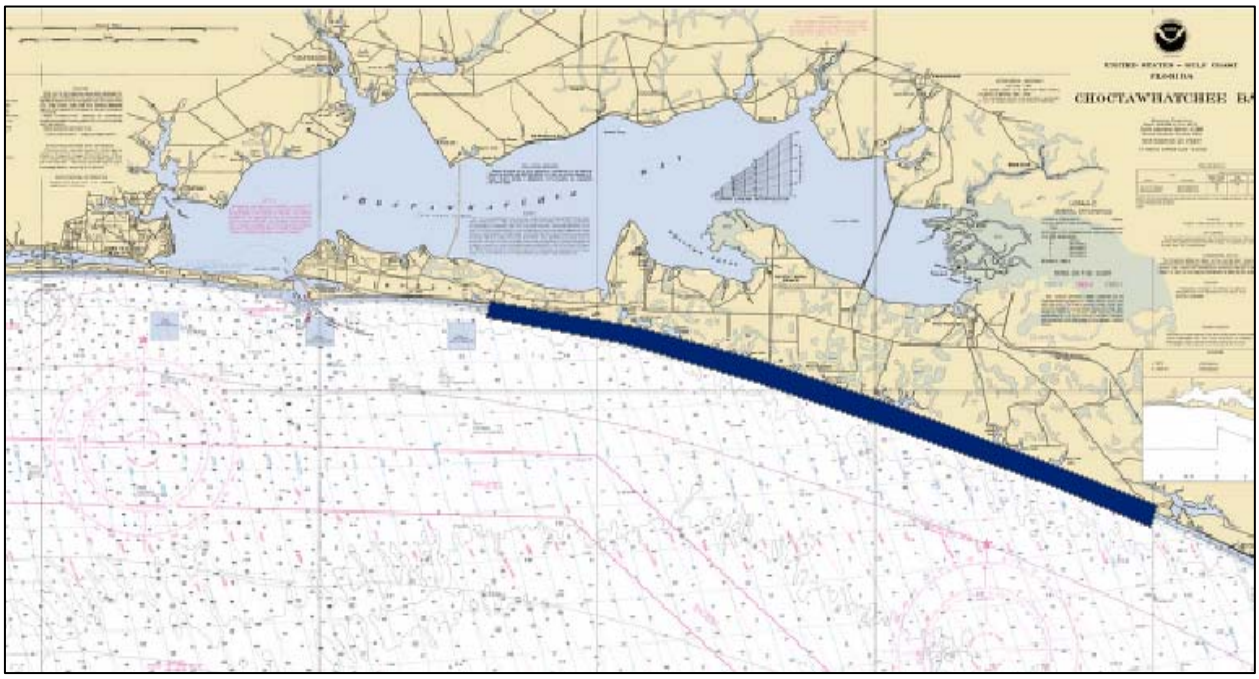
Based on previous discussions with your office, we are requesting initiation of formal coordination for the generation of the Fish and Wildlife Coordination Act (FWCA) Report according to the requirements of the FWCA of 1958, regarding impacts to significant fish and wildlife resources and impacts to federally listed or proposed species or their designated or proposed critical habitat, which is in accordance with Section 7 of the Endangered Species Act of 1973. It is understood that your office would undertake these activities through a transfer of funds agreement. Our staff is prepared to work with your office to prepare a scope of work for these required efforts. Such a scope would include a project description, schedule, and level of funding. The schedule will be based on submitting the feasibility report in June of this year.

Coordination for this effort should be directed to Mr. Larry Parson at (251) 690-3139 or email at larry.e.parson@usace.army.mil. Thank you for your assistance in this project.

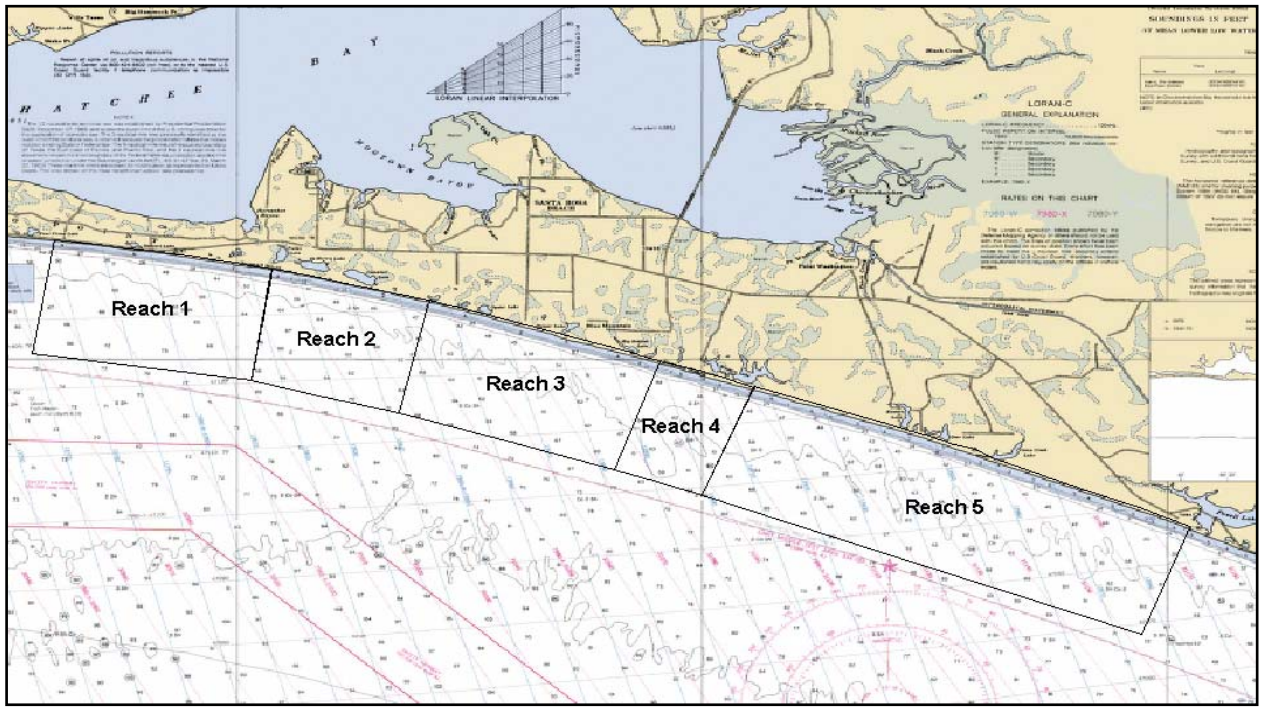
Sincerely,

Kenneth P. Bradley
Chief, Environment and Resources
Branch

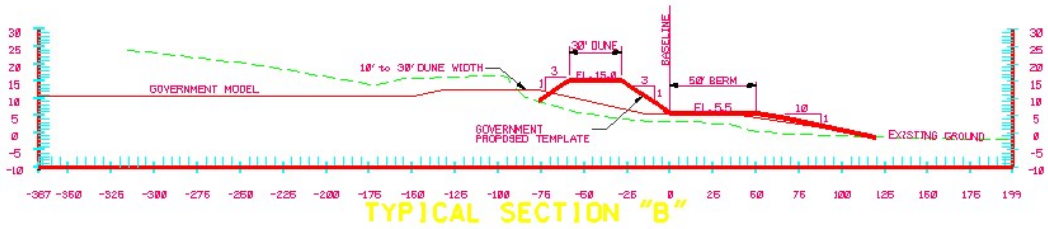
Enclosures



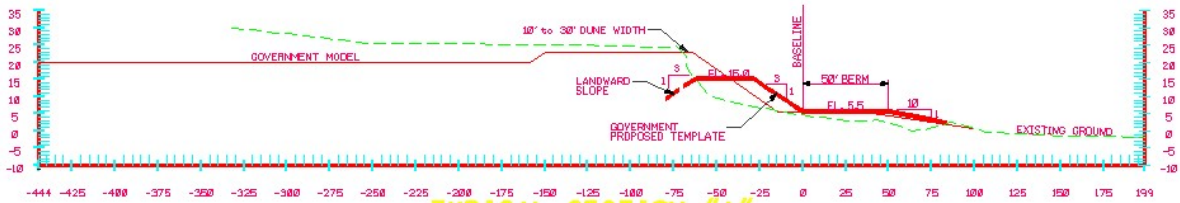
Location of Walton County project area



Location of the 5 construction reaches within the project area.



TYPICAL SECTION "B"



TYPICAL SECTION "A"

Selected plan typical cross sections to be constructed

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF:

PUBLIC NOTICE NO. FP10-WC01-10 **DRAFT**
CESAM-PD-EC

JOINT PUBLIC NOTICE
U.S. ARMY CORPS OF ENGINEERS
AND
FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
HURRICANE AND STORM DAMAGE REDUCTION PROJECT
FOR
WALTON COUNTY, FLORIDA

Interested persons are hereby notified that the U.S. Army Corps of Engineers, Mobile District (Corps) is seeking Federal authorization to conduct a hurricane and storm damage reduction project for Walton County, Florida. Walton County's shoreline located in the Florida's panhandle is receding; the protective dunes and high bluffs are being destroyed by hurricane and storm forces that are occurring more frequently than before. The impacts of these storms to property and environmental resources are considerable and can possibly be reduced through a beach restoration and stabilization project which also includes environmental restoration opportunities associated with the beach and dune system. A feasibility study was authorized by a resolution of both the United States Senate and House of Representatives, which reads as follows:

Resolution Adopted July 15, 2002, by The United States Senate:

> *"Resolved by the Committee on Environment and Public Works of the United States Senate, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and related improvements in Walton County, Florida, in the interest of protecting and restoring the environmental recourses on and behind the beach, including the feasibility of providing shoreline and erosion protection and related improvements consistent with the unique characteristics of the existing beach sand, and with consideration of the need to develop a comprehensive body of knowledge, information, and data on coastal area changes and processes as well as impacts from federally constructed projects in the vicinity of Walton County, Florida.*

Resolution Adopted July 24, 2002, by The United States House of Representatives:

> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and environmental restoration and protection in the vicinity of Walton County, Florida.*

The non-Federal sponsor is the Walton County Board of Commissioners. Their central point of contact is the Director of Beach Management for the Walton County Tourist Development Council (TDC).

This public notice is issued in accordance with rules and regulations published in the Federal Register on 26 April 1988. These laws are applied whenever dredged or fill materials may enter waters of the United States, or for the transportation of dredged material for the purpose of placement into ocean waters. The recipient of this notice is requested specifically to review the proposed action as it may have impact on water quality, relative to the requirements of Section 404(b)(1) of the Clean Water Act. Review of any other potential impacts is also requested.

WATERWAY AND LOCATION: Walton County, Florida

PROJECT AREA LOCATION: Walton County is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet (Figure 1). The western two-thirds of Walton County are comprised of a coastal peninsula extending from the mainland, and the eastern third is comprised of mainland beaches. Choctawhatchee Bay lies north of the peninsula. Walton County includes 11.9 miles of state-designated critically eroding areas and three State of Florida park areas that cover approximately six miles of the 26-mile shoreline.

PROPOSED ACTION: The Walton County upland cross-section is defined by dune elevations ranging from +9.5 to + 33 feet NAVD88 and a natural berm elevation of +5.5 feet NAVD88. The study region was divided into five study reaches based on structural development and state park areas as illustrated in Figure 2. The historical and 2004 beach surveys were used to develop 11 representative profiles which characterize the existing condition for the five study reaches. The representative profiles were identified based on similarity in shape of the upper beach profile (dune height and width, berm width, foreshore beach slope, and profile volume) and shape of the offshore profile.

The selected plan recommended for construction consists of the five construction reaches (Figure 2). The project will be composed of a 50-foot berm width, a 25-foot berm and an additional 25 feet of advanced nourishment in all construction reaches. The project will also feature added dune width in all construction reaches of either 10 or 30 feet. It is estimated that the necessary beach fill requirements will be 3,350,000 cubic yards (cy). Re-nourishments will be on a 12-year cycle with predicted volumes to be approximately 2,000,000 cy. Approved borrow sources lie offshore within the State of Florida waters. The typical cross-sections for the selected plan are illustrated in Figure 3. When dune construction is complete, the dune will be planted with at least three species of dune vegetation to create a dune that matches the surrounding natural dune patterns in the area. Upon reconstruction immediate steps will be taken to plant and stabilize the dune for rapid stabilization. This will be accomplished through the use of sand fences and dune plants. The dune plants will be planted to cover 60-80% of the total area. The vegetation will consist of local dominant species that populate nearby natural dune systems. The selection of the

dune vegetation will consist of species that are most widely used for dune restoration and are readily available from local nurseries and suppliers. The selection will be coordinated with local experts familiar with dune ecosystems in the immediate area.

A large scale reconnaissance level geophysical, lithological and granulomteric investigation was undertaken off Walton County, Florida. Sub-bottom profiles were used to locate prospective core locations to identify high quality sand sources for beach nourishment. Vibracores and selected seismic records were interpreted to confirm the proposed borrow contains suitable beach compatible sediment. The borrow sediments are characterized as well sorted medium sand 0.25 - 0.50 mm. Borrow area B-4 shown on Figure 4 is the borrow site that was selected with some 10,000,000 cy proven by these initial investigations. This volume covers the recommended plan placement and the four planned subsequent re-nourishments for the next 50 years. The B-4 borrow area is most centrally located and offers the best source for the initial project construction and future re-nourishments. Based on the extensive geotechnical investigations, this borrow site has been demonstrated to be the most suitable source and has sand of color, size, and composition generally similar to that of the native beach. All materials used for beach nourishment will be excavated by hopper dredge, transported to the placement area offshore and pumped into the beach template. Small bulldozers will be used on land to shape the material to the design template (Figure 3).

WATER QUALITY CERTIFICATION: Pursuant to the requirements of the Clean Water Act, State Water Certification is required for the proposed action. Water quality certification is being requested for a period of ten (10) years. Upon completion of the required comment period and the State of Florida permitting requirements, a decision relative to water quality certification will be made by Florida Department of Environmental Protection (DEP).

COASTAL ZONE CONSISTENCY: Pursuant to the Coastal Zone Management Act, the proposed action is consistent with the Florida Coastal Management Program to the maximum extent practicable. Upon completion of the required comment period and the State of Florida permitting requirements, a decision relative to coastal zone consistency will be made by DEP.

USE BY OTHERS: The proposed action is not expected to create significant impacts on land and water use plans.

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) CONSIDERATIONS:
The impacts associated with the dredging of the borrow site and beach placement activities have been addressed in the recent Draft 2010 Environmental Assessment (EA) for the Walton County, Florida Hurricane and Storm Damage Reduction Project, Walton County, Florida. A copy of the Draft EA is available for review at the following website: www.sam.usace.army.mil/Pd1.htm

SECTION 404(b)(1) EVALUATION REPORT: An evaluation of water quality impacts associated with the proposed action was prepared in accordance with guidelines promulgated by the Environmental Protection Agency under Section 404(b)(1) of the Clean Water Act. Impacts associated with this action include a temporary increase in turbidity and suspended solids concentrations in and adjacent to the disposal areas, short-term elimination of benthic organisms and localized short-term degradation of esthetics near the disposal area. A Draft 404(b)(1)

Evaluation Report has been prepared is available for review at the follow website: www.sam.usace.army.mil/Pd1.htm.

ENDANGERED/THREATENED SPECIES: There are several listed endangered and/or threatened species that would be affected by the proposed action. The known list of threatened or/and endangered species (T/E) and their critical habitats in the vicinity of the project include: sea turtles, Gulf sturgeon and associated critical habitat, piping plover, Choctawhatchee beach mouse (CBM) and associated critical habitat, and West Indian manatee. Previous coordination by the local sponsor (Walton County) has been conducted for the local Walton County Beach Nourishment Project in the same area, with the U.S. Department of the Interior, Fish and Wildlife Service (FWS). This coordination resulted in the preparation of a biological opinion (BO), which indicated that although the action may affect sea turtles, piping plover, and the CBM, it is their opinion that the effects of the proposed activities are not likely to jeopardize the continued existence of these species and not likely to destroy or adversely modify designated critical habitat for the CBM. It has also been determined that the action is not likely to affect the West Indian manatee.

The Gulf sturgeon and their associated critical habitat fall under the jurisdiction of the U.S. Department of Commerce, National Marine Fisheries Service (NMFS). Previous consultation with NMFS for the local Walton County plan has indicated that similar actions were not likely to adversely affect Gulf sturgeon and is not likely to adversely affect Gulf Sturgeon critical habitat.

The Corps has initiated coordination with these agencies for the selected Federal plan to assure avoidance of any conflicts with these or other known threatened and endangered species and their critical habitats. Areas where the known species are suspected will be monitored before, during and after dredged disposal activities.

ESSENTIAL FISH HABITAT: Essential Fish Habitat (EFH) is defined as waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity, the designation and conservation of EFH seeks to minimize adverse effects on habitat caused by fishing and non-fishing activities. The NMFS has identified EFH habitats for the Gulf of Mexico in its Fishery Management Plan Amendments. These habitats include estuarine areas, such as estuarine emergent wetlands, seagrass beds, algal flats, mud, sand, shell, and rock substrates, and the estuarine water column.

During dredging and placement activities most of the motile benthic and pelagic fauna, such as crab, shrimp, and fish, should be able to avoid the disturbed area and should recover shortly after the activity is completed. The selected borrow area is characterized as sandy bottom and does not contain any hard-bottoms, coral reefs, oyster beds, or seagrasses. No long-term direct impacts to managed species are anticipated. However, it is reasonable to anticipate some non-motile and motile invertebrate species will be physically affected through the dredging and placement operations. These species are expected to recover rapidly after the dredging and disposal operations are complete.

Based on the above assessment of the project in relation to impacts to fisheries resources, the overall impact to identified species is considered negligible given the relatively small area. This

action is being coordinated with the NMFS, Habitat Conservation Division pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (PL 94-265).

CULTURAL RESOURCES CONSIDERATION: In accordance with Section 106 of the National Historic Preservation Act and other relevant cultural resource laws, recommendations and actions are being coordinated with the Florida State Historic Preservation Officer (FLSHPO). The borrow area was surveyed for cultural resources in May and June of 2007 in which the survey found no cultural resources eligible for or listed on the National Register of Historic Places (Historic Properties). The shoreline will be reconstructed to historic dimensions. The nature of the work is such that the deposition will have no effect on historic properties. In addition, the nature of the project precludes any visual effects to historic properties. Based on this information, and the nature of the project, the Mobile District, as lead Federal agency, has determined that the project will have no effect on historic properties as per 36 CFR 800.4(d)(1).

CLEAN AIR ACT: Air quality in the vicinity of the proposed action would not be significantly affected with the proposed action. The equipment and machinery would generate some air pollution during construction activities, such as increased particulate levels from the burning of fossil fuels. However, these impacts would be minor and temporary in nature. The proposed action is in compliance with the Clean Air Act, as amended. The project area is in attainment with the National Ambient Air Quality Standards parameters. The proposed action would not affect the attainment status of the project area or region. A State Implementation Plan conformity determination (42 United States Code 7506(c)) is not required since the project area is in attainment for all criteria pollutants.

EVALUATION: The decision whether to proceed with the proposed action would be based on an evaluation of the overall public interest. That decision would reflect the national concerns for both protection and utilization of important resources. The benefits that may be expected to accrue from this proposal must be balanced against its reasonably foreseeable detriments. The decision whether to proceed, and the conditions under which the activity would occur, would be determined by the outcome of this general balancing process. All factors that may be relevant to the proposal would be considered. Among these are conservation, economics, esthetics, general environmental concerns, wetlands historic properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and in general, the needs and welfare of the public.

The proposed action would proceed unless it is found to be contrary to the overall public interest. Inasmuch as the proposed work would involve dredging and discharge of materials into navigable waters, specification of the proposed placement sites associated with this Federal project is being made through the application of guidelines promulgated by the Administrator of the Environmental Protection Agency in conjunction with the Secretary of the Army. If these guidelines alone prohibit the specification of any proposed disposal site, any potential impairment of the maintenance of navigation, including any economic impacts on navigation and anchorage that would result from the failure to use this site would also be considered.

COORDINATION: Among the agencies receiving copies of this public notice are:

Region 4, U.S. Environmental Protection Agency
Field Representative, Fish and Wildlife Service
Regional Director, National Park Service
Regional Director, National Marine Fisheries Service
Commander, Eighth Coast Guard District
Florida State Historic Preservation Officer
Florida Department of Environmental Protection
Gulf of Mexico Fishery Management Council
Federal Emergency Management Agency

Other Federal, State, and local organizations, affiliated Indian Tribe interests, and U.S. Senators and Representatives of the State of Florida are being sent copies of the notice and are being asked to participate in coordinating this proposed work.

CORRESPONDENCE: Any person who has an interest that may be affected by the proposed activity may request a public hearing. Any comments or requests for a public hearing must be submitted in writing to the District Engineer within 30 days of the date of this public notice. A request for a hearing must clearly set forth the interest that may be affected and the manner in which the interest may be affected. You are requested to communicate the information contained in this notice to any other parties who may have an interest in the proposed activities. Correspondence concerning the public notice should refer to Public Notice No. FP10-WC01-10 and should be directed to the Commander, U.S. Army Engineer District, Mobile, P.O. Box 2288, Mobile, Alabama 36628-0001, ATTN: CESAM-PD-EC. For additional information please contact Larry Parson at (251) 690-3139.

CURTIS M. FLAKES
U.S. Army Corps of Engineers
Mobile District

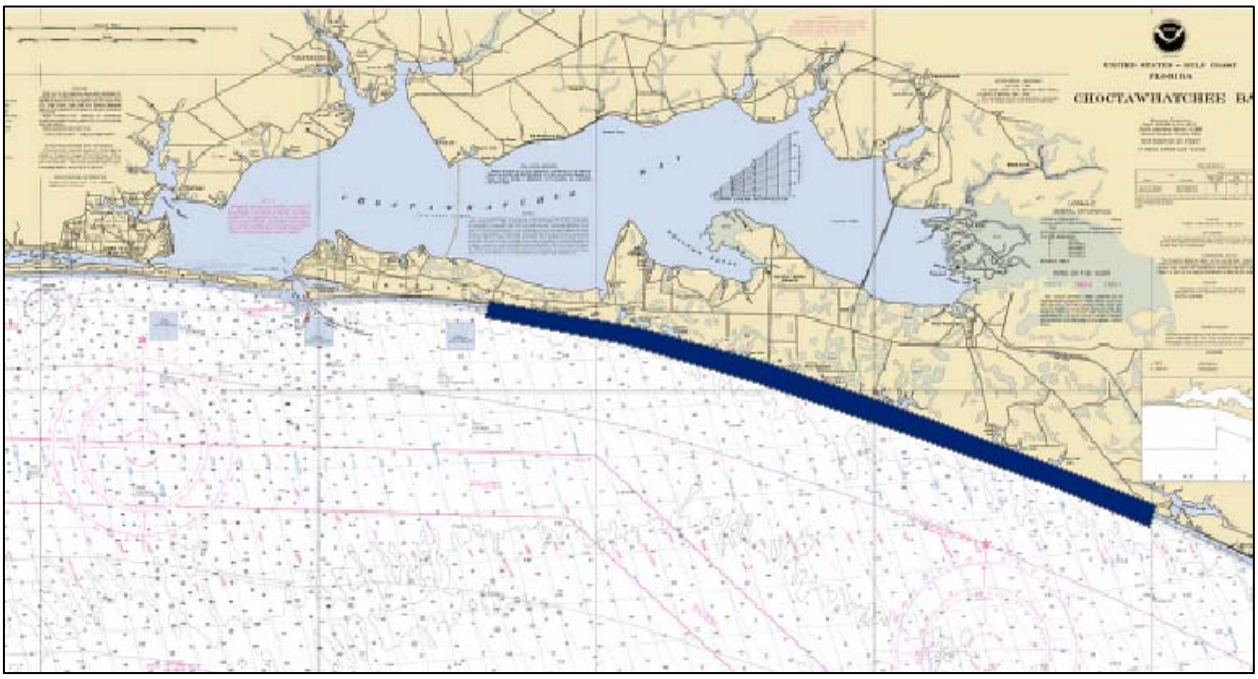


Figure 1. Location of Walton County project area

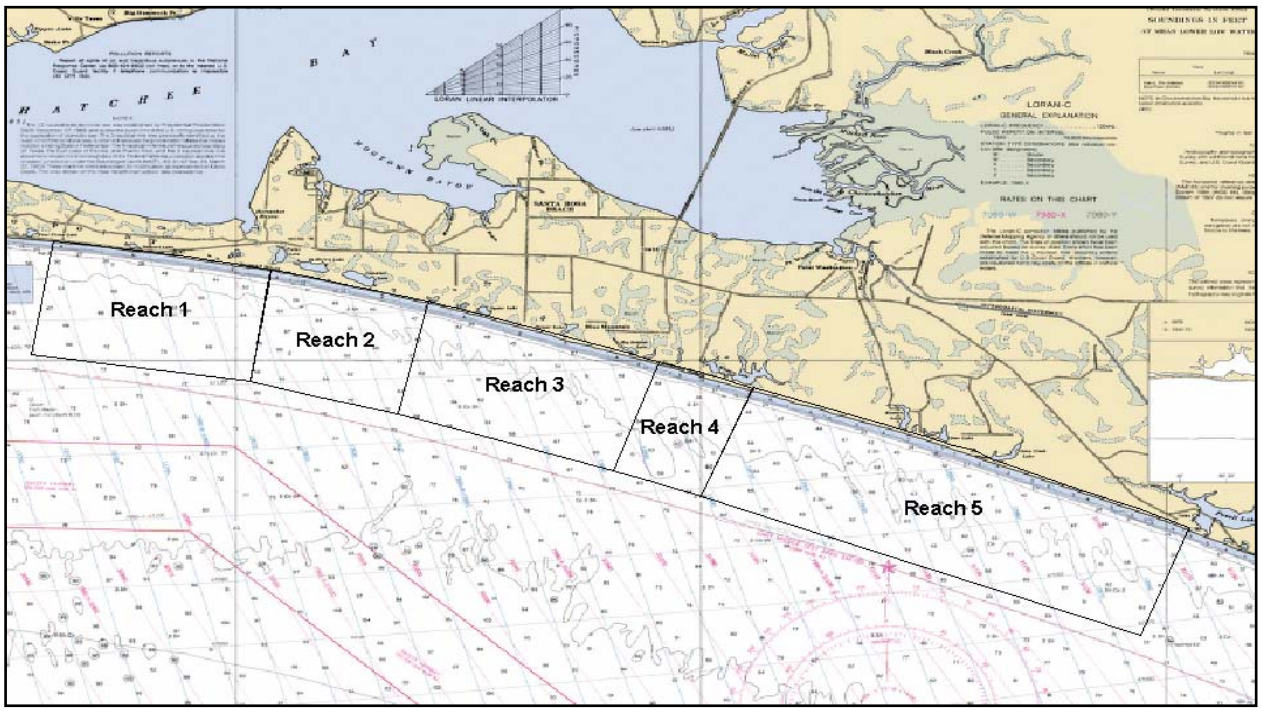


Figure 2. Location of the 5 construction reaches within the project area.

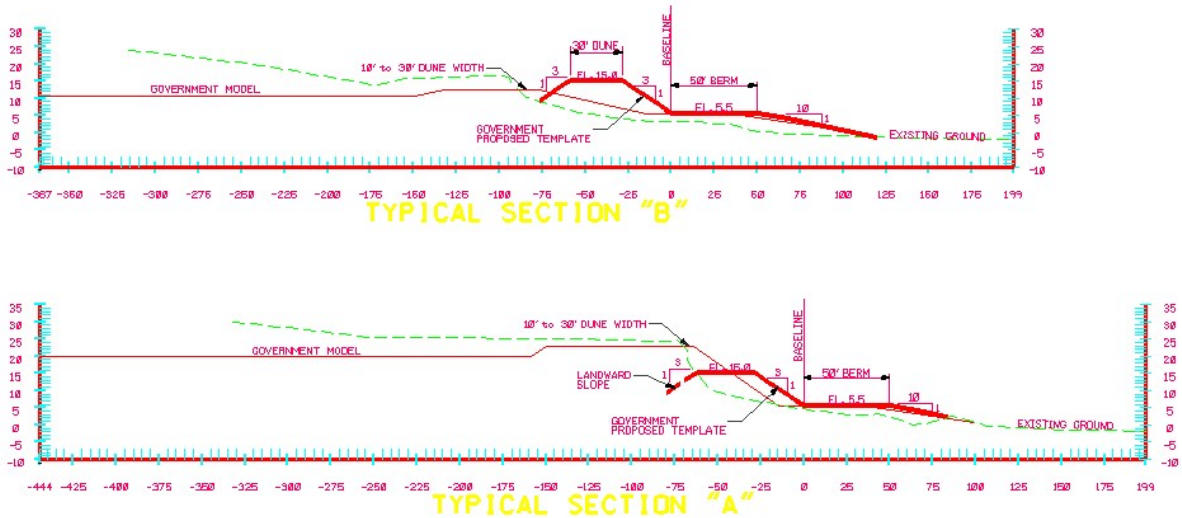


Figure 3. Selected plan typical cross sections to be constructed

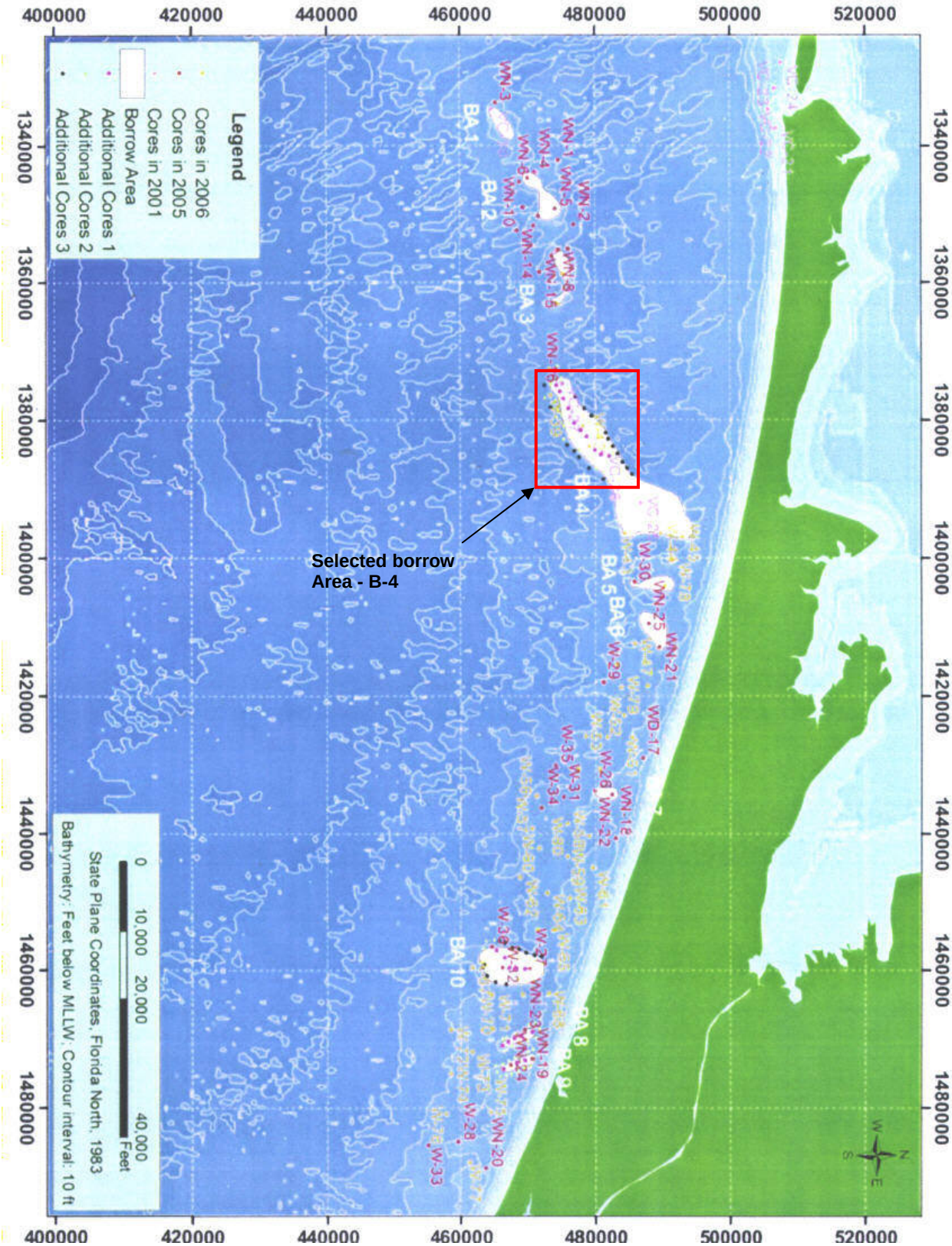


Figure 4. Borrow area investigation locations and selected borrow site.

Parson, Larry E SAM

From: Ryan Hendren [Ryan.Hendren@noaa.gov]
Sent: Monday, March 01, 2010 2:52 PM
To: Parson, Larry E SAM
Subject: Walton County Hurricane Damage Reduction Project

Larry:

Upon review of your project, it looks like the Walton County Hurricane Damage Reduction Project (T/SER/2010/00241) would be covered by a previously issued informal consultation letter for Walton County Board of County Commissioners (I/SER/2007/06965). This consultation reviews the effects of a project that is essentially the same as the current proposed project, with a larger scope than the current one proposed by the USACE. It is understood that the effects of the current project would be less than that of the previously issued project and would be subject to the same conditions listed in the previous consultation letter (I/SER/2007/06965). If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat in a manner or to an extent not previously considered, or if a new species is listed or critical habitat designated that may be affected by the identified action, consultation will need to be reestablished.

Please contact me if you have any additional questions. -rH

--
Ryan Hendren
Office of Protected Resources
National Marine Fisheries Service
263 13th Ave S
St. Petersburg, FL 33701
PH: (727) 824-5312
FX: (727) 824-5309
Email: ryan.hendren@noaa.gov
Web: http://sero.nmfs.noaa.gov/pr/pr.htm

FLORIDA DEPARTMENT OF STATE
Kurt S. Browning
Secretary of State
DIVISION OF HISTORICAL RESOURCES

Mr. Kenneth P. Bradley
Mobile Planning and Environmental Division
Mobile USACE
Post Office Box 2288
Mobile, Alabama 36628-0001

March 11, 2010

Re: DHR Project File No. 2010-529/ Received by DHR: January 26, 2010
U.S. Army Corps of Engineers, Mobile District
Florida Hurricane and Storm Damage Reduction Project
Walton County

Dear Mr. Bradley:

This office reviewed the referenced project for possible impact to historic properties listed, or eligible for listing, in the National Register of Historic Places. The review was conducted in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, 36 CFR Part 800: Protection of Historic Properties, and the National Environmental Policy Act of 1969, as amended.

We note that the project area has previously been subjected to a cultural resource assessment, reviewed by our office in December 2008 (DHR Project File No. 2008-2705). The results of this survey indicate that there are no historic properties located within the area of potential effect for this project. Therefore, this office concurs with your determination that the proposed undertaking will have no effect on historic properties.

If you have any questions concerning our comments, please contact Samantha Earnest, Historic Preservationist, by electronic mail *swearnest@dos.state.fl.us*, or at 850.245.6333.Your continued interest in protecting Florida's historic properties is appreciated.

Sincerely,

Laura A. Kammerer

Laura A. Kammerer
Deputy State Historic Preservation Officer
For Review and Compliance

500 S. Bronough Street • Tallahassee, FL 32399-0250 • http://www.flheritage.com

☐ Director's Office
850.245.6300 • FAX: 245.6436

☐ Archaeological Research
850.245.6444 • FAX: 245.6452

✓ Historic Preservation
850.245.6333 • FAX: 245.6437

EA-APPENDIX B

SECTION III

Environmental Coordination Documents from the Agencies

For the

Selected Federal Plan

This section of APPENDIX B contains the documents received from the support agencies pertaining to the environmental compliance requirements.

- **Public Notice**
- **ESA Section 7 Coordination Responses**
- **Draft Biological Opinion**
- **Preliminary Fish and Wildlife Coordination Act Report (FWCAR)**
- **CBRA Coordination Response**
- **Essential Fish Habitat (EFH) Concurrence**
- **Cultural Resources Concurrence from the Florida SHPO**

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 2288
MOBILE, ALABAMA 36628-0001

REPLY TO
ATTENTION OF

PUBLIC NOTICE NO. FP10-WC01-10 **April 27, 2010**
CESAM-PD-EC

JOINT PUBLIC NOTICE
U.S. ARMY CORPS OF ENGINEERS
AND
FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
HURRICANE AND STORM DAMAGE REDUCTION PROJECT
FOR
WALTON COUNTY, FLORIDA

Interested persons are hereby notified that the U.S. Army Corps of Engineers (Corps), Mobile District is seeking Federal authorization to conduct a hurricane and storm damage reduction project for Walton County, Florida. Walton County's shoreline located in the Florida's panhandle is receding; the protective dunes and high bluffs are being destroyed by hurricane and storm forces that are occurring more frequently than before. The impacts of these storms to property and environmental resources are considerable and can possibly be reduced through a beach restoration and stabilization project which also includes environmental restoration opportunities associated with the beach and dune system. A feasibility study was authorized by a resolution of both the United States Senate and House of Representatives, which reads as follows:

Resolution Adopted July 15, 2002, by The United States Senate:

> *"Resolved by the Committee on Environment and Public Works of the United States Senate, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and related improvements in Walton County, Florida, in the interest of protecting and restoring the environmental recourses on and behind the beach, including the feasibility of providing shoreline and erosion protection and related improvements consistent with the unique characteristics of the existing beach sand, and with consideration of the need to develop a comprehensive body of knowledge, information, and data on coastal area changes and processes as well as impacts from federally constructed projects in the vicinity of Walton County, Florida."*

Resolution Adopted July 24, 2002, by The United States House of Representatives:

> *"Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That in accordance with Section 110 of the Rivers and Harbors Act of 1962, the Secretary of the Army is requested to review the feasibility of providing beach nourishment, shore protection and environmental restoration and protection in the vicinity of Walton County, Florida."*

The non-federal sponsor is the Walton County Board of Commissioners. Their central point of contact is the Director of Beach Management for the Walton County Tourist Development Council (TDC).

This public notice is issued in accordance with rules and regulations published in the Federal Register on 26 April 1988. These laws are applied whenever dredged or fill materials may enter waters of the United States, or for the transportation of dredged material for the purpose of placement into ocean waters. The recipient of this notice is requested specifically to review the proposed action as it may have impacts on water quality, relative to the requirements of Section 404(b)(1) of the Clean Water Act. Review of any other potential impacts is also requested.

WATERWAY AND LOCATION: Walton County, Florida

PROJECT AREA LOCATION: Walton County is located approximately 103 miles east of Pensacola, Florida and 98 miles west of Tallahassee, Florida. The beaches of Walton County encompass approximately 26 miles of shoreline extending from the City of Destin in Okaloosa County, Florida (about six miles to the east of East Pass) to the Walton/Bay County line near Phillips Inlet (Figure 1). The western two-thirds of Walton County are comprised of a coastal peninsula extending from the mainland, and the eastern third is comprised of mainland beaches. Choctawhatchee Bay lies north of the peninsula. Walton County includes 11.9 miles of state-designated critically eroding areas and three State of Florida park areas that cover approximately six miles of the 26-mile shoreline.

PROPOSED ACTION: The Walton County upland cross-section is defined by dune elevations ranging from +9.5 to +33 feet NAVD88 and a natural berm elevation of +5.5 feet NAVD88. The study region was divided into five study reaches based on structural development and state park areas as illustrated in Figure 2. The historical and 2004 beach surveys were used to develop 11 representative profiles which characterize the existing condition for the five study reaches. The representative profiles were identified based on similarity in shape of the upper beach profile (dune height and width, berm width, foreshore beach slope, and profile volume) and shape of the offshore profile.

The selected plan recommended for construction consists of the five construction reaches (Figure 2). The project will be composed of a 50-foot berm width, a 25-foot berm and an additional 25 feet of advanced nourishment in all construction reaches. The project will also feature added dune width in all construction reaches of either 10 or 30 feet. It is estimated that the necessary beach fill requirements will be 3,350,000 cubic yards (cy). Re-nourishments will be on a 12-year cycle with predicted volumes to be approximately 2,000,000 cy. Approved borrow sources lie offshore within the State of Florida waters. The typical cross-sections for the selected plan are illustrated in Figure 3. When dune construction is complete, the dune will be planted with at least three species of dune vegetation to create a dune that matches the surrounding natural dune patterns in the area. Upon reconstruction immediate steps will be taken to plant and stabilize the dune for rapid stabilization. This will be accomplished through the use of sand fences and dune plants. The dune plants will be planted to cover 60-80% of the total area. The vegetation will consist of local dominant species that populate nearby natural dune systems. The selection of the

dune vegetation will consist of species that are most widely used for dune restoration and are readily available from local nurseries and suppliers. The selection will be coordinated with local experts familiar with dune ecosystems in the immediate area.

A large scale reconnaissance level geophysical, lithological and granulometeric grain size investigation was undertaken off Walton County, Florida. Sub-bottom profiles were used to locate prospective core locations to identify high quality sand sources for beach nourishment. Vibracores and selected seismic records were interpreted to confirm the proposed borrow contains suitable beach compatible sediment. The borrow sediments are characterized as well sorted medium sand 0.25 - 0.50 mm. Borrow area B-4 shown on Figure 4 is the borrow site that was selected with some 10,000,000 cy proven by these initial investigations. This volume covers the recommended plan placement and the four planned subsequent re-nourishments for the next 50 years. The B-4 borrow area is most centrally located and offers the best source for the initial project construction and future re-nourishments. Based on the extensive geotechnical investigations, this borrow site has been demonstrated to be the most suitable source and has sand of color, size, and composition generally similar to that of the native beach. All materials used for beach nourishment will be excavated by hopper dredge, transported to the placement area offshore and pumped into the beach template. Small bulldozers will be used on land to shape the material to the design template (Figure 3).

WATER QUALITY CERTIFICATION: Pursuant to the requirements of the Clean Water Act, State Water Certification is required for the proposed action. Water quality certification is being requested for a period of ten years. Upon completion of the required comment period and the State of Florida permitting requirements, a decision relative to water quality certification will be made by Florida Department of Environmental Protection (DEP).

COASTAL ZONE CONSISTENCY: Pursuant to the Coastal Zone Management Act, the proposed action is consistent with the Florida Coastal Management Program to the maximum extent practicable. Upon completion of the required comment period and the State of Florida permitting requirements, a decision relative to coastal zone consistency will be made by DEP.

USE BY OTHERS: The proposed action is not expected to create significant impacts on land and water use plans.

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) CONSIDERATIONS:
The impacts associated with the dredging of the borrow site and beach placement activities have been addressed in the recent Draft 2010 Environmental Assessment (EA) for the Walton County, Florida Hurricane and Storm Damage Reduction Project, Walton County, Florida. A copy of the Draft EA is available for review at the following website: www.sam.usace.army.mil/Pd1.htm.

SECTION 404(b)(1) EVALUATION REPORT: An evaluation of water quality impacts associated with the proposed action was prepared in accordance with guidelines promulgated by the Environmental Protection Agency under Section 404(b)(1) of the Clean Water Act. Impacts associated with this action include a temporary increase in turbidity and suspended solids concentrations in and adjacent to the disposal areas, short-term elimination of benthic organisms and localized short-term degradation of esthetics near the disposal area. A Draft 404(b)(1) Evaluation Report has been prepared is available for review at the follow website: www.sam.usace.army.mil/Pd1.htm.

ENDANGERED/THREATENED SPECIES: There are several listed endangered and/or threatened species that would be affected by the proposed action. The known list of threatened or/and endangered species (T/E) and their critical habitats in the vicinity of the project include: sea turtles, Gulf sturgeon and associated critical habitat, piping plover, Choctawhatchee beach mouse (CBM) and associated critical habitat, and West Indian manatee. Previous coordination by the local sponsor (Walton county) has been conducted for the local Walton County Beach Nourishment Project in the same area, with the U.S. Department of the Interior, Fish and Wildlife Service (FWS). This coordination resulted in the preparation of a biological opinion (BO), which indicated that although the action may affect sea turtles, piping plover, and the CBM, it is their opinion that the effects of the proposed activities are not likely to jeopardize the continued existence of these species and not likely to destroy or adversely modify designated critical habitat for the CBM. It has also been determined that the action is not likely to affect the West Indian manatee.

The Gulf sturgeon and their associated critical habitat fall under the jurisdiction of the U.S. Department of Commerce, National Marine Fisheries Service (NMFS). Previous consultation with NMFS for the local Walton County plan has indicated that similar actions were not likely to adversely affect Gulf sturgeon and is not likely to adversely affect Gulf Sturgeon critical habitat.

The Corps has initiated coordination with these agencies for the selected Federal plan to assure avoidance of any conflicts with these or other known threatened and endangered species and their critical habitats. Areas where the known species are suspected will be monitored before, during and after dredged disposal activities.

ESSENTIAL FISH HABITAT: Essential Fish Habitat (EFH) is defined as waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity, the designation and conservation of EFH seeks to minimize adverse effects on habitat caused by fishing and non-fishing activities. The NMFS has identified EFH habitats for the Gulf of Mexico in its Fishery Management Plan Amendments. These habitats include estuarine areas, such as estuarine emergent wetlands, seagrass beds, algal flats, mud, sand, shell, and rock substrates, and the estuarine water column.

During dredging and placement activities most of the motile benthic and pelagic fauna, such as crab, shrimp, and fish, should be able to avoid the disturbed area and should recover shortly after the activity is completed. The selected borrow area is characterized as sandy bottom and does not contain any hard-bottoms, coral reefs, oyster beds, or seagrasses. No long-term direct impacts to managed species are anticipated.

However, it is reasonable to anticipate some non-motile and motile invertebrate species will be physically affected through the dredging and placement operations. These species are expected to recover rapidly after the dredging and disposal operations are complete.

Based on the above assessment of the project in relation to impacts to fisheries resources, the overall impact to identified species is considered negligible given the relatively small area. This action is being coordinated with the NMFS, Habitat Conservation Division pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (PL 94-265).

CULTURAL RESOURCES CONSIDERATION: In accordance with Section 106 of the National Historic Preservation Act and other relevant cultural resource laws, recommendations and actions are being coordinated with the Florida State Historic Preservation Officer (FLSHPO). The borrow area was surveyed for cultural resources in May and June of 2007 in which the survey found no cultural resources eligible for or listed on the National Register of Historic Places (Historic Properties). The shoreline will be reconstructed to historic dimensions. The nature of the work is such that the deposition will have no effect on historic properties. In addition, the nature of the project precludes any visual effects to historic properties. Based on this information, and the nature of the project, the Mobile District, as lead Federal agency, has determined that the project will have no effect on historic properties as per 36 CFR 800.4(d)(1).

CLEAN AIR ACT: Air quality in the vicinity of the proposed action would not be significantly affected with the proposed action. The equipment and machinery would generate some air pollution during construction activities, such as increased particulate levels from the burning of fossil fuels. However, these impacts would be minor and temporary in nature. The proposed action is in compliance with the Clean Air Act, as amended. The project area is in attainment with the National Ambient Air Quality Standards parameters. The proposed action would not affect the attainment status of the project area or region. A State Implementation Plan conformity determination (42 United States Code 7506(c)) is not required since the project area is in attainment for all criteria pollutants.

EVALUATION: The decision whether to proceed with the proposed action would be based on an evaluation of the overall public interest. That decision would reflect the national concerns for both protection and utilization of important resources. The benefits that may be expected to accrue from this proposal must be balanced against its reasonably foreseeable detriments. The decision whether to proceed, and the conditions under which the activity would occur, would be determined by the outcome of this general balancing process. All factors that may be relevant to the proposal would be considered. Among these are conservation, economics, esthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and in general, the needs and welfare of the public.

The proposed action would proceed unless it is found to be contrary to the overall public interest. Inasmuch as the proposed work would involve dredging and discharge of materials into navigable waters, specification of the proposed placement sites associated with this Federal project is being made through the application of guidelines promulgated by the Administrator of the Environmental Protection Agency in conjunction with the Secretary of the Army. If these guidelines alone prohibit the specification of any proposed disposal site, any potential impairment of the maintenance of navigation, including any economic impacts on navigation and anchorage that would result from the failure to use this site would also be considered.

COORDINATION: Among the agencies receiving copies of this public notice are:

Region 4, U.S. Environmental Protection Agency
Field Representative, Fish and Wildlife Service
Regional Director, National Park Service
Regional Director, National Marine Fisheries Service
Commander, Eighth Coast Guard District
Florida State Historic Preservation Officer
Florida Department of Environmental Protection
Gulf of Mexico Fishery Management Council
Federal Emergency Management Agency

Other Federal, State, and local organizations, affiliated Indian Tribe interests, and U.S. Senators and Representatives of the State of Florida are being sent copies of the notice and are being asked to participate in coordinating this proposed work.

CORRESPONDENCE: Any person who has an interest that may be affected by the proposed activity may request a public hearing. Any comments or requests for a public hearing must be submitted in writing to the District Engineer within 30 days of the date of this public notice. A request for a hearing must clearly set forth the interest that may be affected and the manner in which the interest may be affected. You are requested to communicate the information contained in this notice to any other parties who may have an interest in the proposed activities. Correspondence concerning the public notice should refer to Public Notice No. FP10-WC01-10 and should be directed to the Commander, U.S. Army Engineer District, Mobile, P.O. Box 2288, Mobile, Alabama 36628-0001, ATTN: CESAM-PD-EC. For additional information please contact Mr. Larry Parson at (251) 690-3139.

CURTIS M. FLAKES
U.S. Army Corps of Engineers
Mobile District

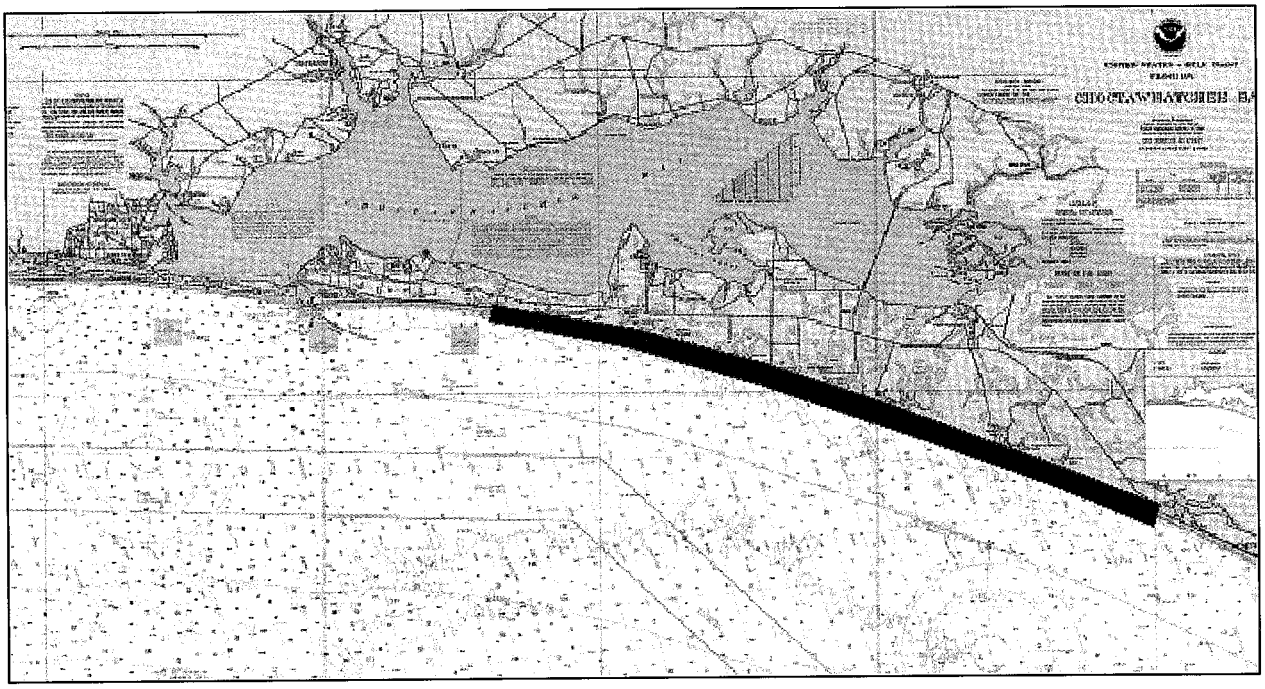


Figure 1. Location of Walton County project area

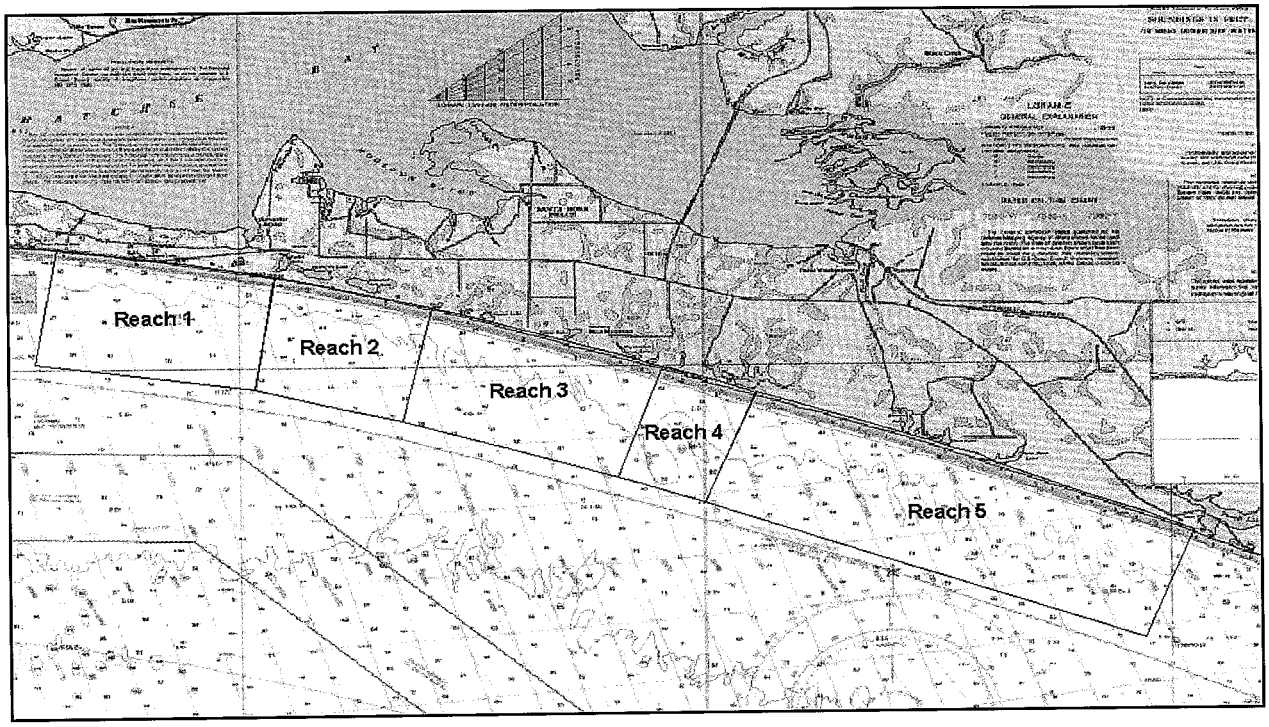


Figure 2. Location of the 5 construction reaches within the project area.

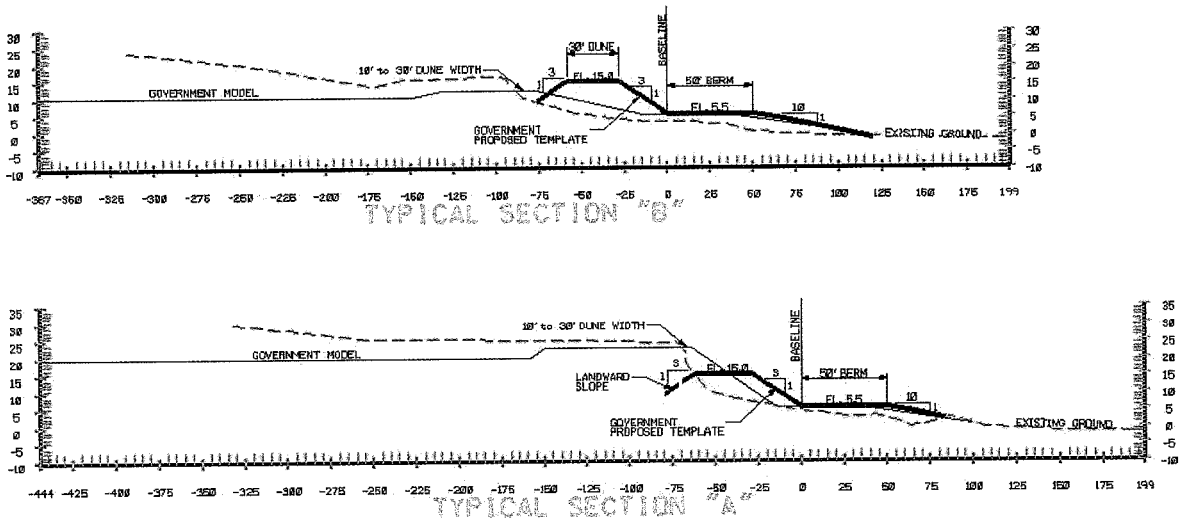


Figure 3. Selected plan typical cross sections to be constructed

Figure 4. Borrow area investigation locations and selected borrow site.

SEMINOLE TRIBE OF FLORIDA
TRIBAL HISTORIC PRESERVATION OFFICE

TRIBAL HISTORIC
PRESERVATION OFFICE

SEMINOLE TRIBE OF FLORIDA
AH-TAH-THI-KI MUSEUM

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CLEWISTON, FL 33440

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TRIBAL OFFICERS
CHAIRMAN
MITCHELL CYPRESS
VICE CHAIRMAN
RICHARD BOWERS JR.
SECRETARY
PRISCILLA D. SAYEN
TREASURER
MICHAEL D. TIGER

Larry Parson
U.S. Army Engineer District, Mobile
P.O. Box 2288
Mobile, AL 36628-0001

THPO: 005770
Re: FP10-WC01-10

May 27, 2010

Subject: Assessment of Effects for the Hurricane and Storm Damage Reduction Project for Walton County, Florida

Dear Mr. Parson,

The Seminole Tribe of Florida's Tribal Historic Preservation Office (STOF-THPO) has received the Corps notice concerning the aforementioned project. The STOF-THPO has no objection to your findings at this time. However, the STOF-THPO would like to be informed if cultural resources that are potentially ancestral or historically relevant to the Seminole Tribe of Florida are inadvertently discovered during the construction process. We thank you for the opportunity to review the information that has been sent to date regarding this project. Please reference to ***THPO-005770*** for any related issues.

We look forward to working with you in the future.

Sincerely,

Direct routine inquiries to:

Willard Steele,
Tribal Historic Preservation Officer
Seminole Tribe of Florida

Anne Mullins,
Compliance Review Supervisor
annemullins@semtribe.com

Parson, Larry E SAM

From: Ryan Hendren [Ryan.Hendren@noaa.gov]
Sent: Monday, March 01, 2010 2:52 PM
To: Parson, Larry E SAM
Subject: Walton County Hurricane Damage Reduction Project

Larry:

Upon review of your project, it looks like the Walton County Hurricane Damage Reduction Project (T/SER/2010/00241) would be covered by a previously issued informal consultation letter for Walton County Board of County Commissioners (I/SER/2007/06965). This consultation reviews the effects of a project that is essentially the same as the current proposed project, with a larger scope than the current one proposed by the USACE. It is understood that the effects of the current project would be less than that of the previously issued project and would be subject to the same conditions listed in the previous consultation letter (I/SER/2007/06965). If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat in a manner or to an extent not previously considered, or if a new species is listed or critical habitat designated that may be affected by the identified action, consultation will need to be reestablished.

