

**POST-HURRICANE DENNIS BEACH ASSESSMENT,
SHOREFRONT DEVELOPMENT RISK ANALYSIS,
AND PROJECT PRIORITIZATION
WALTON COUNTY, FLORIDA
FINAL REPORT**

June 2006

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WALTON COUNTY, FLORIDA
FINAL REPORT**

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1.0 INTRODUCTION

1.1 Overview

The 2004 and 2005 hurricane seasons triggered several powerful tropical storms and hurricanes that tracked through the Gulf of Mexico. Though Walton County did not experience a direct hit by any storms, the northeast quadrant of several storms brought strong onshore winds, storm surges, and large waves to the county's beaches. These storm events, most notably Tropical Storm Irene and Hurricane Ivan during 2004 and Tropical Storm Arlene and Hurricane Dennis during 2005, caused severe erosion throughout the county. Walton County sponsored the current study to help assess existing beach conditions and determine beach management requirements to protect shorefront development and infrastructure from future storm damage.

Following Hurricane Dennis, Walton County ordered a countywide beach profile survey to document the post-storm conditions. To quantify the recent storm effects, Taylor Engineering evaluated mean high water shoreline changes and beach volume changes by comparing the post-Hurricane Dennis survey (conducted in September 2005) with beach profile surveys conducted in December 1997, May 2004, and November 2004. To supplement this analysis, Taylor Engineering conducted a shorefront development risk analysis to help predict the impact to existing shorefront structures during a variety of return period storms. A specifically designed scoring system assimilated the results of the above two analyses to compare the conditions throughout the county to help determine beach management requirements. To conclude the study, Taylor Engineering incorporated results of the scoring system to develop preliminary project designs to provide equal storm protection throughout the county.

1.2 Report Organization

Following this introduction, Chapter 2.0 documents the analysis of the mean high water shoreline position and beach volumes. Chapter 3.0 discusses the shorefront development risk analysis. Chapter 4.0 discusses the scoring system, and Chapter 5.0 presents various preliminary project designs. Chapter 6.0 summarizes and concludes this study.

2.0 MEAN HIGH WATER AND BEACH VOLUME ANALYSIS

To assess the beach response to recent storm activity, analysis of two parameters — changes to the shoreline position and changes in the beach volume — takes on particular importance. The distance from a given point (the survey monument) to a known elevation, in this case mean high water (MHW), defines a shoreline position. Changes to the MHW position between surveys indicate gross scale changes to the beach. In addition, beach volume changes, calculated between surveys, further clarify the history of beach evolution. A more refined look at beach volume changes considers volumes lost or gained above and below the specified elevations. Changes above MHW represent variations to the subaerial or dry beach — the area the public typically considers as “the beach.” Changes between MHW and mean low water (MLW) represent variations to the intertidal zone. Below MLW changes — also called subaqueous changes — indicate material volume remaining within the active profile, frequently in bar formations. This chapter documents the countywide effects of recent storm activity on beach profiles, shoreline positions, and beach volumes.

2.1 Beach Profile Survey Data

The MHW shoreline and beach volume analyses compare data from surveys conducted in December 1997, May 2004, November 2004, and September 2005. The September 2005 data represent post-Hurricane Dennis conditions; the November 2004 data represent post-Hurricane Ivan conditions; the May 2004 data represent beach conditions before the 2004 hurricane season; and the December 1997 data represent the most recent countywide survey conducted before May 2004. The December 1997 survey also represents the most recent data included in the feasibility study (*Walton County and City of Destin Beach Management Feasibility Study*, Taylor Engineering, 2003). Notably, the FDEP conducted the December 1997 survey; the USACE conducted the May 2004 and November 2004 surveys; and Morgan & Eklund, Inc. conducted the September 2005 survey. Appendix A contains profile data plots.

2.2 Reach Delineation

To facilitate comparison of the countywide MHW shoreline and beach volume changes, this analysis evaluated the data reach-by-beach-reach. Each reach represents a beach segment of similar characteristics based on profile geomorphology (dune or bluff profiles), shoreline orientation, and nature of upland development (structures encroaching on the active beach profile region). Table 2.1 summarizes the extents of each reach. Note the reaches are identical to the reaches applied in the feasibility study with two exceptions: (1) the boundary between Reach 7 and 8 changed from R-80 to R-78 and (2) the

boundary between Reach 9 and 10 changed from R-109 to R-106. Both of these changes update the boundaries between developed and undeveloped gulf front property.

Table 2.1 Reach Delineations.

Reach	Monuments	Reach Length (miles)	Communities
1	R1 - R19	3.94	Miramar, Seascape, Sandestin
2	R19 - R24	0.99	Four Mile Village
3	R24 - R41	3.30	Topsail Hill State Preserve
4	R41 - R48	1.46	Dune Allen
5	R48 - R55	1.49	Santa Rosa
6	R55 - R64	1.59	Blue Mountain
7	R64 - R78	2.87	Grayton
8	R78 - R98	3.87	WaterColor, Seaside, Seagrove
9	R98 - R106	1.78	WaterSound, Dear Lake State Park
10	R106 - R127	4.04	Seacrest, Rosemary Beach, Inlet Beach
Total		25.32	-

2.3 Mean High Water Shoreline Analysis

Figures 2.1 and 2.2 present the mean high water (MHW elevation = 1.06 ft-NGVD) shoreline position changes and change rates averaged across each reach from December 1997 – May 2004, May 2004 – November 2004, November 2004 – September 2005, and December 1997 – September 2005. Table 2.2 presents data for the plots. Appendix B presents the MHW shoreline position changes, in tabular and graphic form, at each monument for the same periods. The following analysis examines each period separately.

December 1997 – May 2004

This period represents the relatively calm period preceding the 2004 hurricane season. The county experienced a mix of MHW shoreline advance and recession. The shoreline receded landward in Reaches 1, 2, 5, 6, 7, and 8, whereas the shoreline advanced seaward in Reaches 3, 4, 9, and 10. The shoreline

advanced most in Reach 10 (11 ft) and receded most in Reach 6 (-32 ft). The beaches experienced a relatively minimal shoreline change rate ranging from 1.8 to -5 ft/yr.

May 2004 – November 2004

This period represents pre-storm to post-Hurricane Ivan conditions. The MHW shoreline receded landward in Reaches 1 – 10. The shoreline receded least in Reach 5 (-5 ft) and most in Reach 2 (-24 ft). The magnitude of shoreline change fell in line with the magnitude of the previous period; however, the shoreline change rate, which ranged from -8.9 to -47.2 ft/yr, far exceeded the rate of the previous period.

November 2004 – September 2005

This period represents post-Hurricane Ivan to post-Hurricane Dennis conditions. The MHW shoreline receded landward in Reaches 1 – 10. The shoreline receded least in Reach 4 (-9 ft) and most in Reach 7 (-52 ft). Generally, the shoreline recession experienced during the 2005 hurricane season greatly exceeded the recession experienced during the 2004 hurricane season, except in Reaches 4 and 10. Similarly, the shoreline change rate, which ranged from -11.0 to -62.1 ft/yr, exceeded the rate of the previous period, except in Reaches 4 and 10.

December 1997 – September 2005

This period describes the net change of the three periods previously discussed. The MHW shoreline receded landward in Reaches 1 – 10. By the end of the 2004 hurricane season, the county experienced net shoreline recession, and the 2005 hurricane season exacerbated the recession. As such, the overall (December 1997 – September 2005) shoreline changes exceeded those of any other period. The shoreline receded least in Reach 4 (-21 ft) and most in Reach 2 (-65 ft). The shoreline change rate ranged from -2.7 to -8.4 ft/yr.

