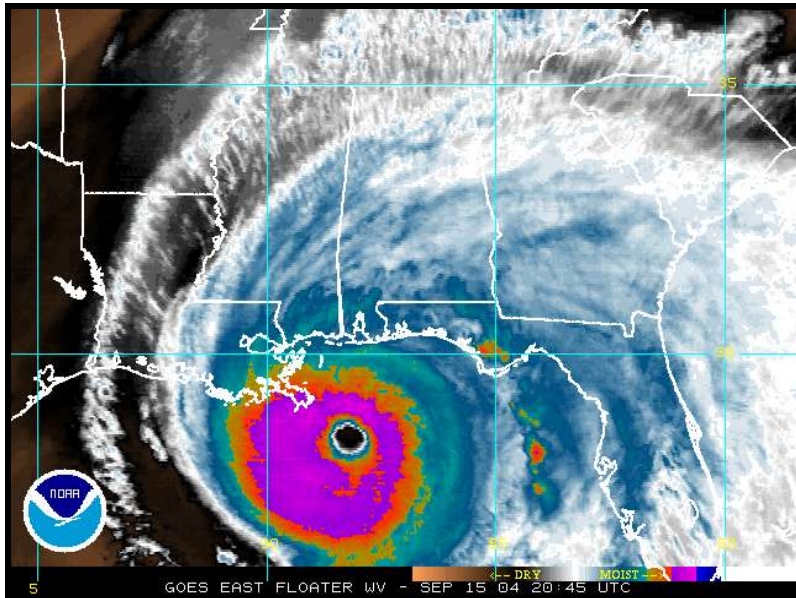


# ***HURRICANE IVAN***

## **BEACH AND DUNE EROSION AND STRUCTURAL DAMAGE ASSESSMENT AND POST-STORM RECOVERY PLAN FOR THE PANHANDLE COAST OF FLORIDA**



**OCTOBER 2004**



**BUREAU OF BEACHES AND COASTAL SYSTEMS  
DIVISION OF WATER RESOURCE MANAGEMENT  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
STATE OF FLORIDA**

## FOREWORD

The Bureau of Beaches and Coastal Systems of the Florida Department of Environmental Protection (FDEP) is responsible for the protection and management of the sandy beaches of Florida fronting the Gulf of Mexico, Atlantic Ocean, and Straits of Florida, and the regulation of coastal development adjacent to the barrier beaches. The monitoring and assessment of coastal storm and hurricane impact to the State's beaches and coastal construction and recommendations for post-storm response and management strategies are an important part of that responsibility.

This report provides an assessment of damages to the beaches and dunes and coastal construction of the Panhandle region of Florida's coast as a result of Hurricane Ivan and provides preliminary recommendations for post-storm response activities. This report was prepared by the Florida State University's Beaches and Shores Resource Center (BSRC) for the FDEP Bureau of Beaches and Coastal Systems (BBCS). The report was prepared by Mark E. Leadon, P.E., Associate Director of BSRC, with major contributions from BSRC staff Emmett Foster, P.E., Nhan Nguyen, Engineer, and Gary Cook, GIS Specialist. Major contributions to this report were made by BBCS staff Robert Brantly, P.E., Ralph Clark, P.E., Junaid As-Salek, Coastal Engineer, Jim LaGrone, Engineer, Jennifer Koch, Geologist, Phil Sanders, Project Manager, and Bill Fokes, Engineer. Contributions were also made by Stacey Roberts of PBS&J, Inc.

APPROVED BY



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## I. Hurricane Ivan Impact Summary and Overview

Hurricane Ivan was one of the most impactful and destructive hurricanes to Florida's Panhandle coast in recorded history and the most severe since Hurricane Opal in 1995. After reaching Category 5 strength at 3 different times in the Caribbean Sea and entering the Gulf of Mexico, Ivan made landfall near Gulf Shores, Alabama, just east of Mobile at approximately 2:00 a.m. CDT (0700 UTC) on September 16, 2004, at Category 3 hurricane strength with maximum sustained winds at landfall of 130 m.p.h.

Initial estimates of storm surge with associated wave action along coastal regions of the western Panhandle were reported to be at elevations of +15 to +20 feet above mean sea level. Wave heights recorded by NOAA wave buoy station 42040, located 62 nautical miles south of Dauphin Island, Alabama, in a water depth of 780 feet, reached 53 feet (see graph in Appendix A). A graphic depiction of Ivan's path through the Caribbean Sea and Gulf of Mexico and through the southeastern United States is shown in Figure 1. As shown on the storm track, remnants of Ivan actually returned to cross the Florida Peninsula and re-enter the Gulf of Mexico before making final landfall near Cameron, Louisiana, on September 23 as a tropical storm and then dissipating.

As Ivan made its initial U.S. landfall on September 16, the greatest convection and strongest winds associated with Ivan were located east-northeast of the storm center. This aspect of the storm coupled with the higher, onshore-directed winds and associated storm surge and accompanying breaking waves resulted in much of Ivan's most destructive impact occurring in areas east of its point of landfall which included the Florida Panhandle coast, as well as, Gulf Shores, Alabama.



Figure 1. Hurricane Ivan made initial landfall just west of the Florida Panhandle Coast (Source: NOAA / NCEP / Tropical Prediction Center).

The coastal areas sustaining the most severe impact from Hurricane Ivan extended eastward from the storm’s landfall with the severity of beach erosion impact and structural damage in Florida corresponding to distance eastward from the point of landfall. Thus, the western counties of Escambia, Santa Rosa, and Okaloosa sustained the worst impact with progressively diminishing levels of impact occurring with increasing distances east of landfall extending through Walton, Bay, Gulf, and Franklin counties.

This report will provide an assessment of storm impact, beach and dune erosion, and structural damages to the coastal regions of the Florida Panhandle. Although extensive structural damage occurred well inland of the Gulf of Mexico coast, the damage assessment in this report will specifically focus on the coastal areas seaward of the state’s Coastal Construction Control Lines (CCCL’s). The CCCL’s are located along the sandy beach coast as set forth in Chapter 161, Florida Statutes, as the area of regulatory jurisdiction of the FDEP Bureau of Beaches and Coastal Systems. It is noteworthy that, while wave-induced impacts from Hurricane Ivan were also sustained along the central and southwest Gulf of Mexico coast of Florida, as well as the Atlantic coast of Florida, such impacts are not specifically addressed in this report.

As expected, the most severe erosional and structural damage impacts from Ivan occurred in the western Panhandle counties of Escambia, Santa Rosa, and Okaloosa, the areas closest to the point of landfall. In addition to the severe damage in the Perdido Key, Pensacola Beach, Navarre Beach, Okaloosa Island, and Destin areas, major structural damage to habitable development occurred on the St. Joseph Peninsula in Gulf County. An overall summary of beach/dune erosion and structural damage is given in Table 1 and 2 below (see Appendix B for an explanation of erosion condition references given herein). A more detailed description of these impacts by specific location is provided in Section II of this report.

**TABLE 1**  
***BEACH AND DUNE EROSION SUMMARY***

<b><u>COUNTY</u></b>	<b><u>EROSION CONDITION</u></b>
<b>ESCAMBIA</b>	<b>IV (Major)</b>
<b>SANTA ROSA</b>	<b>IV (Major)</b>
<b>OKALOOSA</b>	<b>IV (Major)</b>
<b>WALTON</b>	<b>IV (Major)</b>
<b>BAY</b>	
Panama City Beaches (R1-97)	<b>III (Moderate)</b>
Mexico Beach (R128-144)	<b>I - II (Minor)</b>
<b>GULF</b>	
Beacon Hill, Port St. Joe Beach (R1-30)	<b>I - II (Minor)</b>
St. Joseph Peninsula (R77-110)	<b>III - IV (Moderate-Major)</b>
Indian Peninsula (R111-127)	<b>II - III (Minor-Moderate)</b>
(R128-162)	<b>I - II (Minor)</b>
<b>FRANKLIN</b>	<b>I - II (Minor)</b>

**TABLE 2**

**SUMMARY OF STRUCTURAL DAMAGE**  
(Seaward of Coastal Construction Control Lines)

<b>COUNTY</b>	<b>Bldgs. Destroyed/ Major Damage</b>		<b>Major Non-Habitable Structure Destroyed/ Major Damage</b>	<b>Wall/Revetment Damage</b>
	<b>SFD</b>	<b>MFD</b>		
<b>ESCAMBIA</b>				
Perdido Key (R1-32)	24	45	14	0
Pensacola Bch (R107-141)	31	27	26	7
<b>SANTA ROSA</b>				
Navarre Beach (R192-210)	8	15	12	1
<b>OKALOOSA</b>				
Okaloosa Island (R1-16)	0	20	10	3
Destin (west, R17-50)	16	23	10	6
<b>WALTON</b>	0	7	4	6
<b>BAY</b>				
Panama City Beach (R1-97)	0	10	1	1
Mexico Beach (R128-144)	0	0	1	1
<b>GULF</b>				
St. Joseph Peninsula (R77-110)	11	2	0	2
<b>FRANKLIN</b>	1	0	0	0
<hr/>				
<b>TOTAL</b>	<b>91</b>	<b>149</b>	<b>78</b>	<b>27</b>

**Note 1:** The detailed damage assessments in Section II of this report includes the number of major habitable structures which sustained moderate to minor (but noteworthy) damage, predominantly to habitable understructure areas and to roofs.

**Note 2:** The specific locations given in Table 1 and 2 above include FDEP range locations, shown as R number locations, which are located approximately every 1,000 ft along the sandy beach shorelines of the Gulf of Mexico, Straits of Florida and Atlantic Ocean in Florida.