Please contact me if you have any additional questions. -rH

--
Ryan Hendren
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Email: ryan.hendren@noaa.gov
Web: http://sero.nmfs.noaa.gov/pr/pr.htm

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
(727) 824-5317; FAX 824-5300
http://sero.nmfs.noaa.gov

October 6, 2010 F/SER46:MT/mt

Ms. Jennifer L. Jacobson
Chief, Coastal Environment Team
Mobile District, Corps of Engineers
P.O. Box 2288
Mobile, Alabama 36628-0001

Dear Ms. Jacobson:

NOAA's National Marine Fisheries Service (NMFS), Habitat Conservation Division, has received your letter dated January 13, 2010, initiating essential fish habitat (EFH) consultation and providing an EFH Assessment for beach nourishment, shore protection and related improvements in the Gulf of Mexico and Walton County, Florida. This request was initiated pursuant to the consultation provisions of the Magnuson-Stevens Conservation and Management Act (Magnuson-Stevens Act).

Based on today's conversation between our staff and the information provided in your January letter and today, via email, it is the Corps of Engineers position the borrow sites are designed to avoid post-dredging negative impacts and the placement of the material along the shore would not adversely affect EFH for any species managed under the Magnuson-Stevens Act. We have reviewed the EFH Assessment and subsequent information and determined the NMFS does not have any EFH conservation recommendations to offer.

Thank you for you effort to comply with the EFH provisions of the Magnuson-Stevens Act. If you have any questions, please contact Mark Thompson at our Panama City, Florida office. His telephone number is 850-234-5061.

Sincerely,

W. Mark Thompson

for Miles M. Croom
Assistant Regional Administrator
Habitat Conservation Division

cc:
F/SER4
F/SER3

Larry -

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Field Office
1601 Balboa Avenue
Panama City, FL 32405-3721
Tel: (850) 769-0552
Fax: (850) 763-2177

IN REPLY REFER TO:

February 22, 2010

Kenneth P. Bradley
Department of the Army
Mobile District, Corps of Engineers
Coastal Environment Team
Mobile, AL 36628

Re: Walton County Beach Nourishment
Coastal Barrier Resources Act
Walton County, Florida

Dear Mr. Bradley:

Thank you for your letter to the Fish and Wildlife Service (Service) dated January 15, 2010, requesting consultation under the Coastal Barrier Resources Act (CBRA) for the Walton County, Florida, hurricane and storm damage reduction project. The proposed project will occur along approximately 26 miles of Walton County shoreline. Portions of the project area are located within the following units of the Coastal Barrier Resources System (CBRS): P32 (Moreno Point), P31A (Four Mile Village), FL-96 (Draper Lake), FL-95P (Grayton Beach), FL-94 (Deer Lake Complex), and FL-93P (Phillips Inlet). The U.S. Army Corps of Engineers has determined that the project would qualify for an exception under Section 6 of CBRA.

In order to qualify for such an exception, a project must first be established as consistent with the purpose of CBRA, which is to minimize 1) loss of human life, 2) wasteful expenditure of Federal revenues, and 3) the damage to fish, wildlife and other natural resources. To achieve this purpose, CBRA restricts Federal expenditures and financial assistance which have the effect of encouraging development of coastal barriers, and "by considering the means and measures by which the long-term conservation of these fish, wildlife, and other natural resources may be achieved." When an area is located in the CBRS, CBRA prohibits most new Federal assistance, including subsidies for shoreline stabilization, flood insurance, road construction, channel dredging, and other coastal projects in that area. The Service has determined that this project is not consistent with the purpose of CBRA.

Coastal barriers are dynamic systems that include an ever changing mosaic of habitats and that have been on the move through the millennia due to sea level changes. Erosion and accretion are natural processes that continually change their profile, especially during storms. Together with their adjacent wetland, marsh, estuarine, inlet, and nearshore water habitats, coastal barriers support a variety of organisms. The geomorphic characteristics of barrier islands, peninsulas, beaches, dunes, overwash fans, and inlets are critical to a variety of fish and wildlife resources, and they influence a barrier beach's ability to respond to wave action, including natural storm

resources that shape and re-shape themselves over time and through the natural disturbance caused by storms. The fish and wildlife that live in and around them have adapted to, and thrive on, this constant, natural change.

Today, large-scale coastal development disrupts natural coastal processes and dynamics. Since the 1980s beach nourishment has been used in Florida as the preferred solution to the conflict between dynamic beaches and development. While nourishment technology and environmental safeguards have improved, the negative effects to coastal dependent species outweigh the potential benefits.

Even under the best circumstances (e.g., when high quality materials are used, and project design and implementation are sound) the purpose of beach nourishment is typically for structure protection and not restoration of species habitat. As long as there are immovable structures along the shoreline, species habitat cannot be fully restored. For example, sea turtles nest on oceanfront beaches even when they are eroding. The placement of sand on a beach with reduced dry foredune habitat may support sea turtle nesting habitat if that sand is highly compatible (in terms of grain size, shape, color, etc.) with naturally occurring beach sediments in the area, and compaction and escarpment remediation measures are incorporated into the project. However, even with these safeguards, sea turtle nesting continues to be negatively affected for the first few years after nourishment, as evidenced by reduced nesting and nest emergence success.

Coastal dune lakes are lakes that occur in coastal communities along the Gulf of Mexico. The lakes are separated from the Gulf by a barrier beach and dune system which may be intermittent with or without a meandering tidal outlet. The lakes are important breeding areas for insects and crustaceans. Many birds and mammals also utilize the lakes for food and habitat. They are considered "imperiled globally because of rarity" by the Florida Natural Areas Inventory (FNAI) (FNAI and Florida Department of Natural Resources (FDNR), 1990). Water is generally from lateral ground water seepage through well-drained coastal sands (Griffith et al., 1995). Dune lakes fluctuate in water level and vary in salinity due to tidal exchange from the lake outflow, storm surge events, rainfall, evaporation, and wetland drainage (FNAI and FDNR, 1990). The 16 dune lakes that occur in Walton County vary in the amount of shoreline development. All lakes are subject to flooding. Breaching of the outlets allows the lakes to function naturally, draining and filling. To date, no reports indicate that nourishment would improve the natural function of the coastal dune lake system.

In its 2009 report on beach erosion, the Florida Department of Environmental Protection (FDEP) designates seven critically eroded areas in Walton County, comprising a total of 15.7 miles (FDEP 2009). The report defines a critically eroded area as "a segment of the shoreline where natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost." The critically eroded portions in Walton County were so designated because the erosion primarily threatens development in the county, though it may also threaten recreational interests and/or roads. The report further notes that a beach nourishment project for the western 5 miles of Walton County's beaches, partially in CBRS Unit P32, was completed in 2007. Given that erosion is a naturally occurring and

recurring process, and that more than half the project area is considered critically eroded by the state, the request for Federal authorization to fund this project is a strong indicator that additional requests will be made for beach nourishment on a routine basis. CBRA recognizes the inherent nature of shifting shores and attempts to preserve that characteristic by preventing Federal funding for shoreline protection that could have the effect of shoreline stabilization. The very nature of beach restoration/nourishment requires regular replenishment of sand, in this case, using Federal expenditures. Thus, we cannot conclude that regularly adding sand into that system is not a wasteful expenditure.

Beach replenishment frequently leads to more development in greater density within shorefront communities, which are then faced with the need for future replenishment or more drastic stabilization measures (Pilkey and Dixon 1996). The very existence of a beach nourishment project can encourage more development in coastal areas (Dean 1999, Ruppert et al. 2008), especially if Federal funds subsidize each future erosion control event. This happens even within public lands due to such things as increased camp sites, parking areas, etc. We recognize that not nourishing the beaches within the CBRS may decrease the longevity and durability of the proposed Federal project on the adjacent developed lands. For that reason, we understand that the intent of inclusion of those CBRS beaches in the nourishment project is to support the adjacent developed beaches, not to improve the habitat for natural resources. Further development within public lands and the properties adjacent to CBRS units will not serve to minimize future loss of human life or damage to fish and wildlife resources.

Since the proposed project is not consistent with the purposes of CBRA, a request for an exception under Section 6 is not appropriate. However, we also note that the law further prohibits financial assistance from being made available for "the carrying out of any project to prevent the erosion of, or to otherwise stabilize, any inlet, shoreline, or inshore area" unless it meets the criteria for an exception under section 6. To qualify under section 6, a nonstructural shoreline stabilization project must be "designed to mimic, enhance, or restore a natural stabilization system." This project has not been designed to do this, or to provide significant enhancement to the fish and wildlife resources of the CBRS unit aside from adding sand to the dynamic system. It is designed to provide stability to the lands adjacent to the CBRS units that are developed. We do not identify a need for adding sediment to the beaches at this time for the benefit of fish and wildlife resources.

If you have any questions, please contact Melody Ray-Culp of this office at extension 232.

Sincerely,

Donald W. Imm, PhD
Assistant Project Leader

cc: Cynthia Bohn, FWS, Regional Office, Atlanta, GA
Katie Niemie, FWS, 4401 N. Fairfax Dr., Room 860A, Arlington, VA 22203

Citations

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FLORIDA DEPARTMENT OF STATE
Kurt S. Browning
Secretary of State
DIVISION OF HISTORICAL RESOURCES

Mr. Kenneth P. Bradley
Mobile Planning and Environmental Division
Mobile USACE
Post Office Box 2288
Mobile, Alabama 36628-0001

March 11, 2010

Re: DHR Project File No. 2010-529/ Received by DHR: January 26, 2010
U.S. Army Corps of Engineers, Mobile District
Florida Hurricane and Storm Damage Reduction Project
Walton County

Dear Mr. Bradley:

This office reviewed the referenced project for possible impact to historic properties listed, or eligible for listing, in the National Register of Historic Places. The review was conducted in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended, 36 CFR Part 800: Protection of Historic Properties, and the National Environmental Policy Act of 1969, as amended.

We note that the project area has previously been subjected to a cultural resource assessment, reviewed by our office in December 2008 (DHR Project File No. 2008-2705). The results of this survey indicate that there are no historic properties located within the area of potential effect for this project. Therefore, this office concurs with your determination that the proposed undertaking will have no effect on historic properties.

If you have any questions concerning our comments, please contact Samantha Earnest, Historic Preservationist, by electronic mail *swearnest@dos.state.fl.us*, or at 850.245.6333.Your continued interest in protecting Florida's historic properties is appreciated.

Sincerely,

Laura A. Kammerer

Laura A. Kammerer
Deputy State Historic Preservation Officer
For Review and Compliance

500 S. Bronough Street • Tallahassee, FL 32399-0250 • http://www.flheritage.com

☐ Director's Office
850.245.6300 • FAX: 245.6436

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United States Department of the Interior
U. S. FISH AND WILDLIFE SERVICE
7915 BAYMEADOWS WAY, SUITE 200
JACKSONVILLE, FLORIDA 32256-7517

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IN REPLY REFER TO:

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SEP 01 2011
South Florida ES Office
Vero Beach, FL

Service Log Number: 41910-2011-F-0170

August 22, 2011

Colonel Alfred A. Pantano, Jr. District Engineer
U.S. Army Corps of Engineers
Regulatory Division, North Permits Branch
Atlantic Permits Section
P.O. Box 4970
Jacksonville, Florida 32232-0019

RECEIVED
SEP 06 2011
U.S. FISH AND WILDLIFE SERVICE
JACKSONVILLE, FLORIDA

Dear Colonel Pantano:

This document is the U.S. Fish and Wildlife Service's revised Statewide Programmatic Biological Opinion (SPBO) for the U.S. Army Corps of Engineers (Corps) planning and regulatory sand placement activities in Florida and their effects on loggerhead (*Caretta caretta*), green (*Chelonia mydas),* leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), and Kemp's ridley (*Lepidochelys kempii*) sea turtles, and the southeastern (*Peromyscus polionotus niveiventris*), Anastasia Island (*Peromyscus polionotus phasma*), Choctawhatchee (*Peromyscus polionotus allophrys*), St. Andrews (*Peromyscus polionotus peninsularis*), and Perdido Key (*Peromyscus polionotus trissyllepsis*) beach mice and their designated critical habitat. It does not include take for the non breeding piping plover (*Charadrius melodus*) and its designated critical habitat.

Each proposed project will undergo an evaluation process by the Corps to determine if it properly fits within a programmatic approach. The project description will determine if the project is appropriate to apply to this programmatic consultation. If it is determined that the minimization measures, Reasonable and Prudent Measures, and Terms and Conditions in the SPBO are applicable to the project, it will be covered by this programmatic consultation. If not, the Corps will consult separately on individual projects that do not fit within this programmatic approach.

Proposed projects that "may affect" the piping plover or occur within piping plover critical habitat are not included in this SPBO and will be consulted on individually. The Corps should consult on all projects that are in areas where piping plover have been observed, all

navigable inlets, washover areas), all projects in or within one mile of piping plover critical habitat, and all projects within public lands (county, state, federal, etc.) where coastal processes are allowed to function, mostly unimpeded.

We will meet annually during the fourth week of August to review the sand placement projects, assess new data, identify information needs, and scope methods to address those needs, including, but not limited to, evaluations and monitoring specified in this SPBO, reviewing results, formulating or amending actions that minimize take of listed species, and monitoring the effectiveness of those actions. We will also discuss progress for the future inclusion of piping plovers in the SPBO.

The entire programmatic consultation will be reviewed every five years or sooner if new information concerning the projects or protected species occurs. Reinitiation of formal consultation is also required 10 years after the issuance of this SPBO.

We are available to meet with agency representatives to discuss the remaining issues with this consultation. If you have any questions, please contact Ann Marie Lauritsen at the North Florida Ecological Services Office at (904) 731-3032, Jeffrey Howe at the South Florida Ecological Services Office at (772) 562-3909 ext. 283, or Richard Zane at the Panama City Ecological Services Office at (850) 769-0552 ext. 241.

Sincerely,

/s/

David L. Hankla
Field Supervisor,
Jacksonville Field Office

/s/

Donald W. Imm
Field Supervisor
Panama City Field Office

/s/

Field Supervisor
South Florida Field Office

Shore Protection Activities along the Coast of Florida

Statewide Programmatic Biological Opinion
August 22, 2011

Prepared by:
U.S. Fish and Wildlife Service

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Acronyms

ABM	Alabama Beach Mouse
Act	Endangered Species Act
AFB	Air Force Base
AIBM	Anastasia Island Beach Mouse
ASP	Anastasia State Park
BO	Biological Opinion
CBM	Choctawhatchee Beach Mouse
CBRA	Coastal Barrier Resources Act
CCAFS	Cape Canaveral Air Force Station
CFR	Code of Federal Regulations
CH	Critical Habitat
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
Corps	U.S. Army Corps of Engineers
DOI	U.S. Department of the Interior
DTRU	Dry Tortugas Recovery Unit
F	Fahrenheit
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FEMA	Federal Emergency Management Agency
FMNM	Fort Matanzas National Monument

FR	Federal Register
FWC	Florida Fish and Wildlife Conservation Commission
FWC/FWRI	Florida Fish and Wildlife Conservation Commission's Florida Fish and Wildlife Research Institute
GCRU	Greater Caribbean Recovery Unit
GINS	Gulf Islands National Seashore
GTMNERR	Guana Tolomato Matanzas National Estuarine Research Reserve
HCP	Habitat Conservation Plan
IMA	Important Manatee Areas
INBS	Index Nesting Beach Survey
IPCC	Intergovernmental Panel on Climate Change
ITP	Incidental Take Permit
K	Carrying Capacity
MANLAA	May Affect, but is Not Likely to Adversely Affect
MHW	Mean High Water
MHWL	Mean High Water Line
MMPA	Marine Mammal Protection Act
mtDNA	Mitochondrial Deoxyribonucleic Acid
NGMRU	Northern Gulf of Mexico Recovery Unit
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRU	Northern Recovery Unit

NWR	National Wildlife Refuge
PBA	Programmatic Biological Assessment
PCE	Primary Constituent Elements
PFRU	Peninsular Florida Recovery Unit
PHVA	Population and Habitat Viability Analysis
PKBM	Perdido Key Beach Mouse
PKSP	Perdido Key State Park
PSI	Per Square Inch
PVA	Population Viability Analysis
SABM	St. Andrews Beach Mouse
SAJ	South Atlantic Jacksonville
SAM	South Atlantic Mobile
SAV	submerged aquatic vegetation
SEBM	Southeastern Beach Mouse
Service	U.S. Fish and Wildlife Service
SNBS	Statewide Nesting Beach Survey
SPBO	Statewide Programmatic Biological Opinion
SR	State Road
TED	Turtle Excluder Device
TEWG	Turtle Expert Working Group
U.S.C.	United States Code

U.S.	United States

August 22, 2011

Colonel Alfred A. Pantano, Jr.
District Engineer
U.S. Army Corps of Engineers
Post Office Box 4970
Jacksonville, Florida 32232-0019

Re: Service Federal Activity No: 41910-2010-F-0284
Applicant: U.S. Army Corps of Engineers
Date Started: May 30, 2007
Project Title: Shore Protection Activities
Ecosystem: Florida Coastline
Counties: Nassau, Duval, St. Johns, Flagler, Volusia, Brevard, Indian River, St. Lucie, Martin, Palm Beach, Broward, Miami-Dade, Monroe, Collier, Lee, Charlotte, Sarasota, Manatee, Hillsborough, Pinellas, Franklin, Gulf, Bay, Walton, Okaloosa, Santa Rosa, Escambia.

Dear Colonel Pantano:

This document is the U.S. Fish and Wildlife Service's (Service) Statewide Programmatic Biological Opinion (SPBO) for the U.S. Army Corps of Engineers (Corps) planning and regulatory shore protection activities in Florida and their effects on loggerhead (*Caretta caretta*), green (*Chelonia mydas),* leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), and Kemp's ridley (*Lepidochelys kempii*) sea turtles, and southeastern (*Peromyscus polionotus niveiventris*), Anastasia Island (*Peromyscus polionotus phasma*), Choctawhatchee (*Peromyscus polionotus allophrys*), St. Andrews (*Peromyscus polionotus peninsularis*), and Perdido Key (*Peromyscus polionotus trissyllepsis*) beach mice and designated critical habitat (CH) for the Perdido Key beach mouse (PKBM), Choctawhatchee beach mouse (CBM), and St. Andrews beach mouse (SABM) **(Table 1)**. This SPBO is provided in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq*.). We have assigned Service Federal Activity number 41910-2010-F-0284 for this consultation.

Table 1. Status of federally listed species within the Action Area that may be adversely affected by the shore protection activities.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	STATUS/CH
Mammals		
Choctawhatchee beach mouse	*Peromyscus polionotus allophrys*	Endangered(CH)
Southeastern beach mouse	*Peromyscus polionotus niveiventris*	Threatened
Anastasia Island beach mouse	*Peromyscus polionotus phasma*	Endangered
St. Andrews beach mouse	*Peromyscus polionotus peninsularis*	Endangered (CH)
Perdido Key beach mouse	*Peromyscus polionotus trissyllepsis*	Endangered (CH)
Birds		
Piping Plover	*Charadrius melodus*	Threatened
Reptiles		
Green sea turtle	*Chelonia mydas*	Endangered
Hawksbill turtle	*Eretmochelys imbricata*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened

The Corps determined that the proposed project "may affect and is likely to adversely affect the above listed species (**Table 1**). The Corps also has determined that the proposed project "may affect, but is not likely to adversely affect" (MANLAA) the West Indian (Florida) manatee (*Trichechus manatus latirostris*), the roseate tern (*Sterna dougallii dougallii*), the beach jacquemontia (*Jacquemontia reclinata*), and the Garber's spurge (*Chamaesyce garberi*) **(Table 2)**. Based on our review of the project plans and the incorporation of the minimization measures listed in the final Programmatic Biological Assessment (PBA) as conditions of the projects where these species are known to exist, we concur with these determinations.

Table 2. Species and critical habitat evaluated for effects and those where the Service has concurred with a "may affect, not likely to adversely affect (MANLAA)" determination.

SPECIES COMMON NAME	SPECIES SCIENTIFIC NAME	STATUS/CH	PRESENT IN ACTION AREA	MANLAA
Florida manatee	*Trichechus manatus latirostris*	Endangered (CH)	Yes	Yes
Roseate tern	*Sterna dougallii dougallii*	Threatened	Yes	Yes
Beach jacquemontia	*Jacquemontia reclinata*	Endangered	Yes	Yes
Garber's spurge	*Chamaesyce garberi*	Threatened	Yes	Yes

Piping Plover

The Corps should consult on all projects that are in areas where piping plover have been observed, all projects in or within one mile of an inlet (includes but not limited to streams, coastal dune lake outfalls, navigable inlets), all projects in or within one mile of piping plover critical habitat, and all projects within public lands (county, state, federal, etc.) where coastal processes are allowed to function, mostly unimpeded. Contact via electronic mail is recommended although contact may be made via telephone or regular mail. The Corps and the Service have agreed to the following interim section 7 consultation procedures.

1. The Corps shall contact the Service with the project description and location (include a map of any optimal habitat features that may be present within the project area). The Corps will also provide a "determination" based on available information.

2. The Service shall provide a response within 30 days. Based on additional information on the piping plover and other factors, the Service shall concur or not concur with the Corps' "determination".

In the final PBA, the Corps listed the following commitments to reduce impacts on piping plovers:

1. Adhere to appropriate windows to the maximum extent possible;
2. Implement survey guidelines for non-breeding shorebirds when appropriate. For Corps Civil Works projects, the "surveys" must be limited to the term of the construction unless they are otherwise authorized and funded (as used in Section 9.00 of the PBA, "funded" means subject to availability and allotment);
3. Pipeline alignment and associated construction activities may be modified to reduce impacts to foraging, sheltering, and roosting;

4. Avoid impacts to the primary constituent elements of piping plover critical habitat to the maximum extent possible;
5. Pre-project surveys will be performed to assess the presence of and/or potential for washover fan formation;
6. The Corps will work with the Service to develop shore protection design guidelines and/or mitigation measures that can be utilized during future project planning to protect and/or enhance high value piping plover habitat locations (*i.e.*, washover fans). For Corps Civil Works projects, "enhancement" must be limited to the extent authorized and funded as a project feature or project purpose; and
7. The Corps will work with the Florida Department of Environmental Protection (FDEP) to consider the value and context of inlet habitat features (*i.e.*, emergent spits, sand bars, etc.) within each inlet's management plan and adjust future dredging frequencies, to the maximum extent practicable and consistent with applicable law, so that adjacent habitats are made available and total habitat loss would not occur at one time within a given inlet complex.

Florida Manatee

<u>Dredging activities offshore associated with submerged borrow areas and navigational channels maintenance</u>

The Corps has determined that the proposed project "may affect, but is not likely to adversely affect" the Florida manatee. The Service has reviewed the draft PBA and concurs that, for dredging activities offshore, if the July 2009 Standard Manatee In-water Construction Conditions are implemented; these activities are not likely to adversely affect the Florida manatee. We also conclude that these activities will not adversely modify its critical habitat. These findings fulfill section 7 requirements of the Act in regard to manatees. In addition, because no incidental take of manatees is anticipated, no such authorization under the Marine Mammal Protection Act (MMPA) is needed.

<u>Dredging activities adjacent to the shore, inlet, and channels associated with submerged borrow areas and navigational channels maintenance</u>

For dredging activities adjacent to the shore, inlets, and/or inshore areas, based on the incorporation of the following additional conditions into the proposed projects and made a condition of the issued permit or Corps project plan and implemented, the Service would be able to concur with a determination by the Corps that these activities may affect, but are not likely to adversely affect the Florida manatee:

1. Barges shall install mooring bumpers that provide a minimum 4-foot standoff distance under maximum compression between other moored barges and large vessels, when in the vicinity of inlets, river mouths, and large estuaries where manatees are known to congregate.

2. Pipelines shall be positioned such that they do not restrict manatee movement to the maximum extent possible. Plastic pipelines shall be weighted or floated. Pipelines transporting dredged material within the vicinity of inlets, river mouths, and large estuaries where manatees are known to congregate shall be weighted or secured to the

bottom substrate as necessary to prevent movement of the pipeline and to prevent manatee entrapment or crushing.

3. In the event that such positioning has the potential to impact submerged aquatic vegetation (SAV) or nearshore hardbottom, the pipeline may be elevated or secured to the bottom substrate to minimize impacts to SAV.

Important Manatee Areas

Important Manatee Areas (IMAs) are areas where increased densities of manatees occur due to the proximity of warm water discharges, freshwater discharges, natural springs, and other habitat features that are attractive to manatees. These areas are heavily utilized for wintering, resting, feeding, drinking, transiting, nursing, etc., as indicated by aerial survey data, mortality data, and telemetry data. A current list of warm water IMAs that may occur within the project area includes:

Brevard County (Indian River) - Reliant and FP&L Power Plants
Hillsborough County (Tampa Bay)
Port Sutton Power Plant
Tampa Electric Big Bend Power Plant
Pinellas County (Old Tampa Bay)
Bartow Electric Generating Plant

A current map of all the IMAs or areas of inadequate protection can be found at the following Corps' website: http://www.saj.usace.army.mil/Divisions/Regulatory/sourcebook.htm.

Dredging activities within the IMA sites (both warm and other aggregation sites) are not included in this SPBO. For dredging activities within IMA sites (both warm water and other aggregation sites), the Corps shall contact the appropriate Service Field Office for project specific conditions (Table 3).

Table 3. Service Field Offices and County jurisdictions.

County	Service Field Office	Address	
Nassau, Duval, St. Johns, Flagler, Volusia, Brevard, Manatee, Pinellas, and Hillsborough	North Florida Ecological Services Office	7915 Baymeadows Way, Suite 200 Jacksonville, FL 32256-7517	(904) 731-3336
Indian River, St. Lucie, Martin, Palm Beach, Broward, Miami-Dade, Monroe, Collier, Lee, Charlotte, and Sarasota	South Florida Ecological Services Office	1339 20th Street Vero Beach, FL 32960	(772) 562-3909
Franklin, Gulf, Bay, Walton, Okaloosa, Santa Rosa, and Escambia	Panama City Ecological Services Office	1601 Balboa Avenue Panama City, FL 32405	(850) 769-0552

Although this does not represent a biological opinion for the manatee as described in section 7 of the Act, it does fulfill the requirements of the Act and no further action is required regarding manatees. It also fulfills the requirements of the MMPA. If modifications are made in the programmatic action or additional information becomes available, reinitiation of consultation may be required.

Migratory Birds

In order to comply with the Migratory Bird Treaty Act (16 U.S.C. 701 *et seq*.) and potential for this project to impact nesting shorebirds, the Corps' or the Applicant should follow Florida Fish and Wildlife Conservation Commission (FWC) standard guidelines to protect against impacts to nesting shorebirds during implementation of this project during the periods from February 15 to August 31.

Consultation History

1980s and 1990s — Beach nourishment projects in Florida began to occur frequently in the late 1980s and early 1990s. During that time, sea turtle protection measures were developed based on research findings available at that time. These measures addressed sand compaction, escarpment formation, and timing restrictions for projects in six south Florida counties with high nesting densities. In the mid-1990s, a sea turtle Biological Opinion (BO) template was developed that included protection measures and information on the status of sea turtles. In 1995, an expanded version of the sea turtle template BO was developed to incorporate new guidance on the required format for BOs and a biological rationale for the Terms and Conditions to be imposed. This document underwent review by four State conservation agencies and the Corps, and was subsequently revised. The primary purposes of the template BO were to: (1) incorporate a standardized format and language required for use in all BOs based on guidance from the Service's Washington Office, (2) assist Service biologists in the preparation of BOs, (3) increase consistency among Service field offices, and (4) increase consistency between the Service and the State agencies.

March 7 and 8, 2006 — The Corps met with the Services' three Florida field office representatives, a representative of the FWC, and a representative of the FDEP. The purpose of that meeting was to begin discussions about a regional consultation for sand placement activities along the coast of Florida and preparation of a PBA for sand placement activities in Florida. In addition to sea turtles, other Federal and state protected species were included in the discussions. At that meeting, the following topics were discussed:

1. Sand placement activities;
2. Sand source and placement methods;
3. Species and habitat;
4. Geographic scope;

5. Information availability; and
6. Minimization of impacts.

July 13, 2006 — A second meeting was held to further discuss the draft PBA. The Service provided the Corps with copies of the latest BO templates for each species to be considered. The Service held conference calls with the species recovery leads during August 2006.

October 16, 2006 — The Service received the draft PBA via email from the Corps for sand placement activities along the coast of Florida.

October 27, 2006 — The Service provided the Corps with draft comments on the PBA via email.

October 31, 2006 — The Corps provided a response to the Service's comments on the PBA via email.

November 9, 2006 — The Service and the Corps held a conference call to discuss the comments.

December 20, 2006 — The Service sent the Corps a letter with the final comments on the draft PBA.

September 18 and 19, 2007 — The Corps met with the Services' three Florida field office representatives, a representative of the FWC, and a representative of the FDEP. The purpose of this meeting was to discuss the Terms and Conditions to be included in the BO.

October 5, 2007 — The Service sent the Corps, via email, the modifications to the draft Reasonable and Prudent Measures and Terms and Conditions for the sea turtles and beach mice as discussed in the previous meeting.

November 1, 2007 — The Corps provided the Service with comments via email on the revised Reasonable and Prudent Measures and Terms and Conditions for the sea turtles and beach mice.

March 31, 2008 — The Service revised the Reasonable and Prudent Measures and Terms and Conditions for the sea turtles and beach mice. The Service also revised the minimization measures for the manatee. The revisions were sent to the Corps.

September 16, 2008 — The Service sent the Corps via mail the draft SPBO.

October 2, 2008 — The Corps provided the Service via email with a summary of the remaining issues concerning the Reasonable and Prudent Measures and Terms and Conditions for the sea turtles and beach mice.

October 15, 2008	The Service sent the Corps, via email, the modifications to the draft Reasonable and Prudent Measures and Terms and Conditions for the sea turtles and beach mice as discussed in the previous email.
March 11, 2009	The Service received via email examples of previous agreements between the Corps and the local sponsor to carry out the Terms and Conditions in previous BOs.
April 7, 2009	The Service sent an email to the Corps with an update of the progress of our analysis of including piping plovers in the SPBO.
August 26, 2009	The Service sent to the Corps via email the latest Terms and Conditions for sea turtles and beach mice.
September 17, 2009	The Corps sent an email to the Service describing the actions to be taken for the completion and submittal of the PBA.
January 6, 2010	The Corps and the Service participated in a meeting to finalize the draft SPBO.
January 21, 2010	The Corps sent to the Service via email the revised draft PBA.
March 25, 2010	The Corps and the Service participated in an implementation meeting and submittal of the final PBA.
February 22, 2011	The Corps submitted the final PBA to the Service.
April 18, 2011	The Service sent the final Statewide PBO to the Corps.
June 21, 20100	The Corps provided written concerns with the final Statewide PBO
June 30, 2011	The Service revised the final Statewide PBO.
July 18, 2011	The Corps provided written agreement with the changes that were made and asked for additional changes.
July 22, 2011	The Service made additional revisions per the Corps request.
July 25, 2011	The Corps provided written agreement with the additional revisions.

This SPBO is based on the PBA, and information provided during meetings and discussions with the Corps' representatives and information from the Florida Fish and Wildlife Conservation Commission's Florida Fish and Wildlife Research Institute (FWC/FWRI) sea turtle databases. A complete administrative record of this consultation is on file in the Service's North Florida, Panama City, and South Florida Ecological Services Offices.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The proposed action includes all activities associated with the placement of compatible sediment on beaches of the Atlantic and Gulf coasts of Florida, encompassing both South Atlantic Jacksonville (SAJ) and South Atlantic Mobile (SAM) Corps Districts. Additionally, the proposed action includes the replacement and rehabilitation of groins, utilized as design components of beach projects for longer retention time and stabilization of associated sediment placed on the beach. This SPBO includes Corps Regulatory and Civil Works shore protection activities. Corps Regulatory activities may include the involvement of other Federal agencies, such as the Department of Defense, Bureau of Ocean Energy Management, and the Federal Emergency Management Agency (FEMA). The shore protection activities covered in the SPBO encompass the following shore protection activities:

1. Sand placement;
2. Sand placement as an associated authorization of sand extraction from the outer continental shelf by the Bureau of Ocean Energy Management;
3. Sand washed onto the beach from being placed in the swash zone;
4. Sand by-passing/back-passing;
5. Operations and Maintenance (O&M) dredging of navigation channels with beach disposal; and
6. Groins and jetty repair or replacement.

A detailed description of each activity is found in the final PBA. The history of shore protection activities throughout the Atlantic and Gulf Coasts of Florida is extensive and consists of a myriad of actions performed by local, State, and Federal entities. Future beach placement actions addressed in this SPBO may include maintenance of these existing projects or beaches that have not experienced a history of beach placement activities.

The Service and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) share Federal jurisdiction for sea turtles under the Act. The Service has responsibility for sea turtles on the nesting beach. NMFS has jurisdiction for sea turtles in the marine environment. This SPBO only addresses activities that may impact nesting sea turtles, their nests and eggs, and hatchlings as they emerge from the nest and crawl to the sea. NMFS will assess and consult with the Corps concerning potential impacts to sea turtles in the marine environment and the shoreline updrift and downdrift area.

Corps Commitments as listed in the final PBA

The following paragraph from the final PBA summarizes the Corps Commitments as listed below:

"For Corps projects, please note that "fish and wildlife enhancement" activities (which are beyond mitigation of project impacts) must be authorized as a project purpose or project feature or must be otherwise approved through Corps headquarters (Engineer Regulation ER 1105-2-100 Appendix G, Amendment #1, 30 Jun 2004). At the present time, no beach fill placement or shore protection activity in Florida has fish and wildlife enhancement as a project purpose or project

feature. Since adding fish and wildlife enhancement as a project purpose or feature is not a budgetary priority (ER 1105-2-100 22 Apr 2000, Appendix C, part C-3b.(3)), authorization and funding for such is not expected."

Sea Turtles

1. Avoid sea turtle nesting season to the maximum extent practicable;

2. Except for O&M disposal actions, implement sea turtle nest monitoring and relocation plan during construction if nesting window cannot be adhered to;

3. Except for O&M disposal actions, escarpments that are identified prior to or during the nesting season that interfere with sea turtle nesting (exceed 18 inches in height for a distance of 100 feet) can be leveled to the natural beach for a given area. If it is determined that escarpment leveling is required during the nesting or hatching season, leveling actions should be directed by the Service. For Corps Civil Works projects, leveling of escarpments would be limited to the term of the construction or as otherwise may be authorized and funded;

4. Placement of pipe parallel to the shoreline and as far landward as possible so that a significant portion of available nesting habitat can be utilized and nest placement is not subject to inundation or washout;

5. Temporary storage of pipes and equipment will be located off the beach to the maximum extent possible;

6. The Corps will continue to work with the FDEP to identify aspects of beach nourishment construction templates that negatively impact sea turtles and develop and implement alternative design criteria that may minimize these impacts;

7. Except for O&M disposal actions, Service compaction assessment guidelines will be followed and tilling will be performed where appropriate. For Corps Civil Works projects, assessment of compaction and tilling will be limited to the term of the construction or as otherwise may be authorized and funded; and

8. All lighting associated with project construction will be minimized to the maximum extent possible, through reduction, shielding, angling, etc., while maintaining compliance with all Corps, U.S. Coast Guard, and OSHA safety requirements.

Beach Mice

1. Pipeline routes for beach construction projects will avoid identified primary constituent elements for beach mouse critical habitat to the maximum extent practicable;

2. Implementation of a trapping and relocation plan if avoidance alternatives are not practical; and

3. Implementation of a lighting plan to reduce, shield, lower, angle, etc. light sources in order to minimize illumination impacts on nocturnal beach mice during construction.

Action Area

The Service has described the action area to include sandy beaches of the Atlantic Coast of Florida (Key West to Fernandina/Kings Bay) and the Gulf Coast (Ten Thousand Islands to Alabama State Line) for reasons that will be explained and discussed in the "EFFECTS OF THE ACTION" section of this consultation.

Underlying Dynamics of a Barrier Island

Of all the states and provinces in North America, Florida is most intimately linked with the sea. Florida's 1,200-mile coastline (exclusive of the Keys) is easily the longest in the continental U.S. Of the 1,200 miles, 745 miles are sandy and mostly in the form of barrier islands. The coastline is dynamic and constantly changing as a result of waves, wind, tides, currents, sea level change, and storms. The entire state lies within the coastal plain, with a maximum elevation of about 400 feet, and no part is more than 60 miles from the Atlantic Ocean or Gulf of Mexico.

The east coast of Florida consists of a dynamic shoreline, with a relatively sloped berm, coarse-grained sand, and moderate to high surf (Witherington 1986). The southeast coast of Florida consists of continuous, narrow, sandy barrier islands bordering a narrow continental shelf (Wanless and Maier 2007). The dynamics of the east coast shoreline are due to the occurrence of storm surges and seas from tropical storms that occur mainly during August through early October. More erosion events can also occur during late September through March due to nor'easters. The impacts of these two types of storms may vary from event to event and year to year.

Northwest (panhandle) and Southwest Florida beaches are considered to be low energy beaches with a gradual offshore slope and low sloped fine grained quartz sand beaches. As along the east coast of Florida, the shoreline dynamics are shaped by tropical storms and hurricanes. Although Gulf beaches may experience winter erosion, they are largely protected from the severe nor'easters.

Coasts with greater tidal ranges are more buffered against storm surges than are those with low tidal ranges, except when the storm strikes during high tide. Mean tidal ranges decrease southward along the Atlantic coast from a mean of seven feet at the Florida-Georgia line to less than two feet in Palm Beach County. The mean tidal range along the Gulf Coast is less than three feet (microtidal) except in the extreme south where it ranges from three to four feet. Because of its lower elevation and lower wave energy regime, the West Coast of the peninsula is subject to greater changes during storm events than is the east coast.

Microtidal coasts have a high vulnerability to sea level rise and barrier islands respond by migrating landward. Migration occurs as a result of overwash from extreme storms that flatten topography and deposit sand on the backside of the island, extending the island landward (Young 2007). Significant widening can occur from a single storm event. For example, Dauphin Island, a barrier island in Alabama, has nearly doubled its width following Hurricanes Ivan and Katrina in 2004 and 2005, respectively.

Sea level has risen globally approximately 7.1 inches in the past century (Douglas 1997). Climate models predict a doubling of the rate of sea level rise over the next 100 years (Pendleton *et al.* 2004). Recent studies indicate a trend toward increasing hurricane number and intensity (Emanuel 2005, Webster *et al.* 2005). Barrier islands need to be able to move and respond to these conditions. By locking in a barrier island's location with infrastructure, the island loses its ability to migrate to higher elevations which can lead to its eventual collapse (Moore 2007).

Overwash from less intense storms can positively affect island topography. Low natural berms can develop along beach fronts, but generally can be exceeded by overwash from frontal storms. The berm is an accretionary feature at the landward extreme of wave influence. Sediment is transported over the berm crest and is deposited in a nearshore overwash fan and in breach corridors. Overwash deposition provides source sand for re-establishing dunes. Onshore winds transport the sediment from overwash fans to the dunes, gradually building back dune elevation during storm-free periods.

The interaction between the biology and geomorphology of barrier islands is complex. Just as the barrier island undergoes a process of continual change, so do the ecological communities present. Vegetation zones gradually re-establish following storms, and in turn affect physical processes such as sand accretion, erosion, and overwash. The beach front, dunes, and overwash areas all provide important habitat components. Many barrier island species are adapted to respond positively to periodic disturbance. As the island widens, new feeding habitat (sand/mud flats) is created for shorebirds such as the piping plover. The beaches provide nesting habitat for sea turtles. Early colonizer plants are favored as a food source by beach mice. These barrier island habitats are becoming increasingly rare as our Nation's coastlines rapidly develop.

SEA TURTLES

STATUS OF THE SPECIES/CRITICAL HABITAT

The Service and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) share Federal jurisdiction for sea turtles under the Act. The Service has responsibility for sea turtles on the nesting beach. NMFS has jurisdiction for sea turtles in the marine environment. This SPBO addresses nesting sea turtles, their nests and eggs, and hatchlings as they emerge from the nest and crawl to the sea. Five species of sea turtles are analyzed in this SPBO: the loggerhead, green, leatherback, hawksbill, and Kemp's ridley.

<u>Loggerhead Sea Turtle</u>

The loggerhead sea turtle was federally listed as a threatened species on July 28, 1978 (43 Federal Register [FR] 32800). The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans.

The loggerhead sea turtle grows to an average weight of about 200 pounds and is characterized by a large head with blunt jaws. Adults and subadults have a reddish-brown carapace. Scales on the top of the head and top of the flippers are also reddish-brown with yellow on the borders.

Hatchlings are a dull brown color (NMFS 2009a). The loggerhead feeds on mollusks, crustaceans, fish, and other marine animals.

The loggerhead may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers. Coral reefs, rocky places, and ship wrecks are often used as feeding areas.
Within the Northwest Atlantic, the majority of nesting activity occurs from April through September, with a peak in June and July (Williams-Walls *et al*. 1983, Dodd 1988, Weishampel *et al*. 2006). Nesting occurs within the Northwest Atlantic along the coasts of North America, Central America, northern South America, the Antilles, Bahamas, and Bermuda, but is concentrated in the southeastern U.S. and on the Yucatán Peninsula in Mexico on open beaches or along narrow bays having suitable sand (Sternberg 1981, Ehrhart 1989, Ehrhart *et al*. 2003, NMFS and Service 2008).

No critical habitat has been designated for the loggerhead sea turtle.

Green Sea Turtle

The green sea turtle was federally listed on July 28, 1978 (43 FR 32800). Breeding populations of the green turtle in Florida and along the Pacific Coast of Mexico are listed as endangered; all other populations are listed as threatened. The green sea turtle has a worldwide distribution in tropical and subtropical waters.

The green sea turtle grows to a maximum size of about four feet and a weight of 440 pounds. It has a heart-shaped shell, small head, and single-clawed flippers. The carapace is smooth and colored gray, green, brown and black. Hatchlings are black on top and white on the bottom (NMFS 2009b). Hatchling green turtles eat a variety of plants and animals, but adults feed almost exclusively on seagrasses and marine algae.

Major green turtle nesting colonies in the Atlantic occur on Ascension Island, Aves Island, Costa Rica, and Surinam. Within the U.S., green turtles nest in small numbers in the U.S. Virgin Islands and Puerto Rico, and in larger numbers along the east coast of Florida, particularly in Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties (NMFS and Service 1991). Nesting also has been documented along the Gulf coast of Florida from Escambia County through Franklin County in northwest Florida and from Pinellas County through Collier County in southwest Florida (FWC 2009a).

Green sea turtles are generally found in fairly shallow waters (except when migrating) inside reefs, bays, and inlets. The green turtle is attracted to lagoons and shoals with an abundance of marine grass and algae. Open beaches with a sloping platform and minimal disturbance are required for nesting.

Critical habitat for the green sea turtle has been designated for the waters surrounding Culebra Island, Puerto Rico, and its outlying keys.

Leatherback Sea Turtle

The leatherback sea turtle was federally listed as an endangered species on June 2, 1970 (35 FR 8491). Leatherbacks have the widest distribution of the sea turtles with nonbreeding animals have been recorded as far north as the British Isles and the Maritime Provinces of Canada and as far south as Argentina and the Cape of Good Hope (Pritchard 1992). Foraging leatherback excursions have been documented into higher-latitude subpolar waters. They have evolved physiological and anatomical adaptations (Frair *et al.* 1972, Greer *et al.* 1973) that allow them to exploit waters far colder than any other sea turtle species would be capable of surviving.

The adult leatherback can reach four to eight feet in length and weigh 500 to 2,000 pounds. The carapace is distinguished by a rubber-like texture, about 1.6 inches thick, made primarily of tough, oil-saturated connective tissue. Hatchlings are dorsally mostly black and are covered with tiny scales; the flippers are edged in white, and rows of white scales appear as stripes along the length of the back (NMFS 2009c). Jellyfish are the main staple of its diet, but it is also known to feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed. This is the largest, deepest diving of all sea turtle species.

Leatherback turtle nesting grounds are distributed worldwide in the Atlantic, Pacific and Indian Oceans on beaches in the tropics and sub-tropics. The Pacific Coast of Mexico historically supported the world's largest known concentration of nesting leatherbacks.

The leatherback turtle regularly nests in the U.S. Caribbean in Puerto Rico and the U.S. Virgin Islands. Along the U.S. Atlantic coast, most nesting occurs in Florida (NMFS and Service 1992). Leatherback nesting has also been reported on the northwest coast of Florida (LeBuff 1990, FWC 2009a); and in southwest Florida a false crawl (nonnesting emergence) has been observed on Sanibel Island (LeBuff 1990). Nesting has also been reported in Georgia, South Carolina, and North Carolina (Rabon *et al.* 2003) and in Texas (Shaver 2008).

Adult females require sandy nesting beaches backed with vegetation and sloped sufficiently so the distance to dry sand is limited. Their preferred beaches have proximity to deep water and generally rough seas.

Marine and terrestrial critical habitat for the leatherback sea turtle has been designated at Sandy Point on the western end of the island of St. Croix, U.S. Virgin Islands (50 Code of Federal Regulations (CFR) 17.95).

Hawksbill Sea Turtle

The hawksbill sea turtle was federally listed as an endangered species on June 2, 1970 (35 FR 8491). The hawksbill is found in tropical and subtropical seas of the Atlantic, Pacific, and Indian Oceans. The species is widely distributed in the Caribbean Sea and western Atlantic Ocean.

Data collected in the Wider Caribbean reported that hawksbills typically weigh around 176 pounds or less; hatchlings average about 1.6 inches straight length and range in weight from 0.5 to 0.7 ounces. The carapace is heart shaped in young turtles, and becomes more elongated or egg-shaped with maturity. The top scutes are often richly patterned with irregularly radiating streaks of brown or black on an amber background. The head is elongated and tapers sharply to a point. The lower jaw is V-shaped (NMFS 2009d).

Within the continental U.S., hawksbill sea turtle nesting is rare and is restricted to the southeastern coast of Florida (Volusia through Miami-Dade Counties) and the Florida Keys (Monroe County) (Meylan 1992, Meylan *et al.* 1995). However, hawksbill tracks are difficult to differentiate from those of loggerheads and may not be recognized by surveyors. Therefore, surveys in Florida likely underestimate actual hawksbill nesting numbers (Meylan *et al.* 1995). In the U.S. Caribbean, hawksbill nesting occurs on beaches throughout Puerto Rico and the U.S. Virgin Islands (NMFS and Service 1993).

Critical habitat for the hawksbill sea turtle has been designated for selected beaches and/or waters of Mona, Monito, Culebrita, and Culebra Islands, Puerto Rico.

Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle was federally listed as endangered on December 2, 1970 (35 FR 18320). The Kemp's ridley, along with the flatback sea turtle (*Natator depressus*), has the most geographically restricted distribution of any sea turtle species. The range of the Kemp's ridley includes the Gulf coasts of Mexico and the U.S., and the Atlantic coast of North America as far north as Nova Scotia and Newfoundland.

Adult Kemp's ridleys, considered the smallest sea turtle in the world, weigh an average of 100 pounds with a carapace measuring between 24-28 inches in length. The almost circular carapace has a grayish green color while the plastron is pale yellowish to cream in color. The carapace is often as wide as it is long. Their diet consists mainly of swimming crabs, but may also include fish, jellyfish, and an array of mollusks.

The majority of nesting for the entire species occurs on the primary nesting beach at Rancho Nuevo, Mexico (Marquez-Millan 1994). Outside of nesting, adult Kemp's ridleys are believed to spend most of their time in the Gulf of Mexico, while juveniles and subadults also regularly occur along the eastern seaboard of the U.S. (Service and NMFS 1992). There have been rare instances when immature ridleys have been documented making transatlantic movements (Service and NMFS 1992). It was originally speculated that ridleys that make it out of the Gulf of Mexico might be lost to the breeding population (Hendrickson 1980), but data indicate that many of these turtles are capable of moving back into the Gulf of Mexico (Henwood and Ogren 1987). In fact, there are documented cases of ridleys captured in the Atlantic that migrated back to the nesting beach at Rancho Nuevo (Schmid and Witzell 1997, Schmid 1998, Witzell 1998).

Hatchlings, after leaving the nesting beach, are believed to become entrained in eddies within the Gulf of Mexico, where they are dispersed within the Gulf and Atlantic by oceanic surface currents until they reach about 7.9 inches in length, at which size they enter coastal shallow water habitats (Ogren 1989).

No critical habitat has been designated for the Kemp's ridley sea turtle.

Life history

Loggerhead Sea Turtle

Loggerheads are long-lived, slow-growing animals that use multiple habitats across entire ocean

basins throughout their life history. This complex life history encompasses terrestrial, nearshore, and open ocean habitats. The three basic ecosystems in which loggerheads live are the:

1. Terrestrial zone (supralittoral) - the nesting beach where both oviposition (egg laying) and embryonic development and hatching occur.

2. Neritic zone - the inshore marine environment (from the surface to the sea floor) where water depths do not exceed 656 feet. The neritic zone generally includes the continental shelf, but in areas where the continental shelf is very narrow or nonexistent, the neritic zone conventionally extends to areas where water depths are less than 656 feet.

3. Oceanic zone - the vast open ocean environment (from the surface to the sea floor) where water depths are greater than 656 feet.

Maximum intrinsic growth rates of sea turtles are limited by the extremely long duration of the juvenile stage and fecundity. Loggerheads require high survival rates in the juvenile and adult stages, common constraints critical to maintaining long-lived, slow-growing species, to achieve positive or stable long-term population growth (Congdon *et al.* 1993, Heppell 1998, Crouse 1999, Heppell *et al.* 1999, 2003, Musick 1999).

The generalized life history of Atlantic loggerheads is shown in **Figure 1** (from Bolten 2003).

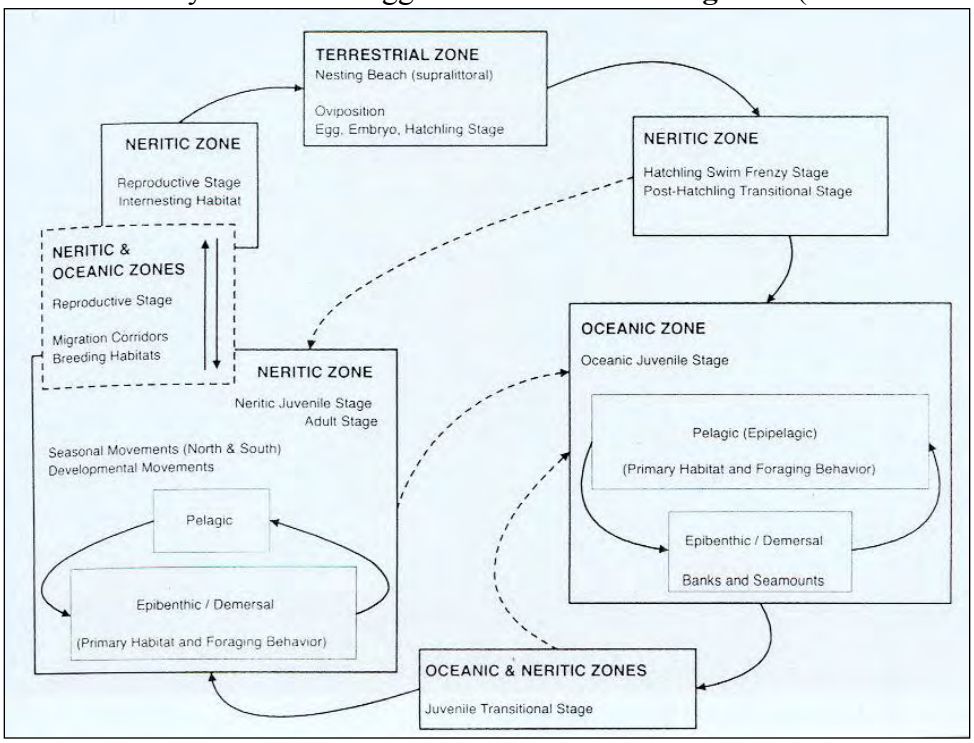

Figure 1. Life history stages of a loggerhead turtle. The boxes represent life stages and the corresponding ecosystems, solid lines represent movements between life stages and ecosystems, and dotted lines are speculative (Bolten 2003).

Numbers of nests and nesting females are often highly variable from year to year due to a number of factors including environmental stochasticity, periodicity in ocean conditions, anthropogenic effects, and density-dependent and density-independent factors affecting survival, somatic growth,

and reproduction (Meylan 1982, Hays 2000, Chaloupka 2001, Solow *et al.* 2002). Despite these sources of variation, and because female turtles exhibit strong nest site fidelity, a nesting beach survey can provide a valuable assessment of changes in the adult female population, provided that the study is sufficiently long and effort and methods are standardized (Meylan 1982, Gerrodette and Brandon 2000, Reina *et al*. 2002). **Table 4** summarizes key life history characteristics for loggerheads nesting in the U.S.

Table 4. Typical values of life history parameters for loggerheads nesting in the U.S. (NMFS and Service 2008).

Life History Trait	**Data**
Clutch size (mean)	100-126 eggs[1]
Incubation duration (varies depending on time of year and latitude)	Range = 42-75 days[2,3]
Pivotal temperature (incubation temperature that produces an equal number of males and females)	84˚F[5]
Nest productivity (emerged hatchlings/total eggs) x 100 (varies depending on site specific factors)	45-70 percent[2,6]
Clutch frequency (number of nests/female/season)	3-4 nests[7]
Internesting interval (number of days between successive nests within a season)	12-15 days[8]
Juvenile (<34 inches Curved Carapace Length) sex ratio	65-70 percent female[4]
Remigration interval (number of years between successive nesting migrations)	2.5-3.7 years[9]
Nesting season	late April-early September
Hatching season	late June-early November
Age at sexual maturity	32-35 years[10]
Life span	>57 years[11]

[1] Dodd (1988).
[2] Dodd and Mackinnon (1999, 2000, 2001, 2002, 2003, 2004).
[3] Witherington (2006) (information based on nests monitored throughout Florida beaches in 2005, n = 865).

[4] National Marine Fisheries Service (2001); Foley (2005).
[5] Mrosovsky (1988).
[6] Witherington (2006) (information based on nests monitored throughout Florida beaches in 2005, n = 1,680).
[7] Murphy and Hopkins (1984); Frazer and Richardson (1985); Hawkes *et al*. 2005; Scott 2006.
[8] Caldwell (1962), Dodd (1988).
[9] Richardson *et al.* (1978); Bjorndal *et al.* (1983).
[10] Snover (2005).
[11] Dahlen *et al.* (2000).

Loggerheads nest on ocean beaches and occasionally on estuarine shorelines with suitable sand. Nests are typically laid between the high tide line and the dune front (Routa 1968, Witherington 1986, Hailman and Elowson 1992). Wood and Bjorndal (2000) evaluated four environmental factors (slope, temperature, moisture, and salinity) and found that slope had the greatest influence on loggerhead nest-site selection on a beach in Florida. Loggerheads appear to prefer relatively narrow, steeply sloped, coarse-grained beaches, although nearshore contours may also play a role in nesting beach site selection (Provancha and Ehrhart 1987).

The warmer the sand surrounding the egg chamber, the faster the embryos develop (Mrosovsky and Yntema 1980). Sand temperatures prevailing during the middle third of the incubation period also determine the sex of hatchling sea turtles (Mrosovsky and Yntema 1980). Incubation temperatures near the upper end of the tolerable range produce only female hatchlings while incubation temperatures near the lower end of the tolerable range produce only male hatchlings.

Loggerhead hatchlings pip and escape from their eggs over a one to three day interval and move upward and out of the nest over a two to four day interval (Christens 1990). The time from pipping to emergence ranges from four to seven days with an average of 4.1 days (Godfrey and Mrosovsky 1997). Hatchlings emerge from their nests en masse almost exclusively at night, and presumably using decreasing sand temperature as a cue (Hendrickson 1958, Mrosovsky 1968, Witherington *et al.* 1990). Moran *et al*. (1999) concluded that a lowering of sand temperatures below a critical threshold, which most typically occurs after nightfall, is the most probable trigger for hatchling emergence from a nest. After an initial emergence, there may be secondary emergences on subsequent nights (Carr and Ogren 1960, Witherington 1986, Ernest and Martin 1993, Houghton and Hays 2001).

Hatchlings use a progression of orientation cues to guide their movement from the nest to the marine environments where they spend their early years (Lohmann and Lohmann 2003). Hatchlings first use light cues to find the ocean. On naturally lighted beaches without artificial lighting, ambient light from the open sky creates a relatively bright horizon compared to the dark silhouette of the dune and vegetation landward of the nest. This contrast guides the hatchlings to the ocean (Daniel and Smith 1947, Limpus 1971, Salmon *et al.* 1992, Witherington and Martin 1996, Witherington 1997, Stewart and Wyneken 2004).

Loggerheads in the Northwest Atlantic display complex population structure based on life history stages. Based on mitochondrial deoxyribonucleic acid (mtDNA), oceanic juveniles show no structure, neritic juveniles show moderate structure and nesting colonies show strong structure (Bowen *et al*. 2005). In contrast, a survey using microsatellite (nuclear) markers showed no significant population structure among nesting populations (Bowen *et al*. 2005), indicating that

while females exhibit strong philopatry, males may provide an avenue of gene flow between nesting colonies in this region.

Green Sea Turtle

Green sea turtles deposit from one to nine clutches within a nesting season, but the overall average is about 3.3 nests. The interval between nesting events within a season varies around a mean of about 13 days (Hirth 1997). Mean clutch size varies widely among populations. Average clutch size reported for Florida was 136 eggs in 130 clutches (Witherington and Ehrhart 1989). Only occasionally do females produce clutches in successive years. Usually two or more years intervene between breeding seasons (NMFS and Service 1991). Age at sexual maturity is believed to be 20 to 50 years (Hirth 1997).

Leatherback Sea Turtle

Leatherbacks nest an average of five to seven times within a nesting season, with an observed maximum of 11 nests (NMFS and Service 1992). The interval between nesting events within a season is about nine to 10 days. Clutch size averages 80 to 85 yolked eggs, with the addition of usually a few dozen smaller, yolkless eggs, mostly laid toward the end of the clutch (Pritchard 1992). Nesting migration intervals of two to three years were observed in leatherbacks nesting on the Sandy Point National Wildlife Refuge, St. Croix, U.S. Virgin Islands (McDonald and Dutton 1996). Leatherbacks are believed to reach sexual maturity in six to 10 years (Zug and Parham 1996).

Hawksbill Sea Turtle

Hawksbills nest on average about 4.5 times per season at intervals of approximately 14 days (Corliss *et al.* 1989). In Florida and the U.S. Caribbean, clutch size is approximately 140 eggs, although several records exist of over 200 eggs per nest (NMFS and Service 1993). On the basis of limited information, nesting migration intervals of two to three years appear to predominate. Hawksbills are recruited into the reef environment at about 14 inches in length and are believed to begin breeding about 30 years later. However, the time required to reach 14 inches in length is unknown and growth rates vary geographically. As a result, actual age at sexual maturity is unknown.

Kemp's Ridley Sea Turtle

Nesting occurs from April into July during which time the turtles appear off the Tamaulipas and Veracruz coasts of Mexico. Precipitated by strong winds, the females swarm to mass nesting emergences, known as "arribadas or arribazones," to nest during daylight hours. The period between Kemp's ridley arribadas averages approximately 25 days (Rostal *et al.* 1997), but the precise timing of the arribadas is highly variable and unpredictable (Bernardo and Plotkin 2007). Clutch size averages 100 eggs and eggs typically take 45 to 58 days to hatch depending on temperatures (Marquez-Millan 1994, Rostal 2007).

Some females breed annually and nest an average of one to four times in a season at intervals of 10 to 28 days. Analysis by Rostal (2007) suggested that ridley females lay approximately 3.1 nests

per nesting season. Interannual remigration rate for female ridleys is estimated to be approximately 1.8 (Rostal 2007) to 2.0 years (Marquez-Millan *et al.* 1989). Age at sexual maturity is believed to be between 10 to 17 years (Snover *et al*. 2007).