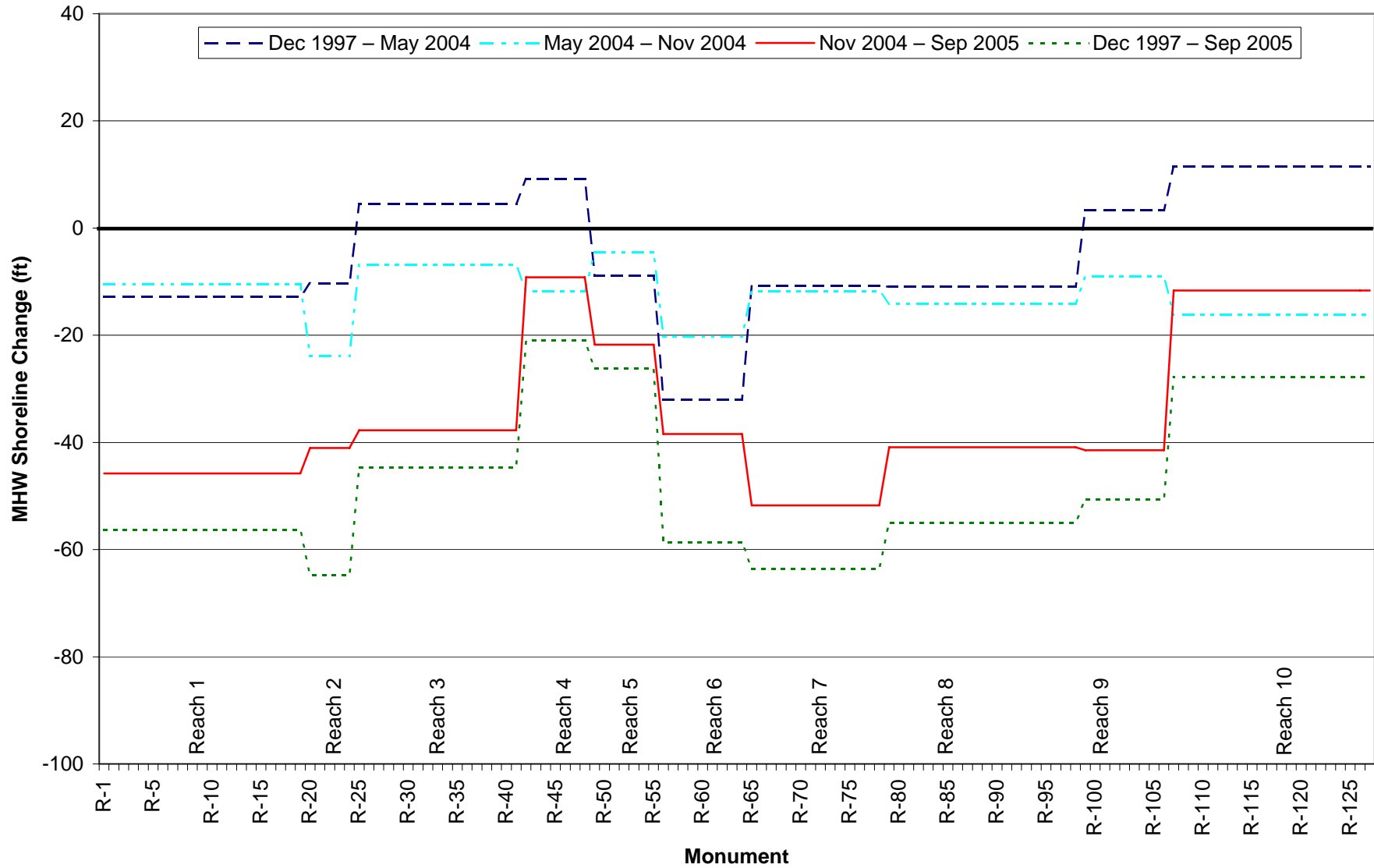


Figure 2.1 MHW Shoreline Change (ft) by Reach

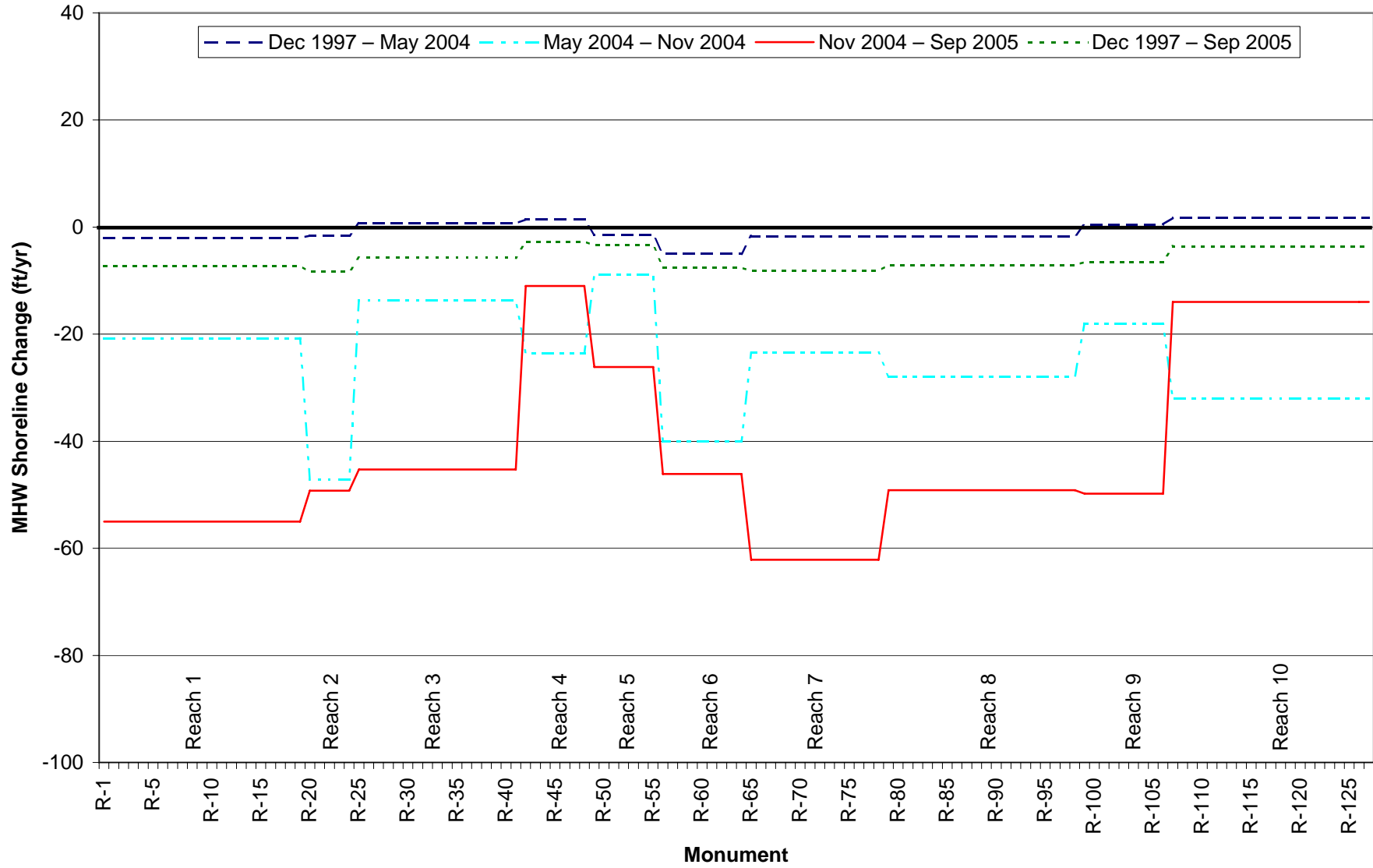


Figure 2.2 MHW Shoreline Change (ft/yr) by Reach

Table 2.2 MHW Shoreline Changes by Reach

Reach	Monuments	Dec. 1997 – May 2004		May 2004 – Nov. 2004		Nov. 2004 – Sep. 2005		Dec. 1997 – Sep. 2005	
		(ft)	(ft/yr)	(ft)	(ft/yr)	(ft)	(ft/yr)	(ft)	(ft/yr)
1	R1 - R19	-13	-2.0	-10	-20.8	-46	-55.0	-56	-7.3
2	R19 - R24	-10	-1.6	-24	-47.2	-41	-49.3	-65	-8.4
3	R24 - R41	5	0.7	-7	-13.7	-38	-45.3	-45	-5.8
4	R41 - R48	9	1.4	-12	-23.5	-9	-11.0	-21	-2.7
5	R48 - R55	-9	-1.4	-4	-8.9	-22	-26.1	-26	-3.4
6	R55 - R64	-32	-5.0	-20	-40.1	-38	-46.1	-59	-7.6
7	R64 - R78	-11	-1.7	-12	-23.5	-52	-62.1	-64	-8.2
8	R78 - R98	-11	-1.7	-14	-27.9	-41	-49.1	-55	-7.1
9	R98 - R106	3	0.5	-9	-18.0	-41	-49.8	-51	-6.5
10	R106 - R127	11	1.8	-16	-32.1	-12	-14.0	-28	-3.6

2.4 Beach Volume Analysis

At each monument location, Taylor Engineering calculated volume changes between vertical compartments — above MHW, from MHW to MLW (MLW elevation = -0.21 ft-NGVD), and from MLW to -35 ft NGVD — along each profile. The limiting depth of -35 ft NGVD represents the deepest contour in common among all profiles. The sum of all compartments yields the overall profile volume change across the profile. Figure 2.3 and 2.4 present the volume changes and change rates above MHW averaged across each reach from December 1997 – May 2004, May 2004 – November 2004, November 2004 – September 2005, and December 1997 – September 2005. Table 2.3 presents data for the plots. Appendix C presents the volume changes, in tabular and graphic form, averaged across each reach for the remaining volume compartments and at each monument for the same periods. The following analysis examines the volume above MHW for each period separately.

December 1997 – May 2004

This period represents the relatively calm period preceding the 2004 hurricane season. The beaches accreted in Reaches 1, 2, 3, 4, 5, 7, and 8, and eroded in Reaches 6, 9, and 10. The beach experienced the most accretion in Reach 4 (+9.1 cy/ft) and eroded most in Reach 6 (-3.8 cy/ft). The beaches experienced a relatively minimal volume change rate ranging from 1.4 to -0.6 cy/ft/yr.

May 2004 – November 2004

This period represents pre-storm to post-Hurricane Ivan conditions and generally indicates the affects of the 2004 hurricane season. The beach volume eroded in Reaches 1 – 10. The beach eroded most in Reach 4 (-19.6 cy/ft) and least in Reach 2 (-6.2 cy/ft). The rate of erosion, which ranged from -12.3 to -38.8 cy/ft/yr, far exceeded the volume change rate of the previous period.

November 2004 – September 2005

This period represents post-Hurricane Ivan to post-Hurricane Dennis conditions and generally indicates the affects of the 2005 hurricane season. The beach volume eroded in Reaches 1 – 10. The beach eroded most in Reach 5 (-20.8 cy/ft) and least in Reach 1 (-7.7 cy/ft). The erosion rate ranged from -9.3 to -24.9 cy/ft/yr. Generally, the 2005 hurricane season caused similar erosion magnitudes as the 2004 hurricane season.