**Note 3:** SFD and MFD above represent single- and multi-family dwelling, respectively.

## II. Detailed Damage Assessment by Specific Location

### Escambia County

Escambia County sustained by far the most severe storm impact and structural damage from Hurricane Ivan in Florida. Impact extended far inland from the coast within the county including extensive damage to the downtown Pensacola area and to the Interstate 10 bridges crossing Pensacola Bay as documented and reported in national news coverage. Impact to coastal areas was severe and widespread as shown in the Table 1 and 2 provided above in Section I of this report.

The detailed assessment provided herein will focus on the primary coastal barrier islands of Perdido Key and Santa Rosa Island, which includes the City of Pensacola Beach. A location reference map of coastal areas in Escambia County with specific identification of FDEP survey range locations is provided herein on page 15.

- **Perdido Key**

#### Beach and Dune Erosion

The entire Escambia County portion of Perdido Key sustained major beach and dune erosion. Based on the qualitative erosion conditions guideline provided in Appendix B, condition IV erosion occurred throughout the Florida portion of Perdido Key, both in terms of beach profile lowering and dune erosion. Extensive overwash of beach and dune sand across the barrier island from the Gulf shoreline landward occurred throughout the area within the developed areas of Perdido Key (R1-32), as well as, the approximately 6.5 miles of undeveloped land within the Gulf Islands National Seashore (R32-67).

#### Structural Damage

The Perdido Key portion of Escambia County's coastal area, the area of Florida nearest to Ivan's point of landfall, suffered extensive structural damage from Hurricane Ivan within the developed areas of the Key. Severe and extensive damages were sustained throughout the coastal areas of Perdido Key seaward of the CCCL, as well as, throughout the entire Perdido Key barrier island.

Seaward of the CCCL within the developed portion of Perdido Key (R1-32), a total of 69 habitable structures were destroyed or sustained major damage, including 24 single-family dwellings and 45 multi-family dwellings. A total of 14 non-habitable major structures, all swimming pools in the Perdido Key area, were destroyed or sustained major damage. In addition, a total of 41 habitable structures, 13 single-family dwellings and 28 multi-family dwellings, sustained moderate to minor damage to understructure areas and/or sustained moderate to minor roof damage. Extensive additional damage to ancillary structures such as parking areas, decks, walkways, etc. was also observed. Examples by referenced location of damages in this area are shown in the photographs below and on the following pages.



Photo ES-1. Destroyed single-family dwelling at R9 (-200') on Perdido Key.



Photo ES-2. Damage to Perdido Key Dr. (C.R. 292) between R11 and R13 on Perdido Key.





Photo ES-3. Destroyed multi-family dwellings at R22 (+450') on Perdido Key.



Photo ES-4. Destroyed single-family dwellings at R27 in Perdido Key.

- **Santa Rosa Island**

Beach and Dune Erosion

The entire Escambia County portion of Santa Rosa Island sustained major beach and dune erosion. Based on the qualitative erosion conditions guideline provided in Appendix B, condition IV erosion occurred throughout Santa Rosa Island, both in terms of beach profile lowering and dune erosion. Extensive overwash of beach and dune sand across the barrier island from the Gulf shoreline landward occurred throughout the area. As much as 4-5 vertical feet of overwash sand has been found throughout coastal roads, properties, and buildings on Santa Rosa Island.

Along the Gulf Islands National Seashore to Fort Pickens (R68-107), major beach/dune erosion and extensive overwash occurred. Much of the road through the national seashore leading to Ft. Pickens was covered with sand or washed out as it was after Hurricane Opal in 1995, Hurricane Georges in 1998, and Hurricane Frederic in 1979. Overwash flooding has breached portions of the barrier island in this area as seen in photo ES-5 below (USGS photo; Olsen Associates, Inc., September, 2004).



ES-5. Extensive overwash and barrier island breaching at Gulf Islands National Seashore. (photo obtained by U.S.G.S.; provided to FDEP courtesy of Olsen Associates, Inc.)

Major beach and dune erosion was sustained throughout Pensacola Beach (R107-142), the developed segment of Santa Rosa Island within Escambia County. The beach restoration project at Pensacola Beach sustained extensive erosional losses through overwash of sand into inland areas and transport of sand into nearshore waters. Initial beach surveys of the project area have indicated volumetric erosion of between 20-50 cubic yards/ft of beachfront (Olsen Associates, Inc., September, 2004). Cross-sectional overlay comparison plots of the

pre-storm vs. post-storm beach at FDEP range locations R121 and R133 provided by Olsen Associates, Inc., are contained in Appendix C of this report.

Comparative photographs below of the Casino Beach area of Pensacola Beach near R120 (Olsen Associates, Inc., September, 2004) depict the extensive erosional losses to the beach and dune topography in this area.



Photos ES-6 and ES-7. Pre-Ivan view (left; 04/06/04) vs. post-Ivan view (right; 09/21/04) depict beach and dune erosional losses in Pensacola Beach (courtesy, Olsen Associates, Inc.)

Between Pensacola Beach and Navarre Beach to the east, the Gulf Islands National Seashore (R142-192) had major beach and dune erosion and extensive overwash across the barrier island covering much of the paved road through this area. Damage to the road and to paved parking lots within this area was observed from oblique aerial photographs.

### Structural Damage

Structural damage assessment along western Santa Rosa Island within the Gulf Islands National Seashore (R68-107) at Fort Pickens was not performed and included in this report. However, extensive road damage along the entire portion of Santa Rosa Island within the national seashore was observed from oblique aerial photography as shown in Photo ES-5.

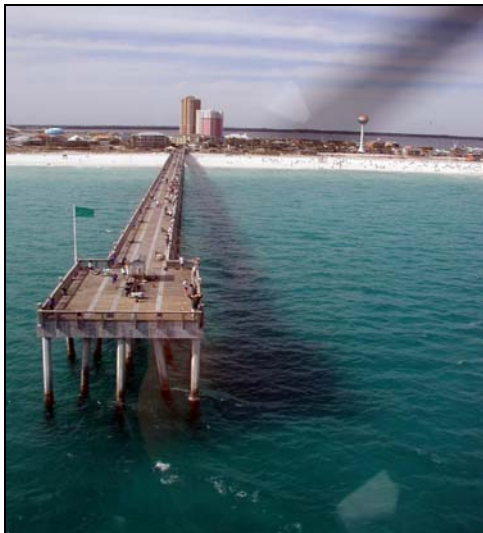
Further to the east, Pensacola Beach, the developed portion of Santa Rosa Island within Escambia County, suffered extensive structural damage from Hurricane Ivan (R107-142) throughout the coastal areas seaward of the CCCL, as well as, throughout the entire barrier island. The protective buffer of the Santa Rosa Island Authority's Pensacola Beach Restoration Project can be credited with reducing losses to beachfront development. However, Ivan's forces far exceeded the design protection levels of the project.

Seaward of the CCCL on Santa Rosa Island in Pensacola Beach, a total of 58 habitable structures were destroyed or sustained major damage, including 31 single-family dwellings and 27 multi-family dwellings. Twenty-six (26) non-habitable major structures and seven (7) seawall/retaining wall structures were destroyed or sustained major damage. In addition, a total of 104 habitable structures sustained moderate to minor damage to understructure areas and/or sustained moderate to minor roof damage. Extensive additional damage to ancillary

structures such as smaller parking areas, decks, walkways, etc. was also observed. Examples of structural damage in this area by referenced location are shown on the photographs below and on the following pages.



Photo ES-8. Remnants of destroyed public picnic shelters at R108 in Pensacola Beach.



Pre-Ivan (04-05-04)



Post-Ivan (09-18-04)

Photo ES-9. Extensive loss of decking to the Pensacola Beach fishing pier at R120 (+500').



Photo ES-10. Destroyed single-family dwelling at R111 (-200') in Pensacola Beach.



Photo ES-11. Destroyed multi-family dwelling at R116 (+300') in Pensacola Beach.



Photo ES-12. Destroyed single-family dwelling at R125 (+350') in Pensacola Beach.



Photo ES-13. Destroyed single-family dwelling at R125 (+500') in Pensacola Beach.



Photo ES-14. Destroyed single-family dwelling at R126 (+100') in Pensacola Beach.



Photo ES-15. Destroyed sheet-pile wall sheared off at eroded grade elevation; R136 (+250').



Photo ES-16. Overwash sand cleared from road (Bulevar Mayor) in Pensacola Beach at R137 (-50'); looking east.



Photo ES-17. Overwash sand cleared from road (Bulevar Mayor) in Pensacola Beach at R137 (+150'); looking west.