Population dynamics

Loggerhead Sea Turtle

The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. However, the majority of loggerhead nesting is at the western rims of the Atlantic and Indian Oceans. The most recent reviews show that only two loggerhead nesting beaches have greater than 10,000 females nesting per year (Baldwin *et al.* 2003, Ehrhart *et al.* 2003, Kamezaki *et al.* 2003, Limpus and Limpus 2003, Margaritoulis *et al.* 2003): South Florida (U.S.) and Masirah (Oman). Those beaches with 1,000 to 9,999 females nesting each year are Georgia through North Carolina (U.S.), Quintana Roo and Yucatán (Mexico), Cape Verde Islands (Cape Verde, eastern Atlantic off Africa), and Western Australia (Australia). Smaller nesting aggregations with 100 to 999 nesting females annually occur in the Northern Gulf of Mexico (U.S.), Dry Tortugas (U.S.), Cay Sal Bank (Bahamas), Sergipe and Northern Bahia (Brazil), Southern Bahia to Rio de Janerio (Brazil), Tongaland (South Africa), Mozambique, Arabian Sea Coast (Oman), Halaniyat Islands (Oman), Cyprus, Peloponnesus (Greece), Island of Zakynthos (Greece), Turkey, Queensland (Australia), and Japan.

The loggerhead is commonly found throughout the North Atlantic including the Gulf of Mexico, the northern Caribbean, the Bahamas archipelago, and eastward to West Africa, the western Mediterranean, and the west coast of Europe.

The major nesting concentrations in the U.S. are found in South Florida. However, loggerheads nest from Texas to Virginia. Total estimated nesting in the U.S. has fluctuated between 49,000 and 90,000 nests per year from 1999-2008 (FWC 2009a, NMFS and Service 2008). About 80 percent of loggerhead nesting in the southeast U.S. occurs in six Florida counties (Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties). Adult loggerheads are known to make considerable migrations between foraging areas and nesting beaches (Schroeder *et al.* 2003, Foley *et al.* 2008). During non-nesting years, adult females from U.S. beaches are distributed in waters off the eastern U.S. and throughout the Gulf of Mexico, Bahamas, Greater Antilles, and Yucatán.

From a global perspective, the U.S. nesting aggregation is of paramount importance to the survival of the species as is the population that nests on islands in the Arabian Sea off Oman (Ross 1982, Ehrhart 1989). The status of the Oman loggerhead nesting population, reported to be the largest in the world (Ross 1979), is uncertain because of the lack of long-term standardized nesting or foraging ground surveys and its vulnerability to increasing development pressures near major nesting beaches and threats from fisheries interaction on foraging grounds and migration routes (Possardt 2005). The loggerhead nesting aggregations in Oman and the U.S. account for the majority of nesting worldwide.

Green Sea Turtle

About 100 to 1,000 females are estimated to nest on beaches in Florida annually (FWC 2009c). In the U.S. Pacific, over 90 percent of nesting throughout the Hawaiian archipelago occurs at the French Frigate Shoals, where about 200 to 700 females nest each year (NMFS and Service 1998b). Elsewhere in the U.S. Pacific, nesting takes place at scattered locations in the Commonwealth of the Northern Marianas, Guam, and American Samoa. In the western Pacific, the largest green turtle nesting aggregation in the world occurs on Raine Island, Australia, where thousands of females nest nightly in an average nesting season (Limpus *et al.* 1993). In the Indian Ocean, major nesting beaches occur in Oman where 30,000 females are reported to nest annually (Ross and Barwani 1995).

Leatherback Sea Turtle

A dramatic drop in nesting numbers has been recorded on major nesting beaches in the Pacific. Spotila *et al.* (2000) have highlighted the dramatic decline and possible extirpation of leatherbacks in the Pacific.

The East Pacific and Malaysia leatherback populations have collapsed. Spotila *et al.* (1996) estimated that only 34,500 females nested annually worldwide in 1995, which is a dramatic decline from the 115,000 estimated in 1980 (Pritchard 1982). In the eastern Pacific, the major nesting beaches occur in Costa Rica and Mexico. At Playa Grande, Costa Rica, considered the most important nesting beach in the eastern Pacific, numbers have dropped from 1,367 leatherbacks in 1988-1989 to an average of 188 females nesting between 2000-2001 and 2003-2004. In Pacific Mexico, 1982 aerial surveys of adult female leatherbacks indicated this area had become the most important leatherback nesting beach in the world. Tens of thousands of nests were laid on the beaches in 1980s, but during the 2003-2004 seasons a total of 120 nests was recorded. In the western Pacific, the major nesting beaches lie in Papua New Guinea, Papua, Indonesia, and the Solomon Islands. These are some of the last remaining significant nesting assemblages in the Pacific. Compiled nesting data estimated approximately 5,000 to 9,200 nests annually with 75 percent of the nests being laid in Papua, Indonesia.

However, the most recent population size estimate for the North Atlantic alone is a range of 34,000 to 94,000 adult leatherbacks (TEWG 2007). In Florida, an annual increase in number of leatherback nests at the core set of index beaches ranged from 27 to 615 between 1989 and 2010. Under the Core Index Nesting Beach Survey (INBS) program, 198.8 miles of nesting beach have been divided into zones, known as core index zones, averaging 0.5 mile in length. Annually, between 1989 and 2008, these core index zones were monitored daily during the 109-day sea turtle index nesting season (May 15 to August 31). On all index beaches, researchers recorded nests and nesting attempts by species, nest location, and date (FWC/FWRI 2010b).

Nesting in the Southern Caribbean occurs in the Guianas (Guyana, Suriname, and French Guiana), Trinidad, Dominica, and Venezuela. The largest nesting populations at present occur in the western Atlantic in French Guiana with nesting varying between a low of 5,029 nests in 1967 to a high of 63,294 nests in 2005, which represents a 92 percent increase since 1967 (TEWG 2007). Trinidad supports an estimated 6,000 leatherbacks nesting annually, which represents more than 80 percent of the nesting in the insular Caribbean Sea. Leatherback nesting along the Caribbean

Central American coast takes place between Honduras and Colombia. In Atlantic Costa Rica, at Tortuguero, the number of nests laid annually between 1995 and 2006 was estimated to range from 199 to 1,623. Modeling of the Atlantic Costa Rica data indicated that the nesting population has decreased by 67.8 percent over this time period.

In Puerto Rico, the main nesting areas are at Fajardo on the main island of Puerto Rico and on the island of Culebra. Between 1978 and 2005, annual population growth rate was estimated to be 1.10 (TEWG 2007). Recorded leatherback nesting on the Sandy Point National Wildlife Refuge on the island of St. Croix, U.S. Virgin Islands between 1990 and 2005, ranged from a low of 143 in 1990 to a high of 1,008 in 2001 (Garner *et al*. 2005). In the British Virgin Islands, annual nest numbers have increased in Tortola from zero to six nests per year in the late 1980s to 35 to 65 nests per year in the 2000s (TEWG 2007).

The most important nesting beach for leatherbacks in the eastern Atlantic lies in Gabon, Africa. It was estimated there were 30,000 nests along 60 miles of Mayumba Beach in southern Gabon during the 1999-2000 nesting season (Billes *et al*. 2000). Some nesting has been reported in Mauritania, Senegal, the Bijagos Archipelago of Guinea-Bissau, Turtle Islands and Sherbro Island of Sierra Leone, Liberia, Togo, Benin, Nigeria, Cameroon, Sao Tome and Principe, continental Equatorial Guinea, Islands of Corisco in the Gulf of Guinea and the Democratic Republic of the Congo, and Angola. In addition, a large nesting population is found on the island of Bioko (Equatorial Guinea) (Fretey *et al*. 2007). .

Hawksbill Sea Turtle

About 15,000 females are estimated to nest each year throughout the world with the Caribbean accounting for 20 to 30 percent of the world's hawksbill population. Only five regional populations remain with more than 1,000 females nesting annually (Seychelles, Mexico, Indonesia, and two in Australia) (Meylan and Donnelly 1999). Mexico is now the most important region for hawksbills in the Caribbean with about 3,000 nests per year (Meylan 1999). In the U.S. Pacific, hawksbills nest only on main island beaches in Hawaii, primarily along the east coast of the island of Hawaii. Hawksbill nesting has also been documented in American Samoa and Guam (NMFS and Service 1998c).

Kemp's Ridley Sea Turtle

Most Kemp's ridleys nest on the coastal beaches of the Mexican states of Tamaulipas and Veracruz, although a small number of Kemp's ridleys nest consistently along the Texas coast (TEWG 1998). In addition, rare nesting events have been reported in Alabama, Florida, Georgia, South Carolina, and North Carolina. Historical information indicates that tens of thousands of ridleys nested near Rancho Nuevo, Mexico, during the late 1940s (Hildebrand 1963). The Kemp's ridley population experienced a devastating decline between the late 1940s and the mid 1980s. The total number of nests per nesting season at Rancho Nuevo remained below 1,000 throughout the 1980s, but gradually began to increase in the 1990s. In 2009, 16,273 nests were documented along the 18.6 miles of coastline patrolled at Rancho Nuevo, and the total number of nests documented for all the monitored beaches in Mexico was 21,144 (Service 2009). In 2010, a total of 13,302 nests were documented in Mexico (Service 2010). In addition, 207 and 153 nests were recorded during 2009 and 2010, respectively, in the U.S., primarily in Texas.

Status and distribution

Loggerhead Sea turtle

Five recovery units have been identified in the Northwest Atlantic based on genetic differences and a combination of geographic distribution of nesting densities, geographic separation, and geopolitical boundaries (NMFS and Service 2008). Recovery units are subunits of a listed species that are geographically or otherwise identifiable and essential to the recovery of the species. Recovery units are individually necessary to conserve genetic robustness, demographic robustness, important life history stages, or some other feature necessary for long-term sustainability of the species. The five recovery units identified in the Northwest Atlantic (**Figure 2**) are:

1. Northern Recovery Unit (NRU) - defined as loggerheads originating from nesting beaches from the Florida-Georgia border through southern Virginia (the northern extent of the nesting range);

2. Peninsula Florida Recovery Unit (PFRU) - defined as loggerheads originating from nesting beaches from the Florida-Georgia border through Pinellas County on the west coast of Florida, excluding the islands west of Key West, Florida;

3. Dry Tortugas Recovery Unit (DTRU) - defined as loggerheads originating from nesting beaches throughout the islands located west of Key West, Florida;

4. Northern Gulf of Mexico Recovery Unit (NGMRU) - defined as loggerheads originating from nesting beaches from Franklin County on the northwest Gulf coast of Florida through Texas; and

5. Greater Caribbean Recovery Unit (GCRU) - composed of loggerheads originating from all other nesting assemblages within the Greater Caribbean (Mexico through French Guiana, The Bahamas, Lesser Antilles, and Greater Antilles).

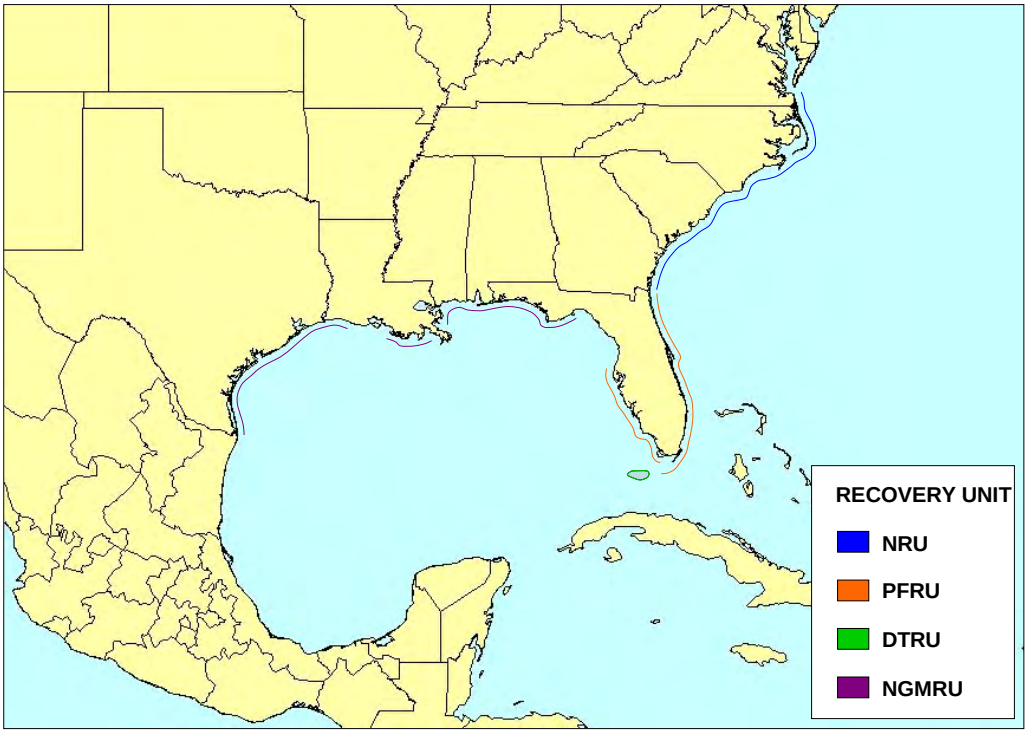

Figure 2. Map of the distribution of the loggerhead recovery units.

The mtDNA analyses show that there is limited exchange of females among these recovery units (Ehrhart 1989, Foote *et al.*, 2000, NMFS 2001, Hawkes *et al.* 2005. Based on the number of haplotypes, the highest level of loggerhead mtDNA genetic diversity in the Northwest Atlantic has been observed in females of the GCRU that nest at Quintana Roo, Mexico (Encalada *et al.* 1999, Nielsen *et al*. in press).

Nuclear DNA analyses show that there are no substantial subdivisions across the loggerhead nesting colonies in the southeastern U.S. Male-mediated gene flow appears to be keeping the subpopulations genetically similar on a nuclear DNA level (Francisco-Pearce 2001).

Historically, the literature has suggested that the northern U.S. nesting beaches (NRU and NGMRU) produce a relatively high percentage of males and the more southern nesting beaches (PFRU, DTRU, and GCRU) a relatively high percentage of females (e.g., Hanson *et al.* 1998, NMFS 2001, Mrosovsky and Provancha 1989). The NRU and NGMRU were believed to play an important role in providing males to mate with females from the more female-dominated subpopulations to the south. However, in 2002 and 2003, researchers studied loggerhead sex ratios for two of the U.S. nesting subpopulations, the northern and southern subpopulations (NGU and PFRU, respectively) (Blair 2005, Wyneken *et al.* 2005). The study produced interesting results. In 2002, the northern beaches produced more females and the southern beaches produced more

males than previously believed. However, the opposite was true in 2003 with the northern beaches producing more males and the southern beaches producing more females in keeping with prior literature. Wyneken *et al.* (2005) speculated that the 2002 result may have been anomalous; however, the study did point out the potential for males to be produced on the southern beaches. Although this study revealed that more males may be produced on southern recovery unit beaches than previously believed, the Service maintains that the NRU and NGMRU play an important role in the production of males to mate with females from the more southern recovery units.

The NRU is the second largest loggerhead nesting aggregation in the Northwest Atlantic. Annual nest totals from northern beaches averaged 5,215 nests from 1989-2008, a period of near-complete surveys of NRU nesting beaches (NMFS and Service 2008), representing approximately 1,272 nesting females per year (4.1 nests per female, Murphy and Hopkins 1984). The loggerhead nesting trend from daily beach surveys showed a significant decline of 1.3 percent annually. Nest totals from aerial surveys conducted by the South Carolina Department of Natural Resources showed a 1.9 percent annual decline in nesting in South Carolina since 1980. Overall, there is strong statistical data to suggest the NRU has experienced a long-term decline (NMFS and Service 2008).

The PFRU is the largest loggerhead nesting assemblage in the Northwest Atlantic. A near-complete nest census of the PFRU undertaken from 1989 to 2007 reveals a mean of 64,513 loggerhead nests per year representing approximately 15,735 females nesting per year (4.1 nests per female, Murphy and Hopkins 1984) (FWC 2008d). This near-complete census provides the best statewide estimate of total abundance, but because of variable survey effort, these numbers cannot be used to assess trends. Loggerhead nesting trends are best assessed using standardized nest counts made at INBS sites surveyed with constant effort over time. In 1979, the Statewide Nesting Beach Survey (SNBS) program was initiated to document the total distribution, seasonality, and abundance of sea turtle nesting in Florida. In 1989, the INBS program was initiated in Florida to measure seasonal productivity, allowing comparisons between beaches and between years (FWC 2009b). Of the 190 SNBS surveyed areas, 33 participate in the INBS program (representing 30 percent of the SNBS beach length).

INBS nest counts from 1989–2010 show a shallow decline. However, recent trends (1998–2010) in nest counts have shown a 25 percent decline, with increases only observed in the most recent three-year period, 2008–2010 (FWC/FWRI 2010a). The analysis that reveals this decline uses nest-count data from 345 representative Atlantic-coast index zones (total length = 187 miles) and 23 representative zones on Florida's southern Gulf coast (total length = 14.3 miles). The spatial and temporal coverage (annually, 109 days and 368 zones) accounted for an average of 70 percent of statewide loggerhead nesting activity between 1989 and 2010.

The NGMRU is the third largest nesting assemblage among the four U.S. recovery units. Nesting surveys conducted on approximately 186 miles of beach within the NGMRU (Alabama and Florida only) were undertaken between 1995 and 2007 (statewide surveys in Alabama began in 2002). The mean nest count during this 13-year period was 906 nests per year, which equates to about 221 females nesting per year (4.1 nests per female, Murphy and Hopkins 1984, (FWC 2008d). Evaluation of long-term nesting trends for the NGMRU is difficult because of changed and expanded beach coverage. Loggerhead nesting trends are best assessed using standardized nest counts made at INBS sites surveyed with constant effort over time. There are 12 years (1997-

2008) of Florida INBS data for the NGMRU (FWC 2008d). A log-linear regression showed a significant declining trend of 4.7 percent annually (NMFS and Service 2008).

The DTRU, located west of the Florida Keys, is the smallest of the identified recovery units. A near-complete nest census of the DTRU undertaken from 1995 to 2004, excluding 2002, (nine years surveyed) reveals a mean of 246 nests per year, which equates to about 60 females nesting per year (4.1 nests per female, Murphy and Hopkins 1984) (FWC 2008d). Surveys after 2004 did not include principal nesting beaches within the recovery unit (*i.e.*, Dry Tortugas National Park). The nesting trend data for the DTRU are from beaches that are not part of the INBS program, but are part of the SNBS program. There are nine years of data for this recovery unit. A simple linear regression accounting for temporal autocorrelation revealed no trend in nesting numbers. Because of the annual variability in nest totals, a longer time series is needed to detect a trend (NMFS and Service 2008).

The GCRU is composed of all other nesting assemblages of loggerheads within the Greater Caribbean. Statistically valid analyses of long-term nesting trends for the entire GCRU are not available because there are few long-term standardized nesting surveys representative of the region. Additionally, changing survey effort at monitored beaches and scattered and low-level nesting by loggerheads at many locations currently precludes comprehensive analyses. The most complete data are from Quintana Roo andYucatán, Mexico, where an increasing trend was reported over a 15-year period from 1987-2001 (Zurita *et al.* 2003). However, since 2001, nesting has declined and the previously reported increasing trend appears not to have been sustained (NMFS and Service 2008). Other smaller nesting populations have experienced declines over the past few decades (e.g., Amorocho 2003).

Recovery Criteria (only the Demographic Recovery Criteria are presented below; for the Listing Factor Recovery Criteria, please see NMFS and Service 2008)

1. Number of Nests and Number of Nesting Females
   a. Northern Recovery Unit
      i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is 2 percent or greater resulting in a total annual number of nests of 14,000 or greater for this recovery unit (approximate distribution of nests is North Carolina =14 percent [2,000 nests], South Carolina =66 percent [9,200 nests], and Georgia =20 percent [2,800 nests]); and
      ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

   b. Peninsular Florida Recovery Unit
      i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is statistically detectable (one percent) resulting in a total annual number of nests of 106,100 or greater for this recovery unit; and

ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

c. Dry Tortugas Recovery Unit
   i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is three percent or greater resulting in a total annual number of nests of 1,100 or greater for this recovery unit; and
   ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

d. Northern Gulf of Mexico Recovery Unit
   i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is three percent or greater resulting in a total annual number of nests of 4,000 or greater for this recovery unit (approximate distribution of nests (2002-2007) is Florida= 92 percent [3,700 nests] and Alabama =8 percent [300 nests]); and
   ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

e. Greater Caribbean Recovery Unit
   i. The total annual number of nests at a minimum of three nesting assemblages, averaging greater than 100 nests annually (e.g., Yucatán, Mexico; Cay Sal Bank, Bahamas) has increased over a generation time of 50 years; and
   ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

2. Trends in Abundance on Foraging Grounds
   A network of in-water sites, both oceanic and neritic across the foraging range is established and monitoring is implemented to measure abundance. There is statistical confidence (95 percent) that a composite estimate of relative abundance from these sites is increasing for at least one generation.

3. Trends in Neritic Strandings Relative to In-water Abundance
   Stranding trends are not increasing at a rate greater than the trends in in-water relative abundance for similar age classes for at least one generation.

The Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle was signed in 2008 (NMFS and Service 2008), and the Recovery Plan for U.S. Pacific Populations of the Loggerhead Turtle was signed in 1998 (NMFS and Service 1998e).

Green Sea Turtle

Annual nest totals documented as part of the Florida SNBS program from 1989-2008 have ranged from 435 nests laid in 1993 to 12,752 in 2007. Nesting occurs in 26 counties with a peak along the

east coast, from Volusia through Broward Counties. Although the SNBS program provides information on distribution and total abundance statewide, it cannot be used to assess trends because of variable survey effort. Therefore, green turtle nesting trends are best assessed using standardized nest counts made at INBS sites surveyed with constant effort over time (1989-2009). Green sea turtle nesting in Florida is increasing based on 19 years (1989-2009) of INBS data from throughout the state (FWC 2009a). The increase in nesting in Florida is likely a result of several factors, including: (1) a Florida statute enacted in the early 1970s that prohibited the killing of green turtles in Florida; (2) the species listing under the Act afforded complete protection to eggs, juveniles, and adults in all U.S. waters; (3) the passage of Florida's constitutional net ban amendment in 1994 and its subsequent enactment, making it illegal to use any gillnets or other entangling nets in State waters; (4) the likelihood that the majority of Florida green turtles reside within Florida waters where they are fully protected; (5) the protections afforded Florida green turtles while they inhabit the waters of other nations that have enacted strong sea turtle conservation measures (e.g., Bermuda); and (6) the listing of the species on Appendix I of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which stopped international trade and reduced incentives for illegal trade from the U.S.

Recovery Criteria

The U.S. Atlantic population of green sea turtles can be considered for delisting if, over a period of 25 years, the following conditions are met:

1. The level of nesting in Florida has increased to an average of 5,000 nests per year for at least six years. Nesting data must be based on standardized surveys;

2. At least 25 percent (65 miles) of all available nesting beaches (260 miles) is in public ownership and encompasses at least 50 percent of the nesting activity;

3. A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds; and

4. All priority one tasks identified in the recovery plan have been successfully implemented.

The Recovery Plan for U.S. Population of Atlantic Green Turtle was signed in 1991 (NMFS and Service 1991), the Recovery Plan for U.S. Pacific Populations of the Green Turtle was signed in 1998 (NMFS and Service 1998b), and the Recovery Plan for U.S. Pacific Populations of the East Pacific Green Turtle was signed in 1998 (NMFS and Service 1998a).

Leatherback Sea Turtle

Declines in leatherback nesting have occurred over the last two decades along the Pacific coasts of Mexico and Costa Rica. The Mexican leatherback nesting population, once considered to be the world's largest leatherback nesting population (historically estimated to be 65 percent of the worldwide population), is now less than one percent of its estimated size in 1980. Spotila *et al.* (1996) estimated the number of leatherback sea turtles nesting on 28 beaches throughout the world from the literature and from communications with investigators studying those beaches. The

estimated worldwide population of leatherbacks in 1995 was about 34,500 females on these beaches with a lower limit of about 26,200, and an upper limit of about 42,900. This is less than one-third the 1980 estimate of 115,000. Leatherbacks are rare in the Indian Ocean and in very low numbers in the western Pacific Ocean. The largest population is in the western Atlantic. Using an age-based demographic model, Spotila *et al.* (1996) determined that leatherback populations in the Indian Ocean and western Pacific Ocean cannot withstand even moderate levels of adult mortality and that the Atlantic populations are being exploited at a rate that cannot be sustained. They concluded that leatherbacks are on the road to extinction and further population declines can be expected unless action is taken to reduce adult mortality and increase survival of eggs and hatchlings.

In the U.S., nesting populations occur in Florida, Puerto Rico, and the U.S. Virgin Islands. In Florida, the SNBS program documented an increase in leatherback nesting numbers from 98 nests in 1988 to between 800 and 900 nests per season in the early 2000s (FWC 2009a, Stewart and Johnson 2006). Although the SNBS program provides information on distribution and total abundance statewide, it cannot be used to assess trends because of variable survey effort. Therefore, leatherback nesting trends are best assessed using standardized nest counts made at INBS sites surveyed with constant effort over time (1989-2009). An analysis of the INBS data has shown a substantial increase in leatherback nesting in Florida since 1989 (FWC 2009b, TEWG Group 2007).

Recovery Criteria

The U.S. Atlantic population of leatherbacks can be considered for delisting if the following conditions are met:

1. The adult female population increases over the next 25 years, as evidenced by a statistically significant trend in the number of nests at Culebra, Puerto Rico, St. Croix, U.S. Virgin Islands, and along the east coast of Florida;

2. Nesting habitat encompassing at least 75 percent of nesting activity in U.S. Virgin Islands, Puerto Rico, and Florida is in public ownership; and.

3. All priority one tasks identified in the recovery plan have been successfully implemented.

The Recovery Plan for Leatherback Turtles in the U.S. Caribbean, Atlantic, and Gulf of Mexico was signed in 1992 (NMFS and Service 1992), and the Recovery Plan for U.S. Pacific Populations of the Leatherback Turtle was signed in 1998 (NMFS and Service 1998d).

Hawksbill Sea Turtle

The hawksbill sea turtle has experienced global population declines of 80 percent or more during the past century and continued declines are projected (Meylan and Donnelly 1999). Most populations are declining, depleted, or remnants of larger aggregations. Hawksbills were previously abundant, as evidenced by high-density nesting at a few remaining sites and by trade statistics.

Recovery Criteria

The U.S. Atlantic population of hawksbills can be considered for delisting if, over a period of 25 years, the following conditions are met:

1. The adult female population is increasing, as evidenced by a statistically significant trend in the annual number of nests on at least five index beaches, including Mona Island and Buck Island Reef National Monument;

2. Habitat for at least 50 percent of the nesting activity that occurs in the U.S. Virgin Islands and Puerto Rico is protected in perpetuity;

3. Numbers of adults, subadults, and juveniles are increasing, as evidenced by a statistically significant trend on at least five key foraging areas within Puerto Rico, U.S. Virgin Islands, and Florida; and

4. All priority one tasks identified in the recovery plan have been successfully implemented.

The Recovery Plan for the Hawksbill Turtle in the U.S. Caribbean, Atlantic, and Gulf of Mexico was signed in 1993 (NMFS and Service 1993), and the Recovery Plan for U.S. Pacific Populations of the Hawksbill Turtle was signed in 1998 (NMFS and Service 1998c).

Kemp's Ridley Sea Turtle

Today, under strict protection, the population appears to be in the early stages of recovery. The recent nesting increase can be attributed to full protection of nesting females and their nests in Mexico resulting from a binational effort between Mexico and the U.S. to prevent the extinction of the Kemp's ridley, and the requirement to use Turtle Excluder Devices (TEDs) in shrimp trawls both in the U.S. and Mexico.

The Mexico government also prohibits harvesting and is working to increase the population through more intensive law enforcement, by fencing nest areas to diminish natural predation, and by relocating most nests into corrals to prevent poaching and predation. While relocation of nests into corrals is currently a necessary management measure, this relocation and concentration of eggs into a "safe" area is of concern since it makes the eggs more susceptible to reduced viability.

Recovery Criteria

The goal of the recovery plan is for the species to be reduced from endangered to threatened status. The Recovery Team members feel that the criteria for a complete removal of this species from the endangered species list need not be considered now, but rather left for future revisions of the plan. Complete removal from the federal list would certainly necessitate that some other instrument of protection, similar to the MMPA, be in place and be international in scope. Kemp's ridley can be considered for reclassification to threatened status when the following four criteria are met:

1. Continuation of complete and active protection of the known nesting habitat and the waters adjacent to the nesting beach (concentrating on the Rancho Nuevo area) and continuation of the bi-national protection project;

2. Elimination of mortality from incidental catch in commercial shrimping in the U.S. and Mexico through the use of TEDs and achievement of full compliance with the regulations requiring TED use;

3. Attainment of a population of at least 10,000 females nesting in a season; and

4. Successful implementation of all priority one recovery tasks in the recovery plan.

The Recovery Plan for the Kemp's Ridley Sea Turtle was signed in 1992 (Service and NMFS 1992). Significant new information on the biology and population status of Kemp's ridley has become available since 1992. Consequently, a full revision of the recovery plan has been undertaken by the Service and NMFS and is nearing completion. The revised plan will provide updated species biology and population status information, objective and measurable recovery criteria, and updated and prioritized recovery actions.

Common threats to sea turtles in Florida

Anthropogenic factors that impact hatchlings and adult female turtles on land, or the success of nesting and hatching include: beach erosion; armoring and nourishment; artificial lighting; beach cleaning; increased human presence; recreational beach equipment; beach driving; coastal construction and fishing piers; exotic dune and beach vegetation; and poaching. An increased human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants (*Solenopsis* spp.), feral hogs (*Sus scrofa*), dogs (*Canis familiaris),* and an increased presence of native species (e.g., raccoons (*Procyon lotor*), armadillos (*Dasypus novemcinctus*), and opossums (*Didelphis virginiana*)), which raid and feed on turtle eggs. Although sea turtle nesting beaches are protected along large expanses of the western North Atlantic coast, other areas along these coasts have limited or no protection.

Anthropogenic threats in the marine environment include oil and gas exploration, and transportation; marine pollution; underwater explosions; hopper dredging; offshore artificial lighting; power plant entrainment or impingement; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; and poaching and fishery interactions. On April 20, 2010, an explosion and fire on the Mobile Offshore Drilling Unit *Deepwater Horizon* MC252 occurred approximately 50 miles southeast of the Mississippi Delta. A broken well head at the sea floor resulted in a sustained release of oil, estimated at 35,000 and 60,000 barrels per day. On July 15, the valves on the cap were closed, which effectively shut in the well and all sub-sea containment systems. Damage assessment from the sustained release of oil is currently ongoing and the Service does not have a basis at the present time to predict the complete scope of effects to the species range-wide.

Fibropapillomatosis, a disease of sea turtles characterized by the development of multiple tumors on the skin and internal organs, is also a mortality factor, particularly for green turtles. This disease has seriously impacted green turtle populations in Florida, Hawaii, and other parts of the

world. The tumors interfere with swimming, eating, breathing, vision, and reproduction, and turtles with heavy tumor burdens may die.

Analysis of the species/critical habitat likely to be affected

The threatened loggerhead sea turtle, the endangered green sea turtle, the endangered leatherback sea turtle, the endangered hawksbill sea turtle, and the endangered Kemp's ridley sea turtle are currently listed because of their reduced population sizes caused by overharvest and habitat loss with continuing anthropogenic threats from commercial fishing, disease, and degradation of remaining habitat. The proposed action has the potential to adversely affect nesting females of these species, their nests, and hatchlings on all nesting beaches where shore protection activities (including the placement of compatible sediment, repair or replacement of groins and jetties, and navigation channel maintenance on the beaches of the Atlantic and Gulf coasts of Florida) occur. Other activities, which include military missions and coastal development that have affected the conservation of sea turtles nesting in Florida, are included in the Service's evaluation of the species current status (**Appendix A)**.

ENVIRONMENTAL BASELINE

Status of the species/critical habitat within the action area

INBS nest counts represent approximately 69 percent of known loggerhead nesting in Florida, 74 percent of known green turtle nesting, and 34 percent of known leatherback nesting (FWC 2009a). The INBS program was established with a set of standardized data-collection criteria to measure seasonal nesting, and to allow accurate comparisons between both beaches and years. The reliability of these comparisons results from the uniformity of beach-survey effort in space and time, and from the specialized annual training of beach surveyors. Under the core INBS program, 178 miles of nesting beach have been divided into zones, known as core index zones, averaging 0.5 mile in length. These beaches are monitored daily beginning May 15 and ending August 31. On all index beaches, researchers record nests and nesting attempts by species, the location of each nest, and the date each nest was laid.

Nesting surveys begin at sunrise. Turtle crawls are identified as a true nesting crawl or false crawl (*i.e.*, nonnesting emergence). Nests are marked with stakes and some are surrounded with surveyor flagging tape and, if needed, screened to prevent predation. The marked nests are monitored throughout the incubation period for storm damage, predation, hatching activity and hatching and emerging success. Nest productivity surveys may continue into mid-November depending on nest incubation periods. All monitoring is conducted in accordance with guidelines provided by the FWC.

<u>Loggerhead Sea Turtle</u>

Five loggerhead sea turtle recovery units have been identified in the Northwest Atlantic (NMFS and Service 2008). Mitochondrial DNA analyses show that there is limited exchange of females among these recovery units (Foote *et al*. 2000, NMFS 2001, Hawkes *et al*. 2005). However, nuclear DNA analyses show that there are no substantial subdivisions across the loggerhead nesting colonies in the southeastern U.S. Male-mediated gene flow appears to be keeping the subpopulations genetically similar on a nuclear DNA level (Francisco-Pearce 2001). The NRU

and NGMRU are believed to play an important role in providing males to mate with females from the more female-dominated recovery units.

Two (NGMRU and PFRU) of the five nesting subpopulations occur within the proposed Action Area. Northwest Florida accounts for 92 percent of the NGMRU in nest numbers consists of approximately 234 miles of nesting shoreline. The PFRU makes up 1,166 miles of shoreline and consists of approximately 64,513 recorded loggerhead nests per year (2000 to 2009).

Recovery Units	**Nesting Range**
NGMRU	Escambia through Franklin Counties
PFRU	Pinellas through Nassau Counties

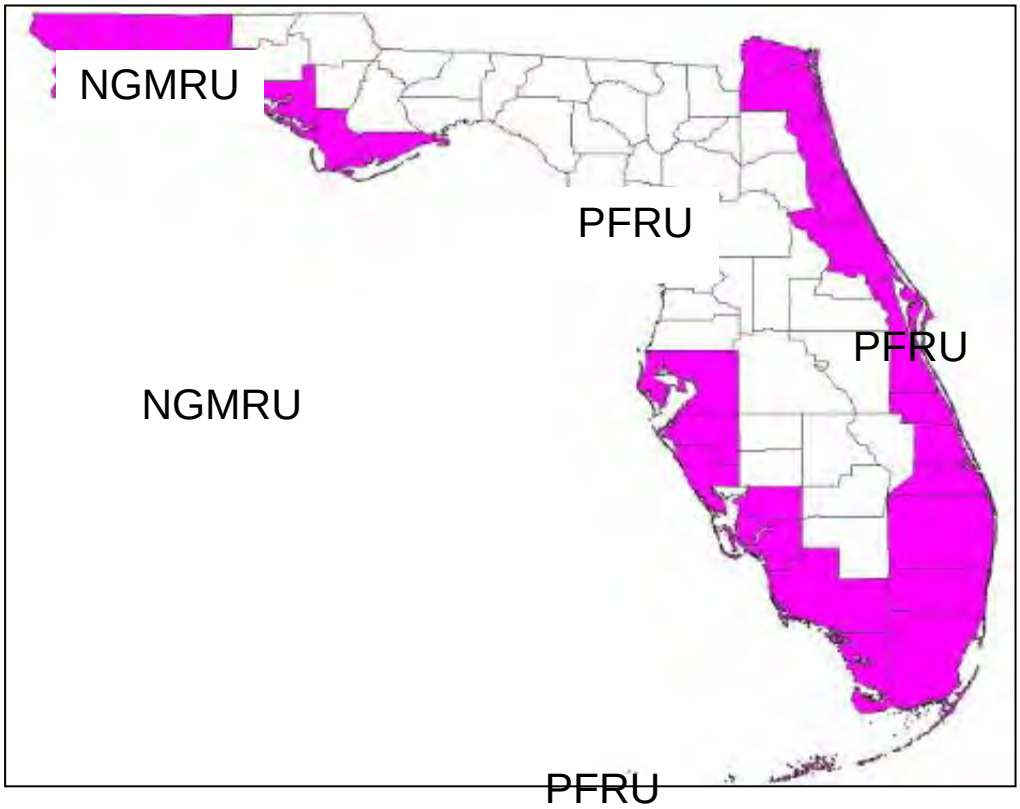

Figure 3. Distribution of loggerhead sea nesting in the PFRU and NGMRU in Florida.

The loggerhead sea turtle nesting and hatching season throughout Florida is shown in **Table 5**.

Table 5. Loggerhead sea turtle nesting and hatching season for Florida.

AREA	COUNTIES	SEA TURTLE NESTING SEASON THROUGH HATCHING SEASON
Northern Gulf of Mexico	Escambia through Pasco	May 1 through October 31
Southern Gulf of Mexico	Pinellas through Monroe	April 1 through November 30
Southern Florida Atlantic	Brevard through Miami-Dade	March 15 through November 30
Northern Florida Atlantic	Nassau through Volusia	April 15 through November 30

An updated analysis by FWC/FWRI reveals a shallow decline in loggerhead nest numbers around the State of Florida based on INBS nest counts from 1989 through 2010 (FWC/FWRI 2010). However, recent trends in nest counts have shown a 25 percent decline from 1998 to 2010 (FWC/FWRI 2010a).

Sea turtles play a vital role in maintaining healthy and productive ecosystems. Nesting sea turtles introduce large quantities of nutrients from the marine ecosystem to the beach and dune system (Bouchard and Bjorndal 2000). In the U.S., loggerheads play a particularly important role in this regard due to their greater nesting numbers. The nutrients they leave behind on the nesting beaches in the form of eggs and eggshells play an important role for dune vegetation and terrestrial predator populations (Bouchard and Bjorndal 2000). In a study at Melbourne Beach, Florida, Bouchard and Bjorndal (2000) estimated that only 25 percent of the organic matter introduced into nests by loggerheads returned to the ocean as hatchlings. They found that 29-40 percent of all nutrients were made available to detritivores, decomposers, and plants, while 26-31 percent of all nutrients were consumed by nest predators. Thus, all loggerhead recovery units play a vital role in the maintenance of a healthy beach and dune ecosystem within their geographic distribution.

Green Sea Turtle

Green turtle nest numbers are increasing in Florida with a record number of nests being recorded during the 2007 season (FWC 2009a).

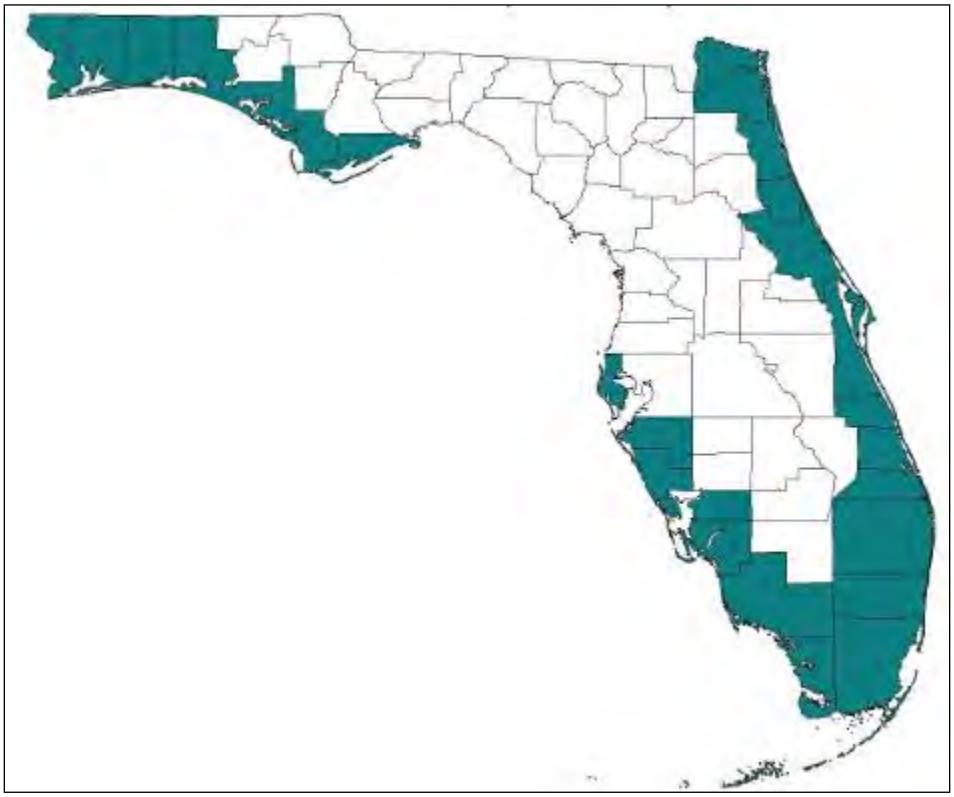

Figure 4. Distribution of green sea turtle nesting in Florida.

The green sea turtle nesting and hatching season throughout Florida is shown in **Table 6**.

Table 6. Green sea turtle nesting and hatching season for Florida.

AREA	COUNTIES	SEA TURTLE NESTING SEASON THROUGH HATCHING SEASON
Northern Gulf of Mexico	Escambia through Pasco	May 15 through October 31
Southern Gulf of Mexico	Pinellas through Monroe	May 15 through October 31
Southern Florida Atlantic	Brevard through Miami-Dade	May 1 through November 30
Northern Florida Atlantic	Nassau through Volusia	May 15 through November 15

Leatherback Sea Turtle

Leatherback nest numbers are increasing in Florida with a record number of leatherback nests being recorded during the 2009 season (FWC 2009a).

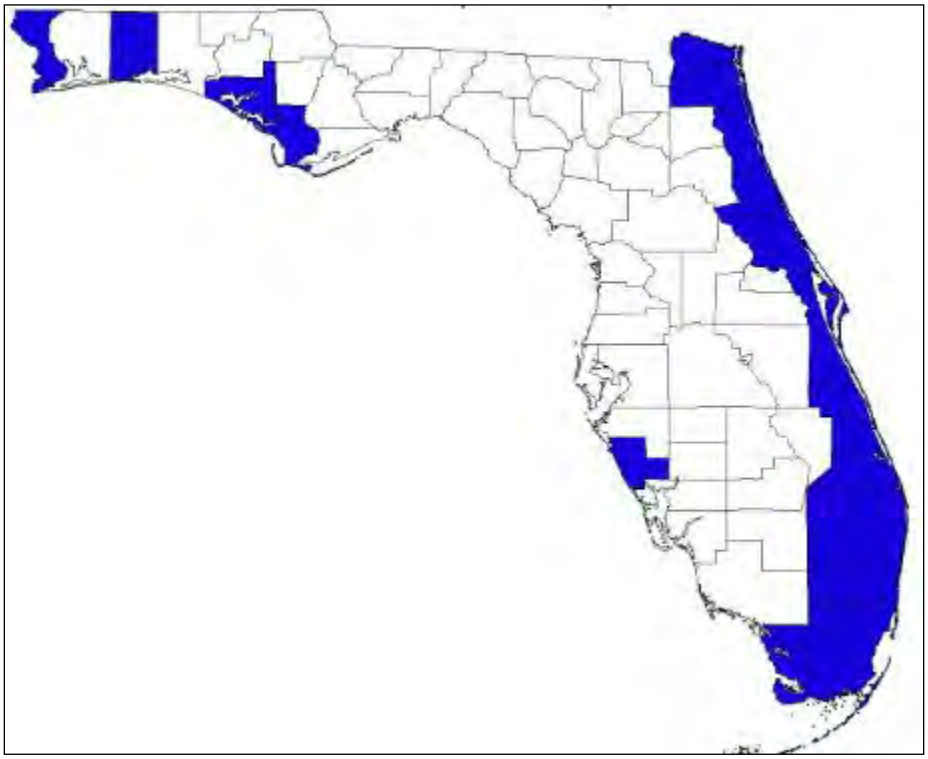

Figure 5. Distribution of leatherback sea turtle nesting in Florida.

The leatherback sea turtle nesting and hatching season throughout Florida is shown in **Table 7**.

Table 7. Leatherback sea turtle nesting and hatching season for Florida.

AREA	COUNTIES	SEA TURTLE NESTING SEASON THROUGH HATCHING SEASON
Northern Gulf of Mexico	Escambia through Pasco	May 1 through September 30
Southern Florida Atlantic	Brevard through Miami-Dade	February 15 through November 30
Northern Florida Atlantic	Nassau through Volusia	April 15 through September 30

Hawksbill Sea Turtle

Thirty-nine hawksbill nests have been documented in Florida from 1979-2007 in Volusia, Martin, Palm Beach, Broward, Miami-Dade, Monroe, and Manatee Counties (FWC 2008c).
The hawksbill sea turtle nesting and hatching season throughout Florida is shown in **Table 8**.

Table 8. Hawksbill sea turtle nesting and hatching season for Florida.

AREA	COUNTIES	SEA TURTLE NESTING SEASON THROUGH HATCHING SEASON
Southern tip of Florida	Monroe	June 1 through December 31
Southern Florida Atlantic	Brevard through Miami-Dade	June 1 through December 31
Northeast Florida	Volusia	June 1 through December 31

Kemp's Ridley Sea Turtle

Twenty-six Kemp's ridley nests have been documented in Florida from 1979-2007 in Volusia, Brevard, Martin, Palm Beach, Lee, Sarasota, Pinellas, Gulf, Walton, Santa Rosa, and Escambia, Counties (FWC 2008c).

Factors affecting species habitat within the action area

In accordance with the Act, the Service completes consultations with all federal agencies for actions that may adversely affect sea turtles. In Florida, consultations have included military missions and operations, beach nourishment and other shoreline protection, and actions related to protection of coastal development on sandy beaches of Florida's Atlantic Coast (Key West to Fernandina/Kings Bay) and the Gulf Coast (Ten Thousand Islands to Alabama State Line) (**Appendix A**).

Coastal Development

Loss of nesting habitat related to coastal development has had the greatest impact on nesting sea turtles in Florida. Beachfront development not only causes the loss of suitable nesting habitat, but can result in the disruption of powerful coastal processes accelerating erosion and interrupting the natural shoreline migration (National Research Council 1990b). This may in turn cause the need to protect upland structures and infrastructure by armoring, groin placement, beach emergency berm construction and repair, and beach nourishment which cause changes in, additional loss of, or impact to the remaining sea turtle habitat.

Hurricanes

Hurricanes were probably responsible for maintaining coastal beach habitat upon which sea turtles depend through repeated cycles of destruction, alteration, and recovery of beach and dune habitat. Hurricanes generally produce damaging winds, storm tides and surges, and rain, which can result in severe erosion of the beach and dune systems. Overwash and blowouts are common on barrier islands. Hurricanes and other storms can result in the direct or indirect loss of sea turtle nests, either by erosion or washing away of the nests by wave action, inundation or "drowning" of the eggs or hatchlings developing within the nest or indirectly by loss of nesting habitat. Depending on their frequency, storms can affect sea turtles on either a short-term basis (nests lost for one season and/or temporary loss of nesting habitat) or long term, if frequent (habitat unable to recover). How hurricanes affect sea turtle nesting also depends on its characteristics (winds, storm

surge, rainfall), the time of year (within or outside of the nesting season), and where the northeast edge of the hurricane crosses land.

Because of the limited remaining nesting habitat in a natural state with no immediate development landward of the sandy beach, frequent or successive severe weather events could threaten the ability of certain sea turtle populations to survive and recover. Sea turtles evolved under natural coastal environmental events such as hurricanes. The extensive amount of predevelopment coastal beach and dune habitat allowed sea turtles to survive even the most severe hurricane events. It is only within the last 20 to 30 years that the combination of habitat loss to beachfront development and destruction of remaining habitat by hurricanes has increased the threat to sea turtle survival and recovery. On developed beaches, typically little space remains for sandy beaches to become reestablished after periodic storms. While the beach itself moves landward during such storms, reconstruction or persistence of structures at their prestorm locations can result in a loss of nesting habitat.

The 2004 hurricane season was the most active storm season in Florida since weather records began in 1851. Hurricanes Charley, Frances, Ivan, and Jeanne, along with Tropical Storm Bonnie, damaged the beach and dune system, upland structures and properties, and infrastructure in the majority of Florida's coastal counties. The cumulative impact of these storms exacerbated erosion conditions throughout the state.

The 2005 hurricane season was a record-breaking season with 27 named storms. Hurricanes Dennis, Katrina, Ophelia, Rita, and Wilma, and Tropical Storms Arlene and Tammy impacted Florida. The cumulative impact of these storms exacerbated erosion conditions in south and northwest Florida.

A common question is whether the 2004 and 2005 hurricane seasons contributed to reduced loggerhead nest numbers observed from 2004-2007. Although Florida has been subject to numerous hurricanes in recent years, these storm events cannot account for the recent decline (1998-2010) observed in the number of loggerhead nests on Florida beaches. The hurricanes have a very limited effect on nesting activity of adult female turtles. Because loggerheads that hatch on Florida beaches require some 20 to 30 years to reach maturity, storm impacts would not manifest themselves for many years. Moreover, hurricane impacts to nests tend to be localized and often occur after the main hatching season for the loggerhead is over (FWC 2008a).

Erosion

The designation of a Critically Eroded Beach is a planning requirement of the State's Beach Erosion Control Funding Assistance Program (http://www.dep.state.fl.us/BEACHES/programs/bcherosn.htm). A segment of beach shall first be designated as critically eroded in order to be eligible for State funding. A critically eroded area is a segment of shoreline where natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost. Critically eroded areas may also include peripheral segments or gaps between identified critically eroded areas which, although they may be stable or slightly erosional now, their inclusion is necessary for continuity of management of the coastal system or for the design integrity of

adjacent beach management projects (FDEP 2009). It is important to note, that for an erosion problem area to be critical, there shall exist a threat to or loss of one of four specific interests – upland development, recreation, wildlife habitat, or important cultural resources.

Beachfront Lighting

Artificial beachfront lighting may cause disorientation (loss of bearings) and misorientation (incorrect orientation) of sea turtle hatchlings. Visual signs are the primary sea-finding mechanism for hatchlings (Mrosovsky and Carr 1967, Mrosovsky and Shettleworth 1968, Dickerson and Nelson 1989, Witherington and Bjorndal 1991). Artificial beachfront lighting is a documented cause of hatchling disorientation and misorientation on nesting beaches (Philibosian 1976, Mann 1977, Witherington and Martin 1996). The emergence from the nest and crawl to the sea is one of the most critical periods of a sea turtle's life. Hatchlings that do not make it to the sea quickly become food for ghost crabs, birds, and other predators, or become dehydrated and may never reach the sea. Some types of beachfront lighting attract hatchlings away from the sea while some lights cause adult turtles to avoid stretches of brightly illuminated beach. Research has documented significant reduction in sea turtle nesting activity on beaches illuminated with artificial lights (Witherington 1992). During the 2007 sea turtle nesting season in Florida, over 64,000 turtle hatchlings were documented as being disoriented (**Table 9**) (FWC 2007a). Exterior and interior lighting associated with condominiums had the greatest impact causing approximately 42 percent of documented hatchling disorientation/misorientation. Other causes included urban sky glow and street lights (FWC 2007a).

Table 9. Documented disorientations along the Florida coast (FWC 2007a).

Year	Total Number of Hatchling Disorientation Events	Total Number of Hatchlings Involved in Disorientation Events	Total Number of Adult Disorientation Events
2001	743	28,674	19
2002	896	43,226	37
2003	1,446	79,357	18
2004	888	46,487	24
2005	976	41,521	50
2006	1,521	71,798	40
2007	1,410	64,433	25
2008[1]	1,192	49,623	62

[1]FWC 2008e

Predation

Predation of sea turtle eggs and hatchlings by native and introduced species occurs on almost all nesting beaches. Predation by a variety of predators can considerably decrease sea turtle nest hatching success. The most common predators in the southeastern U.S. are ghost crabs (*Ocypode quadrata*), raccoons, feral hogs, foxes (*Urocyon cinereoargenteus* and *Vulpes vulpes*), coyotes

(*Canis latrans*), armadillos, and fire ants (Dodd 1988, Stancyk 1995). In the absence of nest protection programs in a number of locations throughout the southeast U.S., raccoons may depredate up to 96 percent of all nests deposited on a beach (Davis and Whiting 1977, Hopkins and Murphy 1980, Stancyk *et al.* 1980, Talbert *et al*. 1980, Schroeder 1981, Labisky *et al.* 1986). In response to increasing predation of sea turtle nests by coyotes, foxes, hogs, and raccoons, multi-agency cooperative efforts have been initiated and are ongoing throughout Florida, particularly on public lands.

Driving on the Beach

The operation of motor vehicles on the beach affects sea turtle nesting by interrupting or striking a female turtle on the beach, headlights disorienting or misorienting emergent hatchlings, vehicles running over hatchlings attempting to reach the ocean, and vehicle tracks traversing the beach which interfere with hatchlings crawling to the ocean. Hatchlings appear to become diverted not because they cannot physically climb out of the rut (Hughes and Caine 1994), but because the sides of the track cast a shadow and the hatchlings lose their line of sight to the ocean horizon (Mann 1977). The extended period of travel required to negotiate tire tracks and ruts may increase the susceptibility of hatchlings to dehydration and depredation during migration to the ocean (Hosier *et al.* 1981). Driving on the beach can cause sand compaction which may result in adverse impacts on nest site selection, digging behavior, clutch viability, and emergence by hatchlings, decreasing nest success and directly killing preemergent hatchlings (Mann 1977, Nelson and Dickerson 1987, Nelson 1988).

The physical changes and loss of plant cover caused by vehicles on dunes can lead to various degrees of instability, and therefore encourage dune migration. As vehicles move either up or down a slope, sand is displaced downward, lowering the trail. Since the vehicles also inhibit plant growth, and open the area to wind erosion, dunes may become unstable, and begin to migrate. Unvegetated sand dunes may continue to migrate across stable areas as long as vehicle traffic continues. Vehicular traffic through dune breaches or low dunes on an eroding beach may cause an accelerated rate of overwash and beach erosion (Godfrey *et al.* 1978). If driving is required, the area where the least amount of impact occurs is the beach between the low and high tide water lines. Vegetation on the dunes can quickly reestablish provided the mechanical impact is removed.

In 1985, the Florida Legislature severely restricted vehicular driving on Florida's beaches, except that which is necessary for cleanup, repair, or public safety. This legislation also allowed an exception for five counties to continue to allow vehicular access on coastal beaches due to the availability of less than 50 percent of its peak user demand for off-beach parking. The counties affected by this exception are Volusia, St. Johns, Gulf, Nassau, and Flagler Counties, as well as limited vehicular access on Walton County beaches for boat launching.

Climate Change

The varying and dynamic elements of climate science are inherently long term, complex, and interrelated. Regardless of the underlying causes of climate change, glacial melting and expansion of warming oceans are causing sea level rise, although its extent or rate cannot as yet be predicted with certainty. At present, the science is not exact enough to precisely predict when and where climate impacts will occur. Although we may know the direction of change, it may not be possible

to predict its precise timing or magnitude. These impacts may take place gradually or episodically in major leaps.

Climate change is evident from observations of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising sea level, according to the Intergovernmental Panel on Climate Change Report (IPCC 2007a). The IPCC Report (2007a) describes changes in natural ecosystems with potential widespread effects on many organisms, including marine mammals and migratory birds. The potential for rapid climate change poses a significant challenge for fish and wildlife conservation. Species' abundance and distribution are dynamic, relative to a variety of factors, including climate. As climate changes, the abundance and distribution of fish and wildlife will also change. Highly specialized or endemic species are likely to be most susceptible to the stresses of changing climate. Based on these findings and other similar studies, the U.S. Department of the Interior (DOI) requires agencies under its direction to consider potential climate change effects as part of their long-range planning activities (Service 2007c).

Climatic changes in Florida could amplify current land management challenges involving habitat fragmentation, urbanization, invasive species, disease, parasites, and water management. Global warming will be a particular challenge for endangered, threatened, and other "at risk" species. It is difficult to estimate, with any degree of precision, which species will be affected by climate change or exactly how they will be affected. The Service will use Strategic Habitat Conservation planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006). As the level of information increases relative to the effects of global climate change on sea turtles and its designated critical habitat, the Service will have a better basis to address the nature and magnitude of this potential threat and will more effectively evaluate these effects to the range-wide status of sea turtles.

Florida is one of the areas most vulnerable to the consequences of climate change. Sea level rise and the possibility of more intense hurricanes are the most serious threats to Florida potentially from climate change. Florida has over 1,350 miles of coastline, low-lying topography, and proximity to the hurricane-prone subtropical mid-Atlantic Ocean and Gulf of Mexico.

One of the most serious threats to Florida's coasts comes from the combination of elevated sea levels and intense hurricanes. Florida experiences more landings of tropical storms and hurricanes than any other state in the U.S. Storm surges due to hurricanes will be on top of elevated sea levels, tides, and wave action. As a result, barrier islands and low-lying areas of Florida will be more susceptible to the effects of storm surge. An important element of adaptation strategy is how to protect beaches, buildings and infrastructure against the effects of rising seas and wind, wave action, and storm surge due to hurricanes.

Temperatures are predicted to rise from 1.6^{o}F to 9°F for North America by the end of this century (IPCC 2007a,b). Alterations of thermal sand characteristics could result in highly female-biased sex ratios because sea turtles exhibit temperature dependent sex determination (e.g., Glen and Mrosovsky 2004, Hawkes *et al*. 2008).

Along developed coastlines, and especially in areas where shoreline protection structures have been constructed to limit shoreline movement, rising sea levels will cause severe effects on nesting

females and their eggs. Erosion control structures can result in the permanent loss of dry nesting beach or deter nesting females from reaching suitable nesting sites (National Research Council 1990a). Nesting females may deposit eggs seaward of the erosion control structures potentially subjecting them to repeated tidal inundation or washout by waves and tidal action.

Based on the present level of available information concerning the effects of global climate change on the status of sea turtles and their designated critical habitat, the Service acknowledges the potential for changes to occur in the action area, but presently has no basis to evaluate if or how these changes are affecting sea turtles or their designated critical habitat. Nor does our present knowledge allow the Service to project what the future effects from global climate change may be or the magnitude of these potential effects.

EFFECTS OF THE ACTION

This section is an analysis of the beneficial, direct, and indirect effects of the proposed actions on nesting sea turtles, nests, eggs, and hatchling sea turtles within the Action Area. The analysis includes effects interrelated and interdependent of the project activities. An interrelated activity is an activity that is part of a proposed action and depends on the proposed activity. An interdependent activity is an activity that has no independent utility apart from the action.

Factors to be considered

The proposed projects will occur within habitat that is used by sea turtles for nesting and may be constructed during a portion of the sea turtle nesting season. Long-term and permanent impacts could include a change in the nest incubation environment from the sand placement activities. Short-term and temporary impacts to sea turtle nesting activities could result from project work occurring on the nesting beach during the nesting or hatching period, changes in the physical characteristics of the beach from the placement of the sand, and changes in the nest incubation environment from the material.

Proximity of action: Sand placement activities would occur within and adjacent to nesting habitat for sea turtles and dune habitats that ensure the stability and integrity of the nesting beach. Specifically, the project would potentially impact loggerhead, green, leatherback, hawksbill, and Kemp's ridley nesting females, their nests, and hatchling sea turtles.

Distribution: Sand placement activities that may impact nesting and hatchling sea turtles and sea turtle nests would occur along Gulf of Mexico and Atlantic Ocean coasts.

Timing: The timing of the sand placement activities could directly and indirectly impact nesting females, their nests, and hatchling sea turtles when conducted between March 1 and November 30.

Nature of the effect: The effects of the sand placement activities may change the nesting behavior of adult female sea turtles, diminish nesting success, cause reduced hatching and emerging success. Sand placement can also change the incubation conditions within the nest. Any decrease in productivity and/or survival rates would contribute to the vulnerability of the sea turtles nesting in Florida.

Duration: The sand placement activity may be a one-time activity or a multiple-year activity and each sand placement project may take between three and seven months to complete. Thus, the direct effects would be expected to be short-term in duration. Indirect effects from the activity may continue to impact nesting and hatchling sea turtles and sea turtle nests in subsequent nesting seasons.