December 1997 – September 2005

This period describes the net change of the three periods previously discussed. The beach volume eroded in Reaches 1 – 10. By the end of the 2004 hurricane season, the county experienced net erosion, and the 2005 hurricane season exacerbated the erosion. As such, the overall (December 1997 – September 2005) erosion volumes exceeded those of any other period. The beach eroded least in Reach 1 (-18.1 cy/ft) and most in Reach 6 (-32.8 cy/ft). The erosion rate ranged from -2.3 to -4.2 cy/ft/yr.

Table 2.3 Subaerial Beach Volume Changes by Reach

Reach	Monuments	Dec. 1997 – May 2004		May 2004 – Nov. 2004		Nov. 2004 – Sep. 2005		Dec. 1997 – Sep. 2005	
		(cy/ft)	(cy/ft/yr)	(cy/ft)	(cy/ft/yr)	(cy/ft)	(cy/ft/yr)	(cy/ft)	(cy/ft/yr)
1	R1 - R19	2.7	0.4	-13.0	-25.8	-7.7	-9.3	-18.1	-2.3
2	R19 - R24	2.6	0.4	-6.2	-12.3	-15.7	-18.8	-26.9	-3.5
3	R24 - R41	7.0	1.1	-19.3	-38.2	-15.7	-18.8	-27.6	-3.6
4	R41 - R48	9.1	1.4	-19.6	-38.8	-18.1	-21.7	-28.3	-3.7
5	R48 - R55	1.1	0.2	-12.2	-24.2	-16.2	-19.5	-27.3	-3.5
6	R55 - R64	-3.8	-0.6	-9.1	-18.1	-20.8	-24.9	-32.8	-4.2
7	R64 - R78	6.7	1.0	-13.4	-26.5	-16.9	-20.3	-23.5	-3.0
8	R78 - R98	0.0	0.0	-12.7	-25.3	-12.4	-14.9	-26.4	-3.4
9	R98 - R106	-3.2	-0.5	-8.8	-17.4	-10.9	-13.1	-22.9	-3.0
10	R106 - R127	-0.2	0.0	-14.2	-28.1	-10.1	-12.1	-22.7	-2.9

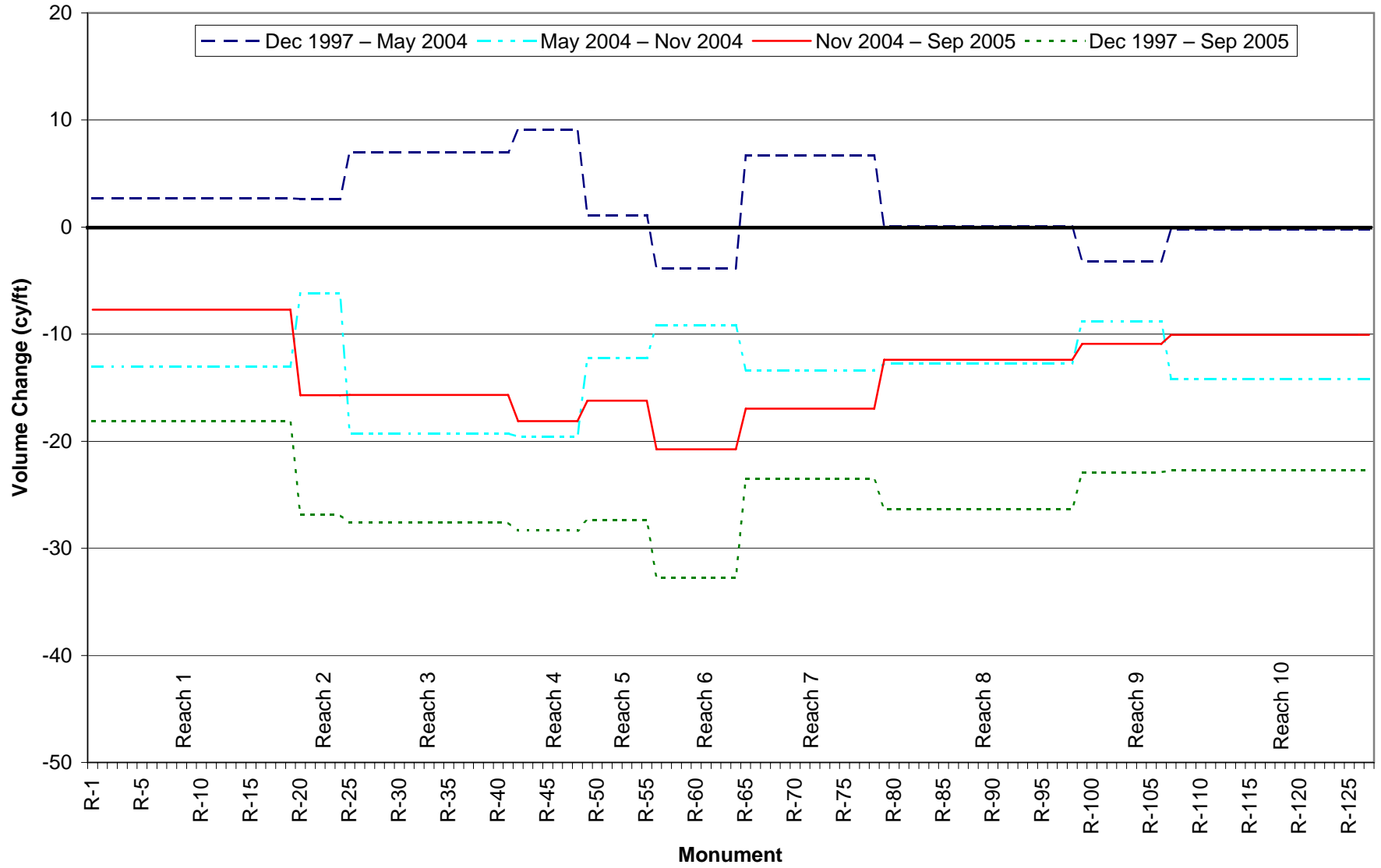


Figure 2.3 Volume Change (cy/ft) Above MHW by Reach

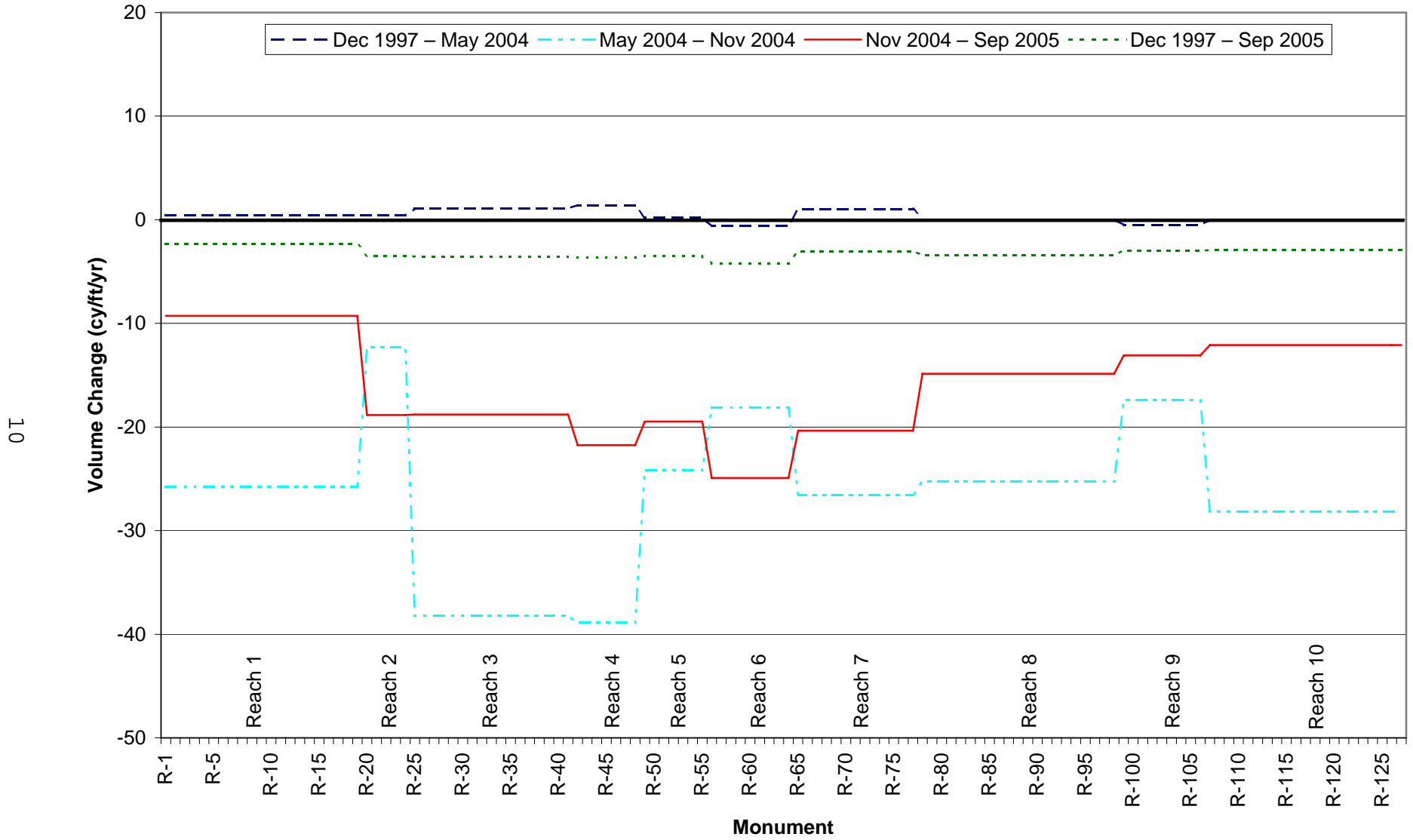


Figure 2.4 Volume Change (cy/ft/yr) Above MHW by Reach

3.0 SHOREFRONT DEVELOPMENT RISK ANALYSIS

The mean high water shoreline and beach volume analyses discussed in Chapter 2.0 assessed the countywide storm impacts to the beach. The shorefront development risk analysis discussed in this chapter complements the previous results by predicting the future impact to existing shorefront structures during a variety of return period storms. This two-fold analysis first determines the amount of encroachment of shorefront property and then assesses the potential risk of these structures from future storms. The combined results of these two separate analyses indicate areas of shorefront development subject to future storm impact and provide another tool for developing appropriate beach management actions. The risk analysis discussed here determines the level of risk in each of Walton County's 10 reaches (described in Section 2.2).