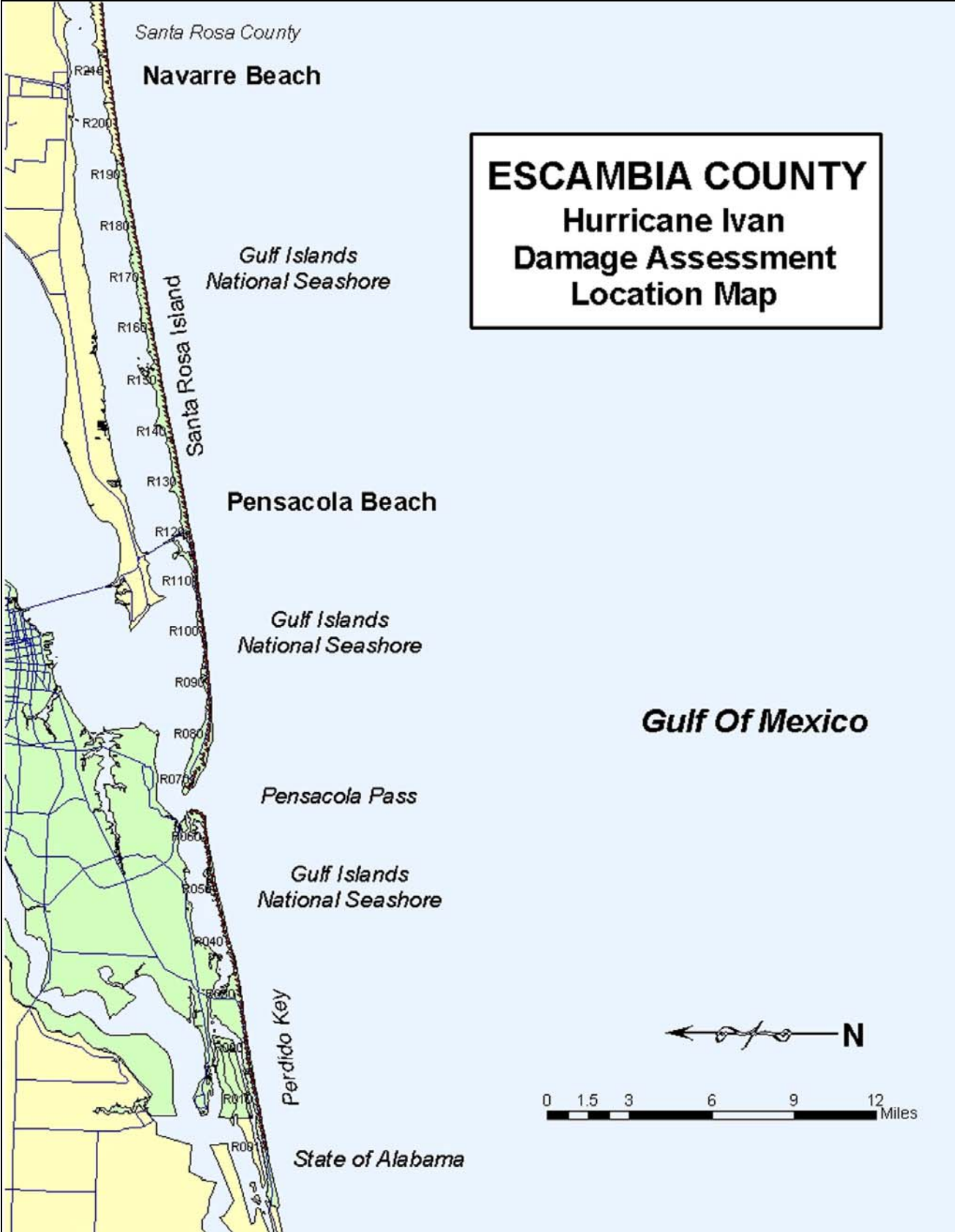




Photo ES-18. Destroyed single-family dwelling at R137 (+50') in Pensacola Beach.



Photo ES-19. Remains of destroyed single-family dwelling; R137 (+100'), Pensacola Beach.



## **Santa Rosa County**

Santa Rosa County sustained severe storm impact and structural damage from Hurricane Ivan. Erosional impact and structural damages to the County's coastal development at Navarre Beach was extensive as summarized in Tables 1 and 2 in Section I of this report.

The detailed assessment provided herein will focus on the coastal barrier island of Santa Rosa Island, which includes the City of Navarre Beach. A location reference map of coastal areas in Santa Rosa County with specific identification of FDEP survey range locations is provided as follows herein on page 20.

- **Navarre Beach**

### Beach and Dune Erosion

The entire Santa Rosa County portion of Santa Rosa Island at Navarre Beach sustained major beach and dune erosion. Based on the qualitative erosion conditions guideline provided in Appendix B, condition IV erosion occurred throughout Santa Rosa Island, both in terms of beach profile lowering and dune erosion. Extensive overwash of beach and dune sand across the barrier island from the Gulf shoreline landward occurred throughout the area.

### Structural Damage

The coastal community of Navarre Beach located within the eastern end of Santa Rosa Island sustained severe and extensive damages throughout the coastal areas seaward of the CCCL, as well as, throughout the entire barrier island. Seaward portions of the Navarre Beach fishing pier suffered major damage to the decking and support structure. Damage to picnic shelters at the Navarre Beach State Park just east of the fishing pier at R-210 was also observed.

Seaward of the CCCL, a total of 23 habitable structures were destroyed or sustained major damage, including 8 single-family dwellings and 15 multi-family dwellings. A total of 12 non-habitable major structures were destroyed or sustained major damage, including 10 swimming pools, a picnic shelter, and the fishing pier. In addition, a total of 68 habitable structures sustained moderate to minor damage to understructure areas and/or sustained moderate to minor roof damage. One wooden retaining wall structure was destroyed. Examples by referenced location of damages in this area are shown on the photographs on the following pages.

- **Gulf Islands National Seashore / Eglin Air Force Base**

Similar to Hurricane Opal in 1995, Hurricane Ivan caused major beach and dune erosion along the 13.6-mile stretch of coast between Navarre Beach and Okaloosa County. The beach and dune system was substantially impacted and this portion of Santa Rosa Island was flooded from gulf to sound along several segments with extensive overwash and beach and dune erosion occurring.



Photo SR-1. Remains of destroyed single-family dwelling at R194 (-100') in Navarre Beach.



Photo SR-2. Destroyed single-family dwellings near R200 (+700') in Navarre Beach adjacent to better designed dwelling that survived major damage from Ivan.



Photo SR-3. Destroyed single-family dwelling at R204 (+500') in Navarre Beach.



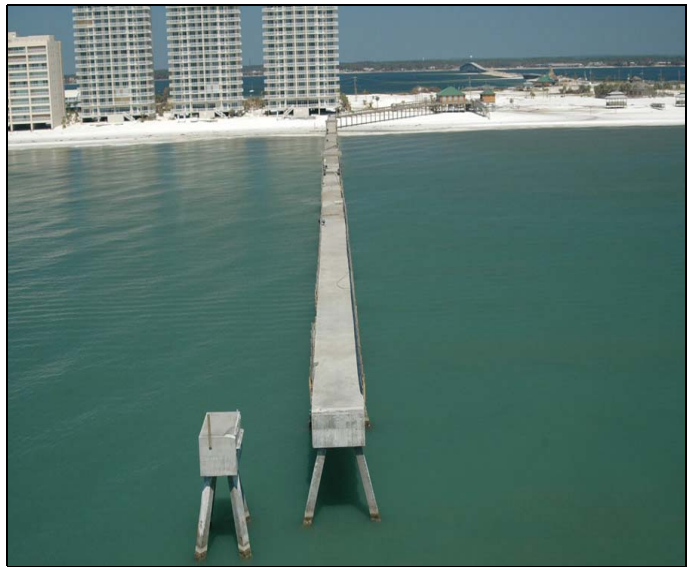
Photo SR-4. Destroyed multi-family dwelling structure at R208 (-200') in Navarre Beach.



Photo SR-5. Multi-family dwelling with major damage near R208 in Navarre Beach.



Pre-Ivan (04-05-04)



Post-Ivan (09-18-04)

Photo SR-6. Comparison showing extensive damage to pier near R209 in Navarre Beach.



## **Okaloosa County**

Okaloosa County sustained major beach and dune erosion and structural damage from Hurricane Ivan. Erosional impact and structural damages to the County's coastal development along Okaloosa Island near Ft. Walton Beach and in the City of Destin was extensive as summarized in Tables 1 and 2 in Section I of this report.

The detailed assessment provided herein will predominantly focus on the areas seaward of the CCCL within the developed, unincorporated portion of Santa Rosa Island known as Okaloosa Island, near the City of Fort Walton Beach, and within the City of Destin and eastern Okaloosa County. A location reference map of coastal areas in Okaloosa County with specific identification of FDEP survey range locations is provided as follows herein on page 27.

The entire Okaloosa County shoreline, from the undeveloped areas of Santa Rosa Island which includes portions of the Gulf Islands National Seashore and Eglin Air Force Base through the Okaloosa Island, City of Destin, and eastern county areas, sustained major beach and dune erosion. Extensive overwash of beach and dune sand on the barrier island from the Gulf of Mexico shoreline landward occurred throughout the County.

As in many other areas of the Panhandle coast, significant damages from Hurricane Ivan in Okaloosa County, particularly on Okaloosa Island, occurred in areas landward of the CCCL.

- **Okaloosa Island**

- Beach and Dune Erosion

- Major beach and dune erosion and overwash occurred in the Okaloosa Island area (R1-16). Based on the qualitative erosion conditions guideline provided in Appendix B, condition IV erosion occurred throughout the County, both in terms of beach profile lowering and dune erosion.

- Structural Damage

- The coastal development of Okaloosa Island sustained severe and extensive damages throughout the coastal areas seaward of the CCCL, as well as, throughout the entire barrier island.

- For the areas seaward of the CCCL, a total of 20 habitable structures (all multi-family dwellings) were destroyed or sustained major damage. A total of 10 non-habitable major structures were destroyed or sustained major damage.

- In addition, a total of 6 habitable structures sustained moderate to minor damage to understructure areas and/or sustained moderate to minor roof damage. Three (3) retaining wall/seawall structures were destroyed. Examples by referenced location of damages to this area are shown on the photographs on the following pages.





Photo OK-1. Damage to decorative wall and lower floor on Okaloosa Island near R1.



Photo OK-2. Overwash sand deposition and flooding damage in bottom floor areas near R1.

### Eastern Santa Rosa Island/Eglin Air Force Base/East Pass

Major beach and dune erosion and overwash occurred throughout this area which includes a 4.7 mile stretch of largely undeveloped Federal land (R16-17; see map). Based on the qualitative erosion conditions guideline provided in Appendix B, condition IV erosion occurred throughout the area, both in terms of beach profile lowering and dune erosion. As with Hurricane Opal, major damage to Highway 98 between Destin and Ft. Walton Beach occurred as a result of extensive overwash as shown in Photo OK-3 below. Structural damage to Federal facilities within this area included the destruction of the Officer's Beach Club building shown in Photo OK-4 below. A breach of Norriego Point at Destin-East Pass as a result of Hurricane Ivan's storm surge and waves is shown in Photos OK-5 and OK-6.