Disturbance frequency: Sea turtle populations in Florida may experience decreased nesting success, hatching success, and hatchling emerging success that could result from the sand placement activities being conducted at night during one nesting season, or during the earlier or later parts of two nesting seasons.

Disturbance intensity and severity: Depending on the need (including post-disaster work) and the timing of the sand placement activities during sea turtle nesting season, effects to the sea turtle populations of Florida, and potentially the U.S. populations, could be important.

Analyses for effects of the action

Beneficial Effects

The placement of sand on a beach with reduced dry foredune habitat may increase sea turtle nesting habitat if the placed sand is highly compatible (*i.e.*, grain size, shape, color, etc.) with naturally occurring beach sediments in the area, and compaction and escarpment remediation measures are incorporated into the project. In addition, a nourished beach that is designed and constructed to mimic a natural beach system may benefit sea turtles more than an eroding beach it replaces.

Adverse Effects

Through many years of research, it has been documented that beach nourishment can have adverse effects on nesting female sea turtles and hatchlings and sea turtle nests. Results of monitoring sea turtle nesting and beach nourishment activities provide additional information on how sea turtles respond to nourished beaches, minimization measures, and other factors that influence nesting, hatching, and emerging success. Science-based information on sea turtle nesting biology and review of empirical data on beach nourishment monitoring is used to manage beach nourishment activities to eliminate or reduce impacts to nesting and hatchling sea turtles and sea turtle nests so that beach nourishment can be accomplished. Measures can be incorporated pre-, during, and post-construction to reduce impacts to sea turtles. Because of the long history of sea turtle monitoring in Florida, it is not necessary to require studies on each project beach to document those effects each time.

Direct Effects

Direct effects are those direct or immediate effects of a project on the species or its habitat. Placement of sand on a beach in and of itself may not provide suitable nesting habitat for sea turtles. Although sand placement activities may increase the potential nesting area, significant negative impacts to sea turtles may result if protective measures are not incorporated during project construction. Sand placement activities during the nesting season, particularly on or near

high density nesting beaches, can cause increased loss of eggs and hatchlings and, along with other mortality sources, may significantly impact the long-term survival of the species. For instance, projects conducted during the nesting and hatching season could result in the loss of sea turtles through disruption of adult nesting activity and by burial or crushing of nests or hatchlings. While a nest monitoring and egg relocation program would reduce these impacts, nests may be inadvertently missed (when crawls are obscured by rainfall, wind, or tides) or misidentified as false crawls during daily patrols. In addition, nests may be destroyed by operations at night prior to beach patrols being performed. Even under the best of conditions, about seven percent of the nests can be misidentified as false crawls by experienced sea turtle nest surveyors (Schroeder 1994).

Nest relocation

Besides the potential for missing nests during surveys and a nest relocation program, there is a potential for eggs to be damaged by nest movement or relocation, particularly if eggs are not relocated within 12 hours of deposition (Limpus *et al.* 1979). Nest relocation can have adverse impacts on incubation temperature (and hence sex ratios), gas exchange parameters, hydric environment of nests, hatching success, and hatchling emergence (Limpus *et al.* 1979, Ackerman 1980, Parmenter 1980, Spotila *et al.* 1983, McGehee 1990). Relocating nests into sands deficient in oxygen or moisture can result in mortality, morbidity, and reduced behavioral competence of hatchlings. Water availability is known to influence the incubation environment of the embryos and hatchlings of turtles with flexible-shelled eggs, which has been shown to affect nitrogen excretion (Packard *et al.* 1984), mobilization of calcium (Packard and Packard 1986), mobilization of yolk nutrients (Packard *et al.* 1985), hatchling size (Packard *et al.* 1981, McGehee 1990), energy reserves in the yolk at hatching (Packard *et al.* 1988), and locomotory ability of hatchlings (Miller *et al.* 1987).

In a 1994 Florida study comparing loggerhead hatching and emerging success of relocated nests with nests left in their original location, Moody (1998) found that hatching success was lower in relocated nests at nine of 12 beaches evaluated. In addition, emerging success was lower in relocated nests at 10 of 12 beaches surveyed in 1993 and 1994. Many of the direct effects of beach nourishment may persist over time. These direct effects include increased susceptibility of relocated nests to catastrophic events, the consequences of potential increased beachfront development, changes in the physical characteristics of the beach, the formation of escarpments, repair/replacement of groins and jetties and future sand migration.

Equipment

The use of heavy machinery on beaches during a construction project may also have adverse effects on sea turtles. Equipment left on the nesting beach overnight can create barriers to nesting females emerging from the surf and crawling up the beach, causing a higher incidence of false crawls and unnecessary energy expenditure.

The operation of motor vehicles or equipment on the beach to complete the project work at night affects sea turtle nesting by: interrupting or colliding with a female turtle on the beach; headlights disorienting or misorienting emergent hatchlings; vehicles running over hatchlings attempting to reach the ocean, and vehicle tracks traversing the beach interfering with hatchlings crawling to the ocean. Apparently, hatchlings become diverted not because they cannot physically climb out of

the rut (Hughes and Caine 1994), but because the sides of the track cast a shadow and the hatchlings lose their line of sight to the ocean horizon (Mann 1977). The extended period of travel required to negotiate tire tracks and ruts may increase the susceptibility of hatchlings to dehydration and depredation during migration to the ocean (Hosier *et al*. 1981). Driving directly above or over incubating egg clutches or on the beach can cause sand compaction which may result in adverse impacts on nest site selection, digging behavior, clutch viability, and emergence by hatchlings, decreasing nest success and directly killing preemergent hatchlings (Mann 1977, Nelson and Dickerson 1987, Nelson 1988).

Depending on when the dune project is completed dune vegetation may have become established in the vicinity of dune restoration sites. The physical changes and loss of plant cover caused by vehicles on vegetated areas or dunes can lead to various degrees of instability and cause dune migration. As vehicles move over the sand, sand is displaced downward, lowering the substrate. Since the vehicles also inhibit plant growth, and open the area to wind erosion, the beach and dunes may become unstable. Vehicular traffic on the beach or through dune breaches or low dunes may cause acceleration of overwash and erosion (Godfrey *et al.* 1978). Driving along the beachfront should be between the low and high tide water lines. To minimize the impacts to the beach and recovering dunes, transport and access to the dune restoration sites should be from the road. However, if the work needs to be conducted from the beach, the areas for the truck transport and bulldozer/bobcat equipment to work in should be designated and marked.

Artificial lighting

Visual cues are the primary sea-finding mechanism for hatchling sea turtles (Mrosovsky and Carr 1967, Mrosovsky and Shettleworth 1968, Dickerson and Nelson 1989, Witherington and Bjorndal 1991). When artificial lighting is present on or near the beach, it can misdirect hatchlings once they emerge from their nests and prevent them from reaching the ocean (Philibosian 1976, Mann 1977, FWC 2007a). In addition, a significant reduction in sea turtle nesting activity has been documented on beaches illuminated with artificial lights (Witherington 1992). Therefore, construction lights along a project beach and on the dredging vessel may deter females from coming ashore to nest, misdirect females trying to return to the surf after a nesting event, and misdirect emergent hatchlings from adjacent non-project beaches.

The newly created wider and flatter beach berm exposes sea turtles and their nests to lights that were less visible, or not visible, from nesting areas before the sand placement activity leading to a higher mortality of hatchlings. Review of over 10 years of empirical information from beach nourishment projects indicates that the number of sea turtles impacted by lights increases on the post-construction berm. A review of selected nourished beaches in Florida (South Brevard, North Brevard, Captiva Island, Ocean Ridge, Boca Raton, Town of Palm Beach, Longboat Key, and Bonita Beach) indicated disorientation reporting increased by approximately 300 percent the first nesting season after project construction and up to 542 percent the second year compared to prenourishment reports (Trindell *et al.* 2005).

Specific examples of increased lighting disorientations after a sand placement project include Brevard and Palm Beach Counties, Florida. A sand placement project in Brevard County, completed in 2002, showed an increase of 130 percent in disorientations in the nourished area. Disorientations on beaches in the County that were not nourished remained constant (Trindell 2007). This same result was also documented in 2003 when another beach in Brevard County was

nourished and the disorientations increased by 480 percent (Trindell 2007). Installing appropriate beachfront lighting is the most effective method to decrease the number of disorientations on any developed beach including nourished beaches. A shoreline protection project was constructed at Ocean Ridge in Palm Beach County, Florida, between August 1997 and April 1998. Lighting disorientation events increased after nourishment. In spite of continued aggressive efforts to identify and correct lighting violations in 1998 and 1999, 86 percent of the disorientation reports were in the nourished area in 1998 and 66 percent of the reports were in the nourished area in 1999 (Howard and Davis 1999).

While the effects of artificial lighting have not been specifically studied on each beach that is nourished in Florida, based on the experience of increased artificial lighting disorientations on other Florida beaches, impacts are expected to potentially occur on all nourished beaches statewide.

Changing to sea turtle compatible lighting can be easily accomplished at the local level through voluntary compliance or by adopting appropriate regulations. Of the 27 coastal counties in Florida where sea turtles are known to nest, 19 have passed beachfront lighting ordinances in addition to 58 municipalities (FWC 2007b). Local governments have realized that adopting a lighting ordinance is the most effective method to address artificial lighting along the beachfront.

Indirect Effects

Indirect effects are those effects that are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Effects from the proposed project may continue to affect sea turtle nesting on the project beach and adjacent beaches in future years.

Increased susceptibility to catastrophic events

Nest relocation within a nesting season may concentrate eggs in an area making them more susceptible to catastrophic events. Hatchlings released from concentrated areas also may be subject to greater predation rates from both land and marine predators, because the predators learn where to concentrate their efforts (Glenn 1998, Wyneken *et al.* 1998).

Increased beachfront development

Pilkey and Dixon (1996) stated that beach replenishment frequently leads to more development in greater density within shorefront communities that are then left with a future of further replenishment or more drastic stabilization measures. Dean (1999) also noted that the very existence of a beach nourishment project can encourage more development in coastal areas. Following completion of a beach nourishment project in Miami during 1982, investment in new and updated facilities substantially increased tourism there (National Research Council 1995). Increased building density immediately adjacent to the beach often resulted as much larger buildings that accommodated more beach users replaced older buildings. Overall, shoreline management creates an upward spiral of initial protective measures resulting in more expensive development which leads to the need for more and larger protective measures. Increased shoreline development may adversely affect sea turtle nesting success. Greater development may support larger populations of mammalian predators, such as foxes and raccoons, than undeveloped areas

(National Research Council 1990a), and can also result in greater adverse effects due to artificial lighting, as discussed above.

Changes in the physical environment

Beach nourishment may result in changes in sand density (compaction), beach shear resistance (hardness), beach moisture content, beach slope, sand color, sand grain size, sand grain shape, and sand grain mineral content if the placed sand is dissimilar from the original beach sand (Nelson and Dickerson 1988a). These changes could result in adverse impacts on nest site selection, digging behavior, clutch viability, and hatchling emergence (Nelson and Dickerson 1987, Nelson 1988).

Beach nourishment projects create an elevated, wider, and unnatural flat slope berm. Sea turtles nest closer to the water the first few years after nourishment because of the altered profile (and perhaps unnatural sediment grain size distribution) (Ernest and Martin 1999, Trindell 2005) (**Figure 6**).

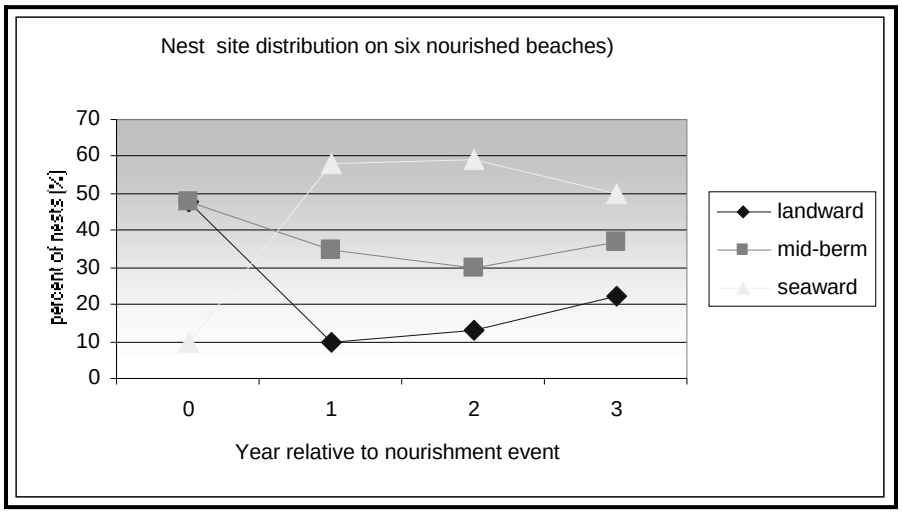

Figure 6. Review of sea turtle nesting site selection following nourishment (Trindell 2005).

Beach compaction and unnatural beach profiles resulting from beach nourishment activities could negatively impact sea turtles regardless of the timing of projects. Very fine sand or the use of heavy machinery can cause sand compaction on nourished beaches (Nelson *et al.* 1987, Nelson and Dickerson 1988a). Significant reductions in nesting success (*i.e.*, false crawls occurred more frequently) have been documented on severely compacted nourished beaches (Fletemeyer 1980, Raymond 1984, Nelson and Dickerson 1987, Nelson *et al.* 1987), and increased false crawls may result in increased physiological stress to nesting females. Sand compaction may increase the length of time required for female sea turtles to excavate nests and cause increased physiological stress to the animals (Nelson and Dickerson 1988b). Nelson and Dickerson (1988c) concluded that, in general, beaches nourished from offshore borrow sites are harder than natural beaches, and while some may soften over time through erosion and accretion of sand, others may remain hard for 10 years or more.

These impacts can be minimized by using suitable sand and by tilling (minimum depth of 36 inches) compacted sand after project completion. The level of compaction of a beach can be assessed by measuring sand compaction using a cone penetrometer (Nelson 1987). Tilling of a nourished beach with a root rake may reduce the sand compaction to levels comparable to unnourished beaches. However, a pilot study by Nelson and Dickerson (1988c) showed that a tilled nourished beach will remain uncompacted for up to one year. Multi-year beach compaction monitoring and, if necessary, tilling would ensure that project impacts on sea turtles are minimized.

A change in sediment color on a beach could change the natural incubation temperatures of nests in an area, which, in turn, could alter natural sex ratios. To provide the most suitable sediment for nesting sea turtles, the color of the nourished sediments should resemble the natural beach sand in the area. Natural reworking of sediments and bleaching from exposure to the sun would help to lighten dark nourishment sediments; however, the timeframe for sediment mixing and bleaching to occur could be critical to a successful sea turtle nesting season.

Escarpment formation

On nourished beaches, steep escarpments may develop along their water line interface as they adjust from an unnatural construction profile to a more natural beach profile (Coastal Engineering Research Center 1984, Nelson *et al.* 1987). These escarpments can hamper or prevent access to nesting sites (Nelson and Blihovde 1998). Researchers have shown that female sea turtles coming ashore to nest can be discouraged by the formation of an escarpment, leading to situations where they choose marginal or unsuitable nesting areas to deposit eggs (e.g., in front of the escarpments, which often results in failure of nests due to prolonged tidal inundation). This impact can be minimized by leveling any escarpments prior to the nesting season.

Construction of groins and jetties

Groins and jetties are shore-perpendicular structures that are designed to trap sand that would otherwise be transported by longshore currents. Jetties are defined as structures placed to keep sand from flowing into channels (Kaufman and Pilkey 1979, Komar 1983). In preventing normal sand transport, these structures accrete updrift beaches while causing accelerated beach erosion downdrift of the structures (Komar 1983, Pilkey *et al.* 1984, National Research Council 1987), a process that results in degradation of sea turtle nesting habitat. As sand fills the area updrift from the groin or jetty, some littoral drift and sand deposition on adjacent downdrift beaches may occur due to spillover. However, these groins and jetties often force the stream of sand into deeper offshore water where it is lost from the system (Kaufman and Pilkey 1979). The greatest changes in beach profile near groins and jetties are observed close to the structures, but effects eventually may extend many miles along the coast (Komar 1983).

Jetties are placed at ocean inlets to keep transported sand from closing the inlet channel. Together, jetties and inlets are known to have profound effects on adjacent beaches (Kaufman and Pilkey 1979). Witherington *et al.* (2005) found a significant negative relationship between loggerhead nesting density and distance from the nearest of 17 ocean inlets on the Atlantic coast of Florida. The effect of inlets in lowering nesting density was observed both updrift and downdrift of the inlets, leading researchers to propose that beach instability from both erosion and accretion may discourage loggerhead nesting.

Construction or repair of groins and jetties during the nesting season may result in the destruction of nests, disturbance of females attempting to nest, and disorientation of emerging hatchlings from project lighting. Following construction, the presence of groins and jetties may interfere with nesting turtle access to the beach, result in a change in beach profile and width (downdrift erosion, loss of sandy berms, and escarpment formation), trap hatchlings, and concentrate predatory fishes, resulting in higher probabilities of hatchling predation.

Escarpments may develop on beaches between groins as the beaches equilibrate to their final profiles. These escarpments are known to prevent females from nesting on the upper beach and can cause them to choose unsuitable nesting areas, such as seaward of an escarpment. These nest sites commonly receive prolonged tidal inundation and erosion, which results in nest failure (Nelson and Blihovde 1998). As groin structures fail and break apart, they spread debris on the beach, which may further impede nesting females from accessing suitable nesting sites and trap both hatchlings and nesting turtles.

Species' response to a proposed action

The following summary illustrates sea turtle responses to and recovery from a nourishment project comprehensively studied by Ernest and Martin (1999). A significantly larger proportion of turtles emerging on nourished beaches abandoned their nesting attempts than turtles emerging on natural or prenourished beaches. This reduction in nesting success is most pronounced during the first year following project construction and is most likely the result of changes in physical beach characteristics associated with the nourishment project (e.g., beach profile, sediment grain size, beach compaction, frequency and extent of escarpments). During the first post-construction year, the time required for turtles to excavate an egg chamber on untilled, hard-packed sands increases significantly relative to natural conditions. However, tilling (minimum depth of 36 inches) is effective in reducing sediment compaction to levels that did not significantly prolong digging times. As natural processes reduced compaction levels on nourished beaches during the second post-construction year, digging times returned to natural levels (Ernest and Martin 1999).

During the first post-construction year, nests on nourished beaches are deposited significantly seaward of the toe of the dune and significantly landward of the tide line than nests on natural beaches. More nests are washed out on the wide, flat beaches of the nourished treatments than on the narrower steeply sloped natural beaches. This phenomenon may persist through the second post-construction year monitoring and result from the placement of nests near the seaward edge of the beach berm where dramatic profile changes, caused by erosion and scarping, occur as the beach equilibrates to a more natural contour.

The principal effect of beach nourishment on sea turtle reproduction is a reduction in nesting success during the first year following project construction. Although most studies have attributed this phenomenon to an increase in beach compaction and escarpment formation, Ernest and Martin (1999) indicated that changes in beach profile may be more important. Regardless, as a nourished beach is reworked by natural processes in subsequent years and adjusts from an unnatural construction profile to a natural beach profile, beach compaction and the frequency of escarpment formation decline, and nesting and nesting success return to levels found on natural beaches.

BEACH MICE

STATUS OF THE SPECIES/CRITICAL HABITAT

Species/critical habitat description

The formal taxonomic classification of beach mouse subspecies follows the geographic variation in pelage and skeletal measurements documented by Bowen (1968). This peer-reviewed, published classification was also accepted by Hall (1981). Since the listing of the beach mice, further research concerning the taxonomic validity of the subspecific classification of beach mice has been initiated and/or conducted. Preliminary results from these studies support the separation of beach mice from inland forms, and support the currently accepted taxonomy (Bowen 1968) (*i.e.*, each beach mouse group represents a unique and isolated subspecies). Recent research using mitochondrial DNA data illustrates that Gulf Coast beach mouse subspecies form a well-supported and independent evolutionary cluster within the global population of the mainland or inland old field mice (Van Zant and Wooten 2006).

The old-field mouse (*Peromyscus polionotus)* is different in form and structure as well as being genetically diverse throughout its range in the southeastern U.S. (Bowen 1968, Selander *et al.* 1971). Currently there are 16 recognized subspecies of old-field mice (Hall 1981). Eight subspecies occupy coastal rather than inland habitat and are referred to as beach mice (Bowen 1968). Two existing subspecies of beach mouse and one extinct subspecies are known from the Atlantic coast of Florida and five subspecies live along the Gulf coast of Alabama and northwestern Florida.

Rivers and various inlets bisect the Gulf and Atlantic beaches and naturally isolate habitats in which the beach mice live. The outer coastline and barrier islands are typically separated from the mainland by lagoons, swamps, tidal marshes, and flatwood areas with hardpan soil conditions. However, these dispersal barriers are not absolute; sections of sand peninsulas may from time to time be cut off by storms and shift over time due to wind and current action. Human development has also fragmented the ranges of the subspecies. As a consequence of coastal development and the dynamic nature of the coastal environment; beach mouse populations are generally comprised of various disjunct populations.

<u>Atlantic Coast beach mice</u>

The southeastern beach mouse (SEBM) was listed as a threatened species under the Act in 1989 (54 FR 20598). Critical habitat was not designated for this subspecies. SEBM is also listed as threatened by the State of Florida. The original distribution of the SEBM was from Ponce Inlet, Volusia County, southward to Hollywood, Broward County, and possibly as far south as Miami in Miami-Dade County. It is currently restricted to Volusia, Brevard, and Indian River Counties. Formerly, this subspecies occurred along about 175 miles of Florida's southeast coast; it now occupies about 50 miles, a significant reduction in range (**Figure 7**).

This subspecies uses both beach dunes and inland areas of scrub vegetation. The most seaward vegetation typically consists of sea oats (*Uniola paniculata*), bitter panicgrass (*Panicum amarum*), railroad vine (*Ipomoea pes-caprae*), beach morning-glory (*Ipomoea stolonifera*), and

camphorweed (*Heterotheca subaxillaris*). Further landward, vegetation is more diverse, including beach tea (*Croton punctatus*), pricklypear (*Opuntia humifusa*), saw palmetto (*Serenoa repens)*, wax myrtle (*Myrica cerifera)*, and sea grape (*Coccoloba uvifera*).

Anastasia Island beach mice

The Anastasia Island beach mouse (AIBM), was listed as endangered under the Act in 1989 (54 FR 20598). Critical habitat was not designated for the subspecies. AIBM is also listed as an endangered species by the State of Florida. The distribution of the AIBM has declined significantly, particularly in the northern part of its range. AIBM was historically known from the vicinity of the Duval-St. Johns County line southward to Matanzas Inlet, St. Johns County, Florida (Frank and Humphrey 1996). Included in their range, AIBM populations are found along 14.5 miles of Anastasia Island, mainly on 3.5 miles at Anastasia State Park (ASP) and one mile at Fort Matanzas National Monument (FMNM). AIBM have been found at low densities in remnant dunes on the remainder of the island. Beach mice have also been located along sections of the 4.2 miles of dune habitat at Guana Tolomato Matanzas National Estuarine Research Reserve (GTMNERR)-Guana River. Anastasia Island is separated from the mainland of Florida to the west by extensive salt marshes and the Mantazas River, to the north by the St. Augustine Inlet, and to the south by the Matanzas Inlet which are both maintained and open. This has restricted the range of AIBM to 14.5 mile length of Anastasia Island and sections of GTMNERR-Guana River (**Figure 8**).

In 1992 to 1993, the Service funded the reintroduction of AIBM to GTMNERR in St. Johns County where historical habitat for the subspecies existed (Service 1993). GMTNERR-Guana River is nine miles north of the existing population of beach mice at ASP. Fifty-five mice (27 females and 28 males) were trapped at FMNM and ASP from September 24, to November 12, 1992, and placed in soft-release enclosures at the state park on September 27, and November 12, 1992. During follow-up trapping conducted in February 1993, beach mice occupied the entire 4.2-mile length of the park; 34 were captured and it was estimated that the population totaled 220. Quarterly trapping has been conducted since the reintroduction and mice have not been captured since September 2006. This may be a result of habitat loss from development or alteration from storms.

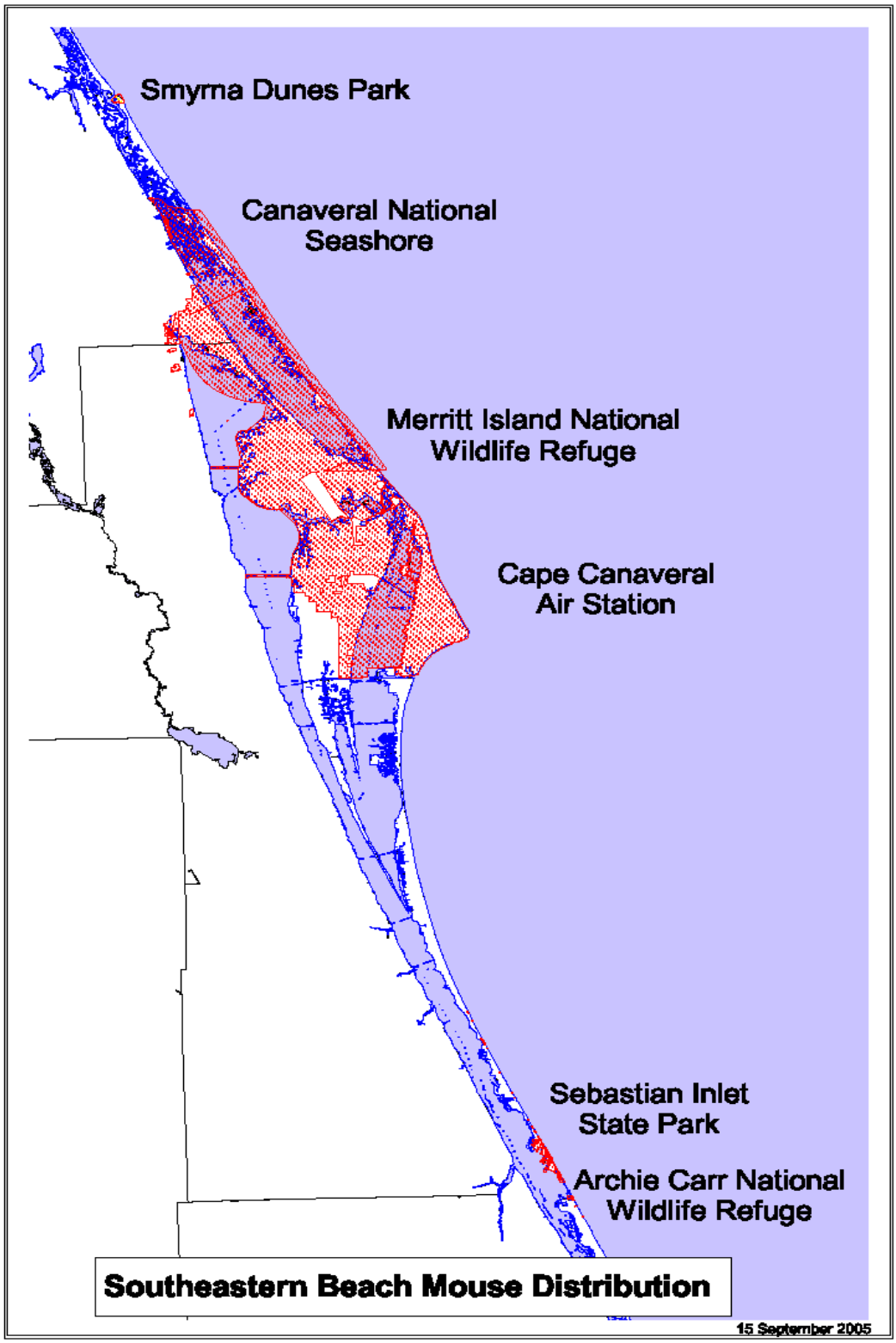

Figure 7. The distribution of the southeastern beach mouse.

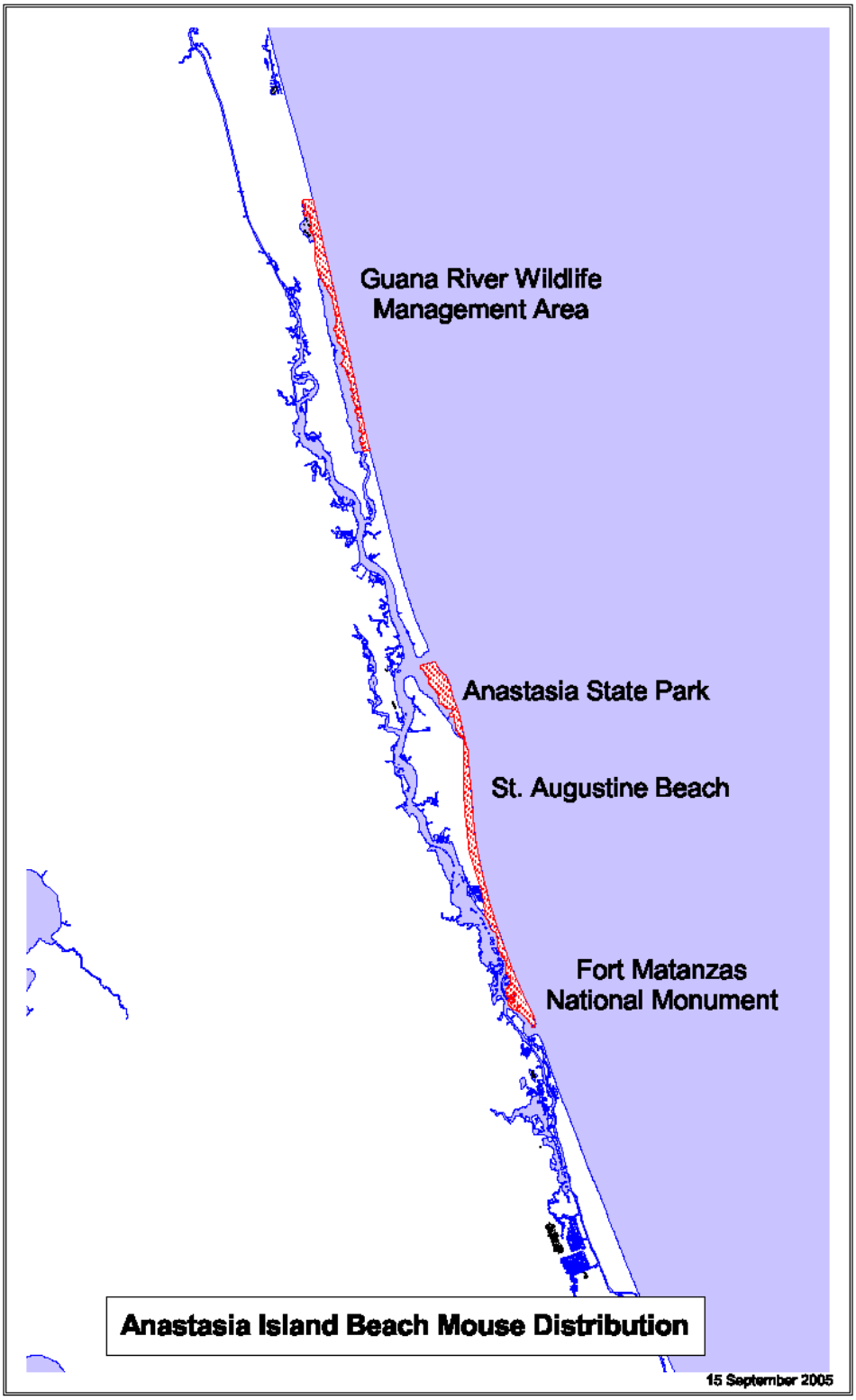

Figure 8. The distribution of the Anastasia Island beach mouse.

Gulf Coast Beach Mice

The CBM and the PKBM were listed with the Alabama beach mouse (ABM) (*Peromyscus polionotus ammobates*), as endangered species under the Act in 1985 (50 FR 23872). The SABM was listed under the Act in 1998 (63 FR 70053). CBM, SABM, and PKBM are also listed as endangered species by the State of Florida (FWC 2010). Critical habitat was designated for the CBM, and PKBM at the time of listing; however, critical habitat was revised in 2006 (71 FR 60238). Critical habitat was also designated for the SABM in 2006 (71 FR 60238).

The historical range of the CBM extended 53 miles between Destin Pass, Choctawhatchee Bay in Okaloosa County and East Pass in St. Andrew Bay, Bay County, Florida. PKBM historically ranged along the entire length of Perdido Key for 16.9 miles between Perdido Bay, Alabama (Perdido Pass) and Pensacola Bay, Florida (Bowen 1968). The historical range of the SABM extended 38 miles between Money Bayou in Gulf County, and Crooked Island at the East Pass of St. Andrews Bay, Bay County, Florida including the St. Joseph peninsula and the coastal mainland adjacent to St. Joseph Bay, Florida (**Figure 9**).

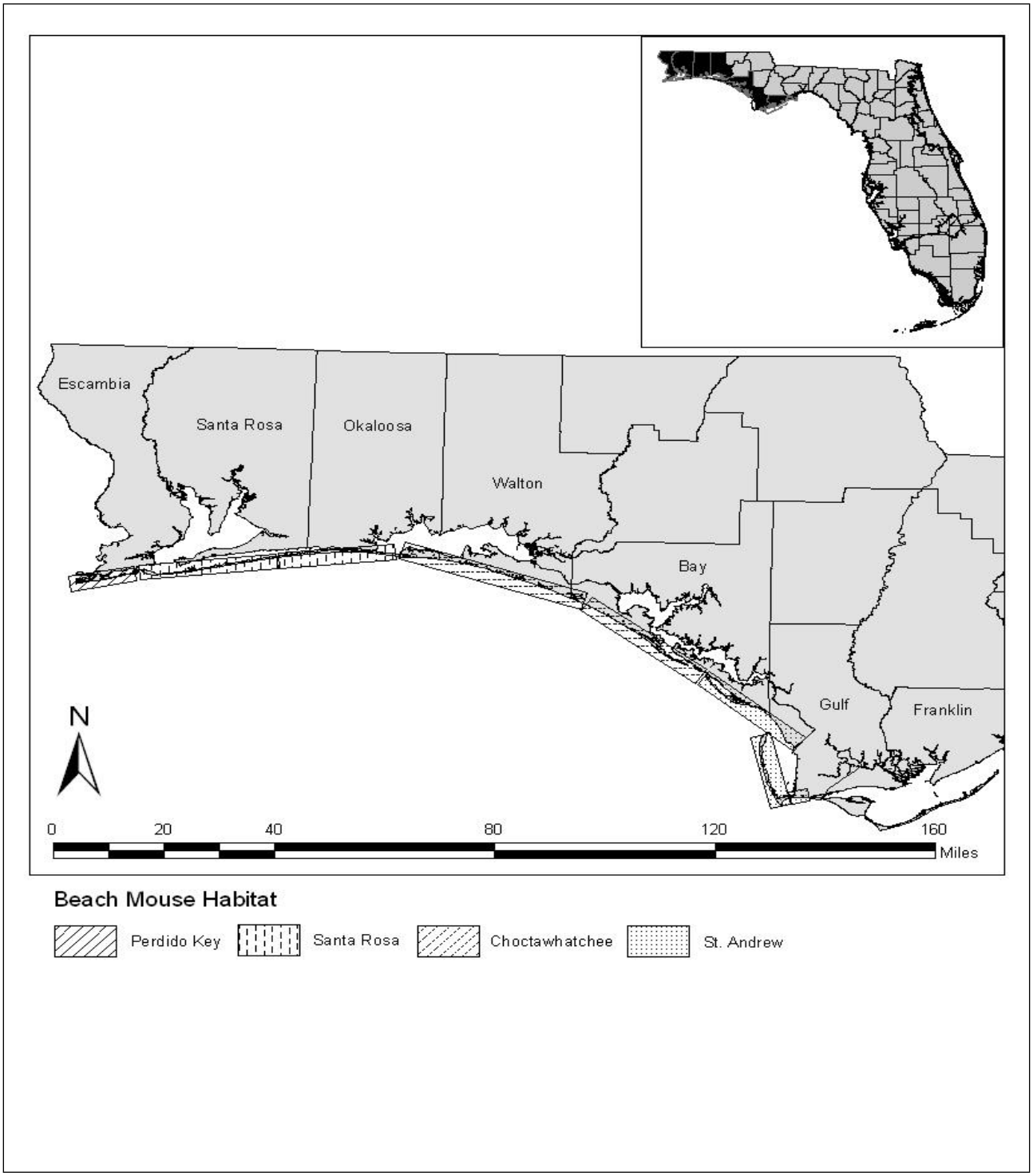

Figure 9. Historical range of Gulf Coast beach mouse subspecies.

Critical habitat

Since the listing of the PKBM and CBM in 1985, research has refined previous knowledge of Gulf Coast beach mouse habitat requirements and factors that influence their use of habitat. Based on the current knowledge of the life history, biology, and ecology of the subspecies and the

requirements of the habitat to sustain the essential life history functions of the subspecies, the primary constituent elements (PCE) of critical habitat for Gulf Coast beach mice consist of:

1. A contiguous mosaic of primary, secondary scrub vegetation, and dune structure, with a balanced level of competition and predation and few or no competitive or predaceous nonnative species present, that collectively provide foraging opportunities, cover, and burrow sites;

2. Primary and secondary dunes, generally dominated by sea oats that despite occasional temporary impacts and reconfiguration from tropical storms and hurricanes provide abundant food resources, burrow sites, and protection from predators;

3. Scrub dunes, generally dominated by scrub oaks, that provide food resources and burrow sites, and provide elevated refugia during and after intense flooding due to rainfall and/or hurricane induced storm surge;.

4. Functional, unobstructed habitat connections that facilitate genetic exchange, dispersal, natural exploratory movements, and recolonization of locally extirpated areas; and

5. A natural light regime within the coastal dune ecosystem, compatible with the nocturnal activity of beach mice, necessary for normal behavior, growth and viability of all life stages.

Thirteen coastal dune areas (units) in southern Alabama and the panhandle of Florida have been determined to be essential to the conservation of PKBM, CBM, and SABM and are designated as critical habitat (**Figures 10 through 12**). These 13 units include five units for PKBM, five units for CBM, and three units for the SABM. These units total 6,194 acres of coastal dunes, and include 1,300 acres for the PKBM in Escambia County, Florida and Baldwin County, Alabama (**Table 10**); 2,404 acres for the CBM, in Okaloosa, Walton, and Bay Counties, Florida (**Table 11**); and 2,490 acres for the SABM in Bay and Gulf Counties, Florida (**Table 12**).

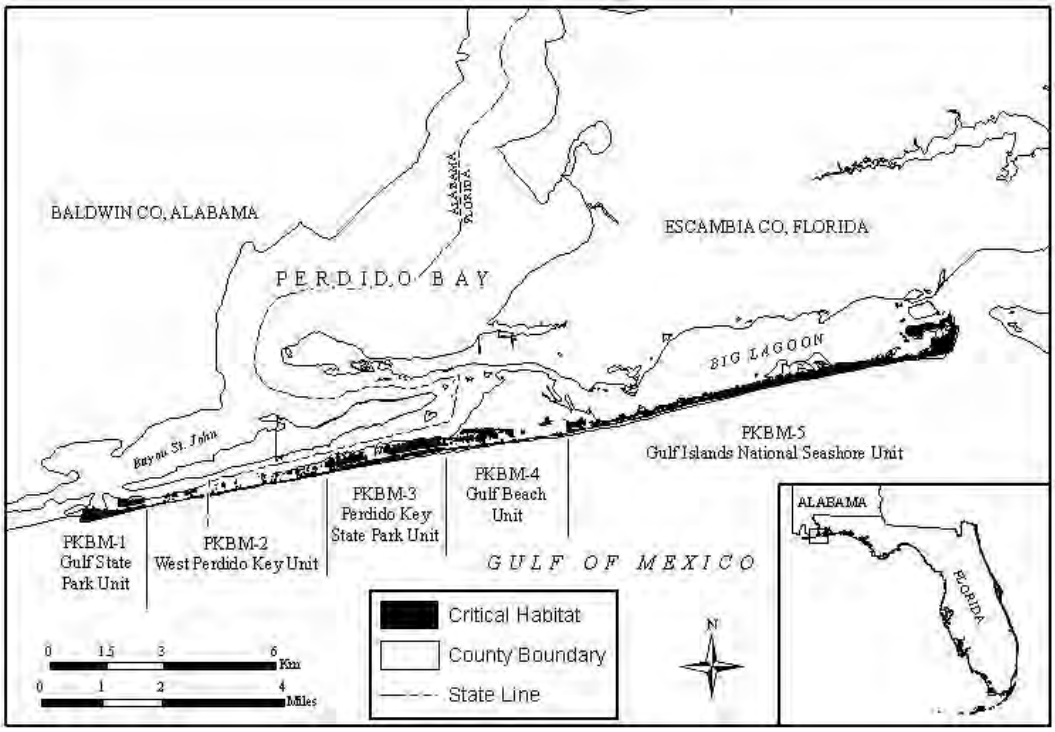

Figure 10. Critical habitat units designated for the Perdido Key beach mouse.

Table 10. Critical habitat units designated for the Perdido Key beach mouse.

Perdido Key Beach Mouse Critical Habitat Units	Federal Acres	State Acres	Local and Private Acres	Total Acres
1. Gulf State Park Unit	0	115	0	115
2. West Perdido Key Unit	0	0	147	147
3. Perdido Key State Park Unit	0	238	0	238
4. Gulf Beach Unit	0	0	162	162
5. Gulf Islands National Seashore Unit	638	0	0	638
Total	638	353	309	1300

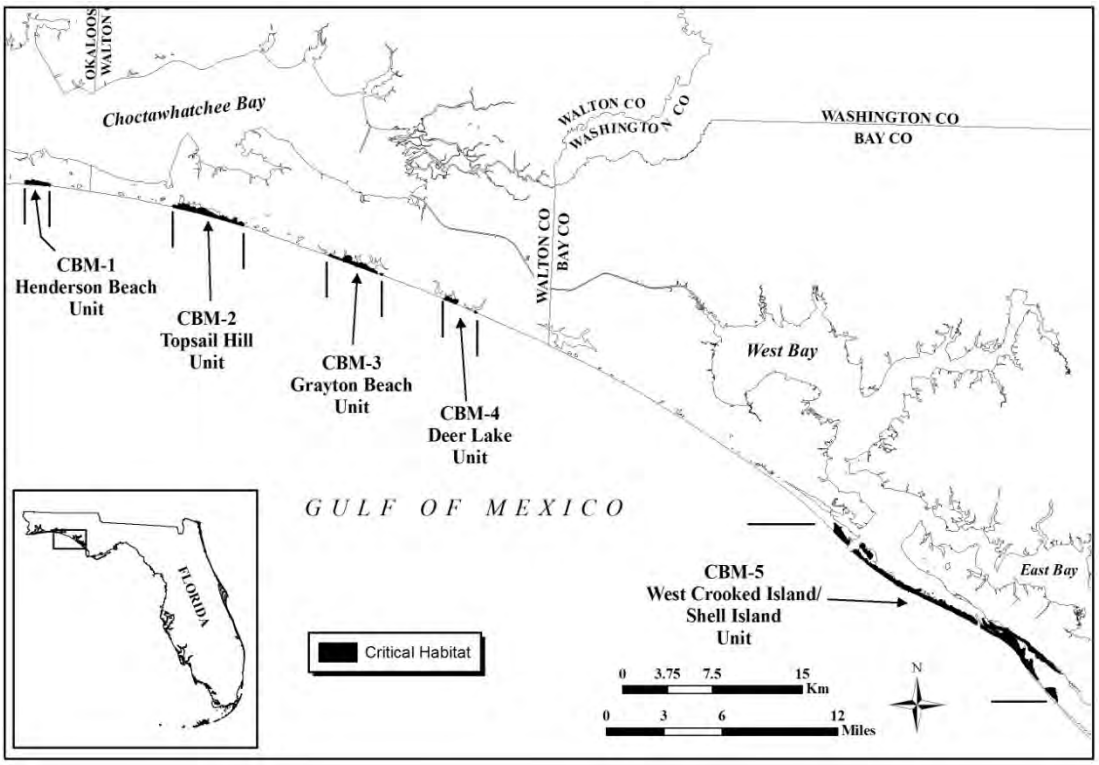

Figure 11. Critical habitat units designated for the Choctawhatchee beach mouse.

Table 11. Critical habitat units designated for the Choctawhatchee beach mouse.

Choctawhatchee Beach Mouse Critical Habitat Units	Federal Acres	State Acres	Local and Private Acres	Total Acres
1. Henderson Beach Unit	0	96	0	96
2. Topsail Hill Unit	0	277	31	308
3. Grayton Beach Unit	0	162	17	179
4. Deer Lake Unit	0	40	9	49
5. W. Crooked Island/Shell Island Unit	1333	408	30	1771
Total	1333	982	87	2404

Map 1. Critical Habitat Units for St. Andrew Beach Mouse

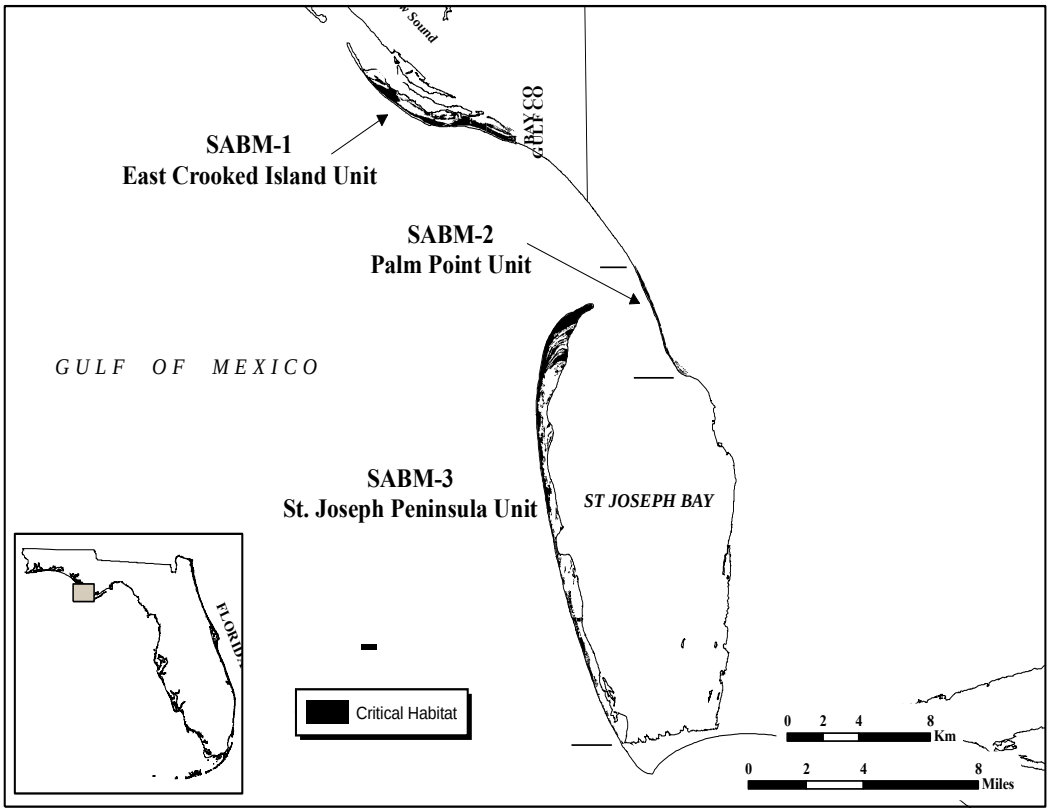

Figure 12. Critical habitat units designated for the St. Andrew beach mouse.

Table 12. Critical habitat units designated for the St. Andrew beach mouse.

St. Andrew Beach Mouse Critical Habitat Units	Federal Acres	State Acres	Local and Private Acres	Total Acres
1. East Crooked Island Unit	649	0	177	826
2. Palm Point Unit	0	0	162	162
3. St. Joseph Peninsula Unit	0	1280	222	1502
Total	649	1280	561	2490

The Gulf State Park Unit (PKBM-1) consists of 115 acres in southern Baldwin County, Alabama, on the westernmost region of Perdido Key. This unit encompasses essential features of beach mouse habitat within the boundary of Gulf State Park from the west tip of Perdido Key at Perdido Pass east to approximately 1.0 mile west of where the Alabama–Florida State line bisects Perdido Key and the area from the mean high water line (MHWL) north to the seaward extent of the maritime forest. This unit was occupied by the species at the time of listing. PKBM were known to inhabit this unit during surveys in 1979 and 1982, and by 1986 this was the only known existing population of the subspecies (Humphrey and Barbour 1981, Holler *et al.* 1989). This population was a core population and was the donor site for the reestablishment of PKBM into Gulf Islands National Seashore (GINS) in 1986. This project ultimately saved PKBM from extinction as the

population at Gulf State Park was considered extirpated in 1998 due to tropical storms and predators (Moyers *et al*. 1999).

Beach mouse habitat in this unit consists of primary, secondary, and scrub dune habitat. Because scrub habitat is separated from the frontal dunes by a highway in some areas, the population inhabiting this unit can be especially vulnerable to hurricane impacts, and therefore further linkage to scrub habitat and/or habitat management would improve connectivity. This unit is managed by the Alabama Department of Conservation and Natural Resources and provides PCEs 2, 3, 4, and 5. Threats specific to this unit that may require special management considerations include artificial lighting, presence of free-roaming cats (*Felis catus*) as well as other predators at unnatural levels, and high recreational use that may result in soil compaction, damage to dunes, and/or a decrease in habitat quality. This unit, which contains interior scrub habitat as well as primary and secondary dunes, serves as an expansion of the original critical habitat designation (50 FR 23872).

The West Perdido Key Unit (PKBM-2) consists of 114 acres in southern Escambia County, Florida, and 33 acres in southern Baldwin County, Alabama. This unit encompasses essential features of beach mouse habitat from approximately 1.0 mile west of where the Alabama-Florida State line bisects Perdido Key east to 2.0 miles east of the State line and areas from the MHWL north to the seaward extent of human development or maritime forest. This unit consists of private lands and ultimately includes essential features of beach mouse habitat between Perdido Key State Park (PKSP) (PKBM-3) and Gulf State Park (PKBM-1). Beach mouse habitat in this unit consists of primary, secondary, and scrub dune habitat and provides PCEs 2, 3, and 4.

Habitat fragmentation and other threats specific to this unit are mainly due to development. Consequently, threats to this unit that may require special management considerations include habitat fragmentation and habitat loss, artificial lighting, presence of free-roaming cats as well as other predators at unnatural levels, excessive foot traffic and soil compaction, and damage to dune vegetation and structure. At the time of listing, it was not known that beach mice occupied this area. While no trapping has been conducted on these private lands to confirm absence for the Act sections 7 and 10 permitting, sign of beach mouse presence was confirmed in 2005 through observations of beach mouse burrows and tracks (Sneckenberger 2005), and this unit is adjacent to contiguous, occupied beach mouse habitat (PKBM-3). Therefore, this unit is considered currently occupied. This unit provides essential connectivity between two core population areas (PKSP and Gulf State Park), provides habitat for expansion, natural movements, and recolonization, and is therefore essential to the conservation of the species. Specifically, this unit may have historically provided for the recolonization of Gulf State Park (PKBM-1) and may facilitate similar recolonization in the future as the habitat recovers from recent hurricane events.

The PKSP Unit (PKBM-3) consists of 238 acres in southern Escambia County, Florida. This unit encompasses essential features of beach mouse habitat within the boundary of PKSP from approximately 2.0 miles east of the Alabama–Florida State line to 4.0 miles east of the State line and the area from the MHWL north to the seaward extent of the maritime forest. Beach mouse habitat in this unit consists of primary, secondary and scrub dune habitat. Trapping efforts in this area were limited in the past. In 2000, a relocation program began to reestablish mice at PKSP. This project is considered a success and the population occupying this unit now considered a core population. This unit provides PCEs 2, 3, 4, and 5, and is essential to the conservation of the species. Improving and/or restoring habitat connections would increase habitat quality and provide more functional connectivity for dispersal, exploratory movements, and population expansion.

The Florida Park Service manages this unit. Threats specific to this unit that may require special management considerations include artificial lighting, presence of feral cats as well as other predators at unnatural levels, and high recreational use that may result in soil compaction, damage to dunes, and/or a decrease in habitat quality. This unit, which contains interior scrub habitat as well as primary and secondary dunes, serves as an expansion of the original critical habitat designation (50 FR 23872).

The Gulf Beach Unit (PKBM-4) consists of 162 acres in southern Escambia County, Florida. This unit includes essential features of beach mouse habitat between GINS and PKSP from approximately 4.0 miles east of the Alabama–Florida State line to 6.0 miles east of the State line and areas from the MHWL north to the seaward extent of human development or maritime forest. This unit consists of private lands. Beach mouse habitat in this unit consists of primary, secondary, and scrub dune habitat. Habitat fragmentation and other threats specific to this unit are mainly due to development. Consequently, threats to this unit that may require special management considerations include habitat fragmentation and habitat loss, artificial lighting, presence of feral cats as well as other predators at unnatural levels, excessive foot traffic and soil compaction, and damage to dune vegetation and structure. While not known as occupied habitat at the time of listing, presence of beach mice has recently been confirmed within the unit as a result of trapping efforts in conjunction with permitting (Lynn 2004a). This unit provides PCEs 2, 3, and 4 and is essential to the conservation of the species. This unit includes high-elevation scrub habitat and serves as a refuge during storm events and as an important repopulation source if storms extirpate or greatly reduce local populations. This unit currently provides essential connectivity between two populations (PKBM-3 and PKBM-5) and provides essential habitat for expansion, natural movements, and recolonization (PCE 4).

The GINS Unit (PKBM-5) consists of 638 acres in southern Escambia County, Florida, on the easternmost region of Perdido Key. This unit encompasses essential features of beach mouse habitat within the boundary of GINS–Perdido Key Area (also referred to as Johnson Beach) from approximately 6.0 miles east of the Alabama–Florida State line to the eastern tip of Perdido Key at Pensacola Bay and the area from the MHWL north to the seaward extent of the maritime forest. Beach mouse habitat in this unit consists mainly of primary and secondary dune habitat, but provides the longest contiguous expanse of frontal dune habitat within the historical range of the PKBM. PKBM were known to inhabit this unit in 1979, though the population was impacted by Hurricane Frederic (1979) and no beach mice were captured during surveys in 1982 and 1986 (Humphrey and Barbour 1981, Holler *et al.* 1989) therefore, the unit was unoccupied at the time of listing. In 1986, PKBM were reestablished at this unit as a part of Service recovery efforts. This reestablishment project was identified as the most urgent recovery need for the mouse (Service 1987, Holler *et al.* 1989). The project is considered a success, as the population inhabiting this unit is considered a core population. In 2000 and 2001, PKBM captured from this site served as donors to reestablish beach mice at PKSP (PKBM-3).

PKBM-5, in its entirety, possesses all five PCEs and is essential to the conservation of the species. However, most of this unit consists of frontal dunes, making the population inhabiting this unit particularly threatened by storm events. Threats specific to this unit that may require special management considerations include artificial lighting, presence of free-roaming cats as well as other predators at unnatural levels, and high recreational use that may result in soil compaction, damage to dunes, and a decrease in habitat quality. The National Park Service GINS manages this unit. This unit was included in the initial critical habitat designation (50 FR 23872).

The Henderson Beach unit (CBM–1) consists of 96 acres in Okaloosa County, Florida. This unit encompasses essential features of beach mouse habitat within the boundary of Henderson Beach State Park from 0.5 miles east of the intersection of Highway 98 and Scenic Highway 98 to 0.25 miles west of Matthew Boulevard and the area from the MHWL north to the seaward extent of the maritime forest. This westernmost unit provides primary, secondary, and scrub dune habitat (PCEs 2 and 3). This unit is within the historical range of the subspecies; however, it was not known to be occupied at the time of listing and current occupancy is unknown because no recent efforts have been made to document beach mouse presence or absence. Because this unit includes protected, high-elevation scrub habitat, it may serve as a refuge during storm events and as an important source population if storms extirpate or greatly reduce local populations or populations to the east.

This unit is managed by the Florida Park Service and is essential to the conservation of the species. Threats specific to this unit that may require special management considerations include habitat fragmentation, Park development, artificial lighting, presence of feral cats as well as other predators at unnatural levels, and high recreational use that may result in soil compaction, damage to dunes, or other decrease in habitat quality.

The Topsail Hill Unit (CBM–2) consists of 308 acres in Walton County, Florida. This unit encompasses essential features of beach mouse habitat within the boundary of Topsail Hill Preserve State Park, as well as adjacent private lands from 0.1 miles east of the Gulf Pines subdivision to 0.6 miles west of the Oyster Lake outlet and the area from the MHWL north to the seaward extent of human development or maritime forest. This unit provides primary, secondary, and scrub dune habitat and possesses all five PCEs. Its large, contiguous, high-quality habitat allows for natural movements and population expansion. Choctawhatchee beach mice were confirmed present in the unit in 1979 (Humphrey *et al*. 1987), were present at the time of listing, and are still present.

Beach mice have been captured on Stallworth County Park and Stallworth Preserve subdivision, a private development within the unit, and east of the Park (Service 2003a). The population of Choctawhatchee beach mice inhabiting this unit appears to harbor unique genetic variation and displays a relatively high degree of genetic divergence considering the close proximity of this population to other populations (Wooten and Holler 1999).

This unit has portions with different ownership, purposes, and mandates. Threats specific to this unit that may require special management considerations include Park and residential development, artificial lighting, presence of feral cats as well as other predators at unnatural levels, and high recreational use that may result in soil compaction, damage to dunes, or other decrease in habitat quality.

Lands containing the features essential to the conservation of the CBM within the area covered under the Habitat Conservation Plan (HCP) for the Stallworth County Preserve (4 acres) are excluded from critical habitat designation under section 4(b)(2) of the Act.

The Grayton Beach Unit (CBM–3) consists of 179 acres in Walton County, Florida. This unit encompasses essential features of beach mouse habitat within the boundary of Grayton Beach State Park, as well as adjacent private lands and inholdings, from 0.3 mi west of the Alligator Lake

outlet east to 0.8 miles west of Seagrove Beach and the area from the MHWL north to the seaward extent of human development or maritime forest. This unit provides primary, secondary, and scrub dune habitat (PCEs 2 and 3), habitat connectivity (PCE 4) and is essential to the conservation of the species. This unit also provides a relatively natural light regime (PCE 5). Beach mice were not detected in the unit in 1979 (Holler 1992a); however, they were found to be present in 1995 after Hurricane Opal (Moyers *et al.* 1999). While it seems likely that beach mice were present at the time of listing (and may have been present, but not detected, in 1979), the Service does not have data to confirm this assumption. Therefore, the Service considered this unit to be unoccupied at the time of listing. A program to strengthen and reestablish the population began in 1989 and yielded a persistent population at the State Park. Recent evidence of beach mice on State Park land was documented in 2004 (Service 2004). Beach mice are also known to currently occupy the private lands immediately east of the park.

This unit has portions with different ownership, purposes, and mandates. Threats specific to this unit that may require special management considerations include hurricane impacts that may require dune restoration and revegetation, excessive open, unvegetated habitat due to recreational use or storm impacts that may require revegetation, Park development, artificial lighting, presence of feral cats as well as other predators at unnatural levels, and high recreational use that may result in soil compaction, damage to dunes, or other decrease in habitat quality.

Lands containing the features essential to the conservation of the Choctawhatchee beach mouse within the area covered under the HCP for the Watercolor development (4 acres) are excluded from critical habitat designation under section 4(b)(2) of the Act.

The Deer Lake Unit (CBM–4) consists of 49 acres in Walton County, Florida. This unit encompasses essential features of beach mouse habitat within the boundary of Deer Lake State Park as well as adjacent private lands from approximately one mile east of the Camp Creek Lake inlet west to approximately 0.5 miles west of the inlet of Deer Lake and the area from the MHWL north to the seaward extent of maritime forest or human development. This unit provides primary, secondary, and scrub dune habitat (PCEs 2 and 3), habitat connectivity to adjacent lands (PCE 4), and is essential to the conservation of the species. This unit also provides a relatively natural light regime (PCE 5). Because live-trapping efforts in this area have been limited to incidental trapping, and beach mice were not detected in 1998 (Moyers *et al*. 1999), the Service considered this unit to be unoccupied at the time of listing. CBM were translocated from Topsail Hill Preserve State Park to private lands adjacent to this unit in 2003 and 2005 (Service 2003b, 2005a, 2005b, 2005c, 2005d). Tracking within the adjacent State park lands have indicated expansion of the population into the park.