For this analysis, storm impact occurs if the landward limit of storm-induced erosion meets or exceeds the encroachment distance. Note that actual property damage, which depends on the severity of beach erosion and the type of shorefront structure, may or may not occur during such an event. Figure 3.1 provides an illustration of encroachment and storm impact as defined in this risk analysis.

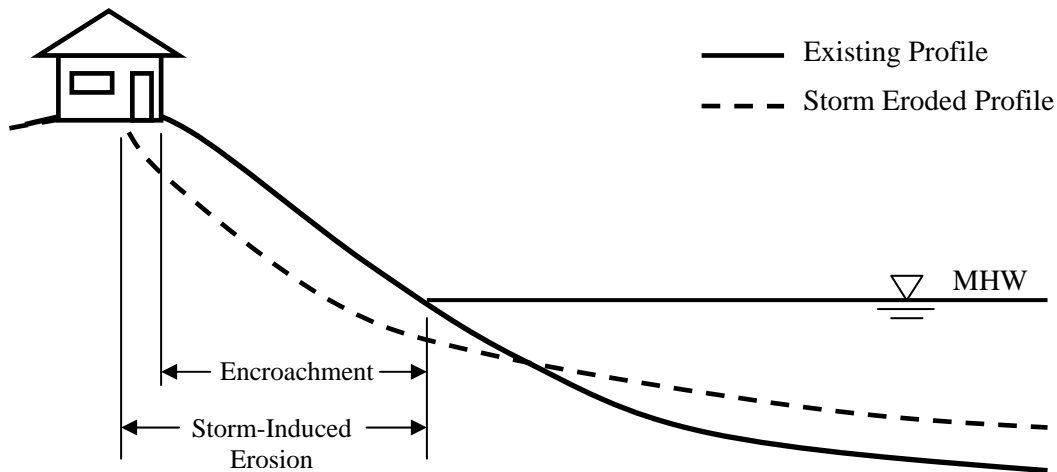


Figure 3.1 Illustration of Encroachment and Storm Impact to Structures

3.1 Level of Encroachment

Comparison of current shorefront structure locations in relation to the historic mean high water (MHW) shoreline positions determines the level of encroachment or proximity of the structures to the shoreline. This valuable information 1) indicates reaches currently at risk, and 2) provides a baseline for assessing future storm impacts. The level of encroachment depends on the variability of both the average historic MHW shoreline position and average structure location. Variability is measured in terms of an envelope, a range of values which extends one standard deviation away from the average value. The minimum distance between the MHW envelope and structure location envelope quantifies the level of risk.

The MHW shoreline position envelope extends one standard deviation landward of the 2005 MHW shoreline position; the standard deviation incorporates the variability among the 2005 MHW position and the historic MHW positions. The historic MHW shoreline positions used in this analysis span from 1997 – 2005. As discussed in Section 2.1, data sources include the December 1997 FDEP beach profile survey, the May 2004 and November 2004 USACE surveys, and the September 2005 Morgan & Eklund survey.

The structure location envelope extends one standard deviation seaward of the average distance between the structures and the 2005 MHW position. The standard deviation in this case represents the variability of structure locations seaward of the average structure location. Notably, superposition of the 2005 MHW shoreline data and parcel boundary information (provided by Walton County) onto 2005 aerial photographs allowed for a direct measurement of the encroachment distance for each structure. Following structure selection criteria — defining a structure as an individual habitable structural entity (homes, condos, restaurants, county facilities) on the gulf front — ensured consistency in structure selection; structures excluded from the analysis include pools, gazebos, and similar entities.

Figure 3.2 illustrates results of the encroachment analysis. The minimum distance between the MHW shoreline envelope and the shorefront structure envelope equals 93 ft (Reach 4), and the maximum distance equals 366.5 ft (Reach 9). The reaches rank in order of decreasing risk (increasing encroachment distance) as follows: Reach 4, Reach 1, Reach 10, Reach 6, Reach 8, Reach 2, Reach 5, Reach 7, and Reach 9. (Note: Reach 3, which contains no data in the figure, represents Topsail Hill State Park where no structures exist.) Storm modeling results discussed in the following section supplement the above data and help predict the number of structures impacted during various return period storms.

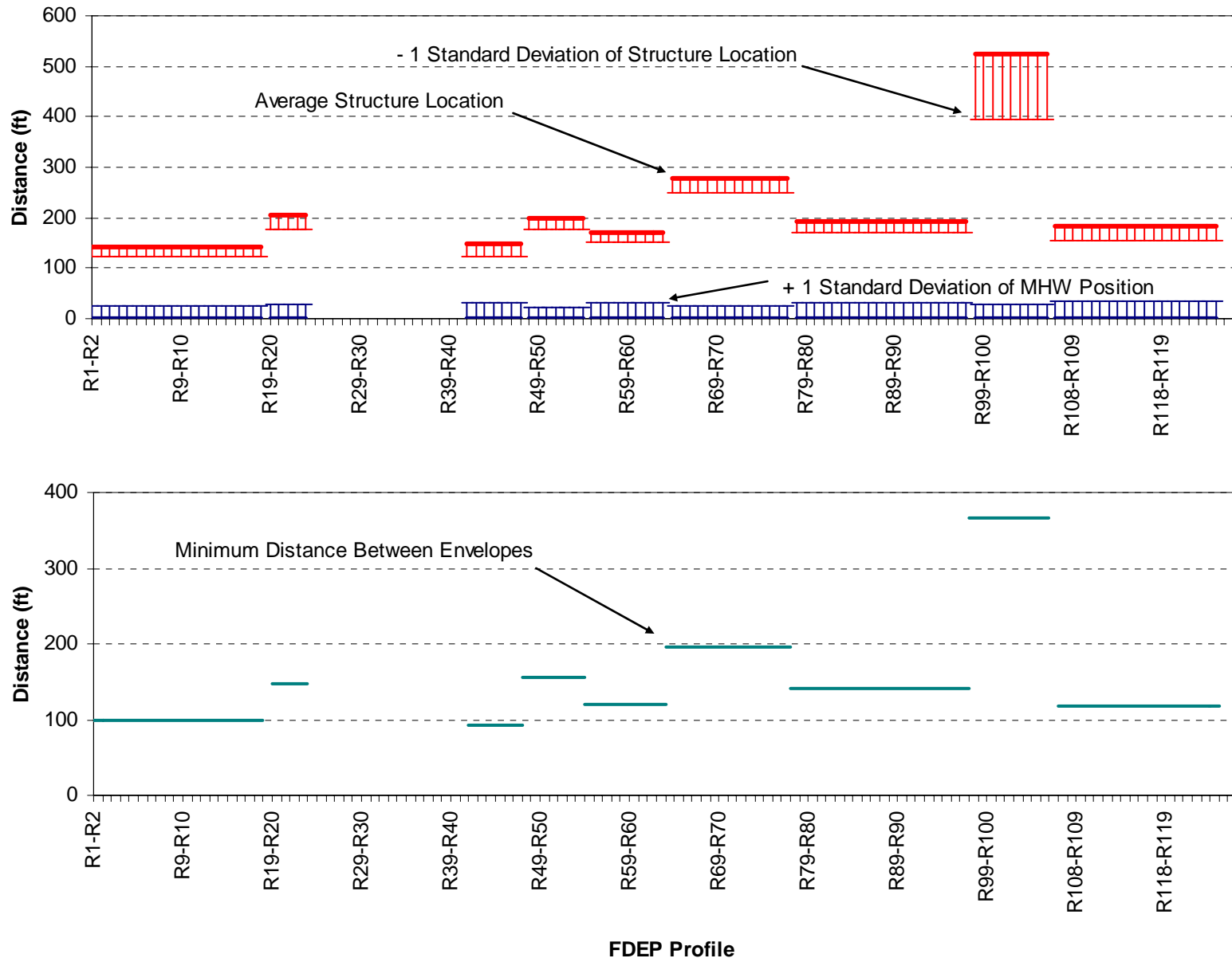


Figure 3.2 Level of Encroachment of Shorefront Structures in Walton County

3.2 Storm-Induced Erosion Modeling

Assessing future impacts to shorefront structures requires an understanding of the beach profile response during storms. Typically during storms, the subaerial portion of the beach erodes and deposits in the subaqueous portion of the beach (see Figure 3.1). Erosion of the upper beach either immediately affects shorefront structures or reduces the level of protection. In turn, inadequate storm protection places the structures at serious risk of impact from future storms. Accordingly, results of storm-induced erosion modeling, together with the encroachment analysis results, help predict the risk of impact to shorefront structures.