Photo OK-3. Damage to Highway 98 between Destin and Ft. Walton Beach.



Photo OK-4. Destroyed beach club building; Eglin Air Force Base; east Santa Rosa Island



Photo OK-5. Breach through Norriego Point at Destin-East Pass.



Photo OK-6. Breach through Norriego Point at Destin-East Pass.

- **Destin**

Beach and Dune Erosion

Major beach and dune erosion and overwash occurred in the west Destin area (R17-32), through Henderson Beach (R32-39), and in the east Destin/Okaloosa County area (R39-50). Based on the qualitative erosion conditions guideline provided in Appendix B, condition IV erosion occurred throughout this area, both in terms of beach profile lowering and dune erosion.

Structural Damage

The coastal development of Destin sustained extensive damages throughout the coastal areas seaward of the CCCL, as well as, throughout the entire barrier island.

For the areas seaward of the CCCL, a total of 39 habitable structures were destroyed or sustained major damage, including 16 single family dwellings and 23 multi-family dwellings. A total of 10 non-habitable major structures were destroyed or sustained major damage, including 3 swimming pools, 2 large parking areas, a road, large gazebo, tennis courts, clubhouse, and large deck. In addition, a total of 32 habitable structures sustained moderate to minor damage to understructure areas and/or sustained moderate to minor roof damage. Six (6) retaining wall structures were destroyed. Examples by referenced location of damages in this area are shown on the photographs below and on the following pages.



Photo OK-7. Overwash and decorative wall damage near R22 in Destin.



Photo OK-8. Extensive overflow of beach sand and road clearing in Destin at R24-25.



Photo OK-9. Major habitable structure damage in Destin between R24-25.



## Walton County

Walton County sustained major beach erosion impact and moderate structural damage from Hurricane Ivan. Erosional impact and structural damages to the County's coastal development were extensive as summarized in Table 1 and 2 in Section I of this report.

The detailed assessment provided herein will predominantly focus on the areas seaward of the CCCL. Since structural damage was not extensive in this county, and erosion impacts were similar throughout the County, assessment by specific town and municipality is not provided, but rather a countywide assessment. The recommended recovery response described in Section III of this report is, however, listed by specific location. A location reference map of coastal areas in Walton County with specific identification of FDEP survey range locations is provided as follows herein on page 35.

### Beach and Dune Erosion

The entire coast of Walton County sustained major beach and dune erosion from Ivan. Based on the qualitative erosion conditions guideline provided in Appendix B, condition IV erosion occurred throughout Walton County, both in terms of beach profile lowering and dune erosion. Major dune recession occurred throughout the County, including a number of locations where the upland habitable development is now located at or within close proximity to high dune-bluff escarpments. These areas have become particularly vulnerable to further damages as a result of proximity to the eroded bluff lines. The post-Ivan photographs herein illustrate this condition.

Specific locations where development appears to be within close proximity (< 10-20 feet) to the dune bluff and thus in a vulnerable condition are listed by referenced locations below:

#### Western Walton County

R1 to R16-300  
R17-200 to R18+200  
R21+600 to R24

#### Beach Highlands/Dune Allen

R41 to R52

#### Blue Mountain Beach

R59+300 to R63

#### Gulf Trace/Grayton Beach

R67+300 to R68+300  
R71-100 to R71+300

#### Seagrove Beach

R85-500 to R86-300  
R88+100 to R88+700  
R92+50 to R92+250  
R93-375  
R93+300 to R94  
R95 to R95+800  
R96-100 to R97-50  
R98-375

Seacrest Beach

R107-350 to R107-75

R110-100 to R110+150

R111+400 to R115-100

Inlet Beach

R122-100 to R124+100

R125+400 to R126+400

Note: Above specified locations are relative to monuments as located on the FDEP 2/95 Walton County aerial set (which should be very similar to updated locations).

There are a number of upland lake outlet channels throughout the Walton County coast. Pre-Ivan photography from April 2004 indicates that most of these outlets were not openly flowing into the Gulf of Mexico. Following Ivan, most all of them were flowing freely into the Gulf as illustrated in Photo WL-9.

Structural Damage

Walton County sustained moderate structural damage overall throughout the coastal areas seaward of the CCCL.

For the areas seaward of the CCCL, a total of 7 habitable structures, all multi-family structures, and a total of 4 non-habitable structures were destroyed or sustained major damage. In addition, a total of 49 habitable structures sustained moderate to minor damage to understructure areas and/or sustained moderate to minor roof damage. A total of six (6) wooden retaining wall structures were destroyed or sustained major damage. Examples by referenced location of damages in this area are shown on the photographs below and on the following pages.



Pre-Ivan (06-02-04)



Post-Ivan (09-18-04)

Photo WL-1. Pre- vs. post-storm comparative photographs at the Miramar Beach Access near R2 demonstrates major beach and dune erosion resulting from Hurricane Ivan.





Photo WL-2. Destroyed retaining wall near R9.



Photo WL-3. Erosion and destroyed swimming pool near R9.



Photo WL-4. Structures located on or very near the beach at R18 (+200').



Photo WL-5. Destroyed retaining wall at location R23 (+500').



Photo WL-6. Habitable structures in relation to beach and dune at R47 (+250') in the Beach Highlands/Dune Allen area.



Photo WL-7. Habitable structures in relation to eroded dune bluff at R60 (+200') in the Blue Mountain Beach area.



Photo WL-8. Habitable structures in relation to beach and dune at R68 in the Gulf Trace area.



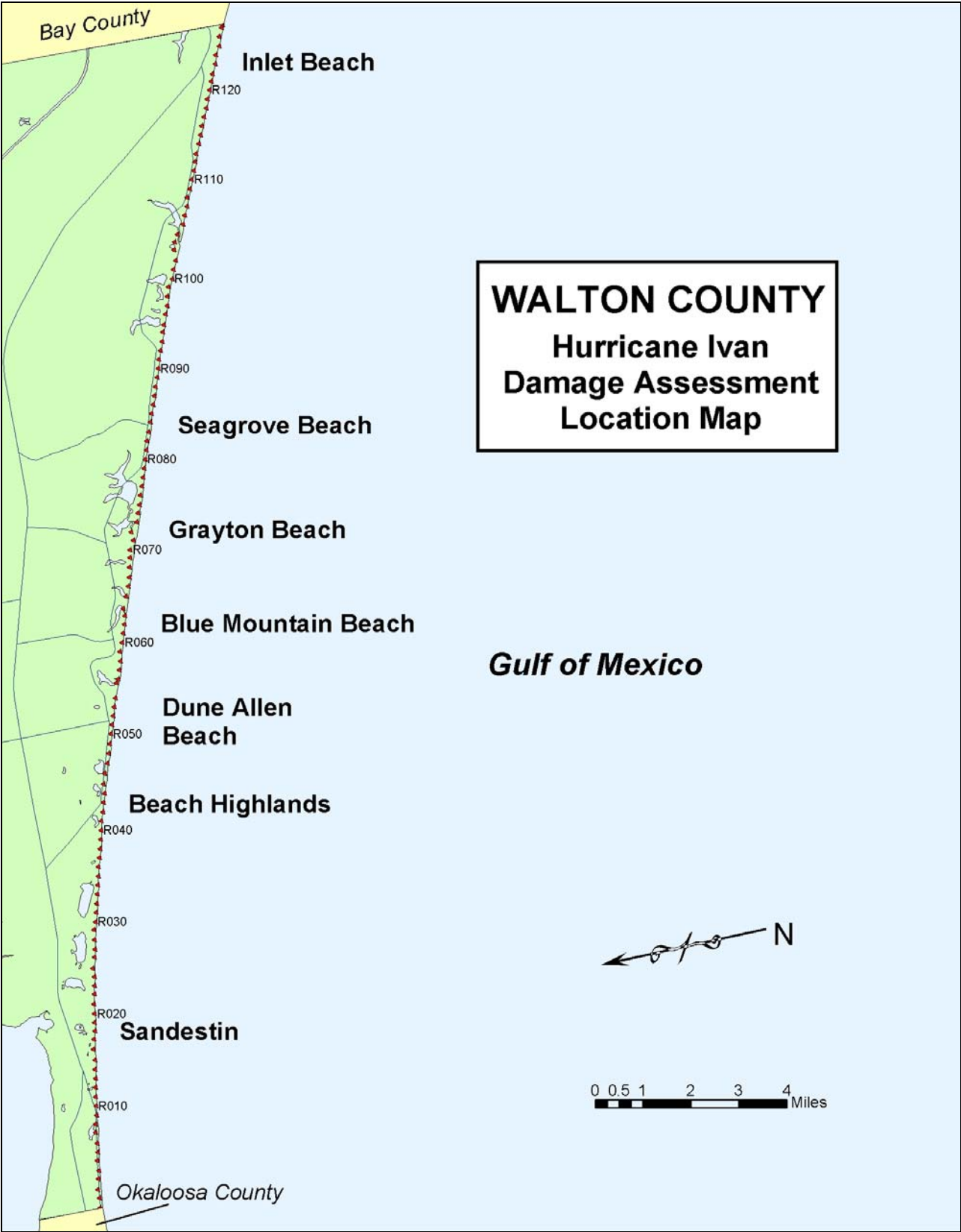
Photo WL-9. Upland lake outlet at Grayton Beach at location R72 (+500').



Figure WL-10. Eroded dune undermining houses at R123 at Inlet Beach.



Figure WL-11. Eroded dune feature at R125 at Inlet Beach; buildings on the active beachface in eastern Walton County and western Bay County in the background.



## **Bay County**

Bay County sustained moderate storm impact and structural damage from Hurricane Ivan. Erosional impact and structural damages to the County's coastal development was significant, though not severe, as summarized in the tables in Section I of this report.