This unit has portions with different ownership, purposes, and mandates. Threats specific to this unit that may require special management considerations include artificial lighting, presence of feral cats as well as other predators at unnatural levels, and high recreational use that may result in soil compaction, damage to dunes, or other decrease in habitat quality.

Lands containing the features essential to the conservation of the CBM within the area covered under the HCP/Incidental Take Permit (ITP) for Watersound (71 acres) are excluded from critical habitat designation under section 4(b)(2) of the Act (see Application of Section 4(a)(3) and Exclusions Under Section 4(b)(2) of the Act section below). This excluded area is 0.5 miles west of the Camp Creek Lake inlet to 0.5 miles east of the Camp Creek Lake inlet.

The West Crooked Island/ Shell Island Unit (CBM–5) consists of 1,771 acres in Bay County, Florida. This unit encompasses essential features of beach mouse habitat within the boundaries of St. Andrew State Park mainland from 0.1 miles east of Venture Boulevard east to the entrance channel of St. Andrew Sound, Shell Island east of the entrance of St. Andrew Sound east to East Pass, and West Crooked Island southwest of East Bay and east of the entrance channel of St. Andrew Sound, and areas from the MHWL north to the seaward extent of the maritime forest. Shell Island consists of State lands, Tyndall Air Force Base (AFB) lands, and small private inholdings. Choctawhatchee beach mice were known to inhabit the majority of Shell Island in 1987 (Holler 1992b) and were again confirmed present in 1998 (Moyers *et al*. 1999), 2002, and 2003 (Lynn 2003a). Because beach mice inhabited nearly the entire suitable habitat on the island less than two years prior to listing and were reconfirmed after listing, the Service considered this area to be occupied at the time of listing. The West Crooked Island population is the result of a natural expansion of the Shell Island population after the two islands became connected in 1998 and 1999, a result of Hurricanes Opal and Georges (Service 2003b). Shell Island was connected to the mainland prior to the 1930s when a navigation inlet severed the connection on the western end. Beach mice were documented at St. Andrew State Park mainland as late as the 1960s (Bowen 1968), though no records of survey efforts exist again until Humphrey and Barbour (1981) and Meyers (1983) at which time beach mice were not detected. Therefore, it seems likely that this area was not occupied at the time of listing. Current beach mouse population levels at this site are unknown, and live-trapping to document the absence of mice has not been conducted. Similar to the original designation, this Park was designated as critical habitat because it has features essential to the CBM. It is also within the historical range of the mouse. This unit supports the easternmost population of CBM, with the next known population 22 miles to the west.

This unit provides primary, secondary, and scrub dune habitat and possesses all five PCEs. Portions of this unit are managed by the Florida Park Service, while the remaining areas are federally (Tyndall AFB) and privately owned.

Threats specific to this unit that may require special management considerations include artificial lighting, presence of feral cats as well as other predators at unnatural levels, and high residential or recreational use that may result in soil compaction, damage to dunes, or other decrease in habitat quality.

The East Crooked Island Unit (SABM–1) consists of 826 acres in Bay County, Florida. This unit encompasses essential features of beach mouse habitat on East Crooked Island from the entrance of St. Andrew Sound to one mile west of Mexico Beach, and the area from the MHWL to the seaward extent of the maritime forest (not including Raffield Peninsula). Beach mouse habitat in this unit consists of primary, secondary, and scrub dune habitat and possesses all five PCEs. SABM were known to inhabit the unit in 1986 and 1989 (James 1992), though the population was presumably extirpated after 1989 due to impacts from hurricanes. The East Crooked Island population was reestablished with donors from St. Joseph State Park in 1997. This unit was occupied at the time of listing. Recent live-trapping confirms present occupation of mice (Moyers and Shea 2002, Lynn 2002a, Slaby 2005). This unit maintains connectivity along the island and this unit is essential to provide a donor population following storm events.

The majority of this unit is federally owned (Tyndall AFB), while the remaining habitat is privately owned. Threats specific to this unit that may require special management considerations

include artificial lighting, presence of feral cats as well as other predators at unnatural levels, and high recreational and military use that may result in soil compaction, damage to dunes, or other decrease in habitat quality.

The Palm Point Unit (SABM–2) consists of 162 acres of private lands in Gulf County, Florida. This unit encompasses habitat from Palm Point 1.25 miles northwest of the inlet of the Gulf County Canal to the southeastern boundary of St. Joseph Beach and the area from the MHWL to the seaward extent of the maritime forest. SABM were documented in the area by Bowen (1968) and were considered to have been present in this unit at the time of listing. Since SABM beach mouse habitat is limited to only two other areas, protecting this mainland site located within the species' historical range is needed for the subspecies' long-term persistence. As other viable opportunities are limited or nonexistent, this unit is essential to reduce the threats of stochastic events to this subspecies. Furthermore, as this unit is on the mainland, it is somewhat buffered from the effects of storm events. This area provides frontal and scrub dune habitat (PCEs 2 and 3), but may provide limited connectivity between habitats. Threats specific to this unit that may require special management considerations include habitat fragmentation, habitat loss, artificial lighting, presence of free-roaming cats as well as other predators at unnatural levels, and high residential use that may result in soil compaction, damage to dunes, or other decrease in habitat quality.

The St. Joseph Peninsula Unit (SABM–3) consists of 1,502 acres in Gulf County, Florida. This unit encompasses essential features of beach mouse habitat within the boundary of St. Joseph Peninsula State Park (Park) as well as south of the Park to the peninsula's constriction north of Cape San Blas (also known as the "stumphole" region) and area from the MHWL to the seaward extent of the maritime forest. Beach mouse habitat in this unit consists of primary, secondary, and scrub dune habitat, and provides a relatively contiguous expanse of habitat within the historical range of the SABM. This unit possesses all five PCEs and was occupied at the time of listing. SABM were known to inhabit this unit in 1986 and 1987 (James 1987, 1992, 1995, Gore 1994, Moyers *et al.* 1999, Slaby 2005). In addition, recent tracking efforts suggest that mice continue to occupy private lands south of the Park (Slaby 2005). The Park alone does not provide sufficient habitat to allow for population expansion along the peninsula, which may be necessary for a population anchored by the tip of a historically dynamic peninsula. A continuous presence of beach mice along the peninsula is the species' best defense against local and complete extinctions due to storm events. The population of SABM inhabiting this unit appears to possess unique genetic variation, and displays greater than expected genetic divergence from other populations (Wooten and Holler 1999).

The Florida Park Service manages portions of this unit, while the remaining area is privately owned. Threats specific to this unit that may require special management considerations include artificial lighting, habitat fragmentation and habitat loss, presence of feral cats as well as other predators at unnatural levels, and high recreational use that may result in soil compaction, damage to dunes, or other decrease in habitat quality. The population inhabiting this unit may also be particularly susceptible to hurricanes due to its location within St. Joseph Bay (the peninsula is a thin barrier peninsula with a north–south orientation).

Life history (All subspecies of beach mice)

Beach mice are differentiated from the inland subspecies by the variety of fur (pelage) patterns on the head, shoulders, and rump. The overall dorsal coloration in coastal subspecies is lighter in color and less extensive than on those of the inland subspecies (Sumner 1926, Bowen 1968). Similarly, beach mouse subspecies can be differentiated from each other by pelage pattern and coloration.

The SEBM averages 5.47 inches in total length (average of 10 individuals = 5.07 inches, with a 2.04-inch tail length (Osgood 1909, Stout 1992). Females are slightly larger than males. These beach mice are slightly darker in appearance than some other subspecies of beach mice, but paler than inland populations of *P. polionotus* (Osgood 1909). SEBM have pale, buffy coloration from the back of their head to their tail, and their underparts are white. The white hairs extend up on their flanks, high on their jaw, and within 0.07 to 0.12 inches of their eyes (Stout 1992). There are no white spots above the eyes as with AIBM (Osgood 1909). Their tail is also buffy above and white below. Juvenile SEBM are more grayish in coloration than adults; otherwise they are similar in appearance (Osgood 1909).

The AIBM averages 5.45 inches in total length (average of 10 individuals); with 2.05 inches mean tail length (James 1992). This subspecies has a very pale, buff-colored head and back with extensive white coloration underneath the sides (Howell 1939). Bowen (1968) noted two distinct rump color pigmentations, one tapered and the other a squared pattern, which extended to the thighs.

The SABM has head and body lengths averaging 2.95 inches, and tail mean lengths averaging 2.05 inches (James 1992). This subspecies has a very pale, buff-colored head and back with extensive white coloration underneath and along the sides (Howell 1939). Bowen (1968) noted two distinct rump color pigmentations, one tapered and the other a squared pattern, which extended to the thighs.

The PKBM is slightly smaller than the other Gulf coast beach mouse subspecies (Bowen 1968). Head and body length ranges from 2.7 to 3.3 inches (Holler 1992b). The pigmentation of PKBM is gray to gray-brown with the underparts white and coloration on the head is less pronounced. The line between pigmented and unpigmented pelage runs dorsally posterior above the eyes and behind the ears. Pigmentation patterns on the rump are either squared or squared superimposed on a tapered pattern (Bowen 1968). There is no tail stripe.

CBM have head and body lengths ranging from 2.7 to 3.5 inches (Holler 1992a). This beach mouse is distinctly more orange-brown to yellow-brown than the other Gulf coast beach mouse subspecies (Bowen 1968). Pigmentation on the head either extends along the dorsal surface of the nose to the tip, or ends posterior to the eyes leaving the cheeks white. A dorsal tail stripe is either present or absent.

Behavior

Peromyscus polionotus is the only member of the genus that digs an extensive burrow. Beach mice are semifossorial, using their complex burrows as a place to rest during the day and between nightly foraging bouts, escape from predators, have and care for young, and hold limited food caches. Burrows of *P. polionotus* generally consist of an entrance tunnel, nest chamber, and escape tunnel. Burrow entrances are usually placed on the sloping side of a dune at the base of a shrub or clump of grass. The nest chamber is formed at the end of the level portion of the entrance tunnel at a depth of 23.6 to 35.4 inches, and the escape tunnel rises from the nest chamber to within 9.8 inches of the surface (Blair 1951). Nests of beach mice are constructed in the nest chamber of their burrows, a spherical cavity about 1.5 to 2.5 inches in diameter. The nest comprises about one-fourth of the size of the cavity and is composed of sea oat roots, stems, leaves and the chaffy parts of the panicles (Ivey 1949). Beach mice have been found to select burrow sites based on a suite of biotic and abiotic features including dune slope, soil compaction, vegetative cover, and height above sea level (Lynn 2000a, Sneckenberger 2001). A shortage of potential burrow sites is considered to be a possible limiting resource.

Reproduction and Demography

Studies on *Peromyscus* species in peninsular Florida suggest that these species may achieve greater densities and undergo more significant population fluctuations than their temperate relatives, partially because of their extended reproductive season (Bigler and Jenkins 1975). Subtropical beach mice can reproduce throughout the year; however, their peak reproductive activity is generally during late summer, fall, and early winter. Extine (1980) reported peak reproductive activity for SEBM on Merritt Island during August and September, based on external characteristics of the adults. This peak in the timing and intensity of reproductive activity was also correlated to the subsequent peak in the proportion of juveniles in the population in early winter (Extine 1980). Peak breeding season for Gulf Coast beach mice is autumn and winter, declining in spring, and falling to low levels in summer (Rave and Holler 1992, Blair 1951). However, pregnant and lactating beach mice have been observed in all seasons (Moyers *et al.* 1999).

Sex ratios in beach mouse populations are generally 1:1 (Extine 1980, Rave and Holler 1992). Beach mice are believed to be generally monogamous (Smith 1966, Foltz 1981, Lynn 2000a). While a majority of individuals appear to pair for life, paired males may sire extra litters with unpaired females. Beach mice are considered sexually mature at 55 days of age; however some are capable of breeding earlier (Weston 2007). Gestation averages 28 to 30 days (Weston 2007) and the average litter size is four pups (Fleming and Holler 1990). Littering intervals may be as short as 26 days (Bowen 1968).

Apparent survival rate estimates (products of true survival and site fidelity) of beach mice along the Gulf Coasts of Florida and Alabama have demonstrated that their average life span is about nine months (Swilling 2000). Other research indicated that 63 percent of Alabama beach mice lived (or remained in the trapping area) for four months or less, 37 percent lived 5 months or greater and two percent lived 12 to 20 months (Rave and Holler 1992). Less than half (44 percent) of beach mice captured for the first time were recaptured the next season (Holler *et al*. 1997). Greater than 10 percent of mice were recaptured three seasons after first capture; and four to eight percent were recaptured more than one year after initial capture. Beach mice held in captivity have lived three years or more (Blair 1951, Holler 1995).

Habitat and Movement

Beach mice inhabit coastal dune ecosystems on the Atlantic and Gulf Coasts of Florida and the Gulf Coast of Alabama. The dune habitat is generally categorized as: primary dunes (characterized by sea and other grasses), secondary dunes (similar to primary dunes, but also frequently include such plants as woody goldenrod (*Chrysoma pauciflosculosa*), false rosemary (*Conradina canescens*), and interior or scrub dunes (often dominated by scrub oaks and yaupon (*Ilex vomitoria*). Contrary to the early belief that beach mice were restricted to (Howell 1909, 1921, Ivey 1949), or preferred the frontal dunes (Blair 1951, Pournelle and Barrington 1953, Bowen 1968), recent research has shown that scrub habitat serves an invaluable role in the persistence of beach mouse populations (Swilling *et al.* 1998, Sneckenberger 2001). Beach mice occupy scrub dunes on a permanent basis and studies have found no detectable differences between scrub and frontal dunes in beach mouse body mass, home range size, dispersal, reproduction, survival, food quality, and burrow site availability (Swilling *et al.* 1998, Swilling 2000, Sneckenberger 2001). While seasonally abundant, the availability of food resources in the primary and secondary dunes fluctuates (Sneckenberger 2001). In contrast, the scrub habitat provides a more stable level of food resources, which becomes crucial when food is scarce or nonexistent in the primary and secondary dunes. This suggests that access to primary, secondary, and scrub dune habitat is essential to beach mice at the individual level.

The sea oat zone of primary dunes is considered essential habitat of beach mice on the Atlantic Coast (Humphrey and Barbour 1981, Humphrey *et al.* 1987, Stout 1992). The SEBM has also been reported from sandy areas of adjoining coastal strand/scrub vegetation (Extine 1980, Extine and Stout 1987), which refers to a transition zone between the fore dune and the inland plant community (Johnson and Barbour 1990). Beach mouse habitat is heterogeneous, and distributed in patches that occur both parallel and perpendicular to the shoreline (Extine and Stout 1987). Because this habitat occurs in a narrow band along Florida's coast, structure and composition of the vegetative communities that form the habitat can change dramatically over distances of several feet.

Primary dune vegetation described from SEBM habitat includes sea oats, bitter panicgrass, railroad vine, beach morning-glory, saltmeadow cordgrass (*Spartina patens*), lamb'squarters (*Chenopodium album*), saltgrass (*Distichlis spicata*), and camphorweed (Extine 1980). Coastal strand and inland vegetation is more diverse, and can include pricklypear, saw palmetto, wax myrtle, Florida rosemary (*Ceratiola ericoides*), sea grape, and sand pine (*Pinus clausa*) (Extine and Stout 1987). Extine (1980) observed this subspecies as far as 0.62 miles inland on Merritt Island; he concluded that the dune scrub communities he found them in represent only marginal habitat for the SEBM. SEBM have been documented in coastal scrub more than a mile from the beach habitat at Kennedy Space Center/Merritt Island National Wildlife Refuge (NWR) and Cape Canaveral Air Force Station (CCAFS) (Stout *et al*. 2006). Extine (1980) and Extine and Stout (1987) reported that the SEBM showed a preference for areas with clumps of palmetto, sea grape, and expanses of open sand.

Essential habitat of the AIBM is characterized by patches of bare, loose, sandy soil (Humphrey and Frank 1992a). Although they are mainly found in the sea oat zone of the primary zone, they will occur in sandy areas with broomsedge (*Andropogon* sp.) (Service 1993). Ivy (1949) reported AIBM to occur in woody vegetation as far as 500 feet inland. Pournelle and Barrington (1953)

found this subspecies in scrub as far as 1,800 feet from the dunes. Because this habitat occurs in a narrow band along Florida's coast, structure and composition of the vegetative communities that form the habitat can change dramatically over distances of only a few feet. Much of the habitat within the range of the AIBM has been converted to condominiums and housing developments. The majority of the high quality habitat, densely occupied by beach mice, remains along the length of both ASP and FMNM, at either end of Anastasia Island.

Two main types of movement have been identified for small mammals: within home-range activity and long-range dispersal. Such movements are influenced by a suite of factors, such as availability of mates, predation risk, and habitat quality. Movement and home range studies have been conducted for most beach mouse subspecies, but are limited to natural habitat (*i.e.*, research has been conducted on public lands within contiguous beach mouse habitat, not within a development or in a fragmented landscape). Novak's (1997) study of the home range of CBM on Shell Island indicated males had a mean home range of 1.0 $\pm$ 4.1 acres and females had a mean home range of 0.81 $\pm$ 2.18 acres. Lynn (2000a) found male and female radio-tagged ABM had a mean home range of 1.68 $\pm$ 0.27 acres and 1.73 $\pm$ 0.40 acres, respectively. Swilling *et al.* (1998) observed one radio-collared ABM to travel over 328 feet during nightly forays after Hurricane Opal to obtain acorns from the scrub dunes. Using radio telemetry, Lynn (2000a) documented an ABM that traveled one mile within a 30-minute period. Moyers and Shea (2002) trapped a male and female CBM that moved about 637 feet and 2,720 feet in one night, respectively. Gore and Schaefer (1993) documented a marked Santa Rosa beach mouse crossing State Road (SR) 399, a two-lane highway. Lynn and Kovatch (2004) through mark and recapture trapping documented PKBM that crossed SR 292, a two-lane highway and right-of-way (100-feet wide).

Sneckenberger (2001) found significant seasonal differences in the movement of ABM, and suggested that this was a result of seasonal fluctuations in food availability, food quality, and nutritional needs. Smith (2003) found that Santa Rosa beach mice demonstrated an increase in movement as habitat isolation increased suggesting that longer travel distances were needed to obtain necessary resources. Smith also found that Santa Rosa beach mice had a preference for vegetation cover and connectivity, which is likely a behavioral response to increased predation risk in open areas. Thus, while beach mice are able and do travel great distances the travel pathways should have vegetated cover and no large gaps or open areas. Previous connectivity research suggests critical thresholds exist for species persistence in fragmented landscapes (With and Crist 1995). As fragmentation increases and connectivity is lost, species' ability to move through and between habitats is reduced in a nonlinear fashion.

Foraging

Beach mice are nocturnal and forage for food throughout the dune system. Beach mice feed primarily upon seeds and fruits, and appear to forage based on availability and have shown no preferences for particular seeds or fruits (Moyers 1996). Beach mice also eat small invertebrates, especially during late spring and early summer when seeds are scarce (Ehrhart 1978, Moyers 1996). Research suggests that the availability of food resources fluctuates seasonally in Gulf Coast coastal dune habitat, specifically that the frontal dunes appear to have more species of high quality foods, but these sources are primarily grasses and annuals that produce large quantities of small seeds in a short period of time. Foods available in the scrub consist of larger seeds and fruits that are produced throughout a greater length of time and linger in the landscape (Sneckenberger 2001).

Nutritional analysis of foods available in each habitat revealed that seeds of plant species in both habitats provide a similar range of nutritional quality.

Population dynamics

Population size

Estimating animal abundance or population size is an important and challenging scientific issue in wildlife biology (Otis *et al.* 1978, Pollock *et al.* 1990). A number of different census methods are available to estimate wildlife populations, each with particular benefits and biases. Beach mouse surveys involve live trapping mark-recapture studies, which is a common method with small mammals. A five-night minimum trapping period has been standard practice since 1987 for Gulf Coast beach mice. As the referenced trapping events were not designed similarly or using a standardized sampling techniques, data should not be compared between subspecies or trapping events, nor should densities (mice per 100 trap nights) be inferred beyond the trapping area during that trapping session.

Population densities of beach mice typically reach peak numbers in the late autumn into spring (Rave and Holler 1992, Holler *et al*. 1997). Peak breeding period occurs in autumn and winter, apparently coinciding with the increased availability of seeds and fruits from the previous growing season. Seasonal and annual variation in size of individual populations may be great (Rave and Holler 1992, Holler *et al.* 1997). Food supplementation studies showed that old field mouse populations increased when foods were abundant; thus, populations of old field mice appear to be food-limited (Smith 1971, Galindo-Leal and Krebs 1998). Similar studies have not been conducted with beach mouse populations.

Gulf Coast Beach Mice

In 1979, Humphrey and Barbour (1981) estimated about 515 CBM existed on Topsail Hill and Shell Island. That estimate was used during the Federal listing of the CBM in 1985. Population estimates on Shell Island from February 1993 to March 1994, ranged from 105 to 338 CBM on a 23-acre study area (Novak 1997). Just prior to Hurricane Opal in 1995, it was estimated that Shell Island supported 800 to 1,200 CBM (Gore 1999). Three years following Hurricane Opal in June 1998, one trapping effort at six different sites on Shell Island resulted in a cumulative population estimate of 195 CBM (164 CBM captured) (Moyers *et al*. 1999). The east portion of the island has been trapped from 2000 to 2003. Population estimates have ranged between 24 and 67 CBM (Lynn 2004b). At Topsail Hill Preserve State Park, trapping conducted in March 2003 and March 2005 yielded a population estimate of 190 to 250 CBM (Service 2003a, Sneckenberger 2005). From late 2006 through 2007 results of tracking tubes surveys at Topsail Hill Preserve State Park suggested that the CBM population was not densely distributed (FWC 2008b). Trapping of four 100-trap transects yielded population estimates of 190, 250, less than 10 (too few to estimate), and 87 in 2003, 2005, 2006, and 2007, respectively (Service 2007a). The track and trapping data together indicate that Topsail Hill Reserve State Park currently does not support a high population of beach mice. In 2003 and again in 2005, a total of 26 mice were translocated from Topsail Hill Preserve State Park to the WaterSound private development adjacent to Deer Lake State Park. Trapping has been sporadic on WaterSound but has yielded population estimates of 5 to 46 individuals in 2003 to 2007 (Moyers 2007). Deer Lake State Park has not been trapped; however, tracks have been observed as recently as 2006 (FWC 2008b). Population estimates from trapping

at Grayton Beach State Park (main unit) from 1995 to 2000, ranged from 25 to 116 CBM (Moyers *et al.* 1999, Van Zant 2000). The central unit was trapped for three nights in August 2002; however, no mice were captured (Lynn 2002b). Limited tracking surveys were accomplished in 2003, 2004 and 2005 and beach mouse tracks were observed (Kovatch 2003, Toothacker 2004, FWC 2008b). The western area, although it provides CBM habitat, has not been documented as occupied by CBM (Moyers *et al.* 1999, Van Zant 2000). The population estimates for the WaterColor development for the two years prior to and one year following development ranged from 3 to 7 CBM (St. Joe Company 1999). CBM were last captured in February of 2001 at WaterSound; quarterly trapping has continued on the site through mid-2008 without CBM being captured (St. Joe/Arvida 2003). Auburn University trapped West Crooked Island in October 2000, and the Service trapped the area in 2001 to 2003. The population estimate ranged from a low of 174 to a high of 244 CBM (Lynn 2000b, 2002d, 2002e, 2002f, 2002g, 2003b). The Service estimated the total population of CBM in 2003, to be about 600 to 1,000 beach mice.

Since its listing in 1985, PKBM population estimates never reached more than 400 to 500 individuals until 2003. Before Hurricane Ivan (2004) a population estimate of 500 to 800 was divided between two populations - the Johnson Beach Unit of GINS and PKSP (Service 2004). The status of PKBM at Gulf State Park (GSP) is uncertain, likely extirpated in 1999. In October 2005, following the active hurricane seasons of 2004 and 2005, a trapping effort of less than one-third of the habitat available on public lands yielded captures of less than 30 individuals. Tracking data from June 2006 indicated that about 25 and 32 percent of the available habitat was occupied at PKSP and GINS, respectively (Loggins 2007). Trapping at PKSP and GINS in March 2007, was cancelled after one night after the capture of only one mouse (a fatality) and very limited sightings of beach mouse sign (tracks, burrows) (Loggins 2007). With no tracks observed in the tube surveys the PKBM may now be absent from PKSP (FWC 2008b). At GINS, the number of PKBM has not increased since the initial high levels in winter of 2005-2006 (FWC 2008b). However, population estimates indicate there may be a few hundred PKBM at GINS (Gore 2008).

The SABM even at its lowest population probably numbered several hundred individuals (Gore as cited in 63 FR 70055). James (1992) estimated that the East Crooked Island subpopulation to be about 150. However, by 1996, SABM were no longer found on East Crooked Island. Following Hurricane Opal in 1995, Mitchell *et al.* (1997) estimated the St. Joe Peninsula State Park population to be between 300 and 500 mice. In November 1997 and January 1998, 19 pairs of St. Andrew beach mice were relocated from St. Joseph Peninsula State Park to East Crooked Island, Tyndall Air Force Base (Moyers *et al.* 1999). Trapping surveys conducted on East Crooked Island in 2000 and 2002 through 2007 indicated that beach mice occupied the entire island (Lynn 2002c, FWC 2008b). Population estimates ranged from 71 to 133 mice (Lynn 2002c). The FWC (2008b) estimates 22 miles of habitat as occupied by SABM throughout the mouse's historical range with population estimates of about 3,000 mice at East Crooked Island and about 1,775 mice in the front dunes at St. Joseph State Park.

Atlantic Coast Beach Mice

Populations of the SEBM have been estimated to be around 5,000 to 6,000 mice. Recent surveys have confirmed that SEBM are found on the beaches of Canaveral National Seashore, Merritt Island NWR, and CCAFS in Brevard County, all on federally protected lands. In April 2002, a

population of SEBM was documented at the Smyrna Dunes Park, at the north end of New Smyrna Beach (Sauzo 2004). Prior to 2006, populations of the SEBM were thought extirpated from both sides of the Sebastian Inlet (Bard 2004). However, during surveys in June 2006, a single mouse was located at the very southern end of the Sebastian Inlet State Park. Mice were also found at Jungle Trail on the Pelican Island National Wildlife Refuge, another area where they where thought extirpated. Additional surveys of other areas south of Brevard County have not located any mice and indicate the distribution of this subspecies in the counties south of Brevard, severely fragmented. SEBM are no longer believed to occur at Jupiter Island, Palm Beach, Lake Worth, Hillsboro Inlet or Hollywood Beach (Service 1999).

Although the distribution of the AIBM has declined significantly, particularly in the northern part of its range, the populations at ASP and FMNM have continued to fluctuate seasonally between two and 90 mice per acre. It is thought that populations should be characterized by a range rather than a static value (Frank and Humphrey 1996). Quarterly surveys of these two sites have shown that the populations have remained stable. Due to the limited dune habitat at the ASP, this population has not been able to maintain a stable population and it is unknown how many mice remain.

Population variability

Beach mouse populations fluctuate on a seasonal and annual basis. Attempts to explain population dynamics have revealed an incomplete understanding of the species and its population cycles. It is clear that beach mice, like all rodents, are known for high reproductive rates and experience extreme highs and lows in population numbers. Depressed beach mouse populations may be associated with tropical storms and drought, perhaps resulting from reduced habitat and food resources. These fluctuations can be a result of reproduction rates, food availability, habitat quality and quantity, catastrophic events, disease, and predation (Blair 1951, Bowen 1968, Smith 1971, Hill 1989, Rave and Holler 1992, Swilling *et al.* 1998, Swilling 2000).

Population stability

Population viability analysis (PVA) is essentially a demographic modeling exercise to predict the likelihood a population will continue to exist over time (Groom and Pascual 1997). The true value in using this analytical approach is not to determine the probability of a species' extinction, but to clarify factors that have the most influence on a species' persistence. From 1996 to 1999, the Service funded Auburn University to develop a PVA for beach mice (Holler *et al*. 1999, Oli *et al.* 2001). Four subpopulations of Gulf Coast beach mice subspecies were modeled. They consisted of two subpopulations of PKBM, one at GINS-Perdido Key Area and one at Florida Point, and two subpopulations of ABM, one at Bon Secour NWR and one at Fort Morgan State Park. They used a stochastic (random) differential equation (Wiener-drift) model, applied to long term demographic data. The model is stochastic because it incorporates the variable effects of the environment upon population change. However, it did not model the effects of hurricanes on the habitat or population of beach mice.

The Oli *et al.* (2001) analyses indicated that all four subpopulations were at risk of extinction, with habitat fragmentation as the most influential factor. The GINS-Perdido Key Area had the highest risk for extinction; the PKBM had a 100 percent chance of reaching one individual (becoming functionally extinct) within 21 (mode) or 45 (median) years. At Florida Point, the PKBM had a

low risk of becoming functionally extinct (1.3 percent) within 13 to 20 years. However, following Hurricane Opal in 1995, and subsequent predation pressure, the PKBM population at Florida Point was believed extirpated in 1999. This localized extirpation clearly demonstrates that while PVA's are useful in determining significant factors in species survival, they have limited use in predicting the time to extinction for a given species.

More recently, the Conservation Breeding Specialist Group (Traylor-Holzer 2004, 2005, 2006) was contracted by the Service to conduct a population and habitat viability analysis (PHVA) on ABM using the Vortex population simulation model (Lacy 1993). The goal was to develop an ABM population model and use the model to assess the status of the ABM habitat, and populations and projections for continued existence. The PHVA results projects the ABM to have a 26.8 percent $\pm$ 1.0 percent likelihood of extinction over the next 100 years. Much of this risk is due to hurricane impacts on ABM populations and habitat, which can result in population declines. The model suggests that hurricanes are a driving force for ABM populations, both directly and also indirectly as their impacts interact with other factors, including development of higher elevation (scrub) habitat and predation by cats. Due to the similarities in the subspecies and proximal location, it can be inferred that these factors also have a strong influence on the persistence of PKBM populations. When reviewing PHVA results, it is crucial that the actual values for the risk of extinction are not the focus of the interpretation. The true value of a PHVA is the ability to compare management strategies and development scenarios, run sensitivity analyses, and determine the main influence(s) on population persistence.

Similar to the land use arrangement on Perdido Key, the Fort Morgan peninsula (occupied by ABM) consists of three areas of public lands separated by two areas of private lands, which allow for limited (varied) dispersal between the public lands. The current level of dispersal between public lands through private lands is unknown, but is affected by development and habitat degradation. Without dispersal between public lands through private lands, the PHVA results project the ABM to have a 41.2 percent $\pm$ 1.1 percent likelihood of extinction. If all privately-owned habitat between the public lands is lost, the likelihood of extinction increases to 46.8 percent $\pm$ 1.1 percent. Again, it can be inferred that a similar increase in risk of extinction would occur with the PKBM if dispersal could not occur through private lands.

Despite the similarities in the subspecies, it is important to note that carrying capacity (K), which was found to be a strong influence on the model, would be different in PKBM. For ABM, K was estimated using maximum ABM density estimates (4.5 to 11.6 ABM per acre) and acres of habitat (2,989 acres). As density estimates for PKBM would likely be lower, and remaining PKBM habitat is less than 1,300 acres, the Vortex model for PKBM would likely project a greater likelihood of extinction.

The Service contracted with the Georgia Cooperative Fish and Wildlife Research Unit to critique the PVAs for the ABM accomplished by Oli *et al.* (2001) and Conservation Breeding Specialist Group (Traylor-Holzer 2006). Conroy and Runge (2006) indicated that neither PVA provided reliable estimates of extinction probability for ABM. They recommended that future PVA work should incorporate sampling, temporal, and possibly spatial variance for input variables and should clearly and explicitly express uncertainty in extinction output. Until this can be done, reliable estimates of extinction probability for the ABM (and other beach mouse subspecies) cannot be estimated.

Species that are protected across their ranges have lower probabilities of extinction (Soulé and Wilcox 1980). Beach mouse populations persist naturally through local extirpations due to storm events or the harsh, stochastic nature of coastal ecosystems. Historically, these areas would be recolonized as population densities increase and dispersal occurred from adjacent populated areas. In addition, from a genetic perspective, beach mice recover well from population size reductions (Wooten 1994), given sufficient habitat is available for population expansion after the bottleneck occurs. As human development has fragmented the coastal dune landscape, beach mice can no longer recolonize along these areas as they did in the past (Holliman 1983). As a continuous presence of beach mice or suitable habitat along the coastline is no longer possible and any hurricane can impact the entire range of each subspecies, the probability of beach mice persisting would be enhanced by the presence of contiguous tracts of suitable habitat occupied by multiple independent populations (Shaffer and Stein 2000). The history of the PKBM alone illustrates the need for multiple populations (a now potentially extirpated population was the source of the two remaining populations of the subspecies) (Holler *et al.* 1989, 71 FR 60238). While maintaining multiple populations of beach mouse subspecies provides protection from total loss (extinction), especially when migration and relocations are possible (Oli *et al.* 2001), conservation of each subspecies necessitates protection of genetic variability throughout their ranges (Ehrlich 1988). Preservation of natural populations is therefore crucial, as the loss of a population of beach mice can result in a permanent loss of alleles (Wooten and Holler 1999). This loss of genetic variability cannot be regained through translocations or other efforts.

Status and Distribution

The distribution of all the beach mouse subspecies is significantly reduced from their historical ranges due to modification and destruction of the coastal dune ecosystem inhabit. Habitat loss and alteration was likely a primary cause of the extinction of one subspecies, the Pallid beach mouse, which was endemic to barrier beach between Matanzas and Ponce de Leon inlets in Volusia and Flagler Counties (Humphrey and Barbour 1981).

Atlantic Coast Beach Mice

The distribution of the SEBM has declined significantly, particularly in the southern part of its range. Historically, it was reported to occur along about 174 miles of Florida's central and southeast Atlantic coast from Ponce (Mosquito) Inlet, Volusia County, to Hollywood Beach, Broward County (Hall 1981). Bangs (1898) reported it as extremely abundant on all the beaches of the east peninsula from Palm Beach at least to Mosquito (Ponce) Inlet. During the 1990s, the SEBM was reported only from Volusia County (Canaveral National Seashore); in Brevard County (Canaveral National Seashore, Kennedy Space Center/Merritt Island NWR, and CCAFS); a few localities in Indian River County (Sebastian Inlet State Park, Treasure Shores Park, and several private properties), and St. Lucie County (Pepper Beach County Park and Fort Pierce Inlet State Park) (Humphrey *et al*. 1987, Robson 1989, Land Planning Group, Inc. 1991, Humphrey and Frank 1992b, Service 1993). The SEBM is geographically isolated from all other subspecies of beach mice.

Populations of the SEBM are still found on the beaches of Canaveral National Seashore, Merritt Island NWR, and CCAFS in Brevard County, all on federally protected lands. In April 2002, a population of SEBM was documented at the Smyrna Dunes Park, at the north end of New Smyrna Beach (Sauzo 2004). Populations from the north side of Sebastian Inlet appear to be extirpated

(Bard 2004). SEBM were documented on the south side of Sebastian Inlet in 2006, although none have been found since then.

The status of the species south of Brevard County is currently unknown. The surveys conducted during the mid-1990s indicated the distribution of this subspecies in the counties south of Brevard County was severely limited and fragmented. There are not enough data available to determine population trends for these populations. These surveys revealed that it occurred only in very small numbers where it was found. In Indian River County, the Treasure Shores Park population experienced a significant decline in the 1990s, and it is uncertain whether populations still exist at Turtle Trail or adjacent to the various private properties (Jennings 2004). Trapping efforts documented a decline from an estimated 300 individuals down to numbers in the single digits. In 2006, a population off Jungle Trail at Pelican Island NWR was discovered (Van Zant 2006). No beach mice were found during surveys in St. Lucie County and it is possible that this species is extirpated there. The SEBM no longer occurs at Jupiter Island, Palm Beach, Lake Worth, Hillsboro Inlet or Hollywood Beach (Service 1999).

The primary reason for the significant reduction in the range of the SEBM is the loss and alteration of coastal dunes. Large-scale commercial and residential development on the coast of Florida has eliminated SEBM habitat in the southern part of its range. This increased urbanization has also increased the recreational use of dunes, and harmed the vegetation essential for dune maintenance. Loss of dune vegetation results in widespread wind and water erosion and reduces the effectiveness of the dune to protect other beach mouse habitat. In addition to this increased urbanization, coastal erosion is responsible for the loss of the dune environment along the Atlantic coast, particularly during tropical storms and hurricanes. The extremely active 2004 hurricane season had a pronounced affect on Florida's Atlantic coast beaches and beach mouse habitat.

The encroachment of residential housing onto the Atlantic coast also increases the likelihood of predation and harassment by free-roaming cats and dogs. A healthy population of SEBM on the north side of Sebastian Inlet State Park in Brevard County was completely extirpated by 1972, presumably by free-roaming cats (Bard 2004). Urbanization of coastal habitat could also lead to potential competition of beach mice with house mice (*Mus musculus*) and introduced rats.

The distribution of the beach mouse is limited due to modification and destruction of its coastal habitats due mostly to developmental pressures. One additional Atlantic coast subspecies, the pallid beach mouse (*P. p. decoloratus*), was formerly reported from two sites in Volusia County, but extensive surveys provide substantial evidence that this subspecies is extinct (Humphrey and Barbour 1981).

The distribution of the AIBM has declined significantly, particularly in the northern part of its range. Historically, it was reported to occur from the vicinity of the Duval-St. Johns County line southward to Matanzas Inlet, St. Johns County, Florida (Humphrey and Frank 1992a). It currently occurs only on Anastasia Island, primarily at the north (ASP) and south (FMNM) ends of the island, although beach mice still occur at low densities in remnant dunes along the entire length of the island (Service 1993). The original distribution consisted of about 50 miles of beach; current populations occupy about 14 miles of beach with possibly only 3 miles supporting viable populations (Service 1993).

In 1992 to 1993, 55 mice (27 females and 28 males) were reintroduced to GMTNERR-Guana River in St. Johns County. In 1993, the population was estimated at 220 mice. Quarterly trapping has been conducted since the reintroduction and mice have not been captured since September 2006. This may be a result of habitat loss or alteration from storms and commercial and residential development.

The primary reason for the significant reduction in the range of the AIBM is the loss and alteration of coastal dunes. Large-scale commercial and residential development on the coast of Florida has eliminated AIBM habitat in the northern two-thirds of its range. This increased urbanization has also increased the recreational use of dunes, and harmed the vegetation essential for dune maintenance. Loss of dune vegetation results in widespread wind and water erosion and reduces the effectiveness of the dune to protect other beach mouse habitat. In addition to this increased urbanization, coastal erosion is responsible for the loss of the dune environment along the Atlantic coast, particularly during tropical storms and hurricanes. The extremely active 2004 hurricane season had a severe effect on Florida's Atlantic coast beaches and beach mouse habitat.

The encroachment of residential housing onto the Atlantic coast also increases the likelihood of predation by free-roaming cats and dogs. ASP has successfully reduced feral cat populations at the recreation area and has seen a benefit to the beach mice. Urbanization of coastal habitat could also lead to potential competition of beach mice with house mice and introduced rats.

Gulf Coast Beach Mice

PKBM populations have existed since the late 1970s as isolated populations along its historical range (16.9 miles). The effects of Hurricane Frederic (1979) coupled with increased habitat fragmentation due to human development led to the extirpation of all but one population of PKBM. The less than 30 individuals at Gulf State Park (at the westernmost end of Perdido Key) were once the only known existing population of PKBM (Holler *et al*. 1989). Beach mice from this site were used to reestablish PKBM at Gulf Islands National Seashore (GINS) between 1986 and 1988 (Holler *et al.* 1989). Then in 1999 the population at Gulf State Park was considered extirpated (Moyers *et al.* 1999). In 2000, 10 PKBM (five pairs) was relocated from GINS to PKSP. In February of 2001, this relocation was supplemented with an additional 32 PKBM (16 pairs). The PKBM were released on both north and south sides of SR 292 in suitable habitat. Two years of quarterly survey trapping indicated that the relocations of PKBM to PKSP were successful and this was considered an established population (Lynn and Kovatch 2004). PKBM were also trapped on private land between GINS and PKSP in 2004, increasing documentation of current occurrences of the mouse (Lynn 2004a). Based on the similarity of habitat between these areas and the rest of Perdido Key, as well as the continuity of the habitat, the mouse is believed to inhabit other private properties where suitable habitat exists north and south of SR 292. The PKBM is considered to occur on 42 percent of Perdido Key (1,227 acres of 2,949 acres) (**Table 13**).

Table 13. Perdido Key beach mouse habitat on Perdido Key in Florida and Alabama – 2007 estimate[1].

Area	Total in AL & FL		Total in Florida		Total in Alabama	
	Acres	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Perdido Key	2,949	100	2,615	89	334	11
PKBM habitat	**1,292**	100	**1,146**	**88**	148	12
Private lands	1,440	49	1,278	43	162	5
PKBM habitat	**302**	**23**	**270**	**24**	33	3
Public lands	1,509	51	1,337	45	172	6
			GINS		GSP	
			1,052		172	
			PKSP			
			285			
PKBM habitat	990	76	876	67	114	9
			GINS		GSP	
			638		114	
			PKSP			
			238			

[1]Data calculated by Service's Panama City, Florida using 2004 Digital Orthophoto Quarter-Quadrangle (DOQQ) aerial photography, 2005 parcel data from Baldwin County, Florida and 2005 parcel data from Escambia County, Florida and revised June 2006.

The listing of PKBM was based on data collected in 1983-84, and at that time the mouse was recovering from the effects of Hurricane Frederick in 1979. Following Hurricane Frederic estimated population numbers based on trapping were 13 PKBM found at one location (Gulf State Park). Just prior to listing, only one PKBM was captured in trapping surveys, this again being at Gulf State Park. Since that time, numbers have fluctuated dramatically based on hurricanes and/or translocation efforts, but were at their highest estimate ever documented just prior to Hurricane Ivan in 2004 at between 500-800 individuals. This was a result of significant partnership efforts and included translocation and habitat restoration on public lands. Even with the destructive hurricanes in 2004 and 2005, current numbers of PKBM, while low (no population estimates are available), are greater than one mouse and mice have been confirmed from two areas (PKSP and GINS). Survey efforts (tracking and trapping) have also been sporadic and inconsistent; therefore, it is difficult to establish long term trend information at this time.

CBM subpopulations currently persist along approximately 15 miles of Gulf of Mexico shoreline consisting of four isolated areas along 11 miles of beachfront within its former range. Another five miles outside of the CBM's known historical range has been recently colonized (Lynn, 2000a, 2003a). In the 1950s, the CBM was widespread and abundant at that time according to Bowen (1968). By 1979, Humphrey and Barbour (1981) reported only 40 percent of the original habitat remained undeveloped in noncontiguous areas. They also documented that the CBM had been extirpated from seven of its nine historical localities being restricted to the Topsail Hill area in Walton County and Shell Island in Bay County. In 1985 when the CBM became federally

protected, CBM were still only known from the Topsail Hill area and Shell Island, an area consisting of about 10 miles of coastline (50 FR 23872). In 1989, a cooperative interagency effort reintroduced CBM onto the central and west units of Grayton Beach State Park increasing the occupied coastline by another mile (Holler *et al*. 1989). In 1999, with the closing of East Pass and Shell Island connecting to West Crooked Island, CBM increased their range by approximately four miles (Lynn 2000b). CBM are now known to occupy approximately 15 miles of Gulf of Mexico beachfront; 12 of the 15 miles are publicly owned lands.

There are four subpopulations of CBM that exist: 1) Topsail Hill Preserve State Park (and adjacent eastern and western private lands), 2) Shell Island (includes St. Andrew State Park mainland and Shell Island with private inholdings and Tyndall AFB), 3) Grayton Beach (and adjacent eastern private lands), and 4) West Crooked Island. Approximately 96 percent of the lands known to be occupied by CBM are public lands. Translocations to establish a fifth subpopulation of CBM occurred in March of 2003 and 2005. CBM from Topsail Hill Preserve State Park were moved to private lands at Camp Creek/Water Sound in Walton County, Florida (Lynn 2003a, Service 2005a, 2005b, 2005c, 2005d).

Topsail Hill Preserve State Park consists of 1,637 acres of which 262 acres provide CBM habitat; the majority being occupied by CBM. The Florida Park Service prepared a Unit Management Plan for the Preserve that explicitly plans for conservation and protection of CBM habitats (FDEP 2007). Private lands on the east side consist of approximately 9.63 acres. Of that, 7 acres consist of the development known as the Stallworth Preserve. The Service issued an ITP for CBM associated with the Stallworth Preserve HCP in 1995; an amendment to the permit was issued in 1999. The remaining 2.63 acres has been purchased by Walton County with a grant from the Service. Private lands on the west side of the Preserve consist of 24 acres and include Four-Mile Village, a low density single family development, and the Coffeen Nature Preserve managed by the Sierra Club.

Shell Island consists of lands within the St. Andrew State Park, Tyndall AFB, and private lands. The Unit Management Plan for the State Park was completed in 1999. The plan identifies the need for protection and management of the CBM. Tyndall AFB manages their portion of Shell Island under the installation's Integrated Natural Resources Management Plan. The Service has joined with the State Park and Tyndall AFB since 1995 by providing funding to protect and restore CBM habitats on Shell Island.

The St. Andrew State Park mainland consists of 1,260 acres of which 123 acres are beach mouse habitat. Several tracking efforts looking for signs of CBM on the mainland were made between 1995 and 1998; no evidence was found that indicated the presence of the beach mouse (Moyers 1996, Moyers *et al.* 1999). However, live-trapping to document the absence of the mouse has not been conducted. Reintroduction of this area is considered an action to support recovery of CBM.

The Grayton Beach subpopulation consists of two units in Grayton Beach State Park. The Park is divided into a central and western unit and is currently connected by a narrow band of primary dunes. Total acreage of the Park is 2,236 acres with 153 acres providing suitable CBM habitat. The Unit Management Plan for the Park identified the protection of the CBM as an important component. The Park has requested and received funds from the Service to implement CBM habitat restoration and protection. Portions of private lands (WaterColor and Seaside developments) on the east side of the central unit are occupied by CBM or provide suitable habitat.

West Crooked Island consists of 1,558 acres of which 730 acres provide CBM habitat and remains occupied by CBM (Lynn 2004b). The West Crooked Island subpopulation resulted from its connection to Shell Island in 1998 -1999. The construction of the St. Andrew Pass navigation inlet in the early 1930s severed Shell Island from the mainland on its western end. Since then, the original pass, East Pass (or Old Pass) began to close. After passage of Hurricane Opal in 1995, East Pass temporarily closed and reopened; however, after passage of hurricanes Earl and Georges in 1998, the pass closed (Coastal Tech 1999, Middlemas 1999). CBM dispersed onto West Crooked Island from Shell Island colonizing most of the island within two years (Lynn 2004b). East Pass was reopened as a joint venture between Tyndall AFB and Bay County in December of 2001 but has since closed again.

SABM is now known to consist of two subpopulations, East Crooked Island and St. Joseph Peninsula State Park. The majority of the East Crooked Island subpopulation is located on Tyndall AFB and the other on the St. Joseph Peninsula State Park. Other important public lands for the conservation of the mouse would include Eglin Air Force Base lands at Cape San Blas and Billy Joe Rish Park. Private lands adjacent to Tyndall AFB and the State Park are either known to be occupied by SABM or contain habitat. Trapping by St Joe/Arvida on about 111 acres of SABM habitat at East Crooked Island was conducted in 2000, 2001, and 2003. The trapping confirmed existence of SABM on the property (Moyers and Shea 2002). However, trapping their property in St. Joseph Beach did not result in capture of any beach mice (Moyers and Shea 2002). Although SABM is thought to continue to occupy habitat south of St. Joseph Peninsula State Park, only tracking has been conducted to confirm its presence on private lands since the late 1990s. Private lands adjacent to public lands are available for population dispersal and food source during periods of high population and after severe weather events. However, subpopulations on large tracts of private land within the historical range of the subspecies are needed for conservation of the SABM.

Land development has been primarily responsible for the permanent loss of SABM habitat along its approximately 40-mile long historical range. In addition, construction of U.S. highway 98 accelerated the habitat loss from associated development. By the mid 1990's about 12 linear miles were known to be occupied (Gore 1994, 1995), indicating a 68 percent reduction in it historical distribution (63 FR 70053). An effort to re-establish the SABM back into its historical range was initiated around the time of listing (Moyers *et al.* 1999); however, the range reduction described above did not take this into account since the success of the reintroduction was not known at the time (63 FR 70053). Similar analyses have not been conducted since.

Our best documentation of the species' decline can be seen from trapping or tracking surveys conducted at various times throughout its range. By the mid to late 1980's concerns were raised when trapping efforts failed to result in captures at West Crooked Island (Gore 1987). By 1990 the SABM appeared to only inhabit a small portion (approximately 11 linear miles) of its original range: west end of East Crooked Island and within St. Joseph Peninsula State Park (Gore 1990). SABM's apparent decline continued into the mid-1990's when in 1994, the population on East Crooked Island was "presumed to be extinct" (Wooten and Holler 1999), leaving only one known population on St. Joseph Peninsula (Moyers *et al.* 1999). Subsequent reintroduction efforts in 1997-1998 appeared to have re-established the population on East Crooked Island (Moyers *et al.* 1999).

Recovery Criteria

The Recovery Plan for the SEBM identifies the primary recovery objectives for the subspecies (Service 1993). The SEBM can be considered for delisting if 10 viable, self-sustaining populations can be established throughout a significant portion of its historical range. More specifically, delisting can be considered if the following conditions are met:

1. Viable populations are maintained on the five public land areas where the subspecies currently occurs. Each population should not fluctuate below an effective breeding size of 500 individuals;

2. Five additional viable populations are established throughout the historical range of the subspecies; and

3. These populations should be monitored for at least five years.

The Recovery Plan for the AIBM identifies the primary recovery objectives for the subspecies (Service 1993). The AIBM can be considered for reclassification from endangered to threatened status if five viable, self-sustaining populations can be established. Because the majority of this subspecies' historical range has been permanently destroyed, it is not likely that it can be fully recovered or delisted. For the AIBM to be considered for downlisting to threatened, it is required that those populations at the northern and southern end of Anastasia Island continue to be viable. Each population should support a breeding population of 500 individuals. Two additional viable populations shall be established within the mainland portion of the historical range. All of these populations should be monitored for five years.

The Recovery Plan for the PKBM, CBM, and ABM identifies the primary recovery objectives to be the stabilization of present populations by preventing further habitat deterioration, and the reestablishment of populations in areas where they were extirpated (Service 1987). For each of the subspecies to be considered for downlisting to threatened, it is required that there be a minimum of at least three distinct self-sustaining populations in designated critical habitat with at least 50 percent of the critical habitat being protected and occupied by beach mice (Service 1987).

While this is the currently approved Recovery Plan for the three beach mouse subspecies, studies and research since the Recovery Plan publication provided additional information concerning recovery needs for the subspecies. Protection and enhancement of existing populations and their habitat, plus reestablishment of populations in suitable areas within their historical ranges, are necessary for the subspecies survival and recovery. Core beach mouse populations remain isolated and are vulnerable to natural and anthropogenic factors that may further reduce or degrade habitat and/or directly reduce beach mouse population sizes. Maximizing the number of independent populations is critical to species survival. Protection of a single, isolated, minimally viable population risks the extirpation or extinction of a species as a result of harsh environmental conditions, catastrophic events, or genetic deterioration over several generations (Kautz and Cox 2001). To reduce the risk of extinction through these processes, it is important to establish multiple protected populations across the landscape (Soulé and Simberloff 1986, Wiens 1996). Through the critical habitat designation process we are addressing this by designating five independent units for the subspecies spaced throughout its historical range, depending on the

relative fragmentation, size, and health of habitat, as well as availability of areas with beach mouse PCEs.

The Service completed a five-year status review of the CBM and PKBM in August 2007 (Service 2007a, 2007b). For both subspecies the following was recommended: designate a beach mouse recovery coordinator; revise the recovery plan; accomplish viable populations, monitor habitat improvement, corridor persistence and hurricane response; conduct genetic studies and translocations as necessary; participate in education and outreach and complete an emergency response plan. A draft Recovery Plan for the SABM has been completed and distributed for public review..

In accordance with the Act, Federal agencies (including the Service) consult with the Service for actions that may adversely affect beach mice and their designated habitat. In Florida, consultations have included military missions and operations, beach nourishment and other shoreline protection, and actions related to protection of coastal development (**Table 14**).

Table 14. Previous biological opinions within Florida that have been issued for projects that had adverse impact to the nesting beach mice.

PROJECT	YEAR	IMPACT (Habitat/critical habitat/individuals)
GINS Dune Protection (PKBM)	2000	0.01 acre (CH)
Translocation to PKSP (PKBM)	2000	≤ 3 beach mice (source mice from CH; relocation to CH and non-CH in PKSP)
Supplemental translocation to PKSP (PKBM)	2003	≤ 3 beach mice (source mice from CH; relocation to CH and non-CH in PKSP)
FEMA Berm Orange Beach, AL (PKBM)	2003	0.14 acre non-CH
Service scientific collecting permit program (PKBM)	2004-2005	1 beach mouse per 400 trap-nights per area (partial CH)
Florencia Development (within Action Area) (PKBM)	2005	3.5 acres (non-CH)
PKSP Re-build (PKBM)	2005	1.99 acres (CH)
FEMA Berm Emergency consultation (within Action Area) (PKBM)	2005	Consultation not complete (non-CH)
GINS road rebuild (PKBM)	2005	1.7 acres (CH)
Magnolia West Development (within Action Area) (PKBM)	2006	5.2 acres (not CH at time of construction, presently CH)
Palazzo Development (PKBM)	2006	0.58 acre (not CH at time of construction, presently CH)
Searinity Development (PKBM)	2006	0.32 acre (not CH at time of construction, presently CH)

Retreat Development (PKBM)	2006	0.21 acre (not CH at time of construction, presently CH)
Bond Residence (PKBM)	2006	0.17 acre (CH)
Three-batch condo (Island Club, Marquesas, Lorelei) (PKBM)	2007	0.95 acres (CH)
Naval Air Station Pensacola Pensacola Pass navigation channel dredging (PKBM)	2007	6.3 miles (CH)
Paradise Island development (PKBM)	2007	0.91 acres (CH)
Calabria condo development (PKBM)	2008	0.33 acres (non-CH)
Escambia County beach nourishment (PKBM)	2008	0.16 acres (partial CH)
Seabreeze Condominiums (PKBM)	2009	0.39 acres
Spanish Key Parking Lot (PKBM)	2009	0.28 acres
Perdido Key Fire Station (PKBM)	2010	0.43 acres (CH)
Stallworth Preserve Development (CBM)	1995	7 acres (CH)
Navy Panama City Beach site 4 construction (CBM)	2000	0.01 acre (CH)
East Pass Re-opening (CBM)	2001	Temporary, indirect take (CH)
WaterColor and WaterSound Developments (CBM)	2000	7.6 acres (non-CH)
Service scientific collecting permit (CBM)	2004-2005	1 beach mouse per 400 trap-nights per area (partial CH)
FEMA beach berms post hurricane Ivan emergency consultation (CBM)	2005	Consultation not complete (partial CH)
Western Lake Reopening consultation (CBM)	2006	2.7 acres annually for 5 years (CH)
FEMA Statewide post-disaster berm programmatic BO (PKBM, CBM, SABM, AIBM, and SEBM)	2007	75 miles for eroded shoreline(partial CH)
Angelos Development (CBM)	2009	0.42 acres
Bonfire Beach (SABM)	2008	38 acres
Ovation (SABM)	2010	5.41 acres (CH)

Sea Colony Development (AIBM)	1998	0.7 acres (non-CH)
Anastasia State Park beach nourishment (AIBM)	2005	50 linear feet (non-CH)
Service scientific collecting permit program (AIBM)	2004-2005	1 beach mouse per 400 trap-nights per area (non-CH)
Rodent Control Program on CCAFS (SEBM)	2002	50 beach mice
Cape Canaveral Air Force borrow source (SEBM)	2007	300 linear feet (non-CH)
Service scientific collecting permit program (SEBM)	2004-2005	1 beach mouse per 400 trap-nights per area (non-CH)
CCAFS Routine Maintenance Programmatic (SEBM)	2008	Temporary loss of habitat during trenching/digging for pipeline installation and repair, roadside mowing, soil remediation, pole placement, wells, soil boring, lines of sight, scrub restoration

Common Threats to Beach Mice in Florida

Habitat Loss or Degradation

Coastal dune ecosystems are continually responding to inlets, tides, waves, erosion and deposition, longshore sediment transport and depletion, and fluctuations in sea level. The location and shape of barrier island beaches perpetually adjusts to these physical forces. Winds move sediment across the dry beach forming dunes and the island interior landscape. The natural communities contain plants and animals that are subject to shoreline erosion and deposition, salt spray, wind, drought conditions, and sandy soils. Vegetative communities include foredunes, primary and secondary dunes, interdunal swales, sand pine scrub, and maritime forests. During storm events, overwash is common and may breach the island at dune gaps or other weak spots, depositing sediments on the interior and backsides of islands, increasing island elevation and accreting the sound shoreline. Breaches may result in new inlets through the island.

The quality of the dune habitat (primary, secondary, and scrub) is an important factor in maintaining and facilitating beach mouse recovery. Habitat manipulation is an old and widely used tool in wildlife management. It is especially useful in improving habitat suitability to increase local populations of a species. For beach mice, improving habitat can enhance the abundance and diversity of food resources, increase the chances of meeting a mate, and reduce competition for food and burrow sites.

Long term trapping data has shown that beach mouse densities are cyclic and fluctuate by order of magnitude on a seasonal and annual basis. These fluctuations can be a result of reproduction rates, food availability, habitat quality and quantity, catastrophic events, disease, and predation (Blair 1951, Bowen 1968, Smith 1971, Hill 1989, Rave and Holler 1992, Swilling *et al.* 1998, Swilling 2000, Sneckenberger 2001). Without suitable habitat sufficient in size to support the natural cyclic nature of beach mouse populations, subspecies are at risk from local extirpation and extinction,

and may not attain the densities necessary to persist through storm events and seasonal fluctuations of resources.

Habitat loss and fragmentation associated with residential and commercial real estate development is the primary threat contributing to the endangered status of beach mice (Holler 1992a, 1992b, Humphrey and Frank 1992a). Coastal commercial and residential development has fragmented all the subspecies into disjunct populations. Isolation of habitats by imposing barriers to species movement is an effect of fragmentation that equates to reduction in total habitat (Noss and Csuti 1997). Furthermore, isolation of small populations of beach mice reduces or precludes gene flow between populations and can result in the loss of genetic diversity. Demographic factors such as predation (especially by cats), diseases, and competition with house mice, are intensified in small, isolated populations, which may be rapidly extirpated by these pressures. Especially when coupled with events such as storms, reduced food availability, and/or reduced reproductive success, isolated populations may experience severe declines or extirpation (Caughley and Gunn 1996). The influence these factors have on populations or individuals is largely dependent on the degree of isolation.

The conservation of multiple large, contiguous tracts of habitat is essential to the persistence of beach mice. At present, large parcels of land exist mainly on public lands. Protection, management, and recovery of beach mice on public areas have been complicated by increased recreational use as public lands are rapidly becoming the only natural areas left on the coast. Public lands and their staff are now under pressure to manage for both the recovery of endangered species and recreational use. Where protection of large contiguous tracts of beach mouse habitat along the coast is not possible, establishing multiple independent populations is the best defense against local and complete extinctions due to storms and other stochastic events (Danielson 2005). Protecting multiple populations increases the chance that at least one population within the range of a subspecies will survive episodic storm events and persist while vegetation and dune structure recover.