Applying the FDEP Coastal Construction Control Line (CCCL) numerical model (Chiu and Dean, 1984) simulates storm-induced erosion for each reach for 10-, 20-, 50-, and 100-year return period storms. Inputs to the model include the beach profile and storm surge hydrograph. Ten composite beach profiles (extending from the dune to -20 ft-NGVD) representative of each reach within Walton County serve as model input. Dean et al. (1988) provide the peak storm surge hydrograph for each return period storm. The hydrographs vary slightly throughout Walton County as shown in Table 3.1.

Table 3.1 Storm Surge Values in Walton County for Various Return Period Storms

Return Period (years)	Storm Surge (ft-NGVD) in Walton County		
	East	Middle	West
10	3.8	3.8	4
20	6.2	6.5	6.9
50	8.9	9.4	9.8
100	10.5	11.2	11.4

Superposition of the post-storm profiles on the pre-storm composite profiles indicates the extent of erosion. As examples, Figures 3.3 and 3.4 illustrate the storm-induced beach erosion for Reach 1 and Reach 6. Scarping of the dune and deposition of sand in the nearshore characterize the storm-induced erosion. The degree of erosion depends on the shape of the composite profile as well as the peak elevation of the storm surge hydrograph. At first glance, the composite profiles in Figures 3.3 and 3.4 appear similar; however, the composite profiles for Reach 1 and Reach 6 vary in shape, especially offshore. Due to the difference in shape of the composite profiles as well as differences in the storm surge hydrographs, the erosion in Reach 6 exceeds that of Reach 1 by 20 – 30 ft. Appendix D contains the 10-, 20-, 50-, and 100-year storm-induced erosion results for all 10 reaches.

Comparison of the storm-induced erosion to the level of encroachment (presented in Section 3.1) indicates shorefront structures subject to future storm impact. For this analysis, the amount of erosion equals the distance from the pre-storm MHW shoreline position to the landward extent of erosion on the post-storm profile (see Figure 3.1). To help predict the percent of existing shorefront structures subject to future storm impact, the most recent (2005) MHW position served as the baseline from which to apply storm-induced erosion distances.

As mentioned in Section 3.1, superposition of the 2005 MHW shoreline data onto 2005 aerial photographs allowed for a direct measurement of the encroachment distance — defined as the distance between the seaward edge of the structure and the 2005 shoreline — for each shorefront structure throughout the county. Using random variable concepts of statistical theory (e.g., Ochi, 1990), these structure-by-structure data assisted development of the cumulative density function, which describes the percentage of structures in each reach with encroachment distances less than any distance x , where x varies from zero to infinity. Encroachment distances less than or equal to the 10-, 20-, 50-, and 100-year return period storm erosion distances indicate impact to structures for each return period storm. Again, this analysis assumes structure impact occurs if the landward limit of storm-induced erosion meets or exceeds the encroachment distance, although property damage may or may not occur during such an event. Figure 3.5 illustrates cumulative probability density functions and storm erosion limits for Reach 1 and Reach 6 in Walton County. Appendix E contains the cumulative probability density function graphs for every reach. Figure 3.6 and Table 3.1 summarize the results for all 10 reaches.

Encroachment and storm erosion modeling results help develop appropriate beach management measures for those reaches in greatest need of assistance. Differences in profile shape and shorefront structure location contribute to the differences in interpretations. However, several other key parameters are necessary to develop the most appropriate and feasible beach management strategies. The following chapter discusses a scoring system, which encompasses many pertinent coastal engineering criteria, to develop these strategies.

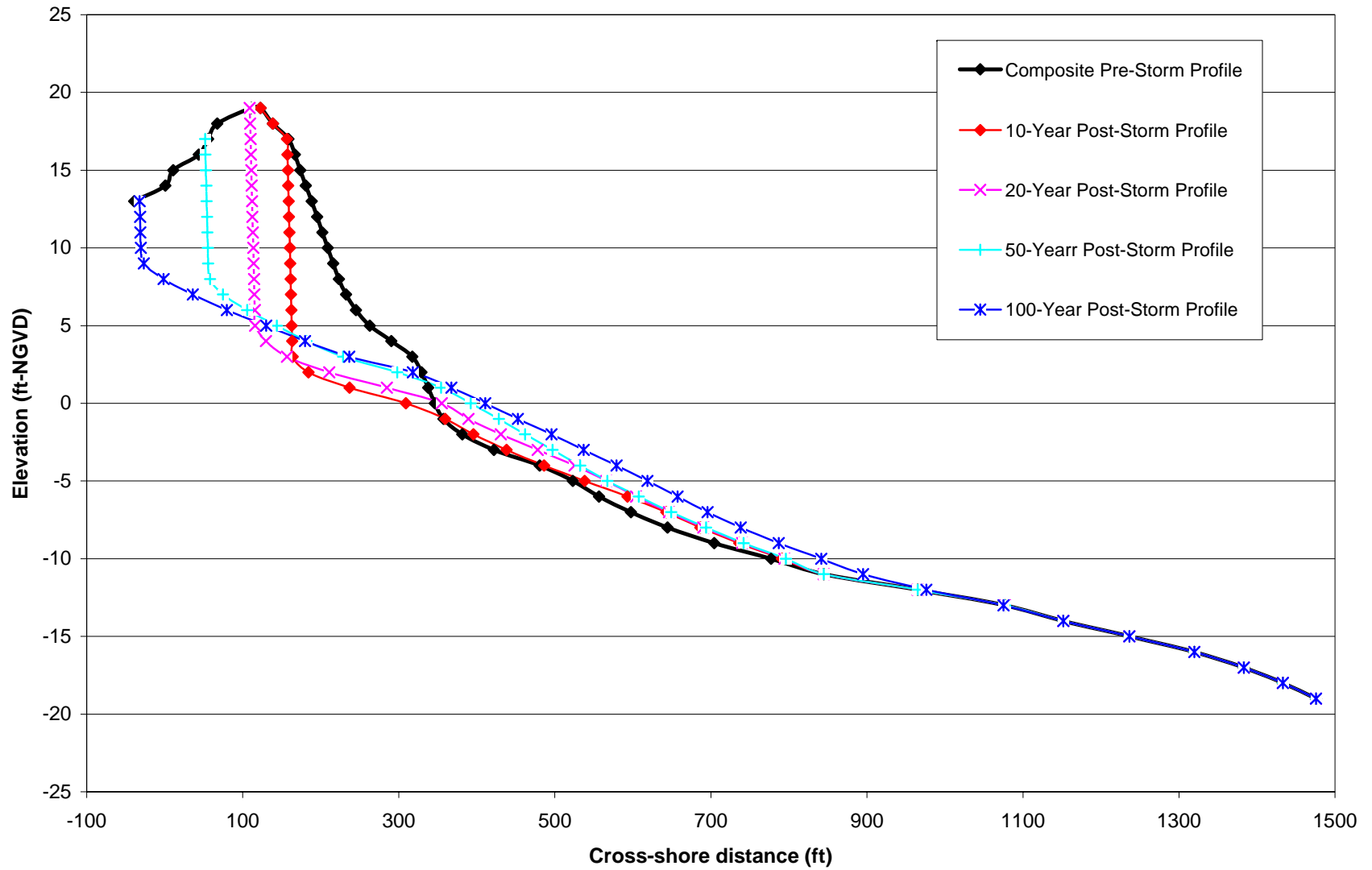


Figure 3.3 Example Plot of Beach Erosion for 10-, 20-, 50-, and 100-Year Return Period Storms in Reach 1