The detailed assessment provided herein will predominantly focus on the areas seaward of the CCCL. A location reference map of coastal areas in Bay County with specific identification of FDEP survey range locations is provided as follows herein on page 42.

- **Panama City Beaches**

- Beach and Dune Erosion

- This area (R1-91) sustained moderate beach and dune erosion from Ivan. Based on the qualitative erosion conditions guideline provided in Appendix B, condition III erosion occurred throughout the Panama City Beaches area, both in terms of beach profile lowering and dune erosion.

- The protective buffer of the Panama City Beaches Beach Erosion Control and Storm Damage Reduction Project can be credited with reducing losses to beachfront development. The project, which was completed in April 1999, consisted of placement of 9 million cubic yards of sand over an approximate 17.5 mile shoreline length extending from approximately R5 through R91.

- Prior to the occurrence of Hurricane Ivan, the project still retained approximately 91% of its original volume. Although a significant volume of sand was lost from the beach area into offshore areas as a result of Ivan, the beach project did the job it was intended to do in providing storm protection to upland development in the Panama City Beaches area.

- Structural Damage

- Bay County sustained moderate to minor damage throughout the coastal areas seaward of the CCCL. For the areas seaward of the CCCL, a total of 10 habitable structures and one non-habitable major structure, the concrete Panama City Beach fishing pier (R40+500; see Photo BA-2), were destroyed or sustained major damage.

- In addition, a total of 10 habitable structures sustained moderate to minor damage to understructure areas and/or sustained moderate to minor roof damage. In addition, one concrete-block retaining wall structure was destroyed. Examples by referenced location of damages to this area are shown on the photographs on the following pages.



Photo BA-1. Demonstration of Condition III erosion in west Bay County at R3.



Photo BA-2. Major damage to motel structure at R22 (-400') in Bay County.





Pre-Ivan (04-05-04)



Post-Ivan (09-18-04)

Photo BA-3. Major damage to Panama City Beach pier at R40 (+500') in Bay County.



Photo BA-4. Damage to block retaining wall at R76 (+200) in Panama City Beach.

- **St. Andrews State Park**

The state park beaches (R91-97) were nourished with a substantial volume of sand placement from Panama City Harbor dredging over the past year. This protective buffer of sand served to greatly reduce the extent of dune erosion and possible increased structural damage to park facilities from Hurricane Ivan along the Gulf beach and inlet shoreline at Gator Lake.

Significant lowering of the nourished beach elevations occurred as a result of Ivan. Flattening and lowering of the beach profile with vertical loss of as much as 4 to 5 feet was observed. Based on the qualitative erosion conditions guideline provided in Appendix B, condition III erosion occurred throughout the state park, both in terms of beach profile lowering and dune erosion.

The coastal areas of the park seaward of the CCCL sustained only minor structural damages to walkway structures, although significant impact from apparent tornado winds was observed within the park's camping areas well landward of the CCCL .

- **Mexico Beach**

Mexico Beach, located on the east side of Bay County, sustained minor damages as a result of its distance from the point of landfall of Ivan. However, storm-generated waves reached the shoreline here and resulted in some erosion and damage.

Beach and Dune Erosion

This area (R128-144) sustained moderate/minor beach and dune erosion from Ivan. Based on the qualitative erosion conditions guideline provided in Appendix B, generally condition II erosion occurred throughout Mexico Beach.

Generally minor dune recession and beach profile lowering was observed throughout much of the area resulting in loss of sand and, in some cases, soil support beneath buildings along this area, though no major damage to buildings occurred.

Structural Damage

Mexico Beach sustained minor overall damage throughout the coastal areas seaward of the CCCL. Mexico Beach Inlet sustained some sand deposition into the channel and structural damage to the concrete navigational structure (jetty) to the west of the inlet entrance channel as shown in Photo BA-5 below.

Significant damage did occur to the seawall at the El Governor hotel. The seawall lost beach elevation seaward of the wall and lost soil support and tieback support behind the wall, and thus experienced seaward rotation and some structural damage (see Photos BA-6 and BA-7 below).



Photo BA-5. Mexico Beach Inlet impacts following Hurricane Ivan at R128 (-700').

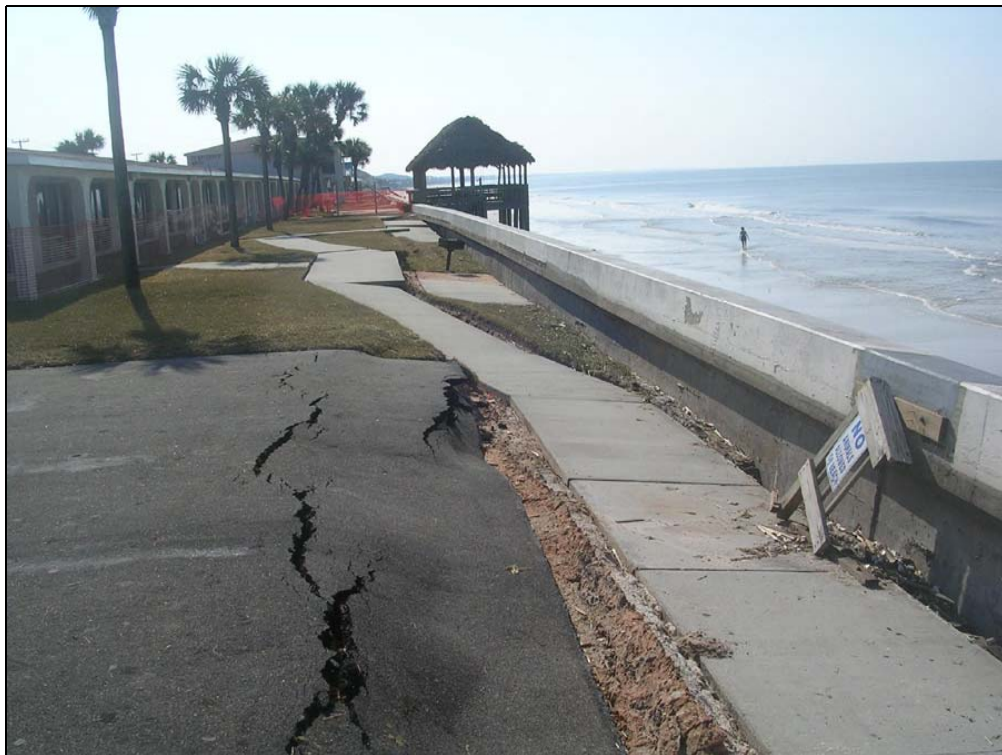


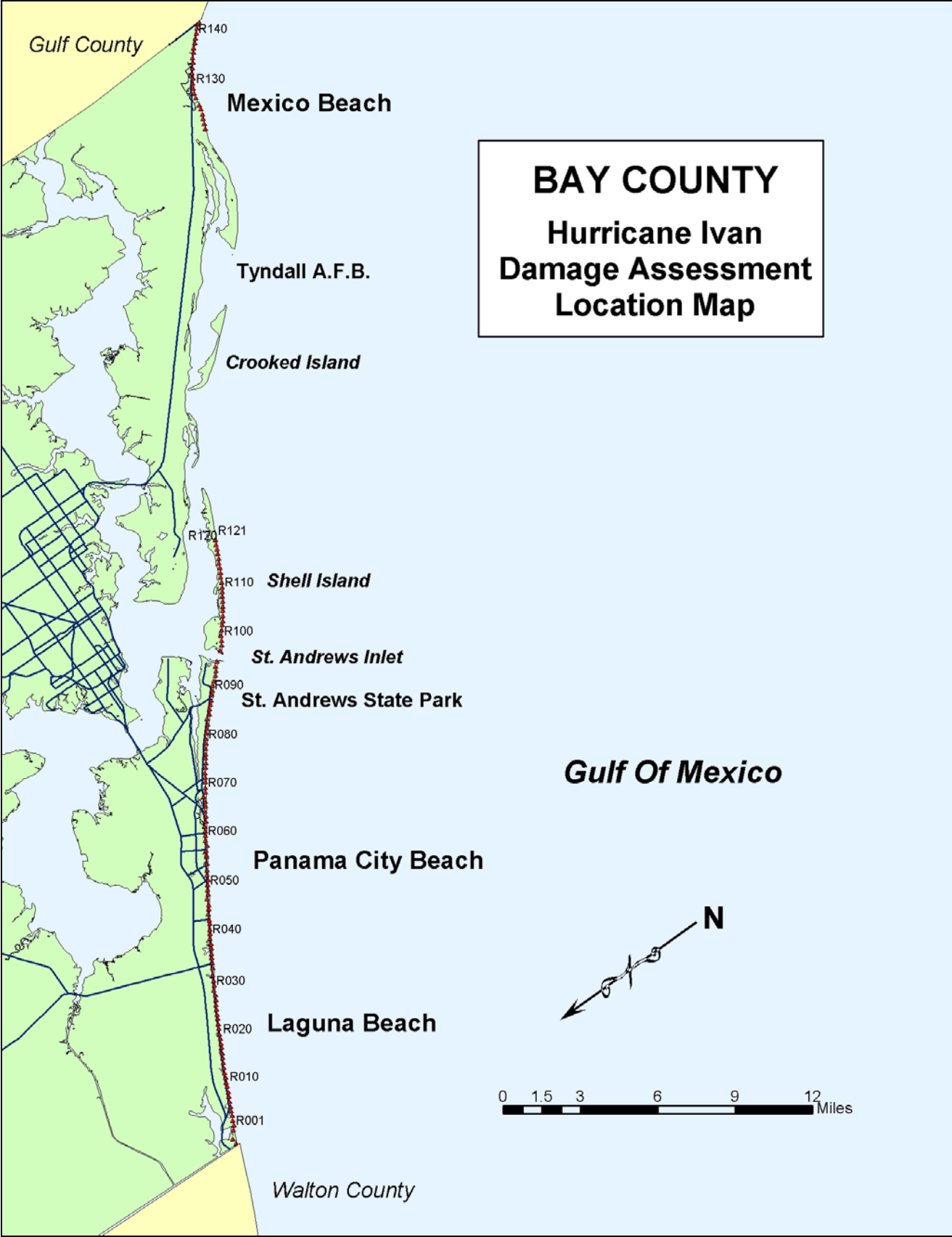
Photo BA-6. Damage to the El Governor seawall in Mexico Beach at R135 (-300').