Habitat connectivity also becomes essential where mice occupy fragmented areas lacking one or more habitat types. If scrub habitat is lacking from a particular tract, adjacent or connected tracts with scrub habitat are necessary for food and burrow sites when resources are scarce in the frontal dunes, and are essential to beach mouse populations during and immediately after hurricanes. Trapping data suggests that beach mice occupying the scrub following hurricanes recolonize the foredune once vegetation and some dune structure have recovered (Swilling *et al*. 1998, Sneckenberger 2001). Similarly, when frontal dune habitat is lacking from a tract and a functional pathway to frontal dune habitat does not exist, beach mice may not be able to attain the resources necessary to expand the population and reach the densities necessary to persist through the harsh summer season or the next storm. Functional pathways may allow for natural behavior such as dispersal and exploratory movements, as well as gene flow to maintain genetic variability of the population within fragmented or isolated areas. To that end, contiguous tracts or functionally connected patches of suitable habitat are essential to the long-term conservation of beach mice.

A lack of suitable burrow sites may be a consequence of habitat degradation. Beach mice use burrows to avoid predators, protect young, store food, and serve as refugia between foraging bouts and during periods of rest. Beach mice have been shown to select burrow sites based on a suite of abiotic and biotic factors. A limitation in one or more factors may result in a shortage of suitable sites and the availability of potential burrow sites in each habitat may vary seasonally. Beach mice

tend to construct burrows in areas with greater plant cover, less soil compaction, steep slopes, and higher elevations above sea level (Lynn 2000a, Sneckenberger 2001). These factors are likely important in minimizing energy costs of burrow construction and maintenance while maximizing the benefits of burrow use by making a safe and physiologically efficient refuge. Similar to food resources, this fluctuation in availability of burrow sites suggests that a combination of primary, secondary, and scrub dune habitat is essential to beach mice at the individual level.

Predation

Beach mice have a number of natural predators including coachwhip (*Masticophis flagellum*) corn snakes (*Elaphe guttata guttata*), pygmy rattlesnake (*Sistrurus miliarius*), eastern diamondback rattlesnake (*Crotalus adamanteus*), short-eared owl (*Asio flammeus*), great-horned owl (*Bubo virginianus*), great blue heron (*Ardea herodias*), northern harrier (*Circus cyaneus*), red fox, gray fox, skunk (*Mephitis mephitis*), weasel (*Shallela frenata*), and raccoon (Blair 1951, Bowen 1968, Holler 1992a, Novak 1997, Moyers *et al.* 1999, Van Zant and Wooten 2003). Predation of beach mouse populations that have sufficient recruitment and habitat availability is natural and not a concern. However, predation pressure from natural and non-native predators may result in the extirpation of small, local populations of beach mice.

Free-roaming cats are believed to have a devastating effect on beach mouse persistence (Bowen 1968, Linzey 1978) and are considered to be the main cause of the loss of at least one population of beach mice (Holliman 1983). Cat tracks have been observed in areas of low trapping success for beach mice (Moyers *et al.* 1999). The PHVA for the ABM indicated that if each population had as few as one cat, which ate one mouse a day, rapid extinction would occur in over 99 percent of all iterations (Traylor-Holzer 2005).

In response to increasing depredation of sea turtle nests by coyote, fox, hogs, and raccoon, multi-agency cooperative effort have been initiated and are ongoing throughout Florida, in particular on public lands. These programs also benefit beach mice.

Hurricanes

Hurricanes can severely affect beach mice and their habitat, as tidal surge and wave action overwash habitat, leaving a flat sand surface denuded of vegetation; sand is deposited inland, completely or partially covering vegetation; blowouts between the ocean and bays and lagoons leave patchy landscapes of bare sand; primary dunes are sheared or eroded; and habitat is completely breached, creating channels from the ocean to bays and lagoons. Other effects include direct mortality of individuals, relocation/dispersal, and subsequent effects of habitat alterations (that impact such factors as forage abundance/production and substrate elevation). Habitat impacts can be widespread, encompassing the range of the subspecies.

Until frontal dune topography and vegetation redevelop, scrub habitat maintains beach mice populations and provides the majority of food resources and potential burrow sites (Lynn 2000a, Sneckenberger 2001). While storms temporarily reduce population densities (often severely), this disturbance regime maintains open habitat and retards plant succession, yielding a habitat more suitable for beach mice than one lacking disturbance. The low-nutrient soil of the coastal dune ecosystem often receives a pulse of nutrients from the deposition of vegetative debris along the

coastline (Lomascolo and Aide 2001). Therefore, as the primary and secondary dunes recover, beach mice recolonize this habitat readily as food plants develop to take advantage of the newly available nutrients. Recovery times vary depending upon factors such as hurricane characteristics (*i.e.*, severity, amount of associated rain, directional movement of the storm eye, storm speed), successional stage of habitat prior to hurricane, elevation, and restorative actions post hurricane. Depending on these factors, recovery of habitat may take from one to over 40 years.

The impact of hurricanes on plant communities temporarily affects food availability, and hence can limit population densities in impacted habitats soon after storms. Observations indicate that Hurricane Opal (a Category 3 storm in November 1995) caused a decrease in one population of ABM by 30 percent (Swilling *et al.* 1998). However, population densities in scrub habitat typically increased following hurricanes (Swilling *et al.* 1998). Sneckenberger (2001) also found atypical numbers of ABM in scrub following a hurricane. Five months post-storm, "densities (individuals/km) were up to 7.5 times greater in scrub areas than in frontal dune grids." Impacts of the storm may have been apparent as long as 17 months after the storm when scrub densities remained triple those of frontal dunes (Sneckenberger 2001). Moyers *et al.* (1999) found similar results for CBM at Grayton Beach State Park. When frontal and primary dunes sustained extensive damage during Hurricane Opal in 1995, beach mice were captured behind what remained of primary dune habitat. By 1998, however, primary dunes and the immediate habitat inland appeared to support higher numbers of beach mice.

In addition to the overall change in post Hurricane Opal distribution of ABM, Swilling *et al*. (1998) found the mean percent of newly marked individuals increased from 14 percent for the three trapping periods before the storm to an average of 26.7 percent for the same interval post hurricane. The average for the three trapping periods immediately following was even higher, at 42.7 percent of the individuals captured. Swilling *et al.* (1998) concluded that this increased presence of new individuals reflected increased reproduction. A statistical analysis of the data indicated that the number of females exhibiting signs of reproduction was significantly higher than normal (18.9 percent higher). Moyers *et al.* (1999) also found similar results at Topsail Hill Preserve State Park. Four to five months following Hurricane Opal, all female CBM captured were pregnant or lactating. Trapping six months after the hurricane, Moyers *et al.* (1999) noted that 51.5 percent of captured CBM were new unmarked beach mice.

Although hurricanes can significantly alter beach mouse habitat and population densities in certain habitats, some physical effects may benefit the subspecies. Hurricanes are probably responsible for maintaining coastal dune habitat upon which beach mice depend through repeated cycles of destruction, alteration, and recovery of dune habitat. Holler *et al.* (1999) suggested that hurricanes could function to break up population subgroups and force population mixing. The resultant breeding between members of formerly isolated subgroups increases genetic heterogeneity and could decrease the probability of genetic drift and bottlenecks.

Beachfront Lighting

Artificial lighting increases the risk of predation and influences beach mouse foraging patterns and natural movements as it increases their perceived risk of predation. Foraging activities and other natural behaviors are influenced by many factors. Artificial lighting alters behavior patterns

causing beach mice to avoid otherwise suitable habitat and decreases the amount of time they are active (Bird *et al.* 2004).

The presence of vegetative cover reduces predation risk and perceived predation risk of foraging beach mice, and allows for normal movements, activity, and foraging patterns. Foraging in sites with vegetative cover is greater and more efficient than in sites without cover (Bird 2002). Beach mice have also been found to select habitat for increased percent cover of vegetation, and decreased distance between vegetated patches (Smith 2003).

Genetic variability

Selander *et al.* (1971) conducted an electrophoretic study on 30 populations of *P. polionotus*, including populations of beach mouse subspecies. Based on 30 allozyme loci, they estimated that the level of allozyme variation found in beach mouse populations was at least 40 percent lower than the level of variation in nearby inland populations. This work indicates that beach mouse populations already have lower genetic variability before inbreeding, bottleneck events, or founder effects that may occur in a reintroduced population. Lower levels of heterozygosity has been linked to less efficient feeding, fewer demonstrations of social dominance and exploratory behavior, and smaller body size (Smith *et al.* 1975, Garten 1976, Teska *et al.* 1990). Research focused on inbreeding depression in old-field mice (including one beach mouse subspecies), determined that the effects of inbreeding negatively influenced factors such as litter size, number of litters, and juvenile survivorship (Lacy *et al.* 1995).

In 1995, the Service contracted with Auburn to conduct genetic analysis of: 1) post-reestablishment gene structure in PKBM and CBM; 2) microgeographic patterning and its relevance to alternate management approaches for ABM on the Bon Secour NWR; and 3) if feasible, the historical relationship of SABM from Crooked Island relative to CBM from Shell Island and SABM from St. Joseph Peninsula.

Results of the work for CBM found: 1) founder effects were observed in the Grayton Beach State Park population (fixation of alleles common to the donor population and allele frequency shifts); 2) incongruity in number and size of several alleles was observed between Grayton Beach State Park and Shell Island; 3) overall genetic divergence between the donor and reestablished population was moderate; 4) genetic differences between Topsail Hill Preserve State Park and other CBM sites were higher than expected given the spatial proximity; 5) Topsail Hill Preserve State Park appears to be a reservoir for unique variation within the remaining populations of CBM; and 6) the overall relatedness estimated for Grayton Beach State Park suggested that any mating would involve close relatives (Wooten and Holler 1999).

Wooten and Holler (1999) recommended strategies for management of CBM based on genetics. Management of the Grayton Beach State Park population for genetic characteristics appears to be needed; however, additional genetic analyses will be needed. Relocation of CBM to Grayton Beach State Park from Shell Island should be continued.

Results of the work for PKBM found that: 1) founder effect (from Florida Point to GINS) did impact the GINS-Perdido Key Area subpopulation. Loss of rare alleles and allele frequency shifts were noted; 2) a low to moderate level of overall genetic divergence was observed; 3) data

suggests that some effects of genetic drift were mediated by continued transfer of individuals; 4) levels of heterozygosity were unexpected given recent history; 5) average levels of relatedness among individuals is high which may portend future inbreeding related problems (however, no evidence of existing inbreeding was observed in the data); and 6) the overall level of microsatellite variation retained in the GINS-Perdido Key Area subpopulation was higher than anticipated. Wooten and Holler (1999) recommended management of PKBM based on genetics by: 1) preserving the natural population to the maximum extent possible since the loss of the Florida Point subpopulation resulted in the permanent loss of alleles; 2) using the GINS-Perdido Key Area subpopulation as a donor for reestablishment of other populations because of the retention of a substantial amount of genetic variation; and 3) reestablishment plans should include transfers between donor and reestablished subpopulations. In addition, translocations should be accomplished in pairs.

Analysis of genetic work focused on SABM indicated that there are two possible genetic histories for Crooked Island beach mice: 1) the last known beach mice from Crooked Island were derived from CBM or 2) the last known beach mouse from Crooked Island were unique from both CBM found on Shell Island or SABM found on St. Joseph peninsula (Van Zant 2003).

Climate Change (refer to page 43)

Analysis of the Species/Critical Habitat Likely to be Affected

Beach mice are currently federally protected because of their low numbers caused by habitat loss with continuing threats to their habitat (including critical habitat for CBM, PKBM, and SABM) and resulting affects from storm and post-storm events. The primary reason for the significant reduction in their range is the loss and alteration of coastal dunes. Large-scale commercial and residential development on the coast of Florida has eliminated beach mouse habitat. Coastal urbanization has also increased the recreational use of beachfront areas. Dune habitat maintenance is an important component of beach mouse conservation. Providing a healthy and continuous dune system assures mouse population stability. Integral to this is keeping visitors to the beach off the dunes and replanting as necessary when impacts occur or are observed. The extremely active 2004 and 2005 hurricane seasons also had a severe affect on Florida's beaches and beach mouse habitat.

Critical habitat for three (PKBM, CBM, and SABM) of the five subspecies of beach mice has been designated and will be discussed. No critical habitat has been designated for the other two subspecies (SEBM and AIBM). Therefore, the proposed action would have no effect on designated critical habitat for these two subspecies because none is designated.

Generally, sand placement activities or dredged navigation channel material is not placed on existing beach mouse habitat consisting of vegetated dunes. Typical effects from these activities to beach mice and their habitats consist of the staging and storage of equipment, work vehicles, or materials and beach access for sand placement activities or dredged material placement. These effects may result in the permanent and temporary loss, degradation, or fragmentation of beach mouse habitat and changes in essential life history behaviors (dispersal and movement, foraging, seeking mates, breeding, and care of young). Beach mice spend their entire lives within the dune ecosystem and are nocturnal. Sand placement projects may occur at anytime of the year depending on their location and are usually conducted on a 24/7 schedule. The quality of the placed sand

could affect the suitability of the beach and dunes to support beach mouse burrow construction and food sources. The effect of the activities covered under the consultation with incorporation of the proposed conservation measures on beach mice overall survival and recovery are considered in this SPBO.

ENVIRONMENTAL BASELINE

Status of the species/Critical Habitat within the Action Area (all subspecies of beach mice)

The action area encompasses the entire range of five subspecies of beach mice, and designated critical habitats of three beach mouse subspecies. Therefore, the previous discussion in "Status of the Species" applies here. The known distribution of the five subspecies of beach mice is a result of cursory surveys and intermittent trapping involving different projects. There has not been a systematic trapping study done in order to determine the status of each subspecies throughout their ranges.

Factors affecting the species environment within the action area

Coastal development

Beach mice were listed as endangered and threatened species primarily because of the fragmentation, adverse alteration, and loss of habitat due to coastal development. The threat of development-related habitat loss continues to increase. Other contributing factors include low population numbers, habitat loss from a variety of reasons (including hurricanes), predation or competition by animals related to human development (cats and house mice), and the existing strength or lack of regulations regarding coastal development.

Hurricanes

Hurricanes were probably responsible for maintaining coastal beach habitat upon which beach mice depend through repeated cycles of destruction, alteration, and recovery of dune habitat. Hurricanes generally produce damaging winds, storm tides and surges, and rain and can result in severe erosion of the beach and dune systems. Overwash and blowouts are common on barrier islands. Hurricanes can impact beach mice either directly (e.g., drowning) or indirectly (e.g., loss of habitat). Depending on their frequency, storms can affect beach mice on either a short-term basis (e.g., temporary loss of habitat) or long term (e.g., loss of food, which in turn may lead to increased juvenile mortality, resulting in a depressed breeding season). How hurricanes affect beach mice also depends on the characteristics (winds, storm surge, rainfall), the time of year (within or outside of the nesting season), and where the northeast edge of the hurricane crosses land.

Because of the limited remaining habitat, frequent or successive severe weather events could compromise the ability of certain populations of beach mice to survive and recover. Beach mice evolved under natural coastal environmental events such as hurricanes. The extensive amount of predevelopment coastal beach and dune habitat allowed beach mice to survive even the most severe hurricane events. It is only within the last 20 to 30 years that the combination of habitat loss to beachfront development and destruction of remaining habitat by hurricanes has increased the threat to beach mice survival and recovery. On developed beaches, typically little space

remains for sandy beaches to become re-established after periodic storms. While the beach itself moves landward during such storms, reconstruction or persistence of structures at their prestorm locations can result in a major loss of habitat for beach mice.

The 2004 hurricane season was the most active storm season in Florida since weather records began in 1851. Hurricanes Charley, Frances, Ivan, and Jeanne, along with Tropical Storm Bonnie, damaged the beach and dune system, upland structures and properties, and infrastructure in the majority of Florida's coastal counties. The cumulative impact of these storms exacerbated erosion conditions throughout the state.

The 2005 hurricane season was a record-breaking season with 27 named storms. Hurricanes Dennis, Katrina, Ophelia, Rita, and Wilma, and Tropical Storms Arlene and Tammy impacted Florida. The cumulative impact of these storms exacerbated erosion conditions in south and northwest Florida.

Beachfront Lighting

Artificial lighting along developed areas of both coastlines continues to cause increase susceptibility to predators, altered foraging and breeding habits which impact beach mouse recovery. While a majority of coastal local governments and counties have adopted beachfront lighting ordinances compliance and enforcement is lacking in some areas. Further, the lighting in areas outside the beachfront ordinance coverage areas continues to be unregulated resulting in urban glow. Even the darker areas of conservation managed lands are subject to surrounding sky glow.

Predation

A major continuing threat to beach mice is predation by free-roaming cats and other nonnative species. The domestic cat is not native to North America and is considered a separate species from its wild ancestral species, *Felis silvestris*. Cats are hunters, retaining this behavior from their ancestors. However, wildlife in the western Hemisphere did not evolve in the presence of a small, abundant predator like the domestic cat, and thus did not develop defenses against them. Cats were introduced to North America a few hundred years ago.

Free-roaming pets prey on small mammals, birds, and other native wildlife. In the U.S., on a nationwide basis, cats kill over a billion small mammals and hundreds of millions of birds each year. Worldwide, cats are second only to habitat destruction in contributing to the extinction of birds. Cats have been documented to take beach mice, sea turtle hatchlings, shorebirds, and migratory birds. A significant issue in the recovery of beach mice is predation by free-ranging pet and feral cats. Beach mice have a number of natural predators including snakes, owls, herons, and raccoons. Predation is part of the natural world. However, predation pressure from both natural and nonnative predators may result in the extirpation of small, local populations of beach mice in a very short time (Bowen 1968, Linzey 1978).

Climate Change

Based on the present level of available information concerning the effects of global climate change on the status of beach mice and its designated critical habitat, the Service acknowledges the potential for changes to occur in the action area, but presently has no basis to evaluate if or how these changes are affecting beach mice or its designated critical habitat nor does our present knowledge allow the Service to project what the future effects from global climate change may be or the magnitude of these potential effects.

EFFECTS OF THE ACTION

Factors to be considered

Aspects of the sand placement and dredged material placement activities will occur within habitat that is used by beach mice year round. The activities include the storage of equipment, work vehicles, or materials and creation, expansion, or use of beach access points for sand placement activities or dredged material placement. The work, depending on the location, may be conducted any time of the year. Most effects would be expected to be temporary. These short-term and temporary impacts could include loss of foraging habitat, altered beach mouse movement and dispersal activities. Long-term and permanent impacts from the sand placement activities such as excavation of dune habitat and degradation could impact beach mice by fragmentation of their habitat including critical habitat for the PKBM, CBM, and SABM.

There are typically different "levels" of access sites needed for a project. The primary access is a "lay-down" yard, where pipe is delivered and stored, and storage trailers, and other equipment and materials are stored. These are typically big paved parking lots, so that the Corps's trucks can access the area to drop off and pick up equipment. There's typically a beach access at that point to get the pipe and equipment onto the beach and that access is usually at least 50-ft wide (pipe sections are typically 40 to 50 feet long). In NW Florida and Alabama, these yards have been approximately eight miles apart.

“Intermediate areas" are used at about the quarter points of the project length. These are used for the fuel tank, welding equipment, and other items or systems that get used a couple of times a day. These locations can vary from two to three miles apart. In addition, there are access points to allow project vehicles and trucks on and off the beach. Based on previous projects it would be expected to have single-vehicle entry points at one-half to one-mile intervals.

Protective, avoidance, and minimization measures have been incorporated into the project plan to avoid or minimize the potential impacts from the sand placement and dredged material placement activities. However, even with these measures, impacts to beach mice are expected to occur from some aspects of the project activities. The activities are expected to directly or indirectly adversely affect beach mice and/or their habitat including designated critical habitat for the PKBM, CBM, and SABM. The work may occur on public and/or private lands.

Proximity of Action: Some aspects of the sand placement and dredged material placement activities would occur directly in beach mouse habitat. The storage or staging of pipe and other equipment, and vehicles, use or creation of beach access points, and placement of pipe, nourishment or dredged material could occur in habitat occupied or used by SEBM, AIBM, PKBM, CBM, and SABM. Beach mice spend their entire life cycle within the coastal dune

system.

Distribution: The storage or staging of pipe and other equipment and vehicles and use of beach access points that could occur in habitat occupied or used by SEBM, AIBM, PKBM, CBM, and SABM may vary depending on the individual project length and existing beach accesses and non-beach mouse habitat that can be used for storage and staging.

Timing: The timing of the activities would directly and indirectly impact beach mice and their habitat depending on the season. Beach mice reproduce year-round with more mice being produced in the late winter and early spring. Impacts could include but would not be limited to disrupting mice seeking mates, constructing nest burrows, foraging for food, caring for their young, and young mice leaving the nest burrow dispersing into new habitat.

Nature of the Effect: The effects of the activities may include the temporary loss of habitat including the loss of a few beach mice from excavation of habitat for beach access and reduction of beach mouse activity including feeding, reproduction, and movement from loss or alteration of habitat. Activities that decrease the amount or quality of dune habitat or movement could affect beach mice by reducing the amount of available habitat and fragmenting the habitat.

Duration: Time to complete the project construction may vary depending on the project length, weather, and other factors (equipment mobilization and break downs, availability of fuel, lawsuits, etc.). Project work could take as little as a month and as long as a one or two years. Beach mouse habitats would remain disturbed until the project is completed and the habitats are restored. Dune restoration could be complete from 6 to 12 months after the project has been completed. The short generation time of beach mice combined with the time frames provided in this document (projects from 1 month to 2 years, dune restoration 6 to 12 months following project completion) will impact multiple generations of beach mice. The time to complete a project and restore the habitat can be a complete loss of habitat availability and use for multiple generations of beach mice.

Disturbance frequency: Depending on the sand placement activity and dredging project frequency, this could result in impacts to beach mice and their habitats at any time during the year on a minimum cycle of every 2 years. Following initial sand placement, activities could occur every year depending on the project location and erosion events. The actual number of times the sand placement would occur is unknown. Following initial sand placement or dredge material placement, maintenance activities could occur every two to 10 years depending on the project location and situation (erosion, long shore sand transportation, upstream activities, and weather events). Thus, impacts related to the subject activities would be expected to occur no more often than every two to three years. However, while not anticipated, work could occur annually in response to emergency events. The actual number of times the nourishment and dredging material disposal activities is unknown but can be based on previous work.

Disturbance intensity and severity: Depending on the frequency needed to conduct the nourishment and dredged material work and the existence of staging areas and beach access points, effects to the recovery of beach mouse may vary. However, the action area encompasses entire range of each subspecies and the overall intensity of the disturbance is expected to be minimal. The severity is also likely to be slight as few if any mice would be lost and dune habitats can be restored quickly if protected from other impacts (pedestrians and vehicles).

The staging and storage of equipment and materials and beach access points could occur within habitat occupied or used by SEBM, AIBM, PKBM, CBM, and SABM and could be adjacent to designated critical habitat for the PKBM, CBM, and SABM. Beach mice are permanent inhabitants of the coastal ecosystem conducting all their life cycles in this environment. While the current status of individual beach mouse subspecies is unknown, their general distribution is known.

Analysis for effects of the action

The action area consists of the Atlantic or Gulf beachfront including the wet and dry unvegetated beach, developing foredunes and interdunal swales, and areas that were formerly primary or secondary dunes. Sand placement or dredged material placement work would not occur on existing vegetated primary or secondary dunes. However, construction of or expansion of an existing beach access could be located through scrub, secondary, or primary dunes. Beach mice would generally be found inhabiting stable primary, secondary, and scrub dunes on a permanent basis with other habitats being used periodically on a daily or seasonal basis for feeding and movement. Some of these areas also include critical habitat.

Direct and Indirect Impacts

Direct impacts are effects of the action on the species occurring during project implementation and construction (sand placement or dredged material placement). Direct loss of individual beach mice may occur during the creation or expansion of beach access points when heavy equipment clears the habitat and packs the sand. In general the length of time between project maintenance work is expected to be sufficient for beach mouse habitat to be restored. Thus, it is not anticipated that the nourishment and dredged material placement activities would result in permanent beach mouse habitat destruction (including critical habitat). However, habitat for all the beach mouse subspecies and critical habitat for the PKBM, CBM, and SABM that provides food or cover may be temporarily destroyed or altered from the activities.

Indirect effects are a result of a proposed action that occur later in time and are reasonably certain to occur. The indirect effect of the sand placement and dredged material placement activities would be newly created or expanded existing beach access points that act as barriers to beach mouse movement for foraging, or population expansion or dispersal. Maintaining the connectivity among habitats is vital to persistence of beach mice recovery. Recovery actions needed to assure the connectivity include restoration and maintenance of the dune system following project completion.

For the Service to determine if the project impacts on designated critical habitat would be an adverse modification, the Service shall determine if the impact on the habitat appreciably diminishes the capability of the critical habitat to satisfy essential requirements of beach mice. The long-term maintenance of the beach mouse populations in the project areas could be compromised if the sand placement and dredged material placement activities occur too frequently resulting in a long-term barrier to mice movement. However, our evaluation indicates the impacts to critical habitat should be temporary in nature based on past history of nourishment projects. In addition, the area to be directly affected within the individual subspecies would be a small percentage of the overall critical habitat and would not be expected to reduce the carrying capacity

of the recovery unit or appreciably diminish the ability of the PCE's to provide for the essential functions of the critical habitat units.

Species' response to a proposed action

This SPBO is based on effects that are anticipated to beach mice (all life stages) as a result of the temporary physical disturbance of beach mice habitat from beach nourishment or dredged material placement and associated activities. Some individual beach mice (all life stages) may be lost during the initial construction or expansion of beach accesses where heavy equipment destroys dune habitat and compacts the sand within the access corridor. Any mice that survive the initial construction may move outside of the disturbed area and construct burrows elsewhere in the vicinity. This will result in increased exposure to predation due to the removal of their burrows. Following access construction, a bare gap of sand could form a barrier to limit beach mouse movement within the area altering regular movement patterns. The bare areas could not be used for foraging, breeding or sheltering. These impacts are expected to be limited to the construction phase of the project (one month to two years). As the life span of a beach mouse is estimated to be approximately nine months, the loss of individual mice or the temporary loss of habitat could affect several generations of beach mice, but because beach mice can reproduce rapidly with adequate resources, colonization or recolonization of the restored habitat would be expected.

Beach mice have evolved to adapt to catastrophic weather events. Additional factors such as surrounding development pressure and nonnative predators may affect the species' ability to recover from the loss of individuals. However, the temporary loss of the habitat itself is not expected to permanently impact the populations as all beach mouse habitat within the project areas not permanently destroyed would be restored or maintained as part of the conservation measures committed to by the Corps or the Applicant. The temporary nature of the impacts to dune habitats is not expected to alter the function and conservation role of the remaining beach mouse habitat including designated critical habitat.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this SPBO. Future Federal actions that are unrelated to the proposed project are not considered in this opinion and require separate consultation pursuant to section 7 of the Act.

It is reasonably certain to expect that coastal development, human occupancy and recreational use along the Atlantic and Gulf coasts of Florida will increase in the future. Redevelopment along with new developments following the hurricane seasons of 2004 and 2005 are occurring as allowed by local zoning standards. It is unknown how much influence a nourished beach would contribute to the development and recreational use of the shoreline. Any projects that are within endangered or threatened species habitat will require section 7 consultation or section 10(a) (1)(B) permitting from the Service.

In recognizing the importance of coastal barrier islands along the Atlantic and Gulf coasts, Congress passed the Coastal Barrier Resources Act (CBRA) of 1982 and Coastal Barrier Improvement Act in 1991. The purpose of CBRA is "…to minimize the loss of human life,

wasteful expenditure of Federal revenues, and the damage to fish, wildlife, and other natural resources associated with the coastal barriers along the Atlantic and Gulf coasts by restricting future Federal expenditures and financial assistance which have the effect of encouraging development of coastal barriers." Congress established the Coastal Barrier Resources System units that apply to the CBRA.

Escambia County is currently in the final permitting stages of a beach nourishment project for Perdido Key. The project would cover approximately 4 miles of beachfront along county and private lands, not including state and Federal lands. The Service completed an endangered species consultation for the project in 2008. The project construction is expected to begin in late 2009-2010. The beach nourishment project is likely to enhance beach mouse habitat by providing an additional buffer to the dune habitats from storm events.

The Pensacola Naval Air Station has proposed to dredge their navigation channel resulting in the need to place eight million cubic yards of dredged material that is beach compatible. Because of cost, Perdido Key is the closest area to receive the material. Receiving areas include the Perdido Key Gulf beachfront (in lieu of the County implementing their project described above), PKSP, and GINS, Escambia County. The project could result in the placement of dredged material on 16 miles of beachfront including private, county, state, and Federal lands. The Navy has received their permits to complete the project. The Service completed an endangered species consultation for the project in 2007. The full project is on hold due to funding. However, the Federal navigation channel in the lower portion of the project area is expected to be maintenance dredged in 2009-2010.

Gulf County is currently completing a beach restoration project on St. Joseph peninsula and St. Joseph Peninsula State Park. The project will cover approximately 7.5 miles of Gulf of Mexico beachfront. The Service completed an endangered species consultation for the project. The project was completed in 2008.

CONCLUSION

Sea Turtles

After reviewing the current status of the loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtles, the environmental baseline for the action area, the effects of the proposed activities, the "Conservation Measures," and the cumulative effects, it is the Service's biological opinion that work conducted under the Statewide Programmatic action , as proposed, is not likely to jeopardize the continued existence of the loggerhead, green, leatherback, hawksbill or Kemp's ridley sea turtles. No critical habitat has been designated for any of the sea turtle species in the continental U.S.; therefore, none will be affected.

The conservation of the five loggerhead recovery units in the Northwest Atlantic is essential to the recovery of the loggerhead sea turtle. Each individual recovery unit is necessary to conserve genetic and demographic robustness, or other features necessary for long-term sustainability of the entire population. Thus, maintenance of viable nesting in each recovery unit contributes to the overall population. Three of the five loggerhead recovery units in the Northwest Atlantic occur within the action area, the PFRU, the DTRU, and the NGMRU. Sand placement is not expected to occur within the DTRU. The NGMRU averages about 1,000 nests per year. Northwest Florida

accounts for 92 percent of this recovery unit in nest numbers (920 nests) and consists of approximately 234 miles of nesting shoreline. Of the available nesting habitat within the NGMRU, with most sand placement projects have a project life of five to seven years and channel maintenance activities occurring every two to three years, on average, sand placement impacts will occur on 8.8 miles of sea turtle nesting shoreline per year. This is based on the average linear feet of beach on which sand placement occurred during nonemergency years from 2001 to 2008.

The PFRU averages 64,513 nests per year. The entire recovery unit occurs within Florida and consists of approximately 1,166 miles of shoreline. Of the available nesting habitat within the PFRU, sand placement activities will occur on 18.9 miles of nesting shoreline per year during nonemergency years. This is based on the average linear feet of beach on which sand placement occurred during non-emergency years from 2001 to 2008.

Generally, green, leatherback, hawksbill, and Kemp's ridley nesting overlaps with or occurs within the beaches where loggerhead sea turtles nest on both the Atlantic and Gulf of Mexico beaches. Thus, for green, leatherback, hawksbill, and Kemp's ridley sea turtles, sand placement activities will affect an average of 27.7 miles of shoreline per year. This is based on the average linear feet of beach on which sand placement occurred during nonemergency years from 2001 to 2008.

For all species of sea turtles, post-hurricane sand placement activities occurred on approximately 205 miles of shoreline for the 2004-2005 period following the emergency events (declared disasters and Congressional Orders). These activities are within the approximately 1,400 miles of available sea turtle nesting habitat in the southeastern U.S.

Research has shown that the principal effect of sand placement on sea turtle reproduction is a reduction in nesting success, and this reduction is most often limited to the first year following project construction. Research has also shown that the impacts of a nourishment project on sea turtle nesting habitat are typically short-term because a nourished beach will be reworked by natural processes in subsequent years, and beach compaction and the frequency of escarpment formation will decline. Although a variety of factors, including some that cannot be controlled, can influence how a nourishment project will perform from an engineering perspective, measures can be implemented to minimize impacts to sea turtles.

Beach Mice

The PKBM, CBM, and SABM occur on both public and private lands throughout their historical ranges. Both the SEBM and the AIBM are located completely on county, state, or federally protected lands, except for a small area in St. Johns County in which the AIBM are found on private lands along the Florida coast.

After reviewing the current status of the species of the SEBM, AIBM, PKBM, CBM, and SABM, the environmental baseline for the action area, the effects of beach nourishment and dredged material placement and associated activities, the "Conservation Measures," and the cumulative effects, it is the Service's biological opinion that the Statewide Programmatic action for these projects, as proposed, is not likely to jeopardize the continued existence of any of the above subspecies of beach mice and is not likely to destroy or adversely modify designated critical habitat for the PKBM, CBM, or SABM.

As discussed in the Effects of the Action section of this SPBO, we would not expect the carrying capacity of beach mouse habitat within the action area to be reduced. Beach mouse habitat will continue to provide for the biological needs of the subspecies as demonstrated below:

1. No permanent loss of beach mouse habitat will occur within the action area from the project construction or maintenance;

2. Temporary impacts to beach mouse habitat will be restored within the action area after project completion; and

3. A full complement of beach mouse habitat will remain within the action area after project completion.

Temporary impacts are expected to be limited to the construction/maintenance phase of the project and habitat restoration period following the project, which could be completed between one month and two years.

While a few beach mice may be lost, beach mice recover well from population size reductions (Wooten 1994) given sufficient habitat is available for population expansion after the bottleneck occurs. Therefore, we do not consider the potential loss of individuals to be significant.

Also, 50 feet of beach mouse critical habitat for each subspecies (PKBM, CBM, and SABM) could be temporarily affected each time a project is completed as a result of the sand placement activities. We would not anticipate that the loss of the critical habitat would alter or affect the remaining critical habitat in the action area for each subspecies (PKBM, CBM, and SABM) to the extent that it would appreciably diminish the habitat's capability to provide the intended conservation role for the subspecies in the wild.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the Act provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and shall be implemented by the Corps so that they become binding conditions of any grant or permit issued to the Applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the

activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps shall report the progress of the action and its impacts on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

AMOUNT OR EXTENT OF ANTICIPATED TAKE

Sea Turtles

The Service anticipates that no more than 27.7 miles of highly eroded shoreline along the Florida coastline (no more than 8.8 miles within the NGMRU and no more than 18.9 miles within the PFRU) would receive sand placement per year during nonemergency years with a maximum of 102 miles of shoreline (38 miles within the NGMRU and 64 miles of shoreline within the PFRU) receiving sand during or following an emergency event (declared disaster or Congressional Order) as a result of the Statewide Programmatic action. This represents two percent of the entire shoreline per year during a nonemergency year and seven percent of the entire shoreline during an emergency year. Over the last 10 years, one Congressional Order occurred due to emergency events in the 2004-2005 period. The increased sand placement on 102 miles of shoreline is expected to occur once in a 10-year period due to emergency events. Incidental take of sea turtles will be difficult to detect for the following reasons:

1. Turtles nest primarily at night and all nests are not located because
    a. Natural factors, such as rainfall, wind, and tides may obscure crawls; and
    b. Human-caused factors, such as pedestrian and vehicular traffic, may obscure crawls, and result in nests being destroyed because they were missed during a nesting survey and egg relocation program;

2. The total number of hatchlings per undiscovered nest is unknown;

3. The reduction in percent hatching and emerging success per relocated nest over the natural nest site is unknown;

4. An unknown number of females may avoid the project beach and be forced to nest in a less than optimal area;

5. Lights may misdirect an unknown number of hatchlings and cause death; and

6. Escarpments may form and prevent an unknown number of females from accessing a suitable nesting site.

However, the level of take of these species can be anticipated by the disturbance and sand placement on suitable turtle nesting beach habitat because: (1) turtles nest within the project site; (2) sand placement activities will likely occur during a portion of the nesting season; (3) sand placement activities will modify the incubation substrate, beach slope, and sand compaction; and (4) artificial lighting will deter or misdirect nesting females and hatchlings during and following sand placement.

Take is expected to be in the form of: (1) destruction of all nests that may be constructed and eggs that may be deposited and missed by a nest survey and egg relocation program within the boundaries of the project areas; (2) destruction of all nests deposited during the period when a nest survey and egg relocation program is not required to be in place within the boundaries of the projects; (3) reduced hatching success due to egg mortality during relocation and adverse conditions at the relocation site; (4) harassment in the form of disturbing or interfering with female turtles attempting to nest within the sand placement areas or on adjacent beaches during and after sand placement or construction activities; (5) misdirection of nesting and hatchling turtles on beaches adjacent to the sand placement or construction area as a result of project lighting including the ambient lighting from dredges; (6) behavior modification of nesting females due to escarpment formation within the project area during a nesting season, resulting in false crawls or situations where they choose marginal or unsuitable nesting areas to deposit eggs; and (7) destruction of nests from escarpment leveling within a nesting season when such leveling has been approved by the Service.

According to Schroeder (1994), there is an average survey error of seven percent; therefore, there is the possibility that some nests within the Action Area may be misidentified as false crawls and missed. However, due to implementation of the sea turtle protection measures, we anticipate that the take will not exceed seven percent of the nesting average in the action area. This number is not the level of take anticipated because the exact number cannot be predicted nor can the level of incidental take be monitored.

Beach Mouse

The Service has reviewed the biological information and other information relevant to this action. Based on this review, incidental take is anticipated from the sand placement activities may occur any time of the year within a ten-year period. The Service anticipates incidental take of beach mice would be difficult to detect for the following reasons: (1) an unknown number of beach mice may be injured, crushed or buried during beach access construction work and remain entombed in the sand; (2) beach mice are nocturnal, are small, and finding a dead or injured body is unlikely because of predation, and (3) changes in beach mouse essential life behaviors may not be detectable in standardized monitoring surveys.

For projects that occur within beach mouse habitat it is anticipated that no more than 50 linear feet of beach mouse habitat could be affected per sand placement activity for beach access within a subspecies range statewide as a result of the sand placement activities.

The incidental take is expected to be in the form of: (1) harm or harassment to all beach mice occupying the created or expanded beach access points; (2) harassment of beach mice from disturbance of foraging opportunities within the access areas during the construction period; (3) harassment of beach mice from temporary loss of foraging and burrow habitat; and (4) harassment of beach mice from temporary restriction of movement across access areas.

EFFECT OF THE TAKE

Sea Turtles

In the SPBO, the Service determined that the level of anticipated take is not likely to result in jeopardy to the loggerhead, green, leatherback, hawksbill or Kemp's ridley sea turtles. Critical habitat has not been designated in the project area; therefore, the project will not result in destruction or adverse modification of critical habitat for any of the sea turtle species.

Incidental take of loggerhead nesting and hatchling sea turtles and sea turtle nests is anticipated to occur during project construction and during the life of the project. Take will occur on nesting habitat consisting of the length of the beach where the material will be placed or where jetty or groin maintenance is located but is not expected to exceed 8.8 miles of shoreline per year within the northwest portion of Florida for the NGMRU and 18.9 miles of shoreline per year within the PFRU during a nonemergency year. Take will occur on nesting habitat consisting of the length of the beach where the material will be placed or where groin maintenance is located but is not expected to exceed 102 miles of shoreline (38 miles of shoreline per year within the northwest portion of Florida for the NGMRU and 64 miles of shoreline per year within the PFRU) during an emergency (declared disasters or Congressional Orders) year. The increased sand placement of 102 miles of shoreline is expected to occur once in a 10-year period due to emergency events.

Incidental take of green, leatherback, hawksbill and Kemp's ridley nesting and hatchling sea turtles and sea turtle nests is anticipated to occur during project construction and during the life of the project. Take will occur on nesting habitat consisting of the length of the beach where the material will be placed or where jetty or groin maintenance is located but is not expected to exceed 27.7 miles (8.8 miles within the northwest portion of Florida and 18.9 miles within the northeast, south and west portion of Florida) of shoreline per year during a nonemergency year. Take will occur on nesting habitat consisting of the length of the beach where the material will be placed or where jetty or groin maintenance is located but is not expected to exceed 102 miles of shoreline (38 miles of shoreline per year within the northwest portion of Florida for the NGMRU and 64 miles of shoreline per year within the PFRU) during an emergency (declared disasters or Congressional Orders) year.

Beach Mouse

In the SPBO, the Service determined that this level of anticipated take is not likely to result in jeopardy to AIBM, SEBM, PKBM, CBM, and SABM or in adverse modification or destruction of designated critical habitat for the PKBM, CBM, or SABM. Critical habitat for the SEBM and AIBM has not been designated; therefore, the project will not result in destruction or adverse modification of critical habitat for these subspecies.

Incidental take of SEBM, AIBM, PKBM, CBM, and SABM is anticipated to occur at beach access locations for the sand placement activities. Take will occur during project construction where beach access points are expanded or created and where equipment is staged or stored within beach mouse habitat along approximately 50 feet of vegetated dunes for beach access.

REASONABLE AND PRUDENT MEASURES

The Service has determined that the following reasonable and prudent measures are necessary and appropriate to minimize take of the loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtles; SEBM, AIBM, CBM, PKBM, and SABM in the action area for the following activities:

A. Sand placement from beach nourishment, sand bypass, and sand back pass activities;

B. Sand placement from navigation channel maintenance; and

C. Groin and jetty repair or replacement.

If the Corps is unable to comply with the Reasonable and Prudent Measures and Terms and Conditions, the Corps as the construction agent or regulatory authority may:

1. Inform the Service why the term and condition is not reasonable and prudent for the specific project or activity and request exception under the SPBO or
2. Initiate consultation with the Service for the specific project or activity. The Service may respond by either of the following:
    a. Allowing an exception to the terms and conditions under the SPBO or
    b. Recommending or accepting initiation of consultation (if initiated by the Corps) for the specific project or activity.

Post construction requirements are listed in Reasonable and Prudent measures A10, A11, A12, and A13. These post construction requirements are subject to congressional authorization and the allocation of funds. If the Corps or Applicant cannot fulfill these Reasonable and Prudent Measures, the Corps must reinitiate consultation.

REASONABLE AND PRUDENT MEASURES for:

A. Projects that include sand placement from beach nourishment, sand bypass, and sand back pass activities primarily for shore protection shall include the following measures:

A1. Conservation Measures included in the Corps' PBA that address protection of nesting sea turtles and beach mice shall be implemented in the Corps federally authorized project or regulated activity.

A2. Beach quality sand suitable for sea turtle nesting, successful incubation, and hatchling emergence and beach mouse burrow construction shall be used for sand placement.

A3. Sand placement shall not occur during the period of peak sea turtle egg laying and egg hatching, to reduce the possibility of sea turtle nest burial, crushing of eggs, or nest excavation. In Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward counties, sand placement shall not occur from May 1 through October 31. In St. Joseph Peninsula State Park, St. Joseph peninsula, and Cape San Blas in Gulf County, St. George Island in Franklin County, and Manasota Key in Sarasota and Charlotte counties, sand placement shall not occur from June 1 through September 30. In Nassau, Duval, St. Johns, Flagler, Volusia, Miami-Dade, Monroe, Collier, Lee, Charlotte (except Manasota Key), Sarasota (except Manasota Key), Manatee, Hillsborough, Pinellas, Franklin (except St. George Island), Gulf (except St. Joseph Peninsula State Park, St. Joseph peninsula, and Cape San Blas), Bay, Walton, Okaloosa, Santa Rosa, and Escambia counties, Florida, sand placement may occur during the sea turtle nesting season.

A4. All derelict material or other debris shall be removed from the beach prior to any sand placement.

A5. The Corps shall continue to work with FDEP, FWC and the Service to create a sea turtle friendly beach profile for placement of material during construction.

A6. If a dune system is already part of the project design, the placement and design of the dune shall emulate the natural dune system to the maximum extent possible, including the dune configuration and shape.

A7. Predator-proof trash receptacles shall be installed and maintained at all beach access points used for the project construction to minimize the potential for attracting predators of sea turtles and beach mice.

A8. A meeting between representatives of the Applicant's or Corps, Service, FWC, the permitted sea turtle surveyor, and other species surveyors, as appropriate, shall be held prior to the commencement of work on this project.

A9. If the beach nourishment project will be conducted during the sea turtle nesting season, surveys for nesting sea turtles must be conducted. Surveys for early and late nesting sea turtles shall be conducted where appropriate. If nests are constructed in the area of sand placement, the eggs shall be relocated to minimize sea turtle nest burial, crushing of eggs, or nest excavation.

A10. A post construction survey(s) of all artificial lighting visible from the project beach shall be completed by the Applicant or Corps.

A11. Daily nesting surveys shall be conducted by the Applicant or Corps for two nesting seasons following construction if the new sand still remains on the beach.

A12. Sand compaction shall be monitored and tilling shall be conducted if needed to reduce the likelihood of impacting sea turtle nesting and hatching activities.

A13. Escarpment formation shall be monitored and leveling shall be conducted if needed to reduce the likelihood of impacting nesting and hatchling sea turtles.

A14. Construction equipment and materials shall be stored in a manner that will minimize impacts to nesting and hatchling sea turtles and beach mice.

A15. Lighting associated with the project construction shall be minimized to reduce the possibility of disrupting and disorienting nesting and hatchling sea turtles and nocturnal activities of beach mice.

A16. During the sea turtle nesting season, the Corps shall not extend the beach fill more than 500 feet (or other agreed upon length) between dusk and the time of completion the following day's nesting survey to reduce the impact to emerging sea turtles and burial of new nests.

A17. All vegetation planting shall be designed and conducted to minimize impacts to sea turtles and beach mice.

A18. Beach mouse habitat shall be avoided when selecting sites for storage and staging of equipment to the maximum extent possible.

A19. Equipment and construction materials shall not be stored near the seaward dune toe in areas of occupied beach mouse habitat. This area is highly utilized by beach mice.

A20. Existing vegetated habitat at beach access points and travel corridors shall be protected to the maximum extent possible to ensure vehicles and equipment transport stay within the access corridor.

A21. Expanded or newly created beach access points shall be restored following construction.

A22. A report describing the actions taken shall be submitted to the Service following completion of the proposed work for each year when the activity has occurred.

A23. The Service and the FWC shall be notified if a sea turtle adult, hatchling, or egg, or beach mouse is harmed or destroyed as a direct or indirect result of the project.

TERMS AND CONDITIONS

All conservation measures described in the Corps' PBA are hereby incorporated by reference as Terms and Conditions within this document pursuant to 50 CFR §402.14(I) with the addition of the following Terms and Conditions. In order to be exempt from the prohibitions of section 9 of the Act, the Corps shall comply with the following Terms and Conditions, which implement the Reasonable and Prudent Measures, described above and outline required reporting/monitoring requirements.

These Terms and Conditions are nondiscretionary.

Post construction requirements are listed in Terms and Conditions A10, A11, A12, and A13. These post construction requirements are subject to congressional authorization and the allocation of funds. If the Corps or Applicant cannot fulfill these Terms and Conditions, the Corps must reinitiate consultation.

TERMS AND CONDITIONS for:

A. Projects that include sand placement from beach nourishment, sand bypass, and sand back pass activities primarily for shore protection shall include the following conditions:

All beaches

A1. Conservation Measures included in the Corps' PBA that address protection of nesting sea turtles and beach mice listed on pages 9 and 10 of the SPBO shall be implemented in the Corps federally authorized project or regulated activity.

A2. Beach compatible fill shall be placed on the beach or in any associated dune system. Beach compatible fill must be sand that is similar to a native beach in the vicinity of the site that has not been affected by prior sand placement activity. The fill material must be similar in both coloration and grain size distribution to that native beach. Beach compatible fill is material that maintains the general character and functionality of the material occurring on the beach and in the adjacent dune and coastal system. Fill material shall comply with FDEP requirements pursuant to the Florida Administrative Code (FAC) subsection 62B-41.005(15). A Quality Control Plan shall be implemented pursuant to FAC Rule 62B-41.008(1)(k)4.b.

A3. Sand placement shall not occur during the period of peak sea turtle egg laying and egg hatching to reduce the possibility of sea turtle nest burial, crushing of eggs, or nest excavation.

a. Sand placement projects in Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward counties shall be started after October 31 and be completed before May 1. During the May 1 through October 31 period, no construction equipment or pipes may be placed and/or stored on the beach.

b. Sand placement projects in Nassau, Duval, St. Johns, Flagler, Volusia, Miami-Dade, Monroe, Collier, Lee, Charlotte, Sarasota, Manatee, Hillsborough, Pinellas, Franklin, Gulf, Bay, Walton, Okaloosa, Santa Rosa and Escambia Counties may occur during the sea turtle nesting season except on publicly owned conservation lands such as state parks and areas where such work is prohibited by the managing agency or under applicable local land use codes (see exceptions in A3.c below).

c. For higher density nesting beaches in Gulf and Franklin Counties and on Manasota Key located in Sarasota and Charlotte counties, sand placement shall not occur during the main part of the nesting season (June 1 through September 30). These beaches include St. Joseph Peninsula State Park, St. Joseph peninsula, and Cape San Blas in Gulf County, St. George Island in Franklin County, and Manasota Key in Sarasota and Charlotte counties.

The Service shall be contacted for coordination, on a project-by-project basis, if sand placement is needed on publicly owned conservation lands and in these higher density nesting beaches in Gulf and Franklin Counties and on Manasota Key in Sarasota and Charlotte counties during the above exclusionary period. The Service will determine whether work (1) may proceed in accordance with the Terms and Conditions; (2) proceed in accordance with the Terms and Conditions and other requirements as developed by the Service; or (3) would require that an individual emergency consultation be conducted.

A4. All derelict concrete, metal, and coastal armoring geotextile material and other debris shall be removed from the beach prior to any sand placement to the maximum extent possible. If debris removal activities take place during the peak sea turtle nesting season (**Tables 17 and 18**), the work shall be conducted during daylight hours only and shall not commence until completion of the sea turtle nesting survey each day.

Table 15. Beach Sand Placement and Sea Turtle Nest Monitoring/Relocation Windows, Brevard through Broward Counties, Coast of Florida.

Region	Nest Laying Season	Hatching Season Ends	Beach Placement Window	Early Season Relocation *	Late Season Relocation**	Nesting Season Monitoring
Brevard, Indian River, St. Lucie, and Broward Counties	25 Feb - 11 Nov	15 Jan	1 Nov - 30 Apr	1 Mar - 30 Apr In St. Lucie County, nighttime surveys for leatherback sea turtles shall begin when the first leatherback crawl is recorded	65 days prior to 1 Nov (28 Aug) (or prior to start of construction **)	1 Mar - 15 Oct
Martin and Palm Beach Counties	12 Feb - 16 Oct	20 Dec	1 Nov - 30 Apr	1 Mar - 30 Apr In Martin and Palm Beach Counties, nighttime surveys for leatherback sea turtles shall begin when the first leatherback crawl is recorded	65 days prior to 1 Nov (28 Aug) (or prior to start of construction **)	1 Mar - 15 Oct

Table 16. Beach Sand Placement and Sea Turtle Nest Monitoring/Relocation Windows, Outside of Brevard through Broward Counties, Coast of Florida.

Region	Nest Laying Season	Hatching Season Ends	Beach Placement Window	Nesting Season Monitoring and Relocation
Nassau, Duval, St. Johns, Flagler, and Volusia Counties	27 Apr - 3 Oct	30 Nov	All Year	15 Apr – 30 Sep
Miami-Dade County	30 Mar - 25 Sep	30 Nov	All Year	1 Apr – 30 Sep
Gulf County (St. Joseph Peninsula State Park, St. Joseph peninsula, Cape San Blas) and Franklin County (St. George Island)	1 May - 4 Sep	15 Nov	1 Oct - 31 May	1 May – 15 Sep
All other beaches in Gulf and Franklin Counties, and Escambia, Santa Rosa, Okaloosa, Walton, and Bay Counties	11 May - 5 Sep	15 Nov	All Year	1 May - 31 Aug
Sarasota and Charlotte Counties (Manasota Key)	27 Apr - 7 Sep	15 Nov	1 Nov - 30 Apr	15 Apr – 15 Sep
All other beaches in Sarasota and Charlotte Counties	27 Apr - 7 Sep	15 Nov	All Year	15 Apr – 15 Sep
Pinellas, Hillsborough, Manatee, Lee, Collier, and Monroe Counties	24 Apr - 11 Sep	15 Nov	All Year	15 Apr – 15 Sep

A5. The Corps shall continue to work with FDEP, FWC and the Service in conducting the second phase of testing on the sea turtle friendly profile during project construction. This includes exploring options to include a dune system in the project design for existing authorized projects and new non-Federal projects and how the existing sand placement template may be modified.

A6. Dune restoration or creation included in the profile design (or project) shall have a slope of 1.5:1 followed by a gradual slope of 4:1 for approximately 20 feet seaward on a high erosion beach (**Figure 13)** or a 4:1 slope (**Figure 14**) on a low erosion beach. If another slope is proposed for use, the Corps shall consult the Service.

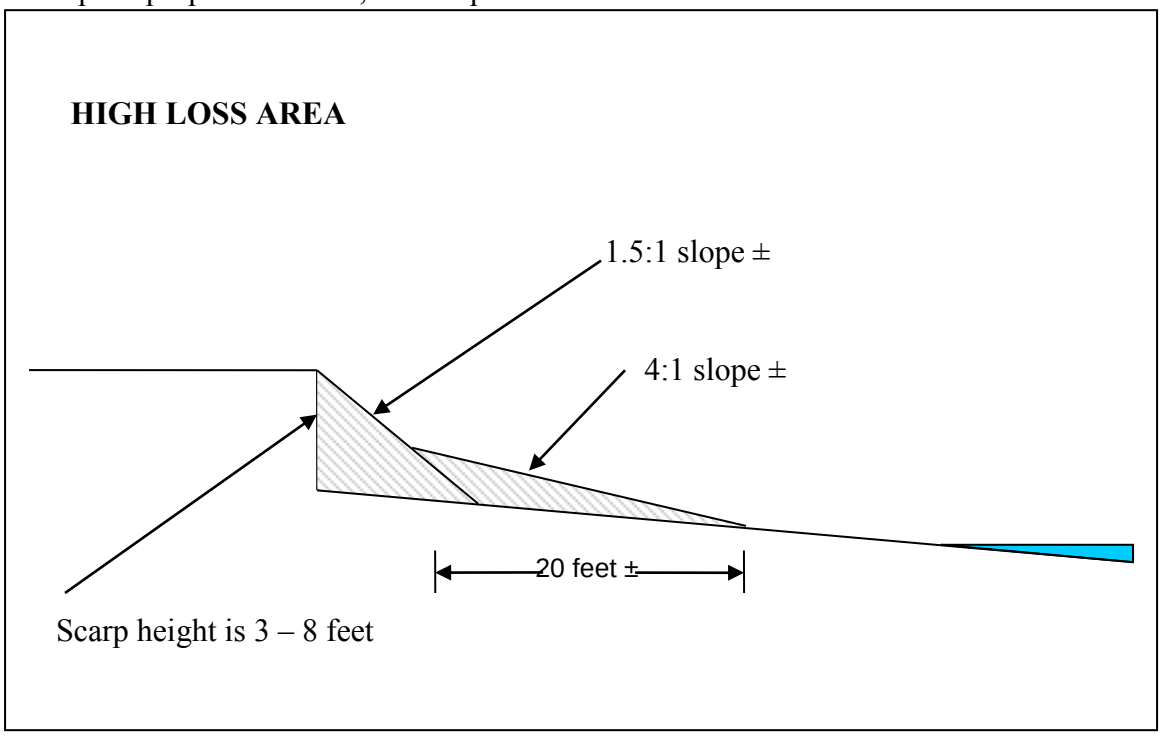

Figure 13. Recommended slope on a high erosion beach for sand placement projects that include the creation of a dune.

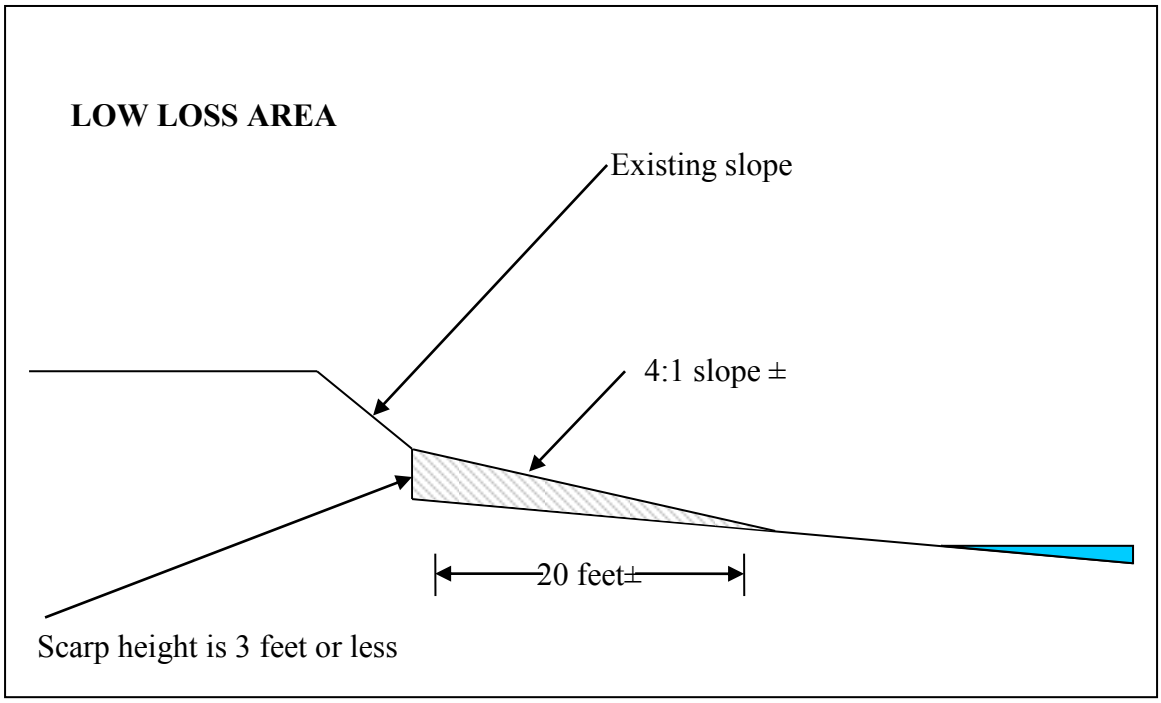

Figure 14. Recommended slope on a low erosion beach for sand placement projects that include the creation of a dune.

A7. Predator-proof trash receptacles shall be installed and maintained during construction at all beach access points used for the project construction to minimize the potential for attracting predators of sea turtles and beach mice (**Appendix C**). The Corps shall provide predator-proof trash receptacles for the construction workers. The Corps shall brief workers on the importance of not littering and keeping the project area trash and debris free.

A8. A meeting between representatives of the Corps, the Service, the FWC, the permitted sea turtle surveyor, and other species surveyors, as appropriate, shall be held prior to the commencement of work on projects. At least 10 business days advance notice shall be provided prior to conducting this meeting. The meeting will provide an opportunity for explanation and/or clarification of the sea turtle and beach mouse protection measures as well as additional guidelines when construction occurs during the sea turtle nesting season, such as storing equipment, minimizing driving, free-roaming cat observation, and reporting within the work area, as well as follow up meetings during construction (**Table 3**).

<u>Sea Turtle Protection</u>

A9. Daily early morning surveys for sea turtle nests shall be required as outlined in **Tables 15 and 16 (Nesting Season Monitoring)**. If nests are constructed in the area of sand placement, the eggs shall be relocated to minimize sea turtle nest burial, crushing of eggs, or nest excavation as outlined in a through f.

a. For sand placement projects in Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties that occur during March 1 through April 30, daily early morning surveys and egg relocation shall be conducted for sea turtle nests until completion of the project (whichever is earliest). Eggs shall be relocated per the following requirements. For sand placement projects that occur during the period from November 1 through November 30, daily early morning sea turtle nesting surveys shall be conducted 65 days prior to project initiation and continue through November 30, and eggs shall be relocated per the requirements listed in (a)i through (a)iii.

i. Nesting surveys and egg relocations will only be conducted by persons with prior experience and training in these activities and who are duly authorized to conduct such activities through a valid permit issued by FWC, pursuant to FAC 68E-1. Please contact FWC's Imperiled Species Management Section in Tequesta at (561) 575-5407 for information on the permit holder in the project area. Nesting surveys shall be conducted daily between sunrise and 9 a.m. (this is for all time zones).

ii. Only those nests that may be affected by sand placement activities will be relocated. Nest relocation shall not occur upon completion of the project. Nests requiring relocation shall be moved no later than 9 a.m. the morning following deposition to a nearby self-release beach site in a secure setting where artificial lighting will not interfere with hatchling orientation. Relocated nests shall not

be placed in organized groupings. Relocated nests shall be randomly staggered along the length and width of the beach in settings that are not expected to experience daily inundation by high tides or known to routinely experience severe erosion and egg loss, predation, or subject to artificial lighting. Nest relocations in association with construction activities shall cease when construction activities no longer threaten nests.

iii. Nests deposited within areas where construction activities have ceased or will not occur for 65 days or nests laid in the nourished berm prior to tilling shall be marked and left in situ unless other factors threaten the success of the nest. The turtle permit holder shall install an on-beach marker at the nest site and a secondary marker at a point as far landward as possible to assure that future location of the nest will be possible should the on-beach marker be lost. No activity will occur within this area nor will any activities occur that could result in impacts to the nest. Nest sites shall be inspected daily to assure nest markers remain in place and the nest has not been disturbed by the project activity.