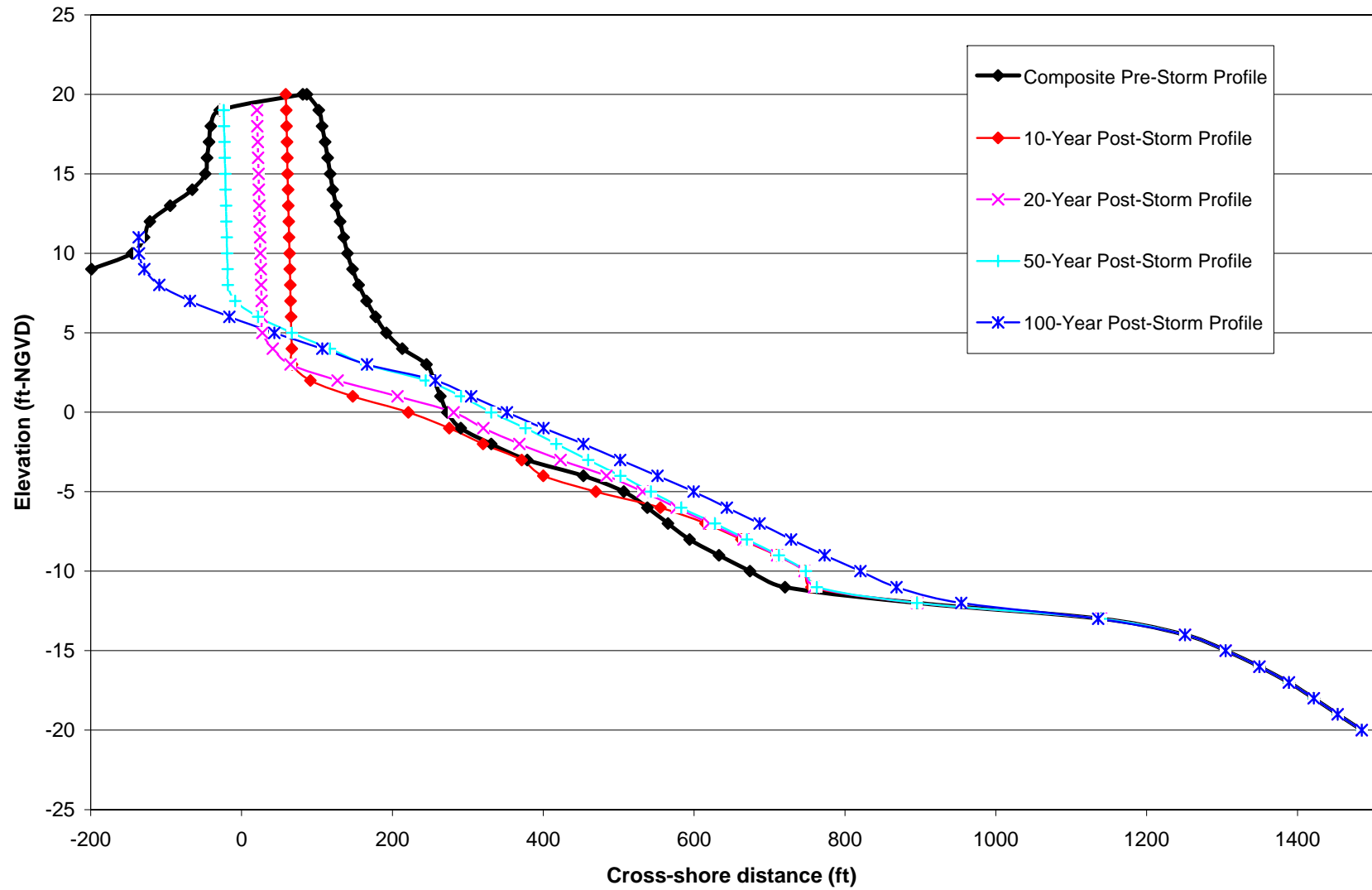
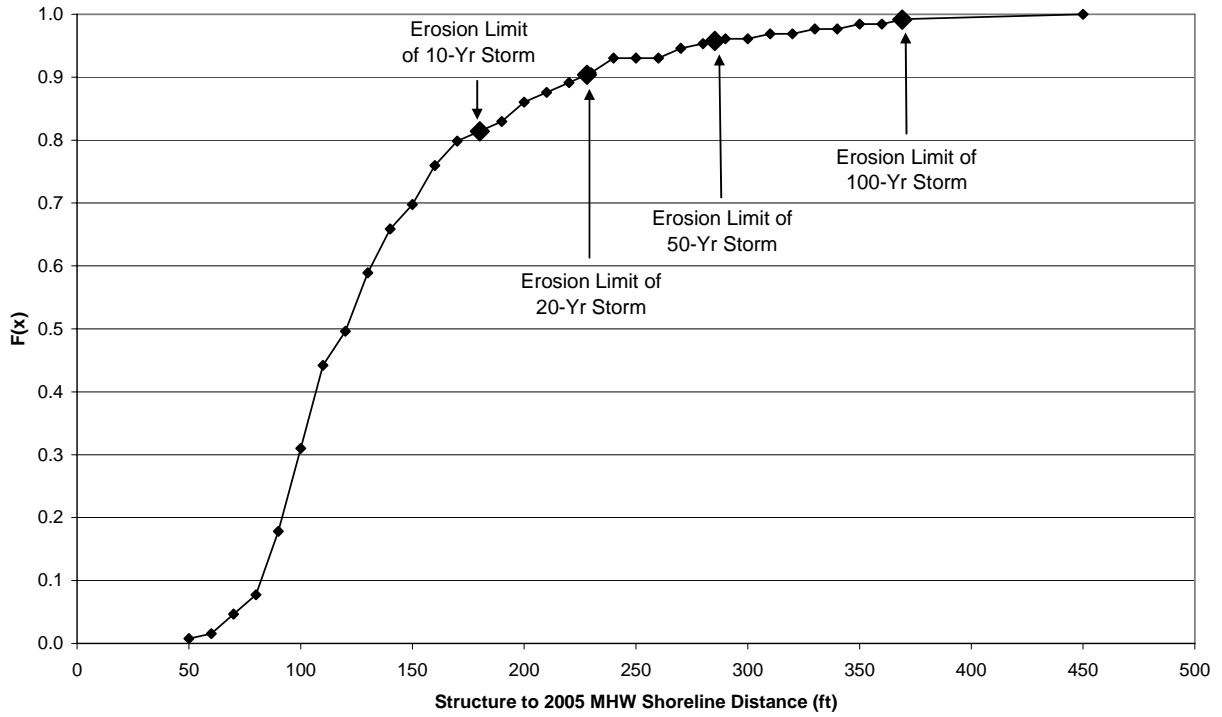


Figure 3.4 Example Plot of Beach Erosion for 10-, 20-, 50-, and 100-Year Return Period Storms in Reach 6

Walton County Reach 1 (R-1 to R-19) Cumulative Density Function of 2005 Structures to 2005 MHW Shoreline Distance



Walton County Reach 6 (R-55 to R-64) Cumulative Density Function of 2005 Structures to 2005 MHW Shoreline Distance