Photo BA-7. Damage to the El Governor seawall in Mexico Beach at R135 (-300').



Photo BA-8. Loss of sand elevation and volume in Mexico Beach at R135 (+200').



## **Gulf County**

Gulf County sustained major storm impact and structural damage along the developed portions of St. Joseph Peninsula from Hurricane Ivan. Beach and dune erosion resulted in the undermining and collapse of habitable structures on St. Joseph Peninsula. Erosional impact and structural damage in other coastal areas of Gulf County were minor.

Erosional impact and structural damages to the County's coastal development are summarized in Tables 1 and 2 in Section I of this report. The detailed assessment provided herein will predominantly focus on the areas seaward of the CCCL. A location reference map of coastal areas in Gulf County with specific identification of FDEP survey range locations is provided as follows herein on page 49.

### Beach and Dune Erosion

The St. Joseph Peninsula portion of the Gulf County shoreline (R77-110) sustained major beach and dune erosion, undermining and destroying several habitable buildings in that area. Based on the qualitative erosion conditions guideline provided in Appendix B, condition IV erosion occurred throughout this area of Gulf County, both in terms of beach profile lowering and dune erosion.

The western end of the Indian Peninsula (R111-127) sustained moderate erosion, condition III based on the guideline. Other areas of the County had less damage, including minor erosion at Beacon Hill and Port St. Joe Beach (R1-30) and the eastern end of Indian Peninsula (R128-162).

### Structural Damage

In conjunction with the areas of greatest beach and dune erosion, the St. Joseph Peninsula sustained the major structural damage in the County. This area (R77-110) has experienced a high long-term shoreline erosion rate and has a history of significant impact from storms and hurricanes.

The road at the Stump Hole area (County Road 30E) again, as during a number of storms and hurricanes over recent years, was overtopped and partially washed out. The road is actually being maintained at a location well seaward of the current shoreline position in this area as evidenced in Photo GU-8. A long-term solution is needed to relocate this road to a more landward position and will likely require inclusion of some bridge construction.

For the areas seaward of the CCCL, a total of 13 habitable structures were destroyed or sustained major damage, including 11 single-family dwellings and 2 multi-family structures. In addition, a number of habitable structures sustained moderate to minor damage to understructure areas and/or sustained moderate to minor roof damage. Also, two (2) wooden retaining wall structures sustained major damage.

Examples by referenced location of damages to this area are shown on the photographs on the following pages.



Photo GU-1. Destroyed single-family dwelling on St. Joseph Peninsula at R100 (+450')



Photo GU-2. Aerial view of above destroyed house on St. Joseph Peninsula at R100 (+450')



Photo GU-3. Destroyed single-family dwelling on St. Joseph Peninsula at R101 (-400')



Photo GU-4. Aerial view of above destroyed house; St. Joseph Peninsula at R101 (-400').





Photo GU-5. Eroded dune bluff; structural damage at R99; St. Joseph Peninsula



Photo GU-6. Major dune erosion at habitable structures on the beach on St. Joseph Peninsula at R90 (+300').



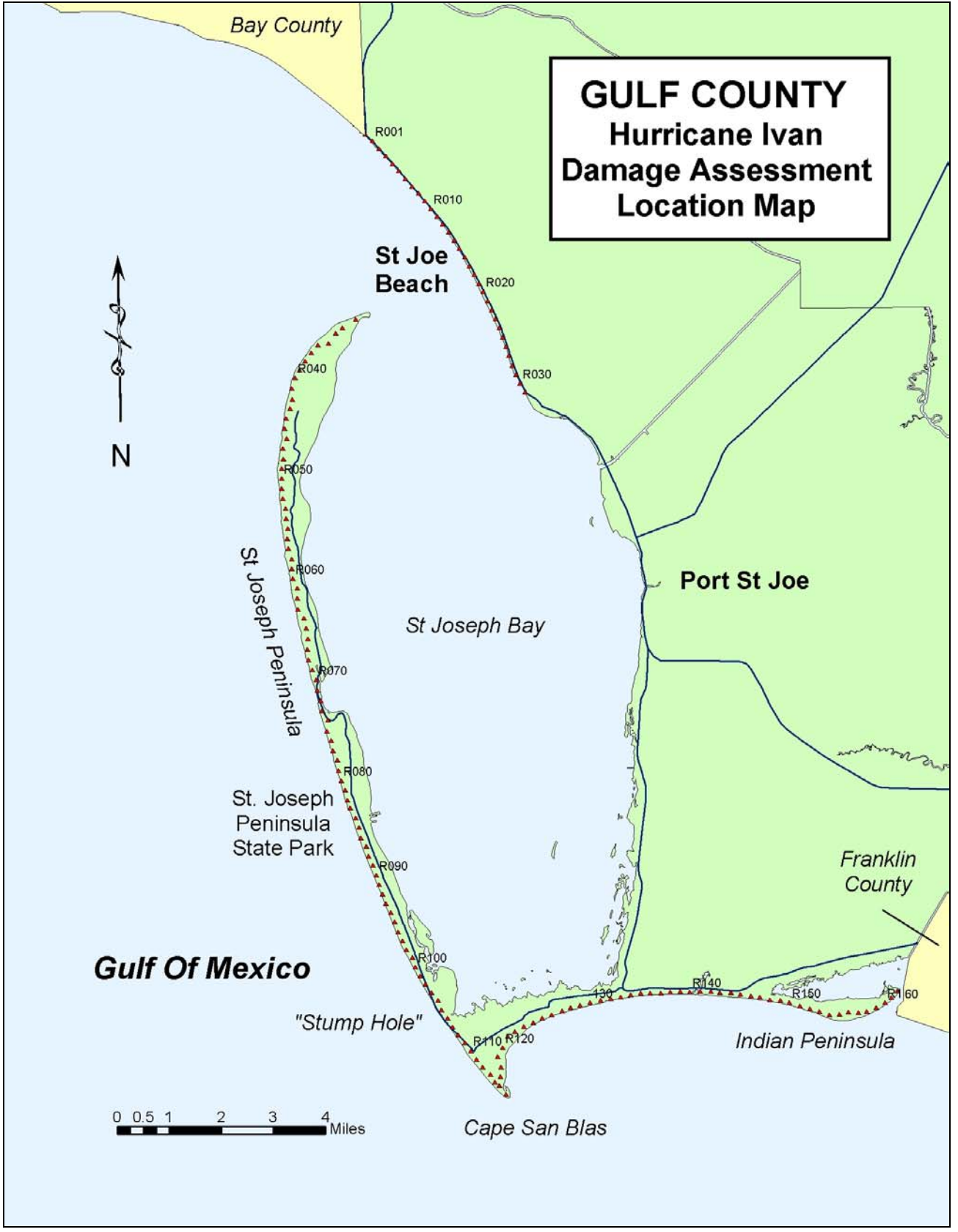
Photo GU-7. Sand loss and collapse of floor beneath habitable structure on St. Joseph Peninsula at R83 (+500').



Photo GU-8. Revetted County Road 30E at "Stump Hole" on St. Joseph Peninsula at R105. (Note: The road was substantially seaward of the shoreline prior to Ivan).



Photo GU-9. Old Coast Guard barracks after Ivan at R110 (-250') (Note: the building was located substantially seaward of the shoreline into the Gulf waters prior to Ivan).



## Franklin County

Franklin County sustained minor storm impact and structural damage from Hurricane Ivan, throughout the County. The County's shoreline was protected from the destructive forces of Ivan by virtue of the distance of the County from the path of the storm, as well as, the sheltering effects of coastline further to the west of Franklin County. Erosional impact and structural damage to the County's coastal development is summarized in Tables 1 and 2 in Section I of this report.

The detailed assessment provided herein will predominantly focus on the areas seaward of the CCCL. A location reference map of coastal areas in Franklin County with specific identification of FDEP survey range locations is provided as follows herein on page 53.



Photo FR-1. View of Cape St. George lighthouse after Ivan (note: the lighthouse was substantially seaward of the shoreline into Gulf waters prior to Ivan).

### Beach and Dune Erosion

The Franklin County coast sustained minor beach and dune erosion from Ivan. Based on the qualitative erosion conditions guideline provided in Appendix B, condition I erosion occurred throughout Franklin County, both in terms of beach profile lowering and dune erosion. Some minor condition II type dune recession and overwash-type flooding occurred within some isolated areas, such as at the St. George Island State Park (see Photo FR-2).



Photo FR-2. Flooding from Hurricane Ivan at St. George Island State Park.