During the period from March 1 through April 30, daytime surveys shall be conducted for leatherback sea turtle nests beginning March 1. Nighttime surveys for leatherback sea turtles shall begin when the first leatherback crawl is recorded within the project or adjacent beach area through April 30 or until completion of the project (whichever is earliest). Nightly nesting surveys shall be conducted from 9 p.m. until 6 a.m. The project area shall be surveyed at 1-hour intervals (since leatherbacks require at least 1.5 hours to complete nesting, this will ensure all nesting leatherbacks are encountered) and eggs shall be relocated per the requirements listed in (a)i through (a)iii.

b. For sand placement projects in Nassau, Duval, St. Johns, Flagler, Volusia, Miami-Dade, Monroe, Collier, Lee, Charlotte, Sarasota, Manatee, Hillsborough, Pinellas, Franklin, Gulf, Bay, Walton, Okaloosa, Santa Rosa and Escambia Counties that occur during the period from May 1 through October 31, daily early morning (before 9 a.m.) surveys and egg relocation shall be conducted. If nests are laid in areas where they may be affected by construction activities, eggs shall be relocated per the requirements listed in (a)i through (a)iii (see nest relocation exceptions for Franklin, Gulf, Sarasota, and Charlotte Counties in A9.d. below).

c. For Franklin, Gulf, Bay, Walton, Okaloosa, Santa Rosa, and Escambia Counties, nesting surveys shall be initiated 70 days prior to sand placement activities (incubation periods are longer in these counties) or by May 1 whichever is later. Nesting surveys and relocation shall continue through the end of the project or through August 31 whichever is earlier. Hatching and emerging success monitoring will involve checking nests beyond the completion date of the daily early morning nesting surveys. If nests are laid in areas where they may be affected by construction activities, eggs shall be relocated per the requirements listed in (a)i through (a)iii (see nest relocation exceptions for Franklin and Gulf Counties in A9.d. below).

d. For St. Joseph Peninsula State Park, St. Joseph peninsula, and Cape San Blas in Gulf County, St. George Island in Franklin County, and Manasota Key in Sarasota and Charlotte Counties, sand placement activities shall not occur from June 1 through September 30, the period of peak sea turtle egg laying and egg hatching for this area. If nests are laid between May 1 and May 31 in areas where they may be affected by construction activities, eggs shall be relocated per the requirements listed in (a)i through (a)iii.

e. For Pinellas, Hillsborough, Manatee, Sarasota, Charlotte, Lee, Collier, and Monroe Counties, nesting surveys shall be initiated 65 days prior to nourishment or dredged channel material placement activities or by April 15 whichever is later. Nesting surveys and egg relocation shall continue through the end of the project or through September 30 whichever is earlier. If nests are laid in areas where they may be affected by construction activities, eggs shall be relocated per the requirements listed in (a)i through (a)iii (see nest relocation exceptions for Sarasota and Charlotte Counties in A9.d. above).

f. For Miami-Dade County, nesting surveys shall be initiated 65 days prior to nourishment or dredged channel material placement activities or by April 1 whichever is later. Nesting surveys and egg relocation shall continue through the end of the project or through September 30 whichever is earlier. If nests are laid in areas where they may be affected by construction activities, eggs shall be relocated per the requirements listed in (a)i through (a)iii

g. For Volusia, Flagler, St. Johns, Duval, and Nassau Counties, nesting surveys shall be initiated 65 days prior to sand placement activities or by April 15 whichever is later. Nesting surveys and egg relocation shall continue through the end of the project or through September 30 whichever is earlier. If nests are laid in areas where they may be affected by construction activities, eggs shall be relocated per the requirements listed in (a)i through (a)iii.

A10. Daily nesting surveys shall be conducted for two nesting seasons in accordance with the FWC's Statewide Nesting Beach Survey Protocol (**Appendix B**) by the Corps or the Applicant following construction if placed material still remains on the beach (**Table 17**). Post construction year-one surveys shall record the number of nests, nesting success, reproductive success, and lost nests due to erosion and/or inundation. Post construction year-two surveys shall only need to record nest numbers and nesting success. This information will be used to periodically assess the cumulative effects of these projects on sea turtle nesting and hatchling production and monitor suitability of post construction beaches for nesting.

Table 17. Post-Construction Sea Turtle Monitoring.

Region	Nest Laying Season	Years 1 and 2 Post-Construction Monitoring
Brevard, Indian River, St. Lucie, and Broward Counties	25 Feb - 11 Nov	Bi-weekly surveys: 1 Mar - 30 Apr and from 15 Oct – 15 Nov Daily surveys: 1 May - 15 Oct
Martin and Palm Beach Counties	12 Feb - 16 Oct	Daily surveys: 1 Mar - 15 Oct
Nassau, Duval, St. Johns, Flagler, and Volusia Counties	27 Apr - 3 Oct	Daily surveys: 1 May – 30 Sep
Miami-Dade County	30 Mar - 25 Sep	Daily surveys: 1 Apr – 30 Sep
Gulf County (St. Joseph Peninsula State Park, St. Joseph peninsula, Cape San Blas) and Franklin County (St. George Island)	1 May - 4 Sep	Daily surveys: 1 May – 31 Aug
All other beaches in Gulf and Franklin Counties, and Escambia, Santa Rosa, Okaloosa, Walton, and Bay Counties	11 May - 5 Sep	Daily surveys: 1 May - 31 Aug
Sarasota and Charlotte Counties (Manasota Key)	27 Apr - 7 Sep	Daily surveys: 1 May –15 Sep
All other beaches in Sarasota and Charlotte Counties	27 Apr - 7 Sep	Daily surveys: 1 May – 15 Sep
Pinellas, Hillsborough, Manatee, Lee, Collier, and Monroe Counties	24 Apr - 11 Sep	Daily surveys: 1 May – 15 Sep

A11. Two surveys shall be conducted of all lighting visible from the beach placement area by the Applicant or Corps, using standard techniques for such a survey (**Appendix C**), in the year following construction. The first survey shall be conducted between May 1 and May 15 and a brief summary provided to the Service. The second survey shall be conducted between July 15 and August 1. A summary report of the surveys, including any actions taken, shall be submitted to the Service by December 1 of the year in which surveys are

conducted. After the annual report is completed, a meeting shall be set up with the Applicant, county or municipality, FWC, Corps, and the Service to discuss the survey report, as well as any documented sea turtle disorientations in or adjacent to the project area. If the project is completed during the nesting season and prior to May 1, the Corps may conduct the lighting surveys during the year of construction.

A12. Sand compaction shall be monitored in the area of sand placement immediately after completion of the project and prior to the dates in **Table 18** for 3 subsequent years.

Table 18. Dates for Compaction Monitoring and Escarpment Surveys by County.

County where project occurs	Date
Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward	March 1
Escambia, Santa Rosa, Okaloosa, Walton, Bay, Gulf, Franklin, Volusia, Flagler, St. Johns, Duval, Nassau, Pinellas, Hillsborough, Manatee, Sarasota, Charlotte, Lee, Collier	April 15
Miami-Dade, Monroe	April 1

If tilling is needed, the area shall be tilled to a depth of 36 inches. Each pass of the tilling equipment shall be overlapped to allow more thorough and even tilling. All tilling activity shall be completed at least once prior to the nesting season. An electronic copy of the results of the compaction monitoring shall be submitted to the appropriate Service Field Office (**Table 3**) prior to any tilling actions being taken or if a request not to till is made based on compaction results. The requirement for compaction monitoring can be eliminated if the decision is made to till regardless of post construction compaction levels. Additionally, out-year compaction monitoring and remediation are not required if placed material no longer remains on the dry beach.
(NOTE: If tilling occurs during shorebird nesting season (February 15-August 31), shorebirds surveys prior to tilling are required per the Migratory Bird Treaty Act http://myfwc.com/docs/Conservation/FBCI_BNB_SeaTurtleMonitors.pdf)

a. Compaction sampling stations shall be located at 500-foot intervals along the sand placement template. One station shall be at the seaward edge of the dune/bulkhead line (when material is placed in this area), and one station shall be midway between the dune line and the high water line (normal wrack line).

b. At each station, the cone penetrometer shall be pushed to a depth of 6, 12, and 18 inches three times (three replicates). Material may be removed from the hole if necessary to ensure accurate readings of successive levels of sediment. The penetrometer may need to be reset between pushes, especially if sediment layering exists. Layers of highly compact material may lie over less compact layers. Replicates shall be located as close to each other as possible, without interacting with the previous hole or disturbed sediments. The three replicate compaction values for each depth shall be averaged to produce final values for each depth at

each station. Reports will include all 18 values for each transect line, and the final six averaged compaction values.

c. If the average value for any depth exceeds 500 pounds per square inch (psi) for any two or more adjacent stations, then that area shall be tilled immediately prior to the appropriate date listed in **Table 18**.

d. If values exceeding 500 psi are distributed throughout the project area but in no case do those values exist at two adjacent stations at the same depth, then consultation with the Service will be required to determine if tilling is required. If a few values exceeding 500 psi are present randomly within the project area, tilling will not be required.

e. Tilling shall occur landward of the wrack line and avoid all vegetated areas 3 square feet or greater with a 3 square foot buffer around the vegetated areas.

A13. Visual surveys for escarpments along the project area shall be made immediately after completion of the sand placement and within 30 days prior to the start dates for Nesting Season Monitoring in **Tables 15 and 16** for 3 subsequent years if sand in the project area still remains on the dry beach.

Escarpments that interfere with sea turtle nesting or that exceed 18 inches in height for a distance of 100 feet shall be leveled and the beach profile shall be reconfigured to minimize scarp formation by the dates listed above. Any escarpment removal shall be reported by location. If the project is completed during the early part of the sea turtle nesting and hatching season (March 1 through April 30), escarpments may be required to be leveled immediately, while protecting nests that have been relocated or left in place. The Service shall be contacted immediately if subsequent reformation of escarpments that interfere with sea turtle nesting or that exceed 18 inches in height for a distance of 100 feet occurs during the nesting and hatching season to determine the appropriate action to be taken. If it is determined that escarpment leveling is required during the nesting or hatching season, the Service or FWC will provide a brief written authorization within 30 days that describes methods to be used to reduce the likelihood of impacting existing nests. An annual summary of escarpment surveys and actions taken shall be submitted to the appropriate Service Field Office (**Table 3**).

A14. If available, staging areas for construction equipment shall be located off the beach during early (March 1 through April 30) and late (November 1 through November 30) nesting season for Brevard through Broward counties and peak nesting season (May 1 through October 31) for the remaining counties. Nighttime storage of construction equipment not in use shall be off the beach to minimize disturbance to sea turtle nesting and hatching activities. In addition, all construction pipes placed on the beach shall be located as far landward as possible without compromising the integrity of the dune system. Pipes placed parallel to the dune shall be 5 to 10 feet away from the toe of the dune if the width of the beach allows. Temporary storage of pipes shall be off the beach to the maximum extent possible. If the pipes are stored on the beach, they shall be placed in a manner that will minimize the impact to nesting habitat and shall not compromise the integrity of the dune systems.

A15. Direct lighting of the beach and nearshore waters shall be limited to the immediate construction area during early (March 1 through April 30) and late (November 1 through November 30) nesting season for Brevard through Broward counties and peak nesting season (May 1 through October 31) for the remaining counties, and shall comply with safety requirements. Lighting on all equipment shall be minimized through reduction, shielding, lowering, and appropriate placement to avoid excessive illumination of the water's surface and nesting beach while meeting all Coast Guard, Corps EM 385-1-1, and OSHA requirements. Light intensity of lighting equipment shall be reduced to the minimum standard required by OSHA for General Construction areas, in order not to misdirect sea turtles. Shields shall be affixed to the light housing and be large enough to block light from all lamps from being transmitted outside the construction area or to the adjacent sea turtle nesting beach in line-of-sight of the dredge (**Figure 15**).

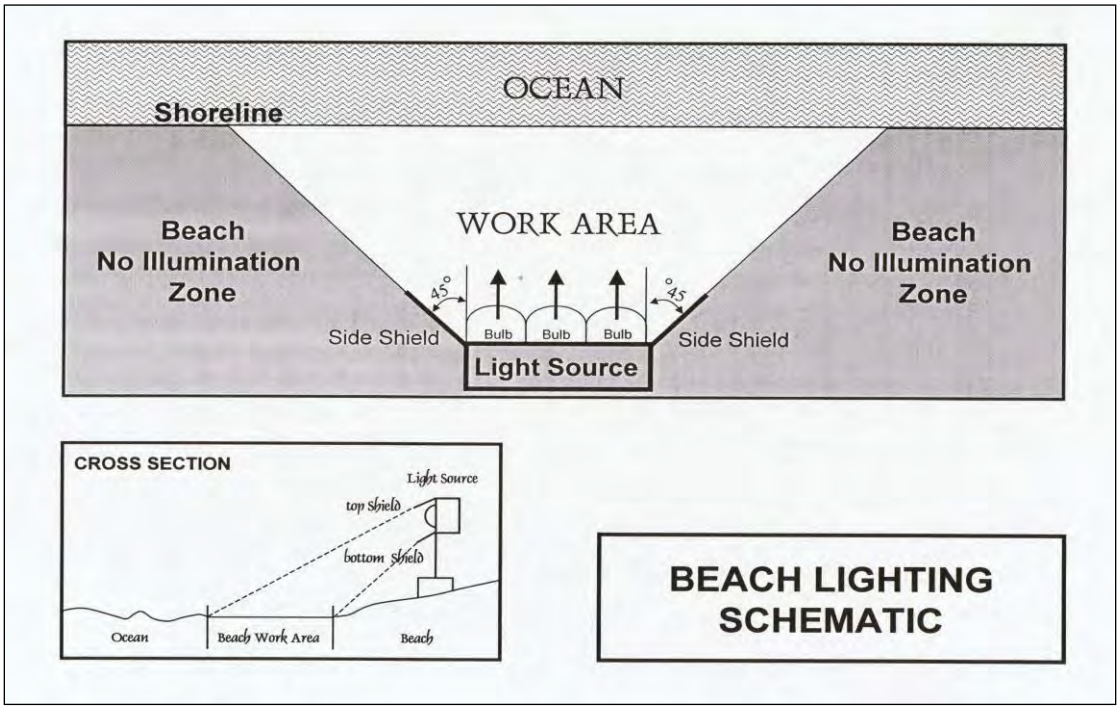

Figure 15. Beach lighting schematic.

A16. During the period during early (March 1 through April 30) and late (November 1 through November 30) nesting season for Brevard through Broward counties and peak nesting season (May 1 through October 31) for the remaining counties, the Corps shall not extend the beach fill more than 500 feet (or other agreed upon length) along the shoreline between dusk and dawn of the following day until the daily nesting survey has been completed and the beach cleared for fill advancement. An exception to this may occur if there is a permitted sea turtle surveyor present on-site to ensure no nesting and hatching sea turtles are present within the extended work area. If the 500 feet is not feasible for the project, an agreed upon distance will be decided on during the preconstruction meeting. Once the beach has been cleared and the necessary nest relocations have been completed, the Corps will be allowed to proceed with the placement of fill during daylight hours until dusk at which time the 500-foot length (or other agreed upon length) limitation shall apply. If any

nesting turtles are sighted on the beach within the immediate construction area, activities shall cease immediately until the turtle has returned to the water and the sea turtle permit holder responsible for nest monitoring has relocated the nest.

Dune Planting

A17. All vegetation planting shall be designed and conducted to minimize impacts to sea turtles and beach mice. Dune vegetation planting may occur during the sea turtle nesting season under the following conditions.

a. Daily early morning sea turtle nesting surveys (before 9 a.m.) shall be conducted during the period from May 1 through October 31 for all counties in Florida where sea turtle nesting occurs. If the planting is conducted in Brevard, Indian River, St. Lucie, Martin, Palm Beach, or Broward Counties, daily early morning surveys shall be extended to include March 1 through April 30 and November 1 through November 30. Nesting surveys shall only be conducted by personnel with prior experience and training in nesting surveys. Surveyors shall have a valid FWC permit. Nesting surveys shall be conducted daily between sunrise and 9 a.m. (all times). No dune planting activity shall occur until after the daily turtle survey and nest conservation and protection efforts have been completed. Hatching and emerging success monitoring will involve checking nests beyond the completion date of the daily early morning nesting surveys;

b. Any nests deposited in the dune planting area not requiring relocation for conservation purposes shall be left in place. The turtle permit holder shall install an on-beach marker at the nest site and a secondary marker at a point as far landward as possible to assure that future location of the nest will be possible should the on-beach marker be lost. A series of stakes and highly visible survey ribbon or string shall be installed to establish a 3-foot radius around the nest. No planting or other activity shall occur within this area nor will any activities be allowed that could result in impacts to the nest. Nest sites shall be inspected daily to assure nest markers remain in place and the nest has not been disturbed by the planting activity;

c. If a nest is disturbed or uncovered during planting activity, the Corps, or the Applicant shall cease all work and immediately contact the project turtle permit holder. If a nest(s) cannot be safely avoided during planting, all activity within 10 feet of a nest shall be delayed until hatching and emerging success monitoring of the nest is completed;

d. All dune planting activities shall be conducted by hand and only during daylight hours;

e. All dune vegetation shall consist of coastal dune species native to the local area; (*i.e.*, native to coastal dunes in the respective county and grown from plant stock from that region of Florida). Vegetation shall be planted with an appropriate amount of fertilizer and antidesiccant material for the plant size;

f. No use of heavy equipment shall occur on the dunes or seaward for planting purposes. A lightweight (all-terrain type) vehicle, with tire pressures of 10 psi or less may be used for this purpose; and

g. Irrigation equipment, if needed, shall be authorized under a FDEP permit.

Beach Mouse Protection

A18. Beach mouse habitat shall be avoided when selecting sites for equipment, pipes, vehicle storage and staging to the maximum extent possible. Suitable beach mouse habitat constitutes the primary dunes (characterized by sea oats and other grasses), secondary dunes (similar to primary dunes, but also frequently includes such plants as woody goldenrod, false rosemary), and interior or scrub dunes.

A19. Equipment placement or storage shall be excluded in the area between 5 to 10 feet seaward of the existing dune toe or 10 percent of the beach width (for projects occurring on narrow eroded beach segments) seaward of the dune toe in areas of occupied beach mouse habitat (**Figure 16**). The toe of the dune is where the slope breaks at the seaward foot of the dune.

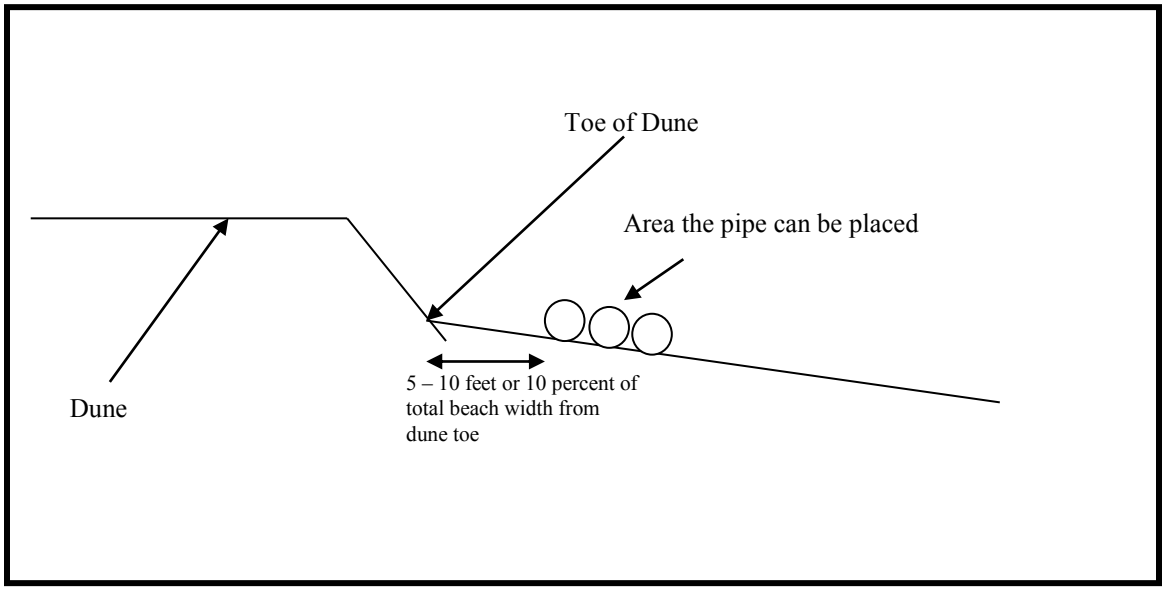

Figure 16. Equipment placement for projects occurring in beach mouse occupied habitat.

A20. Existing beach access points shall be used for vehicle and equipment beach access to the maximum extent possible. These access points shall be delineated by post and rope or other suitable material to ensure vehicles and equipment transport stay within the access corridor. The access corridors shall be fully restored to the preconstruction conditions following project completion. Parking areas for construction crews shall be located as close as possible to the work sites, but outside of vegetated dune areas to minimize impacts to existing habitat and transporting workers along the beachfront.

A21. The location of new or expanded existing beach access corridors for vehicles and equipment within beach mouse habitat consisting of vegetated dunes shall be spaced no closer than every four miles. The distribution of access areas will result in the least number of access areas within beach mouse habitat as possible and delineated by post and rope or other suitable material to ensure vehicles and equipment transport stay within the access corridor. The access corridors shall be (1) no more than 25 feet wide for vehicles and (2) no more than 50 feet wide for equipment. Expanded or new beach access points that impact vegetated dunes shall be restored within 3 months following project completion. Habitat restoration shall consist of restoring the dune to preconstruction conditions with planting of at least three species of appropriate native dune vegetation (*i.e.*, native to coastal dunes in the respective county and grown from plant stock from that region of Florida). Seedlings shall be at least one inch square with a 2.5-inch pot. Planting shall be on 18-inch centers throughout the created dune; however, 24-inch centers may be acceptable depending on the area to be planted. Vegetation shall be planted with an appropriate amount of fertilizer and antidesiccant material, as appropriate, for the plant size. No sand stabilizer material (coconut matting or other material) shall be used in the dune restoration. The plants may be watered without installing an irrigation system. In order for the restoration to be considered successful, 80 percent of the total planted vegetation shall be documented to survive six months following planting of vegetation. If the habitat restoration is unsuccessful, the area shall be replanted following coordination with the Service.

Reporting

A22. An excel sheet with the information listed in **Table 19** shall be submitted to the Service (**Table 3**) by July 31 of the following year of construction. The excel sheet shall be available on the Service's website.

A report with the information listed in **Table 20** shall be submitted to the Service by the Corps by December 31 of the year following construction.

Table 19. Information to include in the report following the project completion.

All projects	Project location (include Florida DEP R-monuments and latitude and longitude coordinates)
	Project description (include linear feet of beach, actual fill template, access points, and borrow areas)
	Dates of actual construction activities
	Names and qualifications of personnel involved in sea turtle nesting surveys and relocation activities (separate the nests surveys for nourished and non-nourished areas)
	Descriptions and locations of self-release beach sites
	Sand compaction, escarpment formation, and lighting survey results by project shall be reported as listed in the Terms and Conditions by December 31 to the FWC and appropriate Service Field Office

	(**Table 3**)
Beach mice	Acreage of new or widened access areas affected in beach mouse habitat
	Vegetation completed for new or widened access areas
	Success rate of vegetation of restoration

Table 20. Sea turtle monitoring following sand placement activity.

CHARACTERISTIC	PARAMETER	MEASUREMENT	VARIABLE
Nesting Success	False crawls - number	Visual assessment of all false crawls	Number and location of false crawls in nourished areas and non-nourished areas: any interaction of the turtle with obstructions, such as groins, seawalls, or scarps, should be noted.
	False crawl - type	Categorization of the stage at which nesting was abandoned	Number in each of the following categories: emergence-no digging, preliminary body pit, abandoned egg chamber.
	Nests	Number	The number of sea turtle nests in nourished and non-nourished areas should be noted. If possible, the location of all sea turtle nests shall be marked on a project map, and approximate distance to seawalls or scarps measured in meters. Any abnormal cavity morphologies should be reported as well as whether turtle touched groins, seawalls, or scarps during nest excavation.
		Lost Nests	The number of nests lost to inundation or erosion or the number with lost markers.
	Nests	Relocated Nests	The number of nests relocated and relocation area on a map of the areas. The number of successfully hatched eggs per relocated nest.
	Lighting Impacts	Disoriented sea turtles	The number of disoriented hatchlings and adults shall be documented and reported in accordance with existing FWC protocol for disorientation events.

A23. In the event a sea turtle nest is excavated during construction activities, the project turtle permit holder responsible for egg relocation for the project shall be notified immediately so the eggs can be moved to a suitable relocation site.

Upon locating a dead or injured sea turtle adult, hatchling, egg, or beach mouse that may have been harmed or destroyed as a direct or indirect result of the project, the Corps, Applicant shall be responsible for notifying FWC Wildlife Alert at 1-888-404-FWCC (3922) and the appropriate Service Field Office immediately (**Table 3**).

Care shall be taken in handling injured sea turtles, eggs or beach mice to ensure effective treatment or disposition, and in handling dead specimens to preserve biological materials in the best possible state for later analysis.

REASONABLE AND PRUDENT MEASURES for:

B. Projects that are navigation maintenance dredging with beach placement, swash zone placement, and submerged littoral zone placement shall include the following measures:

Historically, these sand placement events as a result of a navigation maintenance dredging project with no local sponsor are smaller scaled, conducted at closer time intervals, and the sand often does not remain on the beach for an extended period of time.

Post construction requirements are listed in Reasonable and Prudent Measures B11 and B12. These post construction requirements are subject to congressional authorization and the allocation of funds. If the Corps or Applicant cannot fulfill these Reasonable and Prudent Measures, the Corps must reinitiate consultation.

B1. Conservation Measures included in the Corps' PBA that address protection of nesting sea turtles and beach mice shall be implemented in the Corps federally authorized project or regulated activity.

B2. Beach quality sand suitable for sea turtle nesting, successful incubation, and hatchling emergence and beach mouse burrow construction shall be used for sand placement.

B3. For dredged material placement on the beach, sand placement shall not occur during the period of peak sea turtle egg laying and egg hatching to reduce the possibility of sea turtle nest burial, crushing of eggs, or nest excavation. In Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties, dredged material placement shall not occur from May 1 through October 31. In St. Joseph Peninsula State Park, St. Joseph peninsula, and Cape San Blas in Gulf County, St. George Island in Franklin County, and Manasota Key in Sarasota and Charlotte Counties, dredged material placement shall not occur from June 1 through September 30. In Nassau, Duval, St. Johns, Flagler, Volusia, Miami-Dade, Monroe, Collier, Lee, Charlotte (except Manasota Key), Sarasota (except Manasota Key), Manatee, Hillsborough, Pinellas, Franklin (except St. George Island), Gulf (except St. Joseph Peninsula State Park, St. Joseph peninsula, and Cape Sand Blas), Bay, Walton, Okaloosa, Santa Rosa, and Escambia Counties, sand placement may occur during the sea turtle nesting season (**Table 15 and Table 16**).

B4. For dredged material placement in the swash zone (at or below the MHWL) or submerged littoral zone, sand placement will be conducted at or below the +3-foot contour. The swash zone is that region between the upper limit of wave run-up (approximately one-foot above MHW) and the lower limit of wave run-out (approximately one-foot below MLW. Material will not be stacked too high that the material is above the water during low tide.

B5. For dredged material placement in the swash zone (at or below the MHWL) or submerged littoral zone, sand placement will be conducted at or below the +3-foot contour.

B6. All derelict material or other debris shall be removed from the beach prior to any sand placement.

B7. The Corps shall continue to work with FDEP, FWC, and the Service to create a sea turtle friendly beach profile for placement of material during construction.

B8. Predator-proof trash receptacles shall be installed and maintained at all beach access points used for the project construction to minimize the potential for attracting predators of sea turtles and beach mice.

B9. A meeting between representatives of the Corps, Service, FWC, the permitted sea turtle surveyor, and other species surveyors, as appropriate, shall be held prior to the commencement of work on this project.

B10. If the beach nourishment project will be conducted during the sea turtle nesting season, surveys for nesting sea turtles must be conducted. Surveys for early and late nesting sea turtles shall be conducted where appropriate. If nests are constructed in the area of sand placement, the eggs shall be relocated to minimize sea turtle nest burial, crushing of eggs, or nest excavation.

B11. Sand compaction shall be monitored and tilling shall be conducted if needed to reduce the likelihood of impacting sea turtle nesting and hatching activities. Not required for dredged material placement in the swash and littoral zone.

B12. Escarpment formation shall be monitored and leveling shall be conducted if needed to reduce the likelihood of impacting nesting and hatchling sea turtles. Not required for dredged material placement in the swash and littoral zone.

B13. Construction equipment and materials shall be stored in a manner that will minimize impacts to nesting and hatchling sea turtles and beach mice.

B14. Lighting associated with the project construction shall be minimized to reduce the possibility of disrupting and disorienting nesting and hatchling sea turtles and nocturnal activities of beach mice.

B15. During the sea turtle nesting season, the Corps shall not extend the beach fill more than 500 feet (or other agreed upon length) between dusk and the time of completion of the following day's nesting survey to reduce the impact to emerging sea turtles and burial of new nests.

B16. Beach mouse habitat shall be avoided when selecting sites for storage and staging of equipment to the maximum extent possible.

B17. Equipment and construction materials shall not be stored near the seaward dune toe in areas of occupied beach mouse habitat. This area is highly utilized by beach mice.

B18. Existing vegetated habitat at beach access points and along shoreline travel corridors shall be protected to the maximum extent possible to ensure vehicles and equipment transport stay within the access and travel corridors.

B19. Expanded or newly created beach access points shall be restored.

B20. A report describing the actions taken shall be submitted to the Service following completion of the proposed work for each year when the activity has occurred.

B21. The Service and the FWC shall be notified if a sea turtle adult, hatchling, or egg, or beach mouse is harmed or destroyed as a direct or indirect result of the project.

TERMS AND CONDITIONS for:

B. Projects that are navigation maintenance dredging with beach placement, swash zone placement, and submerged littoral zone placement of Corps civil works project shall include the following measures:

Historically, these sand placement events as a result of a navigation maintenance dredging project with no local sponsor are smaller scaled, conducted at closer time intervals, and the sand often does not remain on the beach for an extended period of time.

Post construction requirements are listed in Terms and Conditions B10 and B11. These post construction requirements are subject to congressional authorization and the allocation of funds. If the Corps or Applicant cannot fulfill these Terms and Conditions, the Corps must reinitiate consultation.

All beaches

B1. Conservation Measures included in the Corps' PBA that address protection of nesting sea turtles and beach mice listed on pages 9 and 10 of the SPBO shall be implemented in the Corps federally authorized project or regulated activity.

B2. Beach compatible fill shall be placed on the beach or in any associated dune system. Beach compatible fill must be sand that is similar to a native beach in the vicinity of the site that has not been affected by prior sand placement activity. The fill material must be similar in both coloration and grain size distribution to that native beach. Beach compatible fill is material that maintains the general character and functionality of the material occurring on the beach and in the adjacent dune and coastal system. Fill material shall comply with FDEP requirements pursuant to the Florida Administrative Code (FAC) subsection 62B-41.005(15). A Quality Control Plan shall be implemented pursuant to FAC Rule 62B-41.008(1)(k)4.b.

B3. Dredged material placement shall not occur during the period of peak sea turtle egg laying and egg hatching to reduce the possibility of sea turtle nest burial, crushing of eggs, or nest excavation.

a. Dredged material placement projects in Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties shall be started after October 31 and be completed before May 1. During the May 1 through October 31 period, no construction equipment or pipes may be placed and/or stored on the beach.

b. Dredged material placement projects in Nassau, Duval, St. Johns, Flagler, Volusia, Miami-Dade, Monroe, Collier, Lee, Charlotte, Sarasota, Manatee, Hillsborough, Pinellas, Franklin, Gulf, Bay, Walton, Okaloosa, Santa Rosa and Escambia Counties may occur during the sea turtle nesting season except on publicly owned conservation lands such as state parks and areas where such work is prohibited by the managing agency or under applicable local land use codes (see exceptions in B3.c. below).

c. For higher density nesting beaches in Gulf and Franklin Counties and on Manasota Key in Sarasota and Charlotte Counties, dredged material placement shall not occur during the main part of the nesting season (June 1 through September 30). These beaches include St. Joseph Peninsula State Park, St. Joseph peninsula, and Cape San Blas in Gulf County, St. George Island in Franklin County, and Manasota Key in Sarasota and Charlotte Counties.

d. For dredged material placement in the swash zone (at or below the MHWL) or submerged littoral zone during the sea turtle nesting season (**Tables 15 and 16**), the Corps shall contact the Service for coordination.

The Service shall be contacted for coordination, on a project-by-project basis, if sand placement is needed on publicly owned conservation lands and in these higher density nesting beaches in Gulf and Franklin Counties and on Manasota Key in Sarasota and Charlotte Counties during the above exclusionary period. The Service will determine whether work (1) may proceed in accordance with the Terms and Conditions; (2) proceed in accordance with the Terms and Conditions and other requirements as developed by the Service; or (3) would require that an individual emergency consultation be conducted.

B4. For dredged material placement in the swash zone (at or below the MHWL) or submerged littoral zone, sand placement will be conducted at or below the +3-foot contour. The swash zone is that region between the upper limit of wave run-up (approximately one-foot above MHW) and the lower limit of wave run-out (approximately one-foot below MLW. Material will not be stacked too high that the material is above the water during low tide and can obstruct the approach of nesting females to the beach.

B5. All derelict concrete, metal, and coastal armoring geotextile material and other debris shall be removed from the beach prior to any dredged material placement to the maximum extent possible. If debris removal activities take place during the peak sea turtle nesting season

(**Tables 15 and 16**), the work shall be conducted during daylight hours only and shall not commence until completion of the sea turtle nesting survey each day.

B6. The Corps shall continue to work with FDEP, FWC and the Service in conducting the second phase of testing on the sea turtle friendly profile during project construction. This includes exploring options to include a dune system in the project design for existing authorized projects and new non-Federal projects and how the existing sand placement template may be modified.

B7. Predator-proof trash receptacles shall be installed and maintained during construction at all beach access points used for the project construction to minimize the potential for attracting predators of sea turtles and beach mice (**Appendix C**). The Corps shall provide predator-proof trash receptacles for the construction workers. All workers shall be briefed on the importance of not littering and keeping the project area trash and debris free.

B8. A meeting between representatives of the Corps, the Service, the FWC, the permitted sea turtle surveyor, and other species surveyors, as appropriate, shall be held prior to the commencement of work on projects. At least 10 business days advance notice shall be provided prior to conducting this meeting. The meeting will provide an opportunity for explanation and/or clarification of the sea turtle and beach mouse protection measures as well as additional guidelines when construction occurs during the sea turtle nesting season, such as storing equipment, minimizing driving, free-roaming cat observation, and reporting within the work area, as well as follow up meetings during construction (**Table 3**).

<u>Sea Turtle Protection</u>

B9. Daily early morning surveys for sea turtle nests shall be required as outlined in a through f. If nests are constructed in the area of sand placement, the eggs shall be relocated to minimize sea turtle nest burial, crushing of eggs, or nest excavation (**Tables 15 and 16**).

a. For sand placement projects in Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties that occur during March 1 through April 30, daily early morning surveys shall be conducted for sea turtle nests until completion of the project (whichever is earliest), and eggs shall be relocated per the following requirements. For sand placement projects that occur during the period from November 1 through November 30, daily early morning sea turtle nesting surveys shall be conducted 65 days prior to project initiation and continue through November 30, and eggs shall be relocated per the requirements listed in (a)i through (a)iii.

i. Nesting surveys and egg relocations will only be conducted by persons with prior experience and training in these activities and who are duly authorized to conduct such activities through a valid permit issued by FWC, pursuant to FAC 68E-1. Please contact FWC's Imperiled Species Management Section in Tequesta at (561) 575-5407 for information on the permit holder in the project area. Nesting surveys shall be conducted daily between sunrise and 9 a.m. (this is for all time zones).

ii. Only those nests that may be affected by sand placement activities will be relocated. Nest relocation shall not occur upon completion of the project. Nests requiring relocation shall be moved no later than 9 a.m. the morning following deposition to a nearby self-release beach site in a secure setting where artificial lighting will not interfere with hatchling orientation. Relocated nests shall not be placed in organized groupings. Relocated nests shall be randomly staggered along the length and width of the beach in settings that are not expected to experience daily inundation by high tides or known to routinely experience severe erosion and egg loss, or subject to artificial lighting. Nest relocations in association with construction activities shall cease when construction activities no longer threaten nests.

iii. Nests deposited within areas where construction activities have ceased or will not occur for 65 days or nests laid in the nourished area prior to tilling shall be marked and left in situ unless other factors threaten the success of the nest. The turtle permit holder shall install an on-beach marker at the nest site and a secondary marker at a point as far landward as possible to assure that future location of the nest will be possible should the on-beach marker be lost. No activity will occur within this area nor will any activities occur that could result in impacts to the nest. Nest sites shall be inspected daily to assure nest markers remain in place and the nest has not been disturbed by the project activity.

During the period from March 1 through April 30, daytime surveys shall be conducted for leatherback sea turtle nests beginning March 1. Nighttime surveys for leatherback sea turtles shall begin when the first leatherback crawl is recorded within the project or adjacent beach area through April 30 or until completion of the project (whichever is earliest). Nightly nesting surveys shall be conducted from 9 p.m. until 6 a.m. The project area shall be surveyed at 1-hour intervals (since leatherbacks require at least 1.5 hours to complete nesting, this will ensure all nesting leatherbacks are encountered) and eggs shall be relocated per the requirements listed in (a)i through (a)iii.

b. For sand placement projects in Nassau, Duval, St. Johns, Flagler, Volusia, Miami-Dade, Monroe, Collier, Lee, Charlotte, Sarasota, Manatee, Hillsborough, Pinellas, Franklin, Gulf, Bay, Walton, Okaloosa, Santa Rosa and Escambia Counties that occur during the period from May 1 through October 31, daily early morning (before 9 a.m.) surveys shall be conducted. If nests are laid in areas where they may be affected by construction activities, eggs shall be relocated per the requirements listed in (a)i through (a)iii (see nest relocation exceptions for Franklin, Gulf, Sarasota, and Charlotte Counties in B9.d. below).

c. For Franklin, Gulf, Bay, Walton, Okaloosa, Santa Rosa, and Escambia Counties, nesting surveys shall be initiated 70 days prior to sand placement activities (incubation periods are longer in these counties) or by May 1 whichever is later. Nesting surveys shall continue through the end of the project or through September 1 whichever is earlier. Hatching and emerging success monitoring will involve checking nests beyond the completion date of the daily early morning nesting surveys. If nests are laid in areas where they may be affected by construction

activities, eggs shall be relocated per the requirements listed in (a)i through (a)iii (see nest relocation exceptions for Franklin and Gulf Counties in B9.d. below).

d. For St. Joseph Peninsula State Park, St. Joseph peninsula, and Cape San Blas in Gulf County, St. George Island in Franklin County, and Manasota Key in Sarasota and Charlotte Counties, sand placement activities shall not occur from June 1 through September 30, the period of peak sea turtle egg laying and egg hatching for this area. If nests laid between May 1 and May 31 in areas where they may be affected by construction activities, eggs shall be relocated per the requirements listed in (a)i through (a)iii below.

e. For Pinellas, Hillsborough, Manatee, Sarasota, Charlotte, Lee, Collier, and Monroe Counties, nesting surveys shall be initiated 65 days prior to nourishment or dredged channel material placement activities or by April 15 whichever is later. Nesting surveys shall continue through the end of the project or through September 15 whichever is earlier. If nests are laid in areas where they may be affected by construction activities, eggs shall be relocated per the requirements listed in (a)i through (a)iii (see nest relocation exceptions for Sarasota and Charlotte Counties in B9.d. above).

f. For Miami-Dade County, nesting surveys shall be initiated 65 days prior to dredged material placement activities or by April 1 whichever is later. Nesting surveys shall continue through the end of the project or through September 30 whichever is earlier. If nests are laid in areas where they may be affected by construction activities, eggs shall be relocated per the requirements listed in (a)i through (a)iii.

g. For Volusia, Flagler, St. Johns, Duval, and Nassau Counties, nesting surveys shall be initiated 65 days prior to dredged material placement activities or by April 15 whichever is later. Nesting surveys shall continue through the end of the project or through September 30 whichever is earlier. If nests are laid in areas where they may be affected by construction activities, eggs shall be relocated per the requirements listed in (a)i through (a)iii.

B10. Sand compaction shall be monitored in the area of dredged material placement immediately after completion of the project and prior to the dates in **Table 18** for 3 subsequent years. Not required for dredged material placement in the swash and littoral zone.

If tilling is needed, the area shall be tilled to a depth of 36 inches. Each pass of the tilling equipment shall be overlapped to allow more thorough and even tilling. All tilling activity shall be completed at least once prior to the nesting season. An electronic copy of the results of the compaction monitoring shall be submitted to the appropriate Service Field Office (**Table 3**) prior to any tilling actions being taken. The requirement for compaction monitoring can be eliminated if the decision is made to till regardless of post construction compaction levels. Additionally, out-year compaction monitoring and remediation are not required if placed material no longer remains on the dry beach.(NOTE: If tilling occurs during shorebird nesting season (February 15-August 31), shorebirds surveys prior to tilling are required per the Migratory Bird Treaty Act (http://myfwc.com/docs/Conservation/FBCI_BNB_SeaTurtleMonitors.pdf)

a. Compaction sampling stations shall be located at 500-foot intervals along the sand placement template. One station shall be at the seaward edge of the dune/bulkhead line (when material is placed in this area), and one station shall be midway between the dune line and the high water line (normal wrack line).

b. At each station, the cone penetrometer shall be pushed to a depth of 6, 12, and 18 inches three times (three replicates). Material may be removed from the hole if necessary to ensure accurate readings of successive levels of sediment. The penetrometer may need to be reset between pushes, especially if sediment layering exists. Layers of highly compact material may lie over less compact layers. Replicates shall be located as close to each other as possible, without interacting with the previous hole or disturbed sediments. The three replicate compaction values for each depth shall be averaged to produce final values for each depth at each station. Reports will include all 18 values for each transect line, and the final six averaged compaction values.

c. If the average value for any depth exceeds 500 pounds per square inch (psi) for any two or more adjacent stations, then that area shall be tilled immediately prior to the appropriate date listed in **Table 18**.

d. If values exceeding 500 psi are distributed throughout the project area but in no case do those values exist at two adjacent stations at the same depth, then consultation with the Service will be required to determine if tilling is required. If a few values exceeding 500 psi are present randomly within the project area, tilling will not be required.

e. Tilling shall occur landward of the wrack line and avoid all vegetated areas 3 square feet or greater with a 3 square foot buffer around the vegetated areas.

B11. Visual surveys for escarpments along the project area shall be made immediately after completion of the dredged material placement and within 30 days prior to the start dates for Nesting Season Monitoring in **Tables 15 and 16** for 3 subsequent years if sand in the project area still remains on the dry beach. Not required for dredged material placement in the swash and littoral zone.

Escarpments that interfere with sea turtle nesting or that exceed 18 inches in height for a distance of 100 feet shall be leveled and the beach profile shall be reconfigured to minimize scarp formation by the dates listed above. Any escarpment removal shall be reported by location. If the project is completed during the early part of the sea turtle nesting and hatching season (March 1 through April 30), escarpments may be required to be leveled immediately, while protecting nests that have been relocated or left in place. The Service shall be contacted immediately if subsequent reformation of escarpments that interfere with sea turtle nesting or that exceed 18 inches in height for a distance of 100 feet occurs during the nesting and hatching season to determine the appropriate action to be taken. If it is determined that escarpment leveling is required during the nesting or hatching season, the Service or FWC will provide a brief written authorization within 30 days that describes methods to be used to reduce the likelihood of impacting existing nests. An annual

summary of escarpment surveys and actions taken shall be submitted to the appropriate Service Field Office (**Table 3**).

B12. If available, staging areas for construction equipment shall be located off the beach during early (March 1 through April 30) and late (November 1 through November 30) nesting season for Brevard through Broward counties and peak nesting season (May 1 through October 31) for the remaining counties. Nighttime storage of construction equipment not in use shall be off the beach to minimize disturbance to sea turtle nesting and hatching activities. In addition, all construction pipes placed on the beach shall be located as far landward as possible without compromising the integrity of the dune system. Pipes placed parallel to the dune shall be 5 to 10 feet away from the toe of the dune if the width of the beach allows. Temporary storage of pipes shall be off the beach to the maximum extent possible. If the pipes are stored on the beach, they shall be placed in a manner that will minimize the impact to nesting habitat and shall not compromise the integrity of the dune systems.

B13. Direct lighting of the beach and nearshore waters shall be limited to the immediate construction area during early (March 1 through April 30) and late (November 1 through November 30) nesting season for Brevard through Broward counties and peak nesting season (May 1 through October 31) for the remaining counties, and shall comply with safety requirements. Lighting on all equipment shall be minimized through reduction, shielding, lowering, and appropriate placement to avoid excessive illumination of the water's surface and nesting beach while meeting all Coast Guard, Corps EM 385-1-1, and OSHA requirements. Light intensity of lighting equipment shall be reduced to the minimum standard required by OSHA for General Construction areas, in order not to misdirect sea turtles. Shields shall be affixed to the light housing and be large enough to block light from all lamps from being transmitted outside the construction area (**Figure 15**).

B14. During the period during early (March 1 through April 30) and late (November 1 through November 30) nesting season for Brevard through Broward counties and peak nesting season (May 1 through October 31) for the remaining counties, the Corps shall not extend the beach fill more than 500 feet (or other agreed upon length) along the shoreline between dusk and dawn of the following day until the daily nesting survey has been completed and the beach cleared for fill advancement. An exception to this may occur if there is a permitted sea turtle surveyor present on-site to ensure no nesting and hatching sea turtles are present within the extended work area. If the 500 feet is not feasible for the project, an agreed upon distance will be decided on during the preconstruction meeting. Once the beach has been cleared and the necessary nest relocations have been completed, the Corps will be allowed to proceed with the placement of fill during daylight hours until dusk at which time the 500-foot length (or other agreed upon length) limitation shall apply. If any nesting turtles are sighted on the beach within the immediate construction area, activities shall cease immediately until the turtle has returned to the water and the sea turtle permit holder responsible for nest monitoring has relocated the nest.

<u>Beach Mouse Protection</u>

B15. Beach mouse habitat shall be avoided when selecting sites for equipment, pipes, vehicle storage and staging, and beach travel corridors to the maximum extent possible. Suitable beach mouse habitat constitutes the primary dunes (characterized by sea oats and other grasses), secondary dunes (similar to primary dunes, but also frequently includes such plants as woody goldenrod, false rosemary), and interior or scrub dunes.

B16. Equipment placement or storage shall be excluded in the area between 5 to 10 feet seaward of the existing dune toe or 10 percent of the beach width (for projects occurring on narrow eroded beach segments) seaward of the dune toe in areas of occupied beach mouse habitat (**Figure 16**). The toe of the dune is where the slope breaks at the seaward foot of the dune.

B17. Existing beach access points shall be used for vehicle and equipment beach access to the maximum extent possible. These access points shall be delineated by post and rope or other suitable material to ensure vehicles and equipment transport stay within the access corridor. The topography at the access points shall be fully restored to preconstruction conditions following project completion. Parking areas for construction crews shall be located as close as possible to the work sites, but outside of vegetated dune areas to minimize impacts to existing habitat and transporting workers along the beachfront.

B18. The location of new or expanded existing beach access corridors for vehicles and equipment within beach mouse habitat consisting of vegetated dunes shall be no closer than every four miles. The distribution of access areas will result in the least number of access areas within beach mouse habitat as possible and delineated by post and rope or other suitable material to ensure vehicles and equipment transport stay within the access corridor. The access corridors shall be (1) no more than 25 feet wide for vehicles and (2) no more than 50 feet wide for equipment. Expanded or new beach access points that impact vegetated dunes shall be restored within 3 months following project completion. Habitat restoration shall consist of restoring the dune to preconstruction conditions with planting of at least three species of appropriate native dune vegetation (*i.e.*, native to coastal dunes in the respective county and grown from plant stock from that region of Florida). Seedlings shall be at least 1 inch square with a 2.5-inch pot. Planting shall be on 18-inch centers throughout the created dune; however, 24-inch centers may be acceptable depending on the area to be planted. Vegetation shall be planted with an appropriate amount of fertilizer and antidesiccant material, as appropriate, for the plant size. No sand stabilizer material (coconut matting or other material) shall be used in the dune restoration. The plants may be watered without installing an irrigation system. In order for the restoration to be considered successful, 80 percent of the total planted vegetation shall be documented to survive six months following planting of vegetation. If the habitat restoration is unsuccessful, the area shall be replanted following coordination with the Service.

<u>Reporting</u>

B19. An excel sheet with the information listed in **Table 21** shall be submitted to the Service (**Table 3**) by July 31 of the year following construction. The excel sheet shall be available on the Service's website. A report with the information from Terms Conditions B9 and B10 shall be submitted to the Service by December 31 of the year following construction.

B20. In the event a sea turtle nest is excavated during construction activities, the project turtle permit holder responsible for egg relocation for the project shall be notified immediately so the eggs can be moved to a suitable relocation site.

Upon locating a dead or injured sea turtle adult, hatchling, egg, or beach mouse that may have been harmed or destroyed as a direct or indirect result of the project, the Corps, Applicant shall be responsible for notifying FWC Wildlife Alert at 1-888-404-FWCC (3922) and the appropriate Service Field Office immediately (**Table 3**).

Care shall be taken in handling injured sea turtles, eggs or beach mice to ensure effective treatment or disposition, and in handling dead specimens to preserve biological materials in the best possible state for later analysis.

REASONABLE AND PRUDENT MEASURES for:

C. Projects that include groin or jetty repair or replacement shall include the following measures:

In Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties:

C1. Groin or jetty repair or replacement projects shall not occur during the period of peak sea turtle egg laying and egg hatching (May 1 through October 31), to reduce the possibility of sea turtle nest burial, crushing of eggs, or nest excavation.

C2. Maintenance of groin or jetty projects conducted during the early (February 1 through April 30) and late sea turtle nesting season (November 1 through November 30) shall adhere to the following conditions:

a. Install a barrier around the perimeter of the groin or jetty repair or replacement work area sufficient to prevent adult sea turtles from accessing the project site.

b. For projects conducted during the early and late sea turtle nesting season, construction equipment and materials shall be stored in a manner that will minimize impacts to sea turtles to the maximum extent possible.

c. For projects conducted during the early and late sea turtle nesting season, no work may occur at night.

In Nassau, Duval, St. Johns, Flagler, Volusia, Miami-Dade, Monroe, Collier, Lee, Charlotte, Sarasota, Manatee, Hillsborough, Pinellas, Franklin, Gulf, Bay, Walton, Okaloosa, Santa Rosa, and Escambia Counties:

C3. For maintenance of groin or jetty projects, conducted during the sea turtle nesting season.

a. Daily surveys shall be conducted by sea turtle permit holders. Nests laid adjacent to the work area shall be marked by flag and rope for avoidance.

b. A barrier shall be installed around the perimeter of the groin or jetty maintenance work area sufficient to prevent adult sea turtles from accessing the project site.

c. Construction equipment and materials shall be stored in a manner that will minimize impacts to sea turtles and beach mice to the maximum extent possible.

d. No work shall occur at night.

In All Counties:

C4. Safety lighting associated with the project shall be minimized to reduce the possibility of disrupting and disorienting nesting or hatchling sea turtles and nocturnal activities of beach mice.

C5. If entrapment of sea turtle hatchlings occurs in the groin or jetty system, the Corps shall meet with the Service to discuss a possible solution prior to the next nesting season.

C6. A report describing the projects conducted during the year and actions taken to implement the Reasonable and Prudent Measures and Terms and Conditions of this incidental take statement shall be submitted to the Service.

TERMS AND CONDITIONS for:

C. Projects that include groin or jetty repair or replacement shall include the following conditions:

In Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties:

C1. Groin or jetty repair or replacement projects shall be started after October 31 and be completed before May 1.

C2. For groin or jetty repair or replacement projects conducted during the early (March 1 through April 30) and/or late (November 1 through November 30) sea turtle nesting season:

a. A barrier (e.g., hay bales, silt screens) sufficient to prevent adult and hatchling sea turtles from accessing the project site shall be installed in a 100-foot buffer around the perimeter of the project site. The barrier shall be placed parallel to shore, at mean high water (MHW), as close to the groin or jetty as feasible, particularly during the period from sunset to sunrise.

b. On-beach access to the construction site shall be restricted to the wet sand below MHW to the maximum extent possible. Travel corridors on the beach to the MHWL shall be delineated. If the project is conducted during the early (March 1 through April 30) and/or late (November 1 through November 30) sea turtle nesting season, daily morning surveys shall be conducted within the travel corridor. If nests are laid within the travel corridor, the travel corridor must be re-routed to avoid the nest. If re-routing is not possible, these nests shall be relocated per the

requirements listed in A9 (a)i through (a)iii.

c. Staging areas for construction equipment shall be located off the beach to the maximum extent possible.

d. No construction shall be conducted at night.

e. Daily early morning surveys for sea turtle nests shall be required as outlined in e(i) and e (ii). All nests laid in the vicinity of the project area shall be marked for avoidance per the requirements specified below:

i. Nesting surveys and nest marking will only be conducted by persons with prior experience and training in these activities and who are authorized to conduct such activities through a valid permit issued by FWC, pursuant to FAC 68E-1. Please contact FWC's Imperiled Species Management Section in Tequesta at (561) 575-5407 for information on the permit holder in the project area. Nesting surveys shall be conducted daily between sunrise and 9 a.m. (this is for all time zones). The Corps shall not initiate work until daily notice has been received from the sea turtle permit holder that the morning survey has been completed. Surveys shall be performed in such a manner so as to ensure that construction activity does not occur in any location prior to completion of the necessary sea turtle protection measures.

ii. Nests deposited within the project area and access areas shall be left in place and marked for avoidance unless other factors threaten the success of the nest (nest laid below debris line marking the typical high tide, erosion). The turtle permit holder shall install an on-beach marker at the nest site and a secondary marker at a point as far landward as possible to assure that future location of the nest will be possible should the on-beach marker be lost. The actual location of the clutch will be determined and nests will be marked. A series of stakes and highly visible survey ribbon or string shall be installed to establish a 10-foot radius around the nest. No activity shall occur within this area nor will any activity occur that could result in impacts to the nest. Nest sites shall be inspected daily to assure nest markers remain in place and that the nest has not been disturbed by the project activity. Nest relocation is only allowed if nests laid within the travel corridor (beach access to MHWL) cannot be rerouted to avoid the nest.

In Nassau, Duval, St. Johns, Flagler, Volusia, Miami-Dade, Monroe, Collier, Lee, Charlotte, Sarasota, Manatee, Hillsborough, Pinellas, Franklin, Gulf, Bay, Walton, Okaloosa, Santa Rosa, and Escambia Counties:

C3. For groin or jetty repair or replacement projects conducted during the sea turtle nesting season:

a. Daily early morning surveys shall be conducted within the travel corridor.

b. A barrier (e.g., hay bales, silt screens) sufficient to prevent adult and hatchling sea turtles from accessing the project site shall be installed in a 100-foot buffer around the perimeter of the project site. The barrier shall be placed parallel to shore, at MHW, as close to the groin or jetty as feasible during the period from sunset to sunrise.

c. On-beach access to the construction site shall be restricted to the wet sand below MHW to the maximum extent possible. Travel corridors on the beach to the MHWL will be delineated. Nests laid within the travel corridor that would impede traffic will be relocated per the requirements listed in A9(a)i through (a)iii.. Nests laid in adjacent areas will be marked and avoided per the requirements listed in C(2)(e) i through iii. Staging areas for construction equipment shall be located off the beach to the maximum extent possible.

d. No nighttime construction may occur during the nesting season.

e. Material stockpiled on the beach shall only occur within the 200-foot barrier (100-foot area on either side). Construction activities shall not occur in any location prior to completion of the necessary sea turtle protection measures outlined below. If any nesting turtles are sighted on the beach, construction activities shall cease immediately until the turtle has returned to the water and the sea turtle permit holder responsible for nest monitoring has marked the nest. All activities shall avoid the marked nest areas.

C4. All nests laid adjacent to the project area shall be marked for avoidance per the following requirements:

a. Nesting surveys and nest marking will only be conducted by persons with prior experience and training in these activities and who are authorized to conduct such activities through a valid permit issued by FWC, pursuant to FAC 68E-1. Please contact FWC's Imperiled Species Management Section in Tequesta at (561) 575-5407 for information on the permit holder in the project area. Nesting surveys shall be conducted daily between sunrise and 9 a.m. (this is for all time zones). The Corps shall not initiate work until daily notice has been received from the sea turtle permit holder that the morning survey has been completed. Surveys shall be performed in such a manner so as to ensure that construction activity does not occur in any location prior to completion of the necessary sea turtle protection measures.

i.b. Nests deposited within the project area and access areas shall be left in place and marked for avoidance unless other factors threaten the success of the nest (nest laid below debris line marking the typical high tide, erosion). The turtle permit holder shall install an on-beach marker at the nest site and a secondary marker at a point as far landward as possible to assure that future location of the nest will be possible should the on-beach marker be lost. The actual location of the clutch will be determined and nests will be marked. A series of stakes and highly visible survey ribbon or string shall be installed to establish a 10-foot

radius around the nest. No activity shall occur within this area nor will any activity occur that could result in impacts to the nest. Nest sites shall be inspected daily to assure nest markers remain in place and that the nest has not been disturbed by the project activity. Nest relocation is only allowed if nests laid within the travel corridor (beach access to MHWL) cannot be rerouted to avoid the nest.

In All Counties:

C5. To the maximum extent possible within the travel corridor, all ruts shall be filled or leveled to the natural beach profile prior to completion of daily construction.

C6. Exterior lighting shall not be permanently installed in association with the project. Temporary lighting of the construction area during the sea turtle nesting season shall be reduced to the minimum standard required by OSHA for general construction areas. Lighting on all equipment including offshore equipment shall be minimized through reduction, shielding, lowering, and appropriate placement to avoid excessive illumination of the water's surface and nesting beach while meeting all Coast Guard, Corps EM 385-1-1, and OSHA requirements. Light intensity of lighting equipment shall be reduced to the minimum standard required by OSHA for general construction areas, in order not to misdirect sea turtles. Shields shall be affixed to the light housing and be large enough to block light from all lamps from being transmitted outside the construction area (**Figure 15**).

C7. If entrapment of sea turtle hatchlings occurs in the groin or jetty system during construction, the Corps shall contact the Service immediately.

C8. A report describing the projects conducted during the year and actions taken to implement the Reasonable and Prudent Measures and Terms and Conditions of this incidental take statement shall be submitted to the Service (**Table 3**) by July 31 of the year following completion of the proposed work for each year when the activity has occurred. This report will include the following information:

Table 21. Information to include in the report following the project completion.