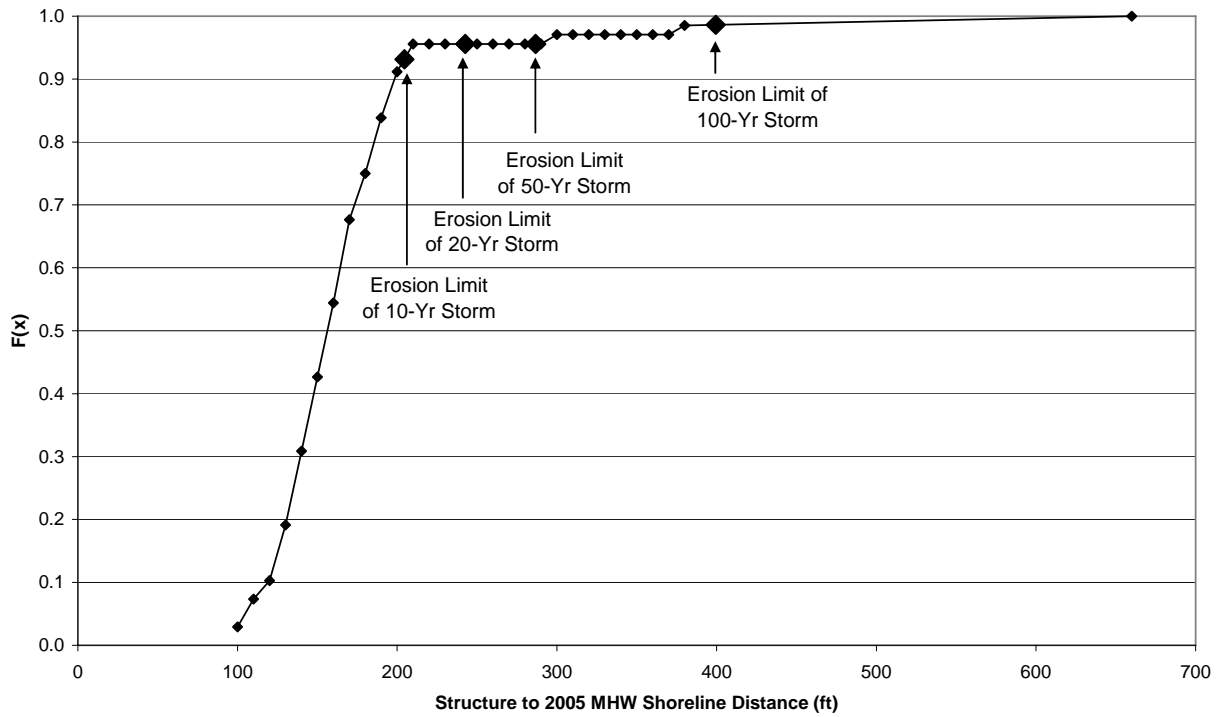


Figure 3.5 Example Plots of Predicted Shorefront Structure Impact

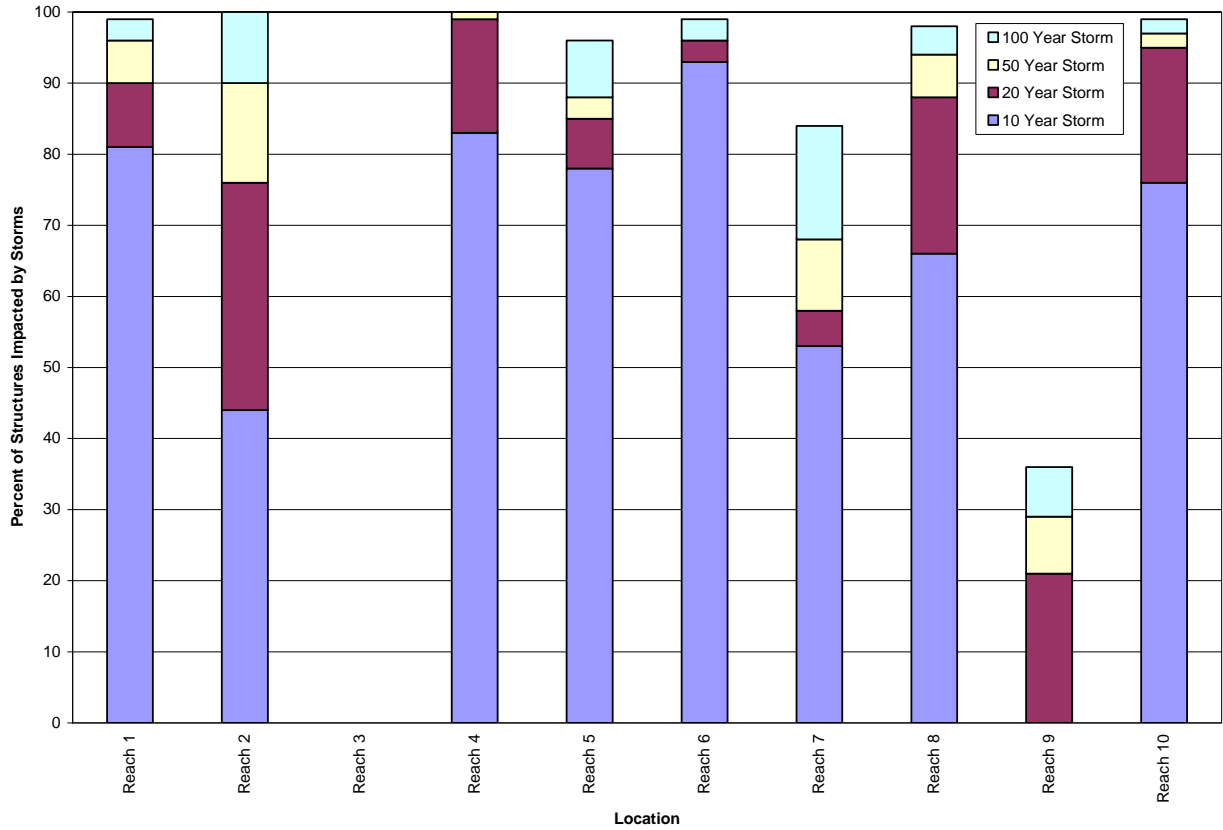


Figure 3.6 Storm Erosion Impact to Shorefront Structures in Walton County

Table 3.2 Storm Erosion Predictions and Percent of Structures Affected

Reach	Number of Structures	Storm Erosion (ft -ref. to 2005 MHW)				Percent of Structures Impacted			
		10-Yr	20-Yr	50-Yr	100-Yr	10-Yr	20-Yr	50-Yr	100-Yr
Reach 1	129	180.14	228.02	285.24	369.13	81	90	96	99
Reach 2	20	194.11	232.98	279.77	391.13	44	76	90	100
Reach 3	0	187.95	243.01	309.78	435.80	-	-	-	-
Reach 4	77	182.21	237.10	284.87	404.41	83	99	100	100
Reach 5	73	204.58	239.53	293.38	412.08	78	85	88	96
Reach 6	68	204.46	242.62	286.68	399.48	93	96	96	99
Reach 7	38	203.80	251.19	348.62	521.80	53	58	68	84
Reach 8	199	193.04	239.11	286.23	383.56	66	88	94	98
Reach 9	14	202.62	245.47	331.49	471.61	0	21	29	36
Reach 10	176	201.68	234.96	271.22	393.28	76	95	97	99

4.0 BEACH MANAGEMENT SCORING SYSTEM

The preceding two chapters discussed the methodology and results of the MHW shoreline and beach volume analyses and the risk assessment on shorefront development, all of which contribute to the development of a list of feasible beach management actions. The next step involves assimilation and analysis of all pertinent information obtained through the previous analyses. A specifically designed scoring system accomplishes this task and helps determine the general need for beach management action. This chapter discusses the scoring system and results and compares the results to the location of state-designated critically eroded beaches.

4.1 Beach Management Scoring System

The scoring system, designed to quantify the beach conditions and compare the relative health of the reaches to determine the need for beach management action, approaches scoring in two phases. The first phase follows the scoring methodology outlined in the feasibility study (Taylor Engineering, 2003) where conditions in each reach scored relative to an absolute scoring criterion. This phase presents an opportunity to quantify the overall health of the present beach following recent (2004 and 2005) storms and compare the overall score of individual reaches to those developed in the feasibility study. However; due to the conditions of the existing beach, the scoring system developed previously proved inadequate to prioritize management action among the 10 reaches. The second phase modified the scoring approach for a more appropriate comparison of the reaches to each other. Results from the second phase determine a prioritized list by reach for beach management action.

The system applied six scoring categories including the MHW shoreline change, dry beach volume change, encroachment, 2005 dune elevations, the present dune health, and expected storm impacts. Table 4.1 contains the constituent beach data, on a reach-by-reach basis, incorporated into the scoring system for each category. Both phases apply identical beach data (Table 4.1) and scoring criteria but differ in their scoring methods. Notably, the scoring system applied the December 1997 – September 2005 and the November 2004 – September 2005 MHW shoreline and dry beach volume changes to incorporate the long-term and immediate short-term changes.

Table 4.1 Scoring System Data

Reach	Monuments	Encroachment (ft)	MHW Shoreline Change (ft/yr)		Subaerial Volume Change (cy/ft/yr)		2005 Dune Elevation (ft)	Dune Health	Structures Impacted During Storms			
			Nov. 2004 – Sep. 2005	Dec. 1997 – Sep. 2005	Nov. 2004 – Sep. 2005	Dec. 1997 – Sep. 2005			10- Yr	20- Yr	50- Yr	100- Yr
1	R1 - R19	98.1	-55.0	-7.3	-9.3	-2.3	20.4	subjective	81	90	96	99
2	R19 - R24	148.4	-49.3	-8.4	-18.8	-3.5	20.4	subjective	44	76	90	100
3	R24 - R41	-	-45.3	-5.8	-18.8	-3.6	17.7	subjective	-	-	-	-
4	R41 - R48	93.4	-11.0	-2.7	-21.7	-3.7	15.5	subjective	83	99	100	100
5	R48 - R55	155.2	-26.1	-3.4	-19.5	-3.5	24.0	subjective	78	85	88	96
6	R55 - R64	120.5	-46.1	-7.6	-24.9	-4.2	22.8	subjective	93	96	96	99
7	R64 - R78	195.7	-62.1	-8.2	-20.3	-3.0	16.1	subjective	53	58	68	84
8	R78 - R98	141.2	-49.1	-7.1	-14.9	-3.4	24.0	subjective	66	88	94	98
9	R98 - R106	366.5	-49.8	-6.5	-13.1	-3.0	17.9	subjective	0	21	29	36
10	R106 - R127	118.8	-14.0	-3.6	-18.5	-2.9	24.9	subjective	76	95	97	99

4.1.1 Phase I

The Phase I criteria (Table 4.2), developed in Taylor Engineering (2003), define limits for healthy, marginal, and unhealthy beach conditions. Based on the existing beach conditions, a given reach received a score of 1 for exhibiting healthy conditions, 2 for exhibiting marginal conditions, or 3 for exhibiting unhealthy conditions for each category. The total score equals the sum of the individual category scores for each reach. The normalized score equals the total score for each reach divided by the highest possible total score. Possible normalized scores ranged from 0.33 to 1.0 with lower values representing healthier beach conditions. For example, if a reach exhibited only healthy conditions, and thus received a score of 1 for every category, the total score would equal 6 and the normalized score would equal 0.33 (6 divided by 18 [determined by multiplying the number of categories, 6, by the maximum score for each category, 3]). Similarly, if a reach exhibited only unhealthy conditions, thus receiving a score of 3 for every category, the total score would equal 18 and the normalized score equals 1.0 (18 divided by 18). Thus, a score between 0 and 0.33 represents healthy beach conditions; a score between 0.33 and 0.67 represents healthy to marginal beach conditions; and a score between 0.67 and 1.0 represents marginal to poor conditions.

Table 4.2 Phase 1 Scoring Criteria

		Rating		
		Good (Score =1)	Marginal (Score =2)	Poor (Score =3)
Encroachment		>150	125 to 150	<125
MHW Shoreline Change (ft/yr)	Nov. 2004 – Sep. 2005	>0	0 to -2	<-2
	Dec. 1997 – Sep. 2005	>0	0 to -5	<-5
Dry Beach Volume Change (cy/ft/yr)	Nov. 2004 – Sep. 2005	>0	0 to -3	<-3
	Dec. 1997 – Sep. 2005	>0	0 to -6	<-6
2005 Dune Elevation (ft - NGVD)		>11.2	6.5 to 11.2	<6.5
Dune Health		Subjective		
Structures Impacted During Storms (%)	10-Year	=0	-	>0
	20-Year	=0	0 to 10	>10
	50-Year	=0	0 to 10	>10
	100-Year	=0	0 to 10	>10

The Phase I results (Figure 4.3) show that all reaches score equal to or higher than 0.67. These scores indicate poor conditions for all beaches in Walton County. For comparison, the 1998 beach condition scores show only 4 of the 10 reaches greater than 0.67. Severe erosion from hurricanes in 2004 and 2005 caused the beach condition degradation.