### Structural Damage

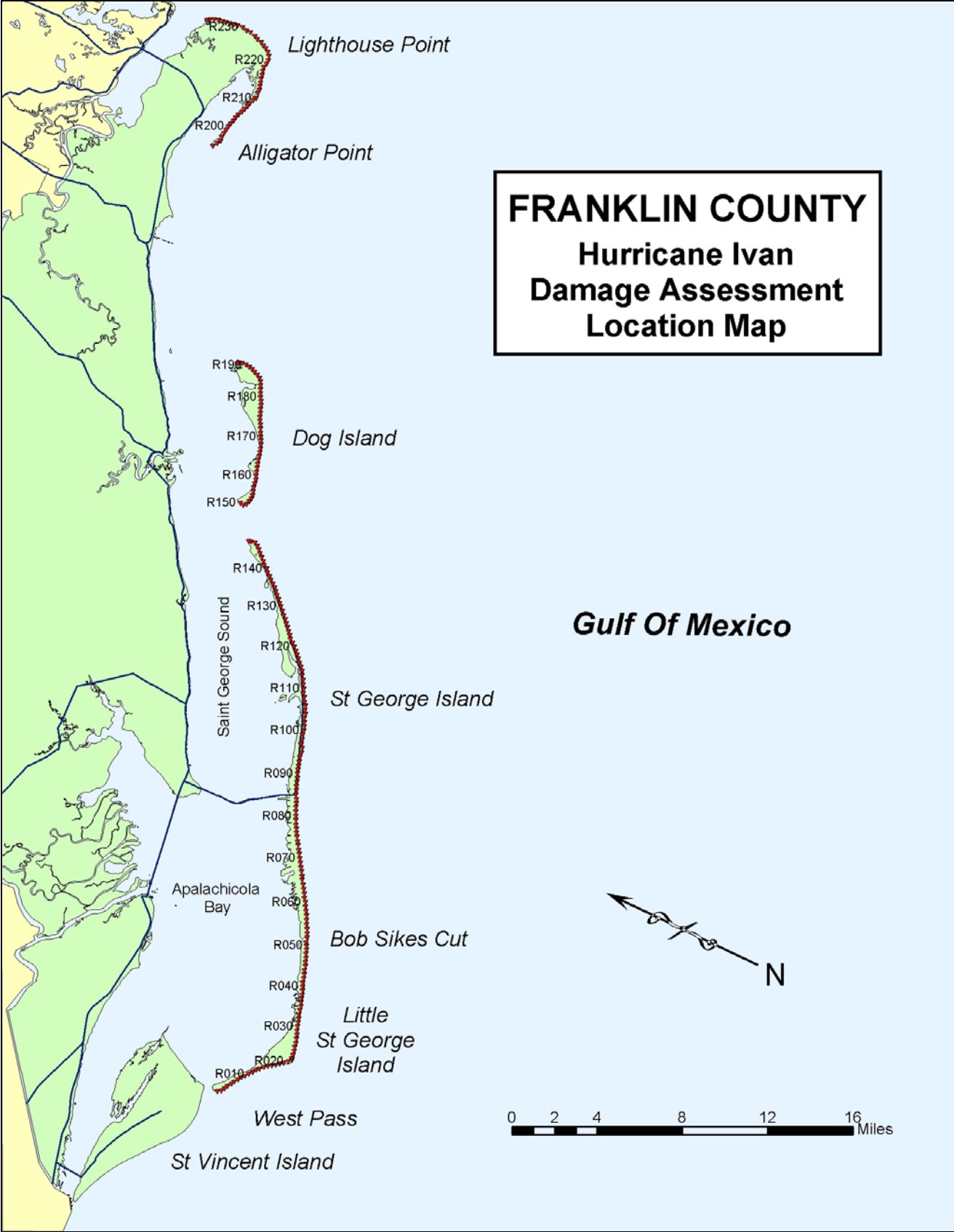
Franklin County sustained minor structural damage overall throughout the coastal areas seaward of the CCCL. One major habitable structure was destroyed in the Lighthouse Point area as a result of undermining of the slab-on-grade structure.



Photo FR-3. Destroyed single-family structure at Lighthouse Point at R221 (+50').



Photo FR-4. Major damage to single-family structure at Lighthouse Point at R221 (+50').





### **III. Recovery Recommendations and Management Strategies**

#### **A. Area-wide Strategies and Recommendations**

- 1) Encourage expedited Federal funding from the U.S. Army Corps of Engineers (USACE) to nourish the Panama City Beaches Beach Erosion Control and Storm Damage Reduction Project.
- 2) Seek Federal Emergency Management Agency (FEMA) assistance to repair non-Federal engineered beach projects.
- 3) Conduct assisted recovery activities consisting of supplemental beach berm and dune restoration and re-vegetation activities, as needed, in areas where significant development is vulnerable to the threat of storm damage.
- 4) Promote natural recovery in undeveloped areas, as appropriate.
- 5) Support further sand search studies to locate sufficient upland and offshore sand resources to replenish storm-eroded beaches.
- 6) Conduct post-storm coastal monitoring to assess beach erosion impacts and to assess beach recovery progress and any additional recovery needs.
- 7) Acquire beach management technical support to assist in coordination with local governments for hazard mitigation/beach management planning, removal of storm-related debris on beaches, and restoration of public dune walkovers.
- 8) Re-evaluate coastal construction design standards for re-validation for the Florida Building Code.

#### **B. Site-specific Recommendations**

##### **Escambia County**

- **Perdido Key**

- 1) Assisted recovery – Dune restoration and re-vegetation (R1-32).
- 2) Shoreline and beach erosion evaluation – Acquire and evaluate beach survey data to assess possible need for beach restoration.

- **Pensacola Beach**

- 1) Assisted recovery – Beach nourishment to replenish the Santa Rosa Island Authority's Pensacola Beach Restoration Project to maintain project design requirements (R107-151); dune restoration and re-vegetation.

- 2) Shoreline and beach erosion evaluation – Acquire and evaluate additional post-storm beach survey data to assess storm-induced erosional losses and recovery potential.

- **Gulf Islands National Seashore**

- 1) Natural recovery – Federal lands.

### **Santa Rosa County**

- **Navarre Beach**

- 1) Assisted recovery – Beach restoration; dune restoration and re-vegetation (R192-211).
- 2) Shoreline and beach erosion evaluation – Acquire and evaluate beach survey data to re-assess beach fill needs and post-storm beach recovery.

### **Okaloosa County**

- **Okaloosa Island**

- 1) Assisted recovery – Dune restoration and re-vegetation (R1-15).
- 2) Shoreline and beach erosion evaluation – Acquire and evaluate beach survey data to assess storm impact, beach recovery, and possible need for beach restoration.

- **Destin (west) / Henderson Beach State Recreation Area**

- 1) Assisted recovery – Dune restoration and re-vegetation (R17-39).
- 2) Shoreline and beach erosion evaluation – Acquire and evaluate beach survey data to re-assess areas in possible need of beach restoration.

- **Destin (east)**

- 1) Assisted recovery – Beach restoration; dune restoration and re-vegetation (R39-50).
- 2) Shoreline and beach erosion evaluation – Acquire and evaluate beach survey data to re-assess beach fill needs and post-storm beach recovery.

### **Walton County**

- **Western Walton County**

- 1) Assisted recovery – Beach restoration; dune restoration and re-vegetation (R1-24).
- 2) Shoreline and beach erosion evaluation – Acquire and evaluate beach survey data to assess storm impact, beach recovery, and re-assess beach fill needs.

- **Topsail Hill**

- 1) Natural recovery – This area is undeveloped state land (R24-41).

- **Beach Highlands / Dune Allen Beach**

- 1) Assisted recovery – Dune restoration and re-vegetation (R41-55).
- 2) Shoreline and beach erosion evaluation – Acquire and evaluate beach survey data to re-assess possible areas in need of beach restoration.

- **Blue Gulf Beach / Blue Mountain Beach**

- 1) Assisted recovery – Dune restoration and re-vegetation (R55-63)
- 2) Shoreline and beach erosion evaluation – Acquire and evaluate beach survey data to re-assess possible areas in need of beach restoration.

- **Gulf Trace / Grayton Beach / Seaside**

- 1) Assisted recovery – Dune restoration and re-vegetation, as needed (R64-82).  
Note: Area between R72-78 is undeveloped state land at Grayton Beach State Park.
- 2) Shoreline and beach erosion evaluation – Acquire and evaluate beach survey data to re-assess possible areas in need of beach restoration.

- **Seagrove Beach**

- 1) Assisted recovery – Dune restoration and re-vegetation (R82-98).
- 2) Shoreline and beach erosion evaluation – Acquire and evaluate beach survey data to re-assess possible areas in need of beach restoration.

- **Deer Lake / Camp Creek Lake**

- 1) Natural recovery – This area is undeveloped state land (R98-105).

- **Seacrest Beach / Dana Beach / Inlet Beach**

- 1) Assisted recovery – Dune restoration and re-vegetation (R105-127).
- 2) Shoreline and beach erosion evaluation – Acquire and evaluate beach survey data to re-assess possible areas in need of beach restoration.

## **Bay County**

- **Panama City Beach**

- 1) Assisted recovery – Supplemental beach restoration or acceleration of the first maintenance nourishment scheduling, if necessary, to replenish the Panama City

Beaches Beach Erosion Control and Storm Damage Reduction Project to maintain project design requirements (R5-91); dune restoration and re-vegetation.

- 2) Shoreline and beach erosion evaluation – Acquire and evaluate additional post-storm beach survey data to assess storm-induced erosional losses and recovery potential.

- **St. Andrews State Park**

- 1) Assisted recovery – Dune restoration and re-vegetation, as needed (R91-97).
- 2) Shoreline and beach erosion evaluation – Acquire and evaluate beach survey data to assess storm-induced erosional losses and recovery potential, and possible areas in need of additional beach renourishment.

- **Mexico Beach**

Assisted recovery – Dune restoration and re-vegetation, as needed (R129-138).

### **Gulf County**

- **St. Joe Beach**

Natural Recovery - (R1-5)

- **St. Joseph Peninsula**

- 1) Natural recovery – (R32-77).
- 2) Assisted recovery – Dune restoration and re-vegetation, as needed (R77-105).
- 3) Shoreline and beach erosion evaluation – Acquire and evaluate beach survey data to assess storm-induced erosional losses and recovery potential.

- **Stump Hole Access Road (County Road 30E)**

Continue to provide technical assistance for consideration and evaluation of alternatives for a long-term solution for road access to the St. Joseph Peninsula.