All projects	Project location (include Florida DEP R-monuments and latitude and longitude coordinates)
	Project description
	Dates of actual construction activities
	Names and qualifications of personnel involved in sea turtle nesting surveys and mark and avoid activities
	Nesting survey, mark and avoid activities, and nest relocation results

The Service believes that incidental take will be limited to the 8.8 miles of shoreline per year within the northwest portion of Florida for the NGMRU (38 miles during an emergency year) and 18.9 miles of shoreline within the PFRU (64 miles during an emergency year) of beach that have been identified for sand placement. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. The Service believes that no more than the following types of incidental take will result from the proposed action: (1) destruction of all nests that may be constructed and eggs that may be deposited and missed by a nest survey and egg relocation program within the boundaries of the project areas; (2) destruction of all nests deposited during the period when a nest survey and egg relocation program is not required to be in place within the boundaries of the projects; (3) reduced hatching success due to egg mortality during relocation and adverse conditions at the relocation site; (4) harassment in the form of disturbing or interfering with female turtles attempting to nest within the sand placement areas or on adjacent beaches during and after sand placement or construction activities; (5) misdirection of nesting and hatchling turtles on beaches adjacent to the sand placement or construction area as a result of project lighting including the ambient lighting from dredges; (6) behavior modification of nesting females due to escarpment formation within the project area during a nesting season, resulting in false crawls or situations where they choose marginal or unsuitable nesting areas to deposit eggs; and (7) destruction of nests from escarpment leveling within a nesting season when such leveling has been approved by the Service. The amount or extent of incidental take for sea turtles will be considered exceeded if the project results in more than a 8.8 miles of shoreline per year within the northwest portion of Florida for the NGMRU (38 miles during an emergency year) and 18.9 miles of shoreline within the PFRU (64 miles during an emergency year) of sand on the of beach that have been identified for sand placement. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Corps must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a) (1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. If public driving is allowed on the project beach, and if the Corps has the authority, we recommend it exercise its discretionary authority to require the local sponsor or Applicant to have authorization from the Service for incidental take of sea turtles, their nests, and hatchlings and beach mice, as appropriate, due to such driving or provide written documentation from the Service that no incidental take authorization is required. If required, the incidental take authorization for driving on the beach should be obtained prior to any subsequent sand placement events.

2. For sand placement projects in Nassau, Duval, St. Johns, Flagler, Volusia, Miami-Dade, Monroe, Collier, Lee, Charlotte, Sarasota, Manatee, Hillsborough, Pinellas, Franklin, Gulf, Bay, Walton, Okaloosa, Santa Rosa and Escambia Counties, construction activities for this

project and similar future projects should be planned to take place outside the main part of the sea turtle nesting and hatching season (May 1 through October 31).

3. Beach nourishment should not occur on publicly owned conservation lands during the sea turtle nesting season.

4. All created dunes should be planted with at least three species of appropriate native salt-resistant dune vegetation. Examples along the Atlantic coast include: bitter panicgrass, sea oats (grown from local genetic stock), beach morning-glory, or railroad vine. Examples along the Northwest Florida coast includes: bitter panicgrass, little bluestem (*Schizachyrium scoparium),* sea oats (grown from local genetic stock), beach morning-glory, or railroad vine. Examples along the Southwest Florida coast include: sea oats (grown from local genetic stock), bitter panicgrass, beach morning-glory, and railroad vine.

5. If the project area is within a local municipality that has not adopted a lighting ordinance, and lighting is shown to be an issue on a nourished beach, and if the Corps has the authority, we recommend it exercise its discretionary authority to require an ordinance be adopted prior to any subsequent sand placement event.

6. To increase public awareness about sea turtles and beach mice, informational signs should be placed at beach access points where appropriate. The signs should explain the importance of the beach to sea turtles and beach mice.

7. If the Corps has the authority, we recommend it exercise its discretionary authority to require predator control programs (including education of pet owners and cat colony supporters) should be implemented that target free-roaming cats.

8. Dune walkovers should be installed at beach access points to protect the restored beach and dunes.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the action outlined in the request. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. Reinitiation of formal consultation is also required ten years after the issuance of this SPBO. In instances where the amount or extent of incidental take is exceeded, any operations causing such take shall cease pending reinitiation.

The above findings and recommendations constitute the report of the Service. If you have any questions about this SPBO, please contact Ann Marie Lauritsen of this office at (904) 525-0661, Richard Zane of the Panama City Field Office at (850) 769-0552, or Jeffrey Howe of the South Florida Field Office at (772) 562-3909.

Service Log Number: 41910-2011-F-0170

Sincerely,

/s/

David L. Hankla
Field Supervisor

cc:
FWC, Tallahassee, Florida, (Robbin Trindell)
FWC, Panama City, Florida (John Himes)
FWC, Lake City, Florida (Terry Doonan)
FWC, Lake City, Florida (Melissa Tucker)
FWC, Lake City, Florida (Nancy Douglass)
Service, Panama City, Florida, (Patricia Kelly, Richard Zane, Ben Frater)Service, Vero Beach, Florida (Jeffrey Howe)
Service, Jacksonville, Florida (Sandy MacPherson)
Service, Atlanta RO digital version in Word (Ken Graham)
NMFS, Protected Species Division, St. Petersburg (Eric Hawk)

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Appendix A

PREVIOUS FORMAL CONSULTATIONS/BIOLOGICAL OPINIONS WITHIN FLORIDA THAT HAVE BEEN ISSUED FOR ALL PROJECTS THAT HAD ADVERSE IMPACTS TO THE SEA TURTLES ON THE NESTING BEACH

YEAR	COUNTY	PROJECT NAME	SERVICE FEDERAL ACTIVITY CODE	PROJECT LOCATION	PROJECT TYPE	ANTICIPATED INCIDENTAL TAKE (linear footage, no. of eggs, etc.)
STATEWIDE	Nassau, Duval, St. Johns, Flagler, Volusia, Brevard, Indian River, St. Lucie, Martin, Palm Beach, Broward, Monroe, Miami-Dade, Collier, Lee, Charlotte, Sarasota, Manatee, Pinellas, Pasco, Franklin, Gulf, Bay, Walton, Okaloosa, Santa Rosa, Escambia	FEMA Emergency Beach Berm Repair	2007-F-0430		Repair of 5-year beach berms post-disaster	75 miles
JAX FIELD OFFICE						
1991	Brevard	Lighting at Cape Canaveral Air Force and Patrick Air Force Station	4-1-91-028	Lighting at both installations	Sea turtle lighting	75 disoriented loggerhead nests; 2 green turtles nests at CCAFS and 2 loggerhead nests at PAFB
1993	Brevard	Beach nourishment on Cape Canaveral	4-1-93-073C		Beach nourishment	2 miles
1995	Brevard	Inlet Bypass on Brevard County Beach at Cape Canaveral		R-1 to R-14	Inlet bypass	
1996	Brevard	Canaveral Port Authority Dredge and Beach Disposal		R-34 to R-38	Dredge and beach restoration	
1998	Brevard	Inlet bypass on Brevard County Beach at Cape Canaveral		R-1 to R-14		
2000	Brevard	Amended Lighting at Cape Canaveral Air Force and Patrick Air Force Station	00-0545	Lighting at both installations	Sea turtle lighting	2 percent hatchling and nesting female disorientations at each installation.
2001	Brevard	Brevard County Shore Protection Project (North Reach)		R-5 to R-12 and R-13 to R-54.5	Beach nourishment	9.4 miles
2001	Brevard	Patrick Air Force Base Beach Restoration		R-53 to R-70	Beach nourishment	
2002	Brevard	Brevard County Shore Protection Project		R-123.5 to R-139	Beach nourishment	3.02 miles

		(South Reach)				
2002	Brevard	Brevard County Shore Protection Project (North Reach)		R-4 to R-20	Beach nourishment	
2002	Brevard	Permanent Sand Tightening of North Jetty at Canaveral Harbor	02-1090	North jetty at Canaveral Inlet	Sand tightening and extension of existing jetty	500 feet
2003	Brevard	Brevard County Shore Protection Project (South Reach)		R-118.3 to R-123.5		0.94 mile
2004	Brevard	Canaveral Harbor Federal Sand Bypass and Beach Placement	04-0077	R-14 to R-20	Inlet bypass and beach nourishment	18,600 linear feet
2005	Brevard	Brevard County Shore Protection Project (North and South Reach)	05-0443	R-5 to R-20 and R-21 to R-54.5 and R-118 to R-139	Beach nourishment	13.2 miles
2005	Brevard	Brevard County FEMA Berm and Dune Restoration	05-1054	R-75 to R-118	Dune repair	12 miles
2005	Brevard	Patrick Air Force Base Beach Restoration	05-0258	R-54.5 to R-75.3	Beach nourishment	
2005	Brevard	Sloped Geotexile Revetment Armoring Structures	05-0454	5 tubes along north and south Melbourne beach	Protec tube installation	4,600 linear feet
2006	Brevard	Brevard County FEMA Berm and Dune Restoration	41910-2006-F-0189	R-75 to R-118	Dune repair	12 miles
2006	Brevard	Amended Lighting at Cape Canaveral Air Force and Patrick Air Force Station	41910-2006-F-0841		Sea turtle lighting	3 percent hatchling and nesting female disorientations at each installation
15 Feb 2008	Brevard	Patrick Air Force Base Dune Restoration	41910-2008-F-0150	R-65 to R-70	Dune restoration	6,000 linear feet
25 Jan 2008	Brevard	Brevard County's Dune Restoration	41910-2008-F-0189	R-75 to R-118 and R-138 to R-202	Dune restoration	140,000 cy along 3,000 linear feet
2009	Brevard	Brevard County's Dune Restoration	41910-2009-F-0125	R 75.4 to R 118.3 and R-139 to R-213	Dune restoration	22 miles
2009	Brevard	Mid Reach		R-75 to R119	Beach berm repair (permanent)	40,748 linear feet
2009	Brevard	South Beach		R-139 to R-215	Beach berm repair (permanent)	70,385 linear feet
2009	Brevard	Patrick Air Force Base Dune Restoration and Beach Nourishment	41910-2009-F-0336	R-36 to R-75, R-53 to R-65	Sand placement	8,500 linear feet for dune restoration and 11,235 linear feet for beach nourishment.
2009	Brevard	Brevard Dune	41910-2009-F-0125	R-75.4 to R-118.3, R-139 to R-213	Dune restoration	Periodically on no more than 22 miles.

		Restoration				
2009	Brevard	Mid Reach Shore Protection	41910-2008-F-0547	R-119 to R-75.4	Sand placement	7.7 linear miles
2009	Brevard	Canaveral Harbor Sand Bypass	41910-2008-F-0547	Canaveral Harbor	Sand bypass	18,600 linear no more than every 2 years
2009	Brevard	Kennedy Space Center Lighting	41910-2009-F-0306			3% of all hatchling disorientation events
2009	Brevard	South Beach Renourishment	41910-2009-F-0327			7.8 miles
1991	Duval	Duval County Beach Erosion Control		R-44 to R-52.5	Beach nourishment	9,000 linear feet
1996	Duval	Duval County Beach Erosion Control		R-47 to R-80	Beach nourishment	5 miles
2003	Duval	Duval County Beach Erosion Control		R-72 to R-80	Beach nourishment	
2005	Duval	Duval County Beach Erosion Control	05-1544	R-43 to R-53 and R-57 to R-80	Beach nourishment	5.7 miles
2010	Duval	Duval County Hurricane and Storm Damage Reduction	2010-CPA-0045	V-501 to R-80	Beach nourishment	52,800 linear feet
2005	Flagler	Road Stabilization from SR A1A	41910-2006-IE-0173		Seawall	140 linear feet
2009	Flager	State Road (SR) A1A Shoreline Stabilization	41910-2007-F-0495	200 feet south of South 28th Street to 980 feet south of Osprey Point Drive	Sand placement, revetments, and seawalls	5.2 miles = length of take; 3,000 linear feet of anticipated incidental take
2005	Hillsborough	Egmont Key Nourishment	05-1845	R-2 to R-10	Beach nourishment	8,000 linear feet
1993	Manatee	Anna Maria Island Beach Restoration		R-2 to R-36	Beach nourishment	4.7 miles
1997	Manatee	Dredge Material Disposal and Longboat Key Beach Restoration		R-48 to R-51	Dredge and beach nourishment	
2002	Manatee	Anna Maria Island Beach Restoration		R-7 to R-10 and R-12 to R-36	Beach nourishment	5.2 miles
2005	Manatee	Anna Maria Island Shore Protection Project	41910-2006-F-0079	R-7 to R-10	Beach nourishment	3,000 linear feet
2005	Manatee	Anna Maria Island Emergency Beach Restoration	05-1227	R-2 to R-41	Beach nourishment	4.2 miles
2005	Manatee	Town of Longboat Key Beach Renourishment	4-1-04-TR-4529	R-44.5 to R-46	Beach nourishment	0.34 mile
2007	Manatee	Longboat Key Groin Installation	41910-2007-F-0521		Groin installation	2,210 linear feet
2009	Manatee	Anna Maria Island Beach Nourishment	41910-2008-F-456	R-7 to R-10, R-35 +790 feet and R-41 +365 feet	Sand placement	8,000 linear feet
2010	Manatee	Longboat Key North	41910-2010-F-0301			4,015 linear feet of beach

		End Nourishment				
1994	Nassau	South Amelia Island Beach Restoration		R-60 to R-78	Beach nourishment	
1997	Nassau	Dredging of Sawpit Creek Cut and Beach Disposal		R-73.5 to R-78	Dredge and beach nourishment	2,900 linear feet
2002	Nassau	South Amelia Island Beach Restoration		R-50 to R-80	Beach nourishment	3.4 miles
2002	Nassau	Fernandina Harbor Dredge and Beach Disposal		R-1 to R-9	Dredge and beach nourishment	8,000 linear feet
2004	Nassau	Nassau County Shore Protection Project at Amelia Island	05-1355	R-9 to R-33	Beach nourishment	3.6 miles
2005	Nassau	Nassau County Shore Protection Project at Amelia Island	05-1355	R-11 to R-34	Beach nourishment	4.3 miles
2005	Nassau	Dredging of Sawpit Creek Cut and Beach Disposal	41910-2006-F-0254	R-73.5 to R-78	Dredge and beach nourishment	2,900 linear feet
1988	Pinellas	Sand Key/Redington Beach Restoration		R-99 to R-107	Beach nourishment	
1990	Pinellas	Sand Key/Indian Rocks Beach Restoration		R-72 to R-85	Beach nourishment	
1991	Pinellas	Long Key Beach Restoration		R-144 to R-147	Beach nourishment	0.45 mile
1991	Pinellas	Johns Pass Dredge Material Disposal		R-127 to R-130	Dredge disposal and sand placement	
1992	Pinellas	Sand Key/Redington Beach Restoration		R-99 to R-107	Beach nourishment	
1992	Pinellas	Sand Key/Indian Shore Beach Restoration		R-85 to R-99	Beach nourishment	
1996	Pinellas	Treasure Island Beach Restoration		R-138 to R-142	Beach nourishment	2,500 linear feet
1996	Pinellas	Long Key Beach Restoration		R-144 to R-146	Beach nourishment	0.45 mile
1998	Pinellas	Sand Key/Belleair Beach Restoration		R-56 to R-66	Beach nourishment	
1999	Pinellas	Sand Key Beach Restoration		R-71 to R-107	Beach nourishment	
2000	Pinellas	Treasure Island Beach Restoration		R-136 to R-141	Beach nourishment	2.0 miles
2000	Pinellas	Terminal Groin at North End of Treasure Island			Groin construction	
2000	Pinellas	Long Key Beach Restoration		R-144 to R-145.6	Beach nourishment	2,800 linear feet
2000	Pinellas	Dredge Material Disposal and Honeymoon Island		R-10 to R-12	Dredge disposal and sand placement	

		Beach Restoration				
2004	Pinellas	Treasure Island Beach Restoration	04-1247	R-136 to R-141	Beach nourishment	5,000 feet
2004	Pinellas	Long Key Beach Restoration	04-1247	R-144 to R-148	Beach nourishment	4,000 linear feet
2005	Pinellas	Sand Key Emergency Renourishment	05-0627	R-56 to R-66 and R-72 to R-106	Beach nourishment	8.6 miles
2006	Pinellas	Treasure Island, Sunset, Long Key, Pass a Grill Emergency Renourishment	41910-2006-F-0480	R-126 to R-146	Beach nourishment	9.5 miles
2006	Pinellas	Dredge Material Disposal and Mullet Key and Fort DeSoto Beach Restoration	41910-2006-F-0692	R-177 to R-179.5 and R-181 to R-183	Dredge disposal and sand placement	4,500 linear feet
2009	Pinellas	Treasure Island Beach Nourishment	41910-2009-F-0250	R-136 to R-141, R-144 to R-148	Sand placement	11,375 linear feet
1997	St. Johns	Maintenance Dredging of Matanzas Inlet and Sand Placement at Summer Haven	98-171D	R-197 to R-209		
2001	St. Johns	Maintenance Dredging of Matanzas Inlet and Sand Placement at Summer Haven	98-171D			
2002	St. Johns	St. Johns County Shore Protection Project at St. Augustine		R-137 to R-152	Beach nourishment	2.5 miles
2003	St. Johns	St. Johns County Shore Protection Project at St. Augustine		R-132 to R-152	Beach nourishment	3.8 miles
2003	St. Johns	Maintenance Dredging of Matanzas Inlet and Sand Placement at Summer Haven	98-171D	R-197 to R-209	Beach nourishment	
2005	St. Johns	St. Johns County Shore Protection Project at St. Augustine	05-0446	R-137 to R-150	Beach nourishment	2.5 miles
2006	St. Johns		TE091980-0		Beach driving	41.1 linear miles
2007	St. Johns	Maintenance Dredging of Matanzas Inlet and Sand Placement at Summer Haven	41910-2007-F-0305	R-200 to R-208	Beach nourishment	4,000 linear feet
2009	St. Johns	Beach berm repair		R-201 to R-203, R-207 to R-208	Beach berm repair	7,000 linear feet
2009	St. Johns	Matanzas Inlet Maintenance Dredge and Summer Haven Sand Placement	41910-2009-F-0462	R-200 to R-208	Sand placement	8,000 linear feet

2009	St. Johns	St. Augustine Shore Protection Project	41910-2009-F-0444	600 feet north of R-137 and 600 feet south of R-151	Sand placement	15,280 linear feet
2010	St. Johns	St. Augustine Inlet Dredge and Sand Placement	41910-2010-F-0105			20,000 linear feet
2004	Volusia	Volusia County FEMA Berm	05-1074	R-40 to R-145 and R-161 to R-208	Beach nourishment	
2005	Volusia	Ponce de Leon Dredge and Beach Placement	05-0884	R-143 to R-145	Dredge and sand placement	3,000 linear feet
2005	Volusia		TE811813-11		Beach driving	50 miles
2006	Volusia	New Smyrna/Silver Sands Dune Restoration	05-1007	R-161 to R-175	Beach restoration	5.4 miles
2006	Volusia	Volusia County FEMA Berm	41910-2006-F-0831		Repair of right of way and beach placement	230 linear feet
2007	Volusia	Ponce de Leon Dredge and Beach Placement	41910-2007-F-0109	R-158 to R-175	Dredge and sand placement	3.2 miles
2009	Volusia	Ponce de Leon Inlet Maintenance Dredging and Sand Placement	41910-2009-F-0362	R-143 to R-145	Sand placement	8,000 linear feet
PANAMA CITY FIELD OFFICE						
8 April 1998	Bay	Panama City Beach Beach Nourishment	4-P-97-108	R-4.4 and R-93.2	Beach nourishment new project	16 miles
24 June 1998	Bay	Tyndall AFB Driving on the Beach	4-P-98-020	V-9 (virtual) to R-122	Driving on the beach for military missions	18 miles
31 July 1998	Bay	Lake Powell Emergency Opening	4-P-97-089	R- 0.5	Emergency outlet opening	1,500 feet
16 April 1999	Bay	Panama City Beach Beach Nourishment Amendment 1	4-P-97-108	R-0.5 to R-9	Beach nourishment completion	16 miles (no additional take provided from original)
9 March 2000	Bay	Panama City Beach Beach Nourishment Amendment 2	4-P-97-108	R-35 to R-71	Relief from tilling requirement beach nourishment	16 miles (no additional take provided from original)
10 April 2000	Bay	Panama City Beach Beach Nourishment Amendment 3	4-P-97-108	R-35 to R-71	Relief from tilling requirement beach nourishment	16 miles (no additional take provided from original)
18 December 2000	Bay	Panama City Beach Beach Nourishment Amendment 4	4-P-97-108	R-35 to R-71	Relief from tilling depth requirement and compaction testing sample numbers beach nourishment	16 miles (no additional take provided from original)
4 January 2001	Bay	East Pass Re-Opening	4-P-00-211	No R-monuments	Dredging of a closed inlet and dredged material placement on beach	2 miles

29 March 2001	Bay	Panama City Beach Beach Nourishment Amendment 5	4-P-97-108	R-35 to R-71	Relief from tilling depth requirement beach nourishment	16 miles (no additional take provided from original)
7 Sept 2001	Bay	City of Mexico Beach Sand Bypass System	4-P-01-178	Mexico Beach canal	Dredging and spoil disposal	3,700 feet 2.0 acres
14 January 2005	Bay	Panama City Beach Beach Nourishment Amendment 5	4-P-97-108	R-4.4 and R-93.2	Post hurricane restoration	16 miles (no additional take provided from original)
2006	Bay	Tyndall Air Force Base INRMP	4-P-05-240	V-9 (virtual) to R-122	Integrated Natural Resources Management Plan	18 miles
26 March 2006	Bay	Mexico Beach Canal Sand By Pass Amendment 1	4-P-05-281 2007-F-0205	R-127 to R-129	By pass system improvements	5,000 feet
24 May 2007	Bay	Panama City Beach Beach Nourishment Amendment 6	4-P-97-108 2007-TA-0127	R-4.5 to R-30 and R-76 to R-88	New work and post hurricane restoration	31,500 feet of 16 miles total no additional take provided
25 October 2007	Bay	Panama City Beach Nourishment Amendment 8	2008-F-0004	2008 project: R-74 to R-91; Entire project: R-0.5 to R-91	Beach nourishment	17.9 miles
29 Feb 2008	Bay	Panama City Harbor (revised BO)	2008-F-0168	R-97	Navigation channel maintenance dredging and beach placement of dredged material.	500 ft of beachfront at St. Andrew State Park
8 June 2009	Bay	Panama City Harbor Navigation Channel Amendment 1	2009-F-0175	R-92 to R-97	Maintenance navigation channel dredging and dredged material placement	0.85 mile
2009	Bay	City of Mexico Beach		R-128.5 to R-138.2	Beach berm repair (emergency)	9,393 linear feet
06 Jan 2010	Bay	Lake Powell Outlet Emergency Opening	2009-F-0226	R-0-A and R-1	Emergency opening of the outlet to the Gulf of Mexico	2,400 feet
7 August 2000	Escambia, Santa Rosa, Okaloosa, Walton, Bay, Gulf, Franklin	Destin Dome OCS Offshore Oil and Gas Drilling	4-P-00-003	Gulf of Mexico federal waters	Oil and gas offshore exploration	Formal consultation with no take
3 June 2002	Escambia	Pensacola Beach Beach Nourishment	4-P-02-056	R-108 to R-143	Beach nourishment	8.3 miles Loggerhead 14 nests Green 1 nest Leatherback < 1 nest Kemp's ridley <1 nest
9 June 2009	Escambia	Perdido Key Beach Nourishment	2008-F-0059	R-1 to R-34	New beach nourishment	6.5 miles
9 Sept 2010	Escambia	Pensacola Navigation Channel	2009-F-0205; using statewide programmatic 41910-2010-F-0547	R-32 to R-64	Navigation channel maintenance and dredge material disposal	6.3 miles

11 Jan 2010	Escambia	FEMA Perdido Key Upland Berm	Using statewide programmatic 41910-2010-F-0547	R-21.5 to R-31.5	Post Tropical Storm Gustav berm	2.0 miles
8 April 2005	Escambia, Santa Rosa, Okaloosa, Walton, Bay, Gulf	FEMA Beach Berms Post Hurricane Ivan Emergency Coordination (consultation incomplete)		UK	Emergency beach berms	Walton 20 miles Okaloosa 4.2 miles Mexico Bch 1 mile Panama City Bch UK St Joseph peninsula UK Perdido Key UK Navarre UK
10 May 2004	Franklin	Alligator Point Beach Nourishment	4-P-02-163	R-207 to R-210	Beach nourishment	2,500 feet Loggerhead,: 2 nests, green 1 nest; leatherback 1 nest
17 May 2007	Gulf	St. Joseph Peninsula Beach Nourishment	4-P-07-056 2007-F-0220	R-67 to R-105.5	Beach nourishment	7.5 miles
31 Jan 2008	Gulf	St. Joseph Peninsula Beach Nourishment; Amendment 2	2008-F-0161	R-67 to R-105.5	Beach nourishment – change from work in 2 to 1 season.	7.5 miles; no increase in IT.
2009	Gulf	St. Joseph Peninsula Beach		R-95.3 to R-105.5	Beach berm repair (emergency)	10,300 linear feet
25 April 2001	Okaloosa	Eglin AFB Porous Groin within Season	4-P-00-207	Eglin AFB Test Sites 1 and 3	Experimental porous groin system	
18 June 2002	Okaloosa	Eglin 737 Sensor Test Site 13-A SRI	4-P-02-088	V-507	Military testing	0.01 acre 0.12 mile
2009	Okaloosa	City of Destin		R-17.37 to R-19	Beach berm repair (emergency)	1,260 linear feet
23 Dec 2009	Okaloosa	East Pass at Destin Navigation Channel	2009-F-0096	R-17 to R-25.5	Navigational channel maintenance	1.7 miles
21 March 2003	Okaloosa Santa Rosa	Eglin Marine Expeditionary Unit Training	4-P-03-052	V-621 to V-501	Military marine training	
9 October 2003	Okaloosa Santa Rosa	Eglin AFB U.S. Army Ranger Los Banos	4-P-03-289	V-502 to V-533	Military army training	7 miles
25 February 2004	Okaloosa, Santa Rosa	Eglin AFB Advance Skills Training	4-P-03-264	R-502 to R-534	Military training	7 miles 70 acres
4 June 2004	Okaloosa Santa Rosa	Eglin AFB Airborne Littoral Reconnaissance Test	4-P-04-225	V-501 to V-514	Military naval testing	0.5 mile 15.2 acres
1 December 2005	Okaloosa Santa Rosa	Eglin Air Force Base Military Mission & Training Santa Rosa Island Programmatic	4-P-05-242	V-621 to V-501	Military missions	17 miles
6 December 2007	Okaloosa Santa Rosa	Eglin AFB Airborne Littoral Reconnaissance Test	2008-F-0056	V-501 to V-514 Test Site A-15	Military naval testing	0.7 acre
3 June 2008	Okaloosa Santa Rosa	Eglin AFB Beach and Dune Restoration	2008-F-0139	V-551 to V-609 excluding non-AF lands and V-512 to	Beach nourishment including dune	5.0 miles

				V-518	restoration (new)	
28 August 2008	Okaloosa, Santa Rosa	Eglin Air Force Base Armoring Santa Rosa Island Test Sites A-3, A-6, A-13B	2008-F-061	Test Sites A-3, A-6, A-13B	Storm protection at air force facilities, Santa Rosa island	0.57 miles
21 April 2009	Okaloosa, Santa Rosa	East Pass Destin Navigation Channel	2009-F-0295	V-619.5 to V-621 and R-17	Maintenance navigation channel dredging and dredged material placement	1.6 miles
28 Dec 2009	Okaloosa, Santa Rosa	Eglin Air Force Base protection of Test Sites A-3, A-13, and A-13b	2008-F-061 amendment 1	V-608 and V-512	Sand placement 100% proposed at sites A-3 and 50% of proposed between sites A-13b and A-13.	A-3, = 7,000 feet; between A-13b and A-13.5=5,500-7,000 feet
28 Dec 2009	Okaloosa, Santa Rosa	Eglin Air Force Base	2008-F-039 amendment 1	V-608 and V-512	Sand placement 100% proposed at sites A-3 and 50% of proposed between sites A-13b and A-13.	A-3, = 7,000 feet; between A-13b and A-13.5=5,500-7,000 feet
26 March 2002	Santa Rosa, Okaloosa, Gulf	Eglin AFB INRMP		V-621 to V-501	Integrated natural resources management program	17 miles
19 July 2005	Santa Rosa	Navarre Beach Nourishment Emergency Coordination (consultation incomplete)	4-P-04-244	R-192.5 to R-213.5	Emergency beach nourishment	4.1 miles
24 Aug 2006	Santa Rosa	Navarre Beach Restoration Amendment 1	4-P-04-244 2007-F-0139		Walkover construction associated with beach nourishment	4.1 miles (no additional take provided from original)
30 Aug 2006	Santa Rosa	Navarre Beach Restoration Amendment 1	4-P-04-244 2007-F-0139		Walkover construction associated with beach nourishment	4.1 miles (no additional take provided from original)
29 Nov 2006	Santa Rosa	Navarre Beach Restoration Amendment 1	4-P-04-244 2007-F-0139		Walkover construction associated with beach nourishment	4.1 miles (no additional take provided from original)
28 August 2008	Santa Rosa	Eglin AFB SRI Armoring at Test Sites	2008-F-0061	V-608, V-551, and V-512	Bulkheads around test sites A-3, A-6, and A-13B	0.57 mile
7 Dec 2006	Santa Rosa	Navarre Beach Restoration Amendment 1	4-P-04-244 2007-F-0139		Walkover construction associated with	4.1 miles (no additional take provided from original)

					beach nourishment	
9 October 2009	Santa Rosa	Navarre Beach Restoration Amendment 7	2010-F-0036	R-192 to R-194	Emergency beach restoration	1,800 feet
30 April 2004	Walton, Okaloosa	Walton County-Destin Beach Nourishment	4-P-01-149	R-39 (Okaloosa Co.) to R-21.93 (Walton Co.)	New beach nourishment	6.7 miles Loggerhead: 11 nests; green 1 nests; leatherback & Kemp's ridley: < 1 nests
8 May 2006	Walton	Western Lake Emergency Opening	4-P-01-105	R-72 to R-73	Emergency outlet opening	0.5 miles 3.0 acres
26 October 2007	Walton	Eastern Lake Emergency Opening	2007-F-0627	R-94 to R-95	Emergency opening of coastal dune lake to GOM	0.5 mile
9 November 2007	Walton	Alligator Lake Emergency Opening	2007-F-0031	R-68 to R-70	Emergency opening of coastal dune lake to GOM	0.5 mile
2 October 2008	Walton	Walton County Beach Nourishment Phase 2	2008-F-060	R-41 to R-67, R-78 to R-98, R-105.5 to R-127	Beach nourishment (new)	13.5 miles
SOUTH FLORIDA FIELD OFFICE						3,390 feet
11 March 2003	Broward	Broward County Shore Protection Project	4-1-99-F-506		Port Everglades dredging and beach nourishment	
4 Dec 2003	Broward	Diplomat Beach Nourishment	4-1-00-F-743		Nourishment and 200 feet of riprap	
25 Aug 2004	Broward	Fishermen's Pier	4-1-04-F-8366		Pier repair	14,910 square feet
18 June 2007	Broward	Hillsboro Inlet Maintenance Dredging and Sand Placement	41420-2006-FA-0896	315 feet of the Inlet and 500 feet of shoreline at R-25.	Inlet dredging and sand nourishment	500 feet
10 Dec 2007	Broward	Town of Hillsboro Beach Pressure Equalizing Modules (PEMs) Pilot Project	41420-2007-F-0859	300 feet north of R-7 to 100 feet south of R-12 1 mile of shoreline	Pilot project to investigate the effectiveness of the PEMs	1 mile
7 Mar 2008	Broward	Broward County Glass Cullet Pilot Project	41420-2007-FA-0599	Centered at R-103	Pilot project to examine the effectiveness of glass cullet as potential beach fill supplement material for shoreline stabilization.	333 feet
28 April 2008	Broward	Town of Hillsboro Truck Haul Beach Nourishment Project	41420-2008-FA-0187	330 feet north and 100 feet south of R-7	Temporary beach nourishment	0.08 mile (430 feet)

3 Sept 2008	Broward	Hillsboro Inlet Maintenance Dredging and Sand Placement	41420-2006-FA-0896	500 feet south of R-25	Inlet dredging and sand placement. This is an amended BO in regard to the original BO completed on 18 June 2007.	500 feet
28 May 2010	Broward	Port Everglades Jetty Repair	41420-2010-CPA-0144	South Jetty	Repair of the south jetty.	0.15 mile
18 June 2010	Broward	Hillsboro Beach Sand Placement	41420-2008-FA-0187	R-5 +300 to R-12 +450 feet	Beach nourishment	1.35 miles
23 March 2005	Charlotte	Manasota Key Groin Construction	4-1-04-F-8338	R-19 to R-20	Stump Pass dredging (material placed on beach); and groin construction	1,000 feet
29 March 2006	Charlotte	Stump Pass Dredging and Beach Nourishment	4-1-04-F-8338	R-16.5 to R-18	Stump Pass dredging and beach nourishment	1,500 feet
26 April 2010	Charlotte	Stump Pass Dredging and Sand Placement	41420-2008-FA-0425	R-14.4 to R-20 R-22 to R-23 R-29 to R-39	Stump Pass dredging and sand placement	3.5 miles
3 April 2003	Collier	Keewaydin Island Limited Partnership T-Groin Project	4-02-F-1099	R-90 to R-91	Gordon Pass – maintenance dredge; nourish the section of beach where groins are to be constructed; construct three t-groins	1,000 feet
14 March 2005	Collier	Hideaway Beach	4-1-04-F-6342	H-1 to H-5 and H-9 to H-12	Beach nourishment and t-groin construction	1.4 miles
20 Sept 2005	Collier	Collier County Beach Re-Nourishment Project	4-1-04-TR-8709	Segments within R-22 and R-79	Beach nourishment	13.4 miles
14 Nov 2005	Collier	South Marco Island Beach Re-Nourishment	4-1-04-TR-11752	R-144 to G-2	Beach nourishment	0.83 mile
28 August 2008	Collier	Doctor's Pass North Jetty Repair	41420-2008-FA-0432	R-57 plus 500 feet south	Removing the existing 240 feet of existing jetty and constructing a new jetty within generally the same footprint.	0.25 mile
27 October 2009	Collier	Hideaway Beach Erosion Control	41420-2008-FA-0935	H-4 to H-9	Sand placement and construction of six T-head groins.	0.47 mile
18 August 2010	Collier	Gordon Pass Erosion Control Project – Phase 2 (T-head groins)	41420-2008-FA-0765	R-91 to R-92	Construction of two T-head groins.	0.19 mile

28 Oct 2010	Collier	Collier County Truck Haul Sand Placement (Park Shore & Naples Beach)	41420-2010-F-0225	R-45 +600 feet to R-46 +400 feet; R-58A -500 feet to R-58	A truck haul sand placement project	0.37 mile
12 Oct 2004	Indian River	Issuance of Permits to Homeowners for Emergency Coastal Armoring	10(a)(1)(B) permit			3,196 feet
28 Feb 2005	Indian River	Indian River County Beach Nourishment - Sectors 3 and 5	4-1-05-F-10922	Gaps between R-21 and R-107	Dune restoration and beach nourishment	5.90 miles dunes 0.8 mile beach
22 Nov 2005	Indian River	Indian River County Beach Nourishment – Sector 7	4-1-05-TR-9179	R-97 to R-108	Beach nourishment	2.2 miles
31 Oct 2006	Indian River	Indian River County Beach Nourishment – Sectors 1 and 2	41420-2006-FA-1491	R-3.5 to R-12	Dune enhancement and beach nourishment	1.62 miles
10 Sept 2007	Indian River	Sebastian Inlet Channel and Sand Trap Dredging, Sectors 1 and 2 Beach Nourishment	41420-2007-F-0864	R-3 to R-12	Sand trap dredging and beach nourishment	1.61 miles
10 October 2008	Indian River	Baytree and Marbrisa Condominium Dune Restoration	41420-2008-FA-0007	200 feet south of R-46 to 200 feet south of R-48	Dune restoration/enhancement	0.38 mile
16 October 2009	Indian River	City of Vero Beach, Outfall Pipe Installation	41420-2009-FA-0255	220 feet north and 930 feet south of R-83	Outfall pipe installation	0.22 mile
2 December 2009	Indian River	Indian River County Beach Nourishment Sector 3	41420-2007-F-0839	Phase 1 = R-32 to R-55 Phase 2 = R-20 to R-32	Beach and dune nourishment	Phase 1 = ~4.4 miles Phase 2 = ~2.3 miles
24 July 2002	Lee	Gasparilla Island Beach Nourishment	4-01-F-765	R-10 to R-26.5 R-25, R-25.5, R-26	Beach nourishment; breakwater construction; and two t-head groins	3.2 miles
19 June 2003	Lee	Bonita Beach Re-nourishment	4-1-02-F-1736		Beach nourishment	3,922 feet
4 March 2005	Lee	Sanibel and Captiva Island Beach Nourishment	4-1-04-F-9180	R-83 to R-109 and R-110 to R-118	Beach nourishment	6.0 miles
14 March 2007	Lee	Gasparilla Island Beach Nourishment (BO amendment)	41420-2007-FA-0509	South of R-26A	Beach nourishment	
27 August 2007	Lee	North Captiva Island Beach Nourishment	41420-2007-FA-1023	R-81 and 208 feet south of R-81A	Beach nourishment	0.23 mile
5 August 2009	Lee	Matanzas Pass Reopening	41420-2009-FA-0132	North end of Estero Island	Channel dredging	0.14 mile
21 March 2008	Lee	Blind Pass Reopening	41420-2006-FA-1549	R-109 to R-114	Reopening Blind Pass and then	0.95 mile

					nourishing the shoreline between R-112 and R-114.	
7 Dec 2009	Lee	Sanibel Island Sand Placement	41420-2009-FA-0066	R-174A to Bay 1A	Beach nourishment	0.25 mile
15 Sept 2010	Lee	Big Hickory Island Sand Placement and Groin Construction	41420-2010-CPA-0100	R-222.3 to R-223.8	Beach nourishment and groin construction	0.47 mile
31 Jan 2002	Martin	Jupiter Island	4-1-05-TR-13281	R-75 to R-117	Beach nourishment	6.5 miles
5 Jan 2005	Martin	Martin County Shore Protection Project	4-1-05-F-10476	R-1 to R-25.6	Beach nourishment	4.1 miles
2 Dec 2005	Martin	Jupiter Island Modification	4-1-05-TR-13281	R-76 to R-84 and R-87 to R-11	Beach nourishment	5 miles
2 Feb 2007	Martin	Sailfish Point Marina Channel Dredging and Beach Nourishment	41420-2007-FA-0196	R-36 to R-39	Channel dredging and beach nourishment	0.66 mile
6 October 2009	Martin	Bathtub Beach Park Sand Placement	41420-2009-FA-0110	R-34.5 to R-36	Beach nourishment	0.24 mile
8 June 2010	Martin	Martin County Beach Erosion Control Project	41420-2009-FA-0190	R-1 to R-25	Beach nourishment	~ 4 miles
23 Sept 2005	Miami-Dade	Bal-Harbour T-Groin Reconstruction	4-1-05-12842	R-27 to R-31.5	Groin removal and reconstruction	0.85 mile
11 Oct 2005	Miami-Dade	Bakers Haulover AIW Maintenance Dredging	4-1-04-TR-8700	R-28 to R-32	Dredging and beach nourishment	0.85 mile
7 June 2006	Miami-Dade	Miami-Dade Beach Nourishment	41420-2006-FA-0028	3 segments within R-48.7 and R-61	Beach nourishment	3,716 feet
25 July 2007	Miami-Dade	Miami Beach Nourishment	41420-2006-F-0028	R-67 to R-70	BO modification to June 7, 2006 BO	3,000 feet
5 Nov 2008	Miami-Dade	Baker's Haulover Dredging and Sand Placement	41420-2008-FA-0729	R-28 to R-32	BO modification to the October 11, 2005 BO. Dredging and sand placement events will be biannual.	4,000 feet
12 Nov 2008	Miami-Dade	DERM Truck Haul Sand Placement	41420-2008-FA-0776	R-27 to R-29 R-7 to R-12 R-43 to R-44+500 feet	Beach nourishment	1.78 miles
25 Nov 2009	Miami-Dade	DERM 27th Street Sand Placement	41420-2009-FA-0045	R-60 to R-61	Beach nourishment	0.19 mile
17 Dec 2009	Miami-Dade	32nd and 63rd Streets Sand Placement	41420-2009-FA-0415	R-37.75 to R-46.25 R-53.7 to R-55.5 R-60 to R-61	Sand placement	2.14 miles
31 March 2010	Miami-Dade	55th Street Sand Placement	41420-2009-FA-0046	R-48.7 to R-50.7	Sand placement	0.38 mile
30 April 2010	Miami-Dade	44th Street Sand Placement	41420-2009-FA-0047	R-53.7 to R-55.5	Sand placement	0.34 mile
25 June 2010	Miami-Dade	Bal Harbour Sand	41420-2009-FA-	R-29 to R-32	Sand Placement –	0.60 mile

		Placement	0593		truck haul	
28 June 2010	Miami-Dade	Sunny Isles BeachSand Placement	41420-2009-FA-0594	R-12 to R-15)	Sand Placement – truck haul	0.58 mile
30 July 2010	Miami-Dade	Miami Beach sand placement	41420-2009-FA-0595	R-45 to R-48 +700 feet	Sand Placement – truck haul	0.78 mile
13 Sept 2010	Miami-Dade	Miami Beach sand placement	41420-2009-FA-0527	R-43 to R-44 + 500 feet	Sand Placement – truck haul	0.26 mile
8 October 2010	Miami-Dade	Sunny Isles Beach Sand Placement	41420-2009-FA-0526	R-7 to R-12	Sand Placement – truck haul	0.95 mile
8 October 2010	Miami-Dade	Bal Harbour Sand Placement	41420-2009-FA-0525	R-27 to R-29	Sand Placement – truck haul	0.38 mile
2009	Monroe	Reclaimed sand placement and sand cleaning (seaweed removal)	41420-2010-F-0006	No R-monuments	Sand placement and cleaning	1,462 linear feet
2009	Monroe	City of Key West (South Beach)	41420-2010-F-0013	No R-monuments	Beach repair (emergency)	235 linear feet
2009	Monroe	City of Key West (Rest Beach)	41420-2010-F-0014	No R-monuments	Beach repair (emergency)	640 linear feet
2009	Monroe	City of Marathon, Sombrero Beach	41420-2010-F-0001	No R-monuments	Beach repair (emergency)	1,380 linear feet
5 March 2010	Monroe	City of Key West – Simonton Beach	41420-2010-FC-0412	Approximately 350 feet ENE of V-416 (latitude 24.562, longitude -81.8054	Emergency beach repair	95 linear feet
5 March 2010	Monroe	City of Key West – Dog Beach	41420-2010-FC-0413	Between V-414 and V-413 (latitude 24.5473, longitude -81.7929	Emergency beach repair	35 linear feet
13 May 2010	Monroe	City of Key West, Smathers Beach	41420-2008-FA-0185	No R-monuments	Sand placement	0.57 mile
27 March 2003	Palm Beach	Palm Beach Harbor M & O	4-1-03-F-139	200 feet south of the south jetty	Jetty sand tightening	200 feet
16 March 2004	Palm Beach	Boca Raton Inlet Sand Bypassing	4-1-04-F-4688	200 feet south of R-223	Inlet sand bypassing and beach nourishment	500 feet
11 Feb 2005	Palm Beach	Palm Beach Shoreline Protection Project - Delray Segment	4-1-05-F-10767	R-175 to R-188	Beach restoration	2.7 miles
24 Feb 2005	Palm Beach	Palm Beach Shoreline Protection Project - Ocean Ridge Section	4-1-05-F-10787	R-153 to R-159	Beach nourishment	1.12 miles
11 April 2005	Palm Beach	South Lake Worth Inlet Sand Transfer Plant Reconstruction and Bypassing	4-1-04-F-8640	135 feet south of R-151, to 275 feet south of R-152	STP reconstruction and bypassing	900 feet
5 Dec 2005	Palm Beach	Mid-Town Beach Nourishment Project (Reach 3 & 4)	4-1-00-F-742	R-90.4 to R-101.4	Beach nourishment	2.4 miles

23 Dec 2005	Palm Beach	Palm Beach Harbor M & O	4-1-05-TR-13258	R-76 to R-79	Dredging and beach nourishment	3,450 feet
23 Feb 2006	Palm Beach	Boca Raton Central Beach Nourishment Project	4-1-01-F-1795	R-216 to R-222	Dredge shoal fronting Boca Raton Inlet and beach nourishment	1.3 miles
23 Feb 2006	Palm Beach	Boca Raton South Beach Nourishment Project	41420-2008-FA-0777 Old database number 41-01-F-652	R-223.3 to R-227.9	Dredge shoal fronting Boca Raton Inlet and beach nourishment	Approx. 1 mile
28 April 2006	Palm Beach	Palm Beach Nourishment Project – Reach 8	41420-2006-F-0018	R-125 to R-134	Beach nourishment	2.17 miles
31 July 2006	Palm Beach	Sea Dunes Condominium Seawall	41420-2006-FA-1108		Seawall construction	0.03 acre
15 Dec 2006	Palm Beach	North Ocean Boulevard Rock Revetment	41420-2006-FA-1490	290 feet north of R-84; 1,150 feet south of R-85	Rock revetment construction	0.34 mile
5 Feb 2007	Palm Beach	Palm Beach Sand Transfer Plant Reconstruction	41420-2006-FA-1447	R-76 to R-79	Sand transfer plant reconstruction and discharge pipe extension	0.57 mile
28 March 2007	Palm Beach	Lake Worth Inlet Jetty Repair	41420-2007-FA-0221	200 feet north of R-75 and 200 feet south of R-76	Jetty repair	400 feet
25 May 2007	Palm Beach	Singer Island and South Palm Beach Emergency Dune Restoration	41420-2007-FA-1001	385' south of R-137 to 500' north of R-136; 500'south of R-60 to 850' south of R-65	Dune Restoration	6,135 feet
25 May 2007	Palm Beach	Jupiter Island ICWW Maintenance Dredging and Beach Nourishment	41420-2006-FA-1582	16,000 feet (130,000 cy) of the ICWW dredged; material placed between R-13 and R-19.	Channel dredging and beach nourishment	1.04 miles
20 July 2007	Palm Beach	North Boca Raton Beach Nourishment	41420-2007-FA-0477	T-205 to 181 feet south of R-212	Beach nourishment	1.45 miles
9 Nov 2007	Palm Beach	Jupiter Inlet and channel dredging	41420-2006-FA-1582	R-13 to R-17	Dune restoration	~ 4,000 linear feet
14 Nov 2007	Palm Beach	Jupiter Inlet Sand Trap Dredging and Sand Placement	41420-2007-FA-0600	Maintenance dredging of the inlet; beach compatible placed R-13 to R-19	Inlet dredging and beach nourishment	1.02 miles
28 Nov 2007	Palm Beach	Modification to a Sheet Pile and Rubble-Mound T-Head Groin System	41420-2007-FA-0574	500 feet north of R-94 south to R-95	T-groin repair, extension, construction	0.4 mile
5 Feb 2008	Palm Beach	Reach 8 Dune Restoration	41420-2006-F-0018	R-125 to 350 feet south of R-134	Dune restoration	2.17 miles
9 Sept 2008	Palm Beach	Juno Beach Sand Placement	41420-2008-FA-0081	R-26 to R-38	Sand placement	2.45 miles
4 Nov 2008	Palm Beach	Palm Beach Harbor M&O and Sand	41420-2008-FA-0524	R-76 to R-79	Biannual Inlet dredging and sand	3,450 feet

		Placement			placement events.	
2009	Palm Beach	Beach berm repair	41420-2010-F-0008	R-60 to R-68	Beach berm repair (permanent work)	6,880 linear feet
2009	Palm Beach	Beach berm repair	41420-2010-F-0009	R-135 to R-138	Beach berm repair (permanent work)	3,590 linear feet
2009	Palm Beach	Beach berm repair	41420-2010-F0010	R-137 to R-138	Beach berm repair (emergency)	125 linear feet
21 June 2010	Palm Beach	Mid-Town Reaches 3 & 4 Sand Placement	41420-2006-F-0011-R001	R-95 to R-100	Beach nourishment	0.95 mile
2 July 2010	Palm Beach	Phipps Ocean Park Reaches 7&8	41420-2010-CPA-0110	R-116 to R-125	Sand Placement	3.4 miles
3 Sept 2010	Palm Beach	Singer Island Breakwater	41420-2008-FA-0019	R-60.5 to R-66	Segmented, submerged breakwater	1.1 miles
19 June 2003	St. Lucie	Fort Pierce Shoreline Protection	4-1-03-F-1867 41420-2006-FA-1575	R-33.8 to R-41	Beach nourishment; berm expansion; and six t-head groins	1.3 miles
9 March 2006	St. Lucie	Blind Creek Restoration and South St. Lucie Emergency Berm Remediation Project	41420-2006-FA-0075	R-98 to R-115 R-88 to R-90	Wetland restoration and beach nourishment	3.6 miles
27 June 2008	St. Lucie	Fort Pierce Shoreline Protection Project	41420-2006-FA-1575	R-34 to R-41	Beach nourishment, berm expansion, and six t-head groins	1.3 miles
25 Aug 2004	Sarasota and Manatee	Longboat Key Beach Nourishment	4-1-04-F-4529	R-46A to R-29.5	Beach nourishment	9.45 miles
4 Oct 2005	Sarasota and Manatee	Longboat Key Beach Nourishment Project – BO Amendment	4-1-04-TR-4529	R-44 to R-44.5 and R-46A to R-44.5	Beach nourishment	0.47 mile
20 Oct 2005	Sarasota	South Siesta Key	4-1-05-TR-12691	R-67 to R-77 plus 200 feet	Beach nourishment	2.1 miles
7 Dec 2007 (original BO) 28 July 08 (BO mod)	Sarasota	Lido Key Beach Fill Placement Project	41420-2007-F-0841	R-35.5 to R-44.2 2.27 miles	Beach nourishment with 425,000 cy of fill material.	2.27 miles
13 August 2008	Sarasota	Longboat Key Permeable Adjustable Groins	41420-2007-FA-0205	R-13 to R-13.5	Construction of two permeable adjustable groins.	0.09 mile project area 0.43 mile action area
2009	Sarasota		41420-2010-F-0003	R-77 to midpoint between R-77 and R-76	Beach restoration	700 linear feet
2009	Sarasota	Longboat Key Beach	41420-2010-F-0007	R-13 to R-14 Sarasota County; R-44 to R-5, and R-48.5 to R-49.5 Manatee County	Beach berm repair	951, 1,197, and 1,142 linear feet, respectively

Appendix B

FWC Fish and Wildlife Research Institute Statewide Nesting Beach Survey Protocol

1. **Survey Period:** There is no set period for Statewide nesting beach surveys, but ideally, all nesting activity is encompassed. Beaches with leatherback nesting usually begin by 1 March.

2. **Survey Time:** Surveys must be conducted in the early morning hours, preferably beginning at dawn in order to optimize crawl interpretation.

3. **Survey Frequency:** Most Statewide nesting beach surveys are conducted seven days a week, but some beaches, particularly remote ones, are surveyed on a less frequent basis.
Ideally, survey frequency should remain constant. All crawls should be marked or "erased" daily to avoid duplicate counts on subsequent survey days. If surveys are not conducted seven days/wk, only emergences made during the preceding 24 hours should be counted on a survey day.

4. **Survey Boundaries:** Survey boundaries should remain the same from year to year. If changes are necessary, please contact FWC well before the nesting season begins.
Boundaries should be permanent physical features.

5. **Crawl Identification:** All fresh crawls are identified to species and as either nests or false crawls based on observable crawl characteristics.

6. **Crawl Verification:** When a crawl does not have characteristics clearly indicating whether it is a nest or a false crawl, surveyors may dig with their hands at the probable location of the eggs to find the soft sand directly above the eggs. Digging should be a rare event. Probing for eggs is not permitted nor is the use of shovels.

7. **Data Reporting:** Data are reported on annual report forms supplied by FWC. The deadline for filing this report is 30 November.

8. **Significant Events:** If significant events occur that may affect turtles or their nests, please let FWC know about them. Significant events include habitat alterations such as beach nourishment, the placement of armoring or beach-access ramps, or erosion due to storms. Indicate date(s) and type of event in the comments section of the data form.

9. **Assistance:** Should questions arise or problems occur, contact Beth Brost at 1-727-896-8626, extension 1914, Fax 727-896-9176.

Appendix C

ASSESSMENTS: DISCERNING PROBLEMS CAUSED BY ARTIFICIAL LIGHTING

LIGHTING INSPECTIONS

WHAT ARE LIGHTING INSPECTIONS?

During a lighting inspection, a complete census is made of the number, types, locations, and custodians of artificial light sources that emit light visible from the beach. The goal of lighting inspections is to locate lighting problems and to identify the property owner, manager, caretaker, or tenant who can modify the lighting or turn it off.

WHICH LIGHTS CAUSE PROBLEMS?

Although the attributes that can make a light source harmful to sea turtles are complex, a simple rule has proven to be useful in identifying problem lighting under a variety of conditions:

An artificial light source is likely to cause problems for sea turtles if light from the source can be seen by an observer standing anywhere on the nesting beach.

If light can be seen by an observer on the beach, then the light is reaching the beach and can affect sea turtles. If any glowing portion of a luminaire (including the lamp, globe, or reflector) is directly visible from the beach, then this source is likely to be a problem for sea turtles. But light may also reach the beach indirectly by reflecting off buildings or trees that are visible from the beach. Bright or numerous sources, especially those directed upward, will illuminate sea mist and low clouds, creating a distinct glow visible from the beach. This "urban skyglow" is common over brightly lighted areas. Although some indirect lighting may be perceived as nonpoint-source light pollution, contributing light sources can be readily identified and include sources that are poorly directed or are directed upward. Indirect lighting can originate far from the beach. Although most of the light that sea turtles can detect can also be seen by humans, observers should realize that some sources, particularly those emitting near-ultraviolet and violet light (e.g., bug-zapper lights, white electric-discharge lighting) will appear brighter to sea turtles than to humans. A human is also considerably taller than a hatchling; however, an observer on the dry beach who crouches to the level of a hatchling may miss some lighting that will affect turtles. Because of the way that some lights are partially hidden by the dune, a standing observer is more likely to see light that is visible to hatchlings and nesting turtles in the swash zone.

HOW SHOULD LIGHTING INSPECTIONS BE CONDUCTED?

Lighting inspections to identify problem light sources may be conducted either under the purview of a lighting ordinance or independently. In either case, goals and methods should be similar.

GATHER BACKGROUND INFORMATION

Before walking the beach in search of lighting, it is important to identify the boundaries of the area to be inspected. For inspections that are part of lighting ordinance enforcement efforts, the jurisdictional boundaries of the sponsoring local government should be determined. It will help to have a list that includes the name, owner, and address of each property within inspection area so that custodians of problem lighting can be identified. Plat maps or aerial photographs will help

surveyors orient themselves on heavily developed beaches.

PRELIMINARY DAYTIME INSPECTIONS

An advantage to conducting lighting inspections during the day is that surveyors will be better able to judge their exact location than they would be able to at night. Preliminary daytime inspections are especially important on beaches that have restricted access at night. Property owners are also more likely to be available during the day than at night to discuss strategies for dealing with problem lighting at their sites.

A disadvantage to daytime inspections is that fixtures that are not directly visible from the beach will be difficult to identify as problems. Moreover, some light sources that can be seen from the beach in daylight may be kept off at night and thus present no problems. For these reasons, daytime inspections are not a substitute for nighttime inspections. Descriptions of light sources identified during daytime inspections should be detailed enough so that anyone can locate the lighting. In addition to a general description of each luminaire (e.g., HPS floodlight directed seaward at top northeast corner of the building at 123 Ocean Street), photographs or sketches of the lighting may be necessary. Descriptions should also include an assessment of how the specific lighting problem can be resolved (e.g., needs turning off; should be redirected 90° to the east). These detailed descriptions will show property owners exactly which luminaries need what remedy.

NIGHTTIME INSPECTIONS

Surveyors orienting themselves on the beach at night will benefit from notes made during daytime surveys. During nighttime lighting inspections, a surveyor walks the length of the nesting beach looking for light from artificial sources. There are two general categories of artificial lighting that observers are likely to detect:

1. **Direct lighting**. A luminaire is considered to be direct lighting if some glowing element of the luminaire (e.g., the globe, lamp [bulb], reflector) is visible to an observer on the beach. A source not visible from one location may be visible from another farther down the beach. When direct lighting is observed, notes should be made of the number, lamp type (discernable by color; Appendix A), style of fixture (Appendix E), mounting (pole, porch, *etc.*), and location (street address, apartment number, or pole identification number) of the luminaire(s). If exact locations of problem sources were not determined during preliminary daytime surveys, this should be done during daylight soon after the nighttime survey. Photographing light sources (using long exposure times) is often helpful.

2. **Indirect lighting**. A luminaire is considered to be indirect lighting if it is not visible from the beach but illuminates an object (e.g., building, wall, tree) that is visible from the beach. Any object on the dune that appears to glow is probably being lighted by an indirect source. When possible, notes should be made of the number, lamp type, fixture style, and mounting of an indirect-lighting source. Minimally, notes should be taken that would allow a surveyor to find the lighting during a follow-up daytime inspection (for instance, which building wall is illuminated

and from what angle?).

WHEN SHOULD LIGHTING INSPECTIONS BE CONDUCTED?

Because problem lighting will be most visible on the darkest nights, lighting inspections are ideally conducted when there is no moon visible. Except for a few nights near the time of the full moon, each night of the month has periods when there is no moon visible. Early-evening lighting inspections (probably the time of night most convenient for inspectors) are best conducted during the period of two to 14 days following the full moon. Although most lighting problems will be visible on moonlit nights, some problems, especially those involving indirect lighting, will be difficult to detect on bright nights.

A set of daytime and nighttime lighting inspections before the nesting season and a minimum of three additional nighttime inspections during the nesting-hatching season are recommended. The first set of day and night inspections should take place just before nesting begins. The hope is that managers, tenants, and owners made aware of lighting problems will alter or replace lights before they can affect sea turtles. A follow-up nighttime lighting inspection should be made approximately two weeks after the first inspection so that remaining problems can be identified. During the nesting-hatching season, lighting problems that seemed to have been remedied may reappear because owners have been forgetful or because ownership has changed. For this reason, two midseason lighting inspections are recommended. The first of these should take place approximately two months after the beginning of the nesting season, which is about when hatchlings begin to emerge from nests. To verify that lighting problems have been resolved, another follow-up inspection should be conducted approximately one week after the first midseason inspection.

WHO SHOULD CONDUCT LIGHTING INSPECTIONS?

Although no specific authority is required to conduct lighting inspections, property managers, tenants, and owners are more likely to be receptive if the individual making recommendations represent a recognized conservation group, research consultant, or government agency. When local ordinances regulate beach lighting, local government code-enforcement agents should conduct lighting inspections and contact the public about resolving problems.

WHAT SHOULD BE DONE WITH INFORMATION FROM LIGHTING INSPECTIONS?

Although lighting surveys serve as a way for conservationists to assess the extent of lighting problems on a particular nesting beach, the principal goal of those conducting lighting inspections should be to ensure that lighting problems are resolved. To resolve lighting problems, property managers, tenants, and owners should be give the information they need to make proper alterations to light sources. This information should include details on the location and description of problem lights, as well as on how the lighting problem can be solved. One should also be prepared to discuss the details of how lighting affects sea turtles. Understanding the nature of the problem will motivate people more than simply being told what to do.

Appendix D

EXAMPLES OF PREDATOR PROOF TRASH RECEPTACLES

Example of predator proof trash receptacle at Gulf Islands National Seashore. Lid must be tight fitting and made of material heavy enough to stop animals such as raccoons.

Example of trash receptacle anchored into the ground so it is not easily turned over.

Example of predator proof trash receptacle at Perdido Key State Park. Metal trash can is stored inside. Cover must be tight fitting and made of material heavy enough to stop animals such as raccoons.

Example of trash receptacle must be secured or heavy enough so it is not easily turned over.