- **Indian Peninsula**

Natural Recovery - (R110-162)

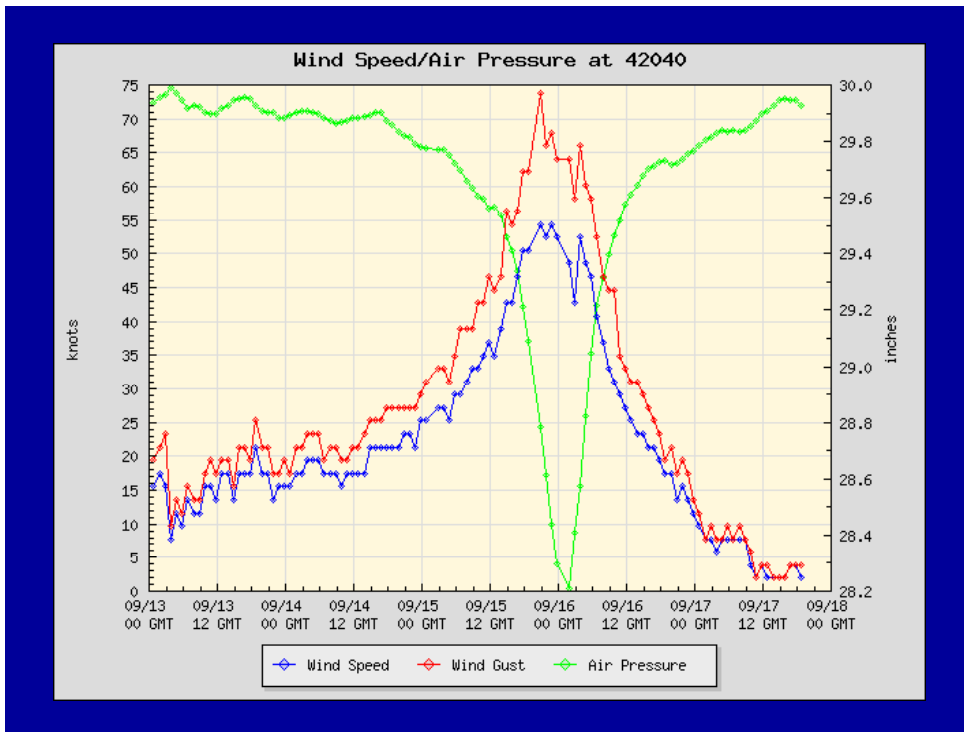
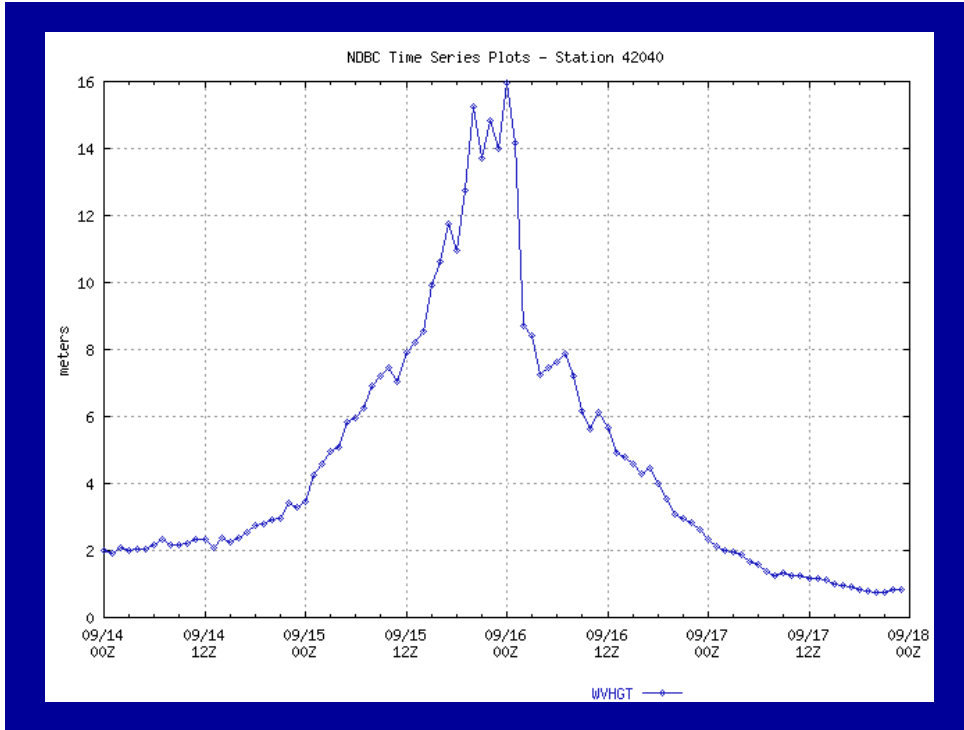
### **Franklin County**

- 1) Natural Recovery - Countywide
- 2) Assisted recovery – Dune restoration and re-vegetation, as needed, at St. George Island State Park.

## IV. References

- 1) Coastal Planning and Engineering, Inc., “Panama City Beaches, Florida, Beach Erosion Control and Storm Damage Reduction Project – Post-Construction Monitoring Report”, March 2000.
- 2) Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems, “Hurricane Opal – Post-Storm Beach and Dune Recovery Strategic Management Plan for the Panhandle Coast of Florida”, March 1996.
- 3) Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems, “Hurricane Opal – Beach and Dune Erosion and Structural Damage Along the Panhandle Coast of Florida”, Report No. BCS-98-01, January 1998.
- 4) Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems, “Hurricane Earl and Hurricane Georges – Beach and Dune Erosion and Structural Damage Assessment and Post-Storm Recovery Plan for the Panhandle Coast of Florida”, Report No. BCS-99-01, January 1999.
- 5) Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems, “Hurricane Charley - Post-Storm Beach Conditions and Coastal Impact Report with Recommendations for Recovery and Modifications of Beach Management Strategies”, August 2004.
- 6) Olsen Associates, Inc., “Pensacola Beach, Florida, 2003 Beach Restoration Project – Year-1 Post-Construction Monitoring Report”, July 2004.
- 7) Olsen Associates, Inc., “Hurricane Ivan – Coastal Erosion Assessment: Pensacola to Gulf Shores”, Presentation from FSBPA Annual Conference, September 2004.

**Appendix A**  
**NOAA-NDBC Buoy Station # 42040**  
**Ivan Wave Heights and Wind Speed/Air Pressure**

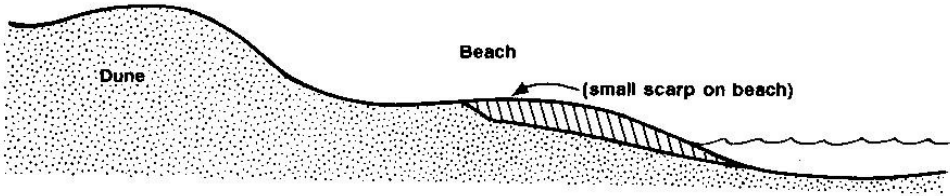


# Appendix B

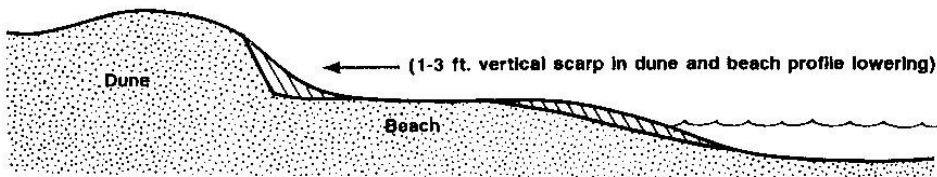
## Beach and Dune Erosion Conditions

(provides a qualitative means to describe erosion after a storm event)

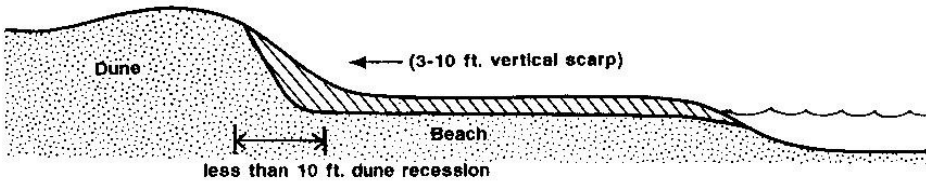
### CONDITION I: MINOR BEACH EROSION



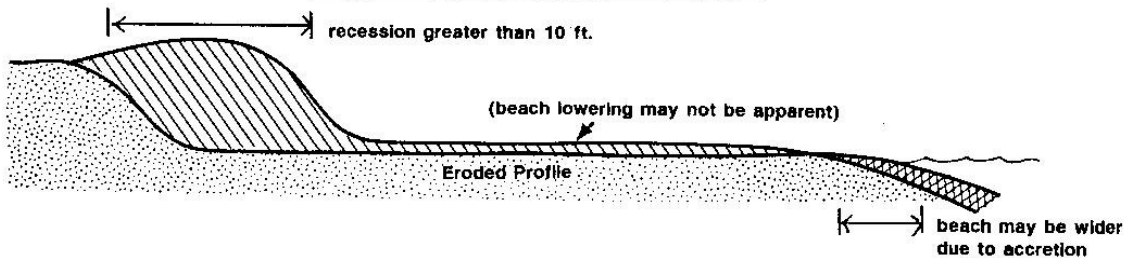
### CONDITION II: MINOR DUNE AND BEACH EROSION



### CONDITION III: MODERATE DUNE EROSION AND BEACH PROFILE LOWERING



### CONDITION IV: MAJOR DUNE EROSION



OR:



R. R. CLARK 8/27/51

**Appendix C**  
**Comparative Pre- vs. Post-Ivan Beach and Dune**  
**Profiles – Pensacola Beach**  
 (provided courtesy of Olsen Associates, Inc.)