Table 4.3 Phase I Scores

Reach	Monuments	Encroachment	MHW Shoreline Change		Subaerial Volume Change		2005 Dune Elevation	Dune Health	Structures Impacted During Storms				Score	Rank
			Nov. 2004 – Sep. 2005	Dec. 1997 – Sep. 2005	Nov. 2004 – Sep. 2005	Dec. 1997 – Sep. 2005			10- Yr	20- Yr	50- Yr	100- Yr		
1	R1 - R19	3	3	3	3	3	1	3	3	3	3	3	0.89	1
2	R19 - R24	2	3	3	3	3	1	3	3	3	3	3	0.83	5
3	R24 - R41	1	3	3	3	3	1	3	1	1	1	1	0.67	10
4	R41 - R48	3	3	3	3	3	1	3	3	3	3	3	0.89	1
5	R48 - R55	1	3	3	3	3	1	3	3	3	3	3	0.78	7
6	R55 - R64	3	3	3	3	3	1	3	3	3	3	3	0.89	1
7	R64 - R78	1	3	3	3	3	1	3	3	3	3	3	0.78	7
8	R78 - R98	2	3	3	3	3	1	3	3	3	3	3	0.83	5
9	R98 - R106	1	3	3	3	3	1	3	1	3	3	3	0.75	9
10	R106 - R127	3	3	3	3	3	1	3	3	3	3	3	0.89	1

4.1.2 Phase II

As mentioned above, the Phase I scoring criteria adopted the method employed in Taylor Engineering (2003). The scoring thresholds (good/average/poor) reflect typical values for the previous period (1973 – 1998). However, the scoring thresholds produced insufficient results for the current study. Beach conditions during the previous period varied considerably throughout the county, and the period allowed for beach recovery following the effects of Hurricane Opal in 1995. Conversely, the existing beach conditions analyzed in the current study reflect severely eroded conditions countywide. As a result, many of the scores in individual Phase I criteria show identical value across all reaches. For example, MHW shoreline change values less than -2 ft/yr scored poorly (a score of 3) between November 2004 and September 2005. With this MHW shoreline change threshold adopted in Phase I, all reaches scored poorly. Phase II scoring system uses alternative scoring criteria that result in a more applicable comparison of the relative health of the reaches.

For each Phase II scoring criterion, the scoring system assigns scores to a given reach based on the variation (measured by standard deviation) between the reach's value and the countywide average value. For example, the encroachment average and standard deviation for all reaches equals 159.7 ft and 83.6 ft. All values greater than average (159.7 ft) receive a "good" score of 1. Values within one standard deviation from average (76.1 to 159.7 ft) receive a "marginal" score of 2. Values more than one standard deviation from average (less than 76.1 ft) receive a "poor" score of 3. This format applied to all criteria except dune elevation (scored as absolute value based on 50- and 100-year storm surge elevations) and dune health (scored subjectively from observations made from site visits). Table 4.4 details the Phase II scoring system criteria, and Table 4.5 details the results.

The Phase II scoring scheme ranked Reach 6 as the unhealthiest beach segment followed by Reach 2 and Reach 8. Reach 6 scored higher in part from the comparatively high structure impact for a minor (10-year) storm and loss of subaerial beach volume over the measured periods. Following these three reaches, Reaches 1, 4, and 5 all received the same score. Reaches 3 and 9 ranked the healthiest among the reaches due in part to the small degree of potential impact to structures.

Table 4.4 Phase II Scoring Criteria

		Data Criteria		Rating		
		Average	Standard Deviation	Good (Score =1)	Marginal (Score =2)	Poor (Score =3)
Encroachment		159.7	83.6	>159.7	76.1 to 159.7	<76.1
MHW Shoreline Change (ft/yr)	Nov. 2004 – Sep. 2005	-45.4	19.5	>-45.4	-45.4 to -64.9	<-64.9
	Dec. 1997 – Sep. 2005	-5.7	2.0	>-5.7	-5.7 to -7.7	<-7.7
Dry Beach Volume Change (cy/ft/yr)	Nov. 2004 – Sep. 2005	-20.0	5.0	>-20	-20 to -25	<-25
	Dec. 1997 – Sep. 2005	-3.1	0.5	>-3.1	-3.1 to -3.6	<-3.6
2005 Dune Elevation (ft - NGVD)		n/a	n/a	>11.2	8.2 to 11.4	<8.2
Dune Health		Subjective				
Structures Impacted During Storms (%)	10-Year	63.8	28.4	<63.8	63.8 to 92.2	>92.2
	20-Year	78.7	25.0	<78.8	78.8 to 103.7	>103.7
	50-Year	84.2	22.8	<84.2	84.2 to 107	>107
	100-Year	90.1	20.9	<90.1	90.1 to 111.0	>111.0

Table 4.5 Phase II Scores

Reach	Monuments	Encroachment	MHW Shoreline Change		Subaerial Volume Change		2005 Dune Elevation	Dune Health	Structures Impacted During Storms				Score	Rank
			Nov. 2004 – Sep. 2005	Dec. 1997 – Sep. 2005	Nov. 2004 – Sep. 2005	Dec. 1997 – Sep. 2005			10-Yr	20-Yr	50-Yr	100-Yr		
1	R1 - R19	2	2	2	1	1	1	3	2	2	2	2	0.61	4
2	R19 - R24	2	2	3	2	2	1	3	1	1	2	2	0.67	2
3	R24 - R41	1	2	1	2	2	1	3	1	1	1	1	0.53	9
4	R41 - R48	2	1	1	2	2	1	3	2	2	2	2	0.61	4
5	R48 - R55	2	1	1	2	2	1	3	2	2	2	2	0.61	4
6	R55 - R64	2	2	2	3	3	1	3	3	2	2	2	0.74	1
7	R64 - R78	1	3	3	2	1	1	3	1	1	1	1	0.58	7
8	R78 - R98	2	2	2	1	2	1	3	2	2	2	2	0.64	3
9	R98 - R106	1	2	2	1	1	1	3	1	1	1	1	0.50	10
10	R106 - R127	2	1	1	2	1	1	3	2	2	2	2	0.58	7

In summary, the Phase I scoring system compared the existing conditions of every reach to absolute scoring criteria to assess the health of the beach segments. The Phase II scoring system compared the reaches against each other to rank order the reaches in terms of need for beach management action. The scoring criteria included pertinent information obtained through the MHW shoreline and beach volume analyses, the risk assessment on shorefront structures, and the field-inspected present dune conditions. The scoring system indicated the poor condition of all reaches, with Reaches 6, 2, and 8 ranking in most need of beach management action. With Phase I scores exceeding 0.67 everywhere, actions in the form of beach and dune management — beach and dune restoration, sea oats plantings, sand fence installation, or dune traffic control — appear warranted throughout the study area.

4.2 Critically Eroded Areas

As directed in Sections 161.101 and 161.161, Florida Statutes, the Florida Department of Environmental Protection, Bureau of Beaches and Coastal Systems (FDEP) must identify those critically eroding state beaches and develop and maintain a comprehensive long-term management plan for the restoration of such beaches. Following the 2005 hurricane season, the FDEP published a report with an updated list of state-designated critically eroded beaches. The FDEP has made this report available for download at http://bcs.dep.state.fl.us/reports/crit_ero.pdf. In effect, the state cost-shares projects serving critically eroded beaches. Thus, comparing the scoring system results, discussed in the preceding section, to the state-designated critically eroded beaches provides guidance regarding the economic feasibility of beach management projects. Notably, local governments may construct projects in non-critically eroded areas without state funding.

The FDEP designated eight critically eroded areas, totaling 14 miles in length, in Walton County. Figure 4.1 illustrates the locations of the critical erosion areas. The FDEP report describes these areas as follows:

“The western 5.0 miles (R1-R22.8) threaten development, recreational interests, and the coastal road. This area has a beach restoration project constructed in the spring of 2006.

A 2.7-mile critically eroded segment at Dune Allen (R41-R54.5) threatens development, Fort Panic Road, and County Road 30A.

A 1.0-mile segment of Blue Mountain Beach (R58-R63) 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 (R67.3-R68.3) and a 0.1-mile segment of Grayton Beach (R70.95-R71.4) also threaten development.

A 3.1-mile segment of critical erosion threatens development along Seagrove Beach (R82-R98). To the east along Seacrest Beach, is another 1.8-mile segment (R105.5-R114.7) where development is threatened by erosion of the bluff.

A 0.4-mile segment at Inlet Beach (R122-R124) is designated critically eroded due to its poststorm vulnerability threatening development interests.”

Table 4.6 summarizes the percentage of each reach designated critically eroded. Column 6 of Table 4.1 contains the scoring system results, which rank the reaches in order of decreasing need for beach management action. The rank generally correlates well with the percentage of critically eroded beach within each reach. Reach 6, the reach in most need of beach management action, contains 60.8% critically eroded beach. The next five reaches in need of beach management — Reaches 2, 8, 1, 4, and 5 — contain at least 75% critically eroded beach. Three of the four reaches with the least need of beach management action contain less than 10% critically eroded beach; of these four, only Reach 10 contains a considerable amount of critically eroded beach (56.0%). The results reported in Table 4.5 generally indicate that beach management projects within Walton County would qualify for state funding. Development of future projects would require further examination of project boundaries and state funding criteria. Note that construction of the Walton County/Destin Beach Restoration Project is currently underway in Reach 1 and Reach 2.

Table 4.6 Critically Eroded Beaches by Reach

Reach	Monuments	Reach Length (miles)	Critically Eroded Length (miles)	Percentage Critically Eroded	Scoring System Rank (see Table 4.5)
1	R1 - R19	3.94	3.94	100.0%	4
2	R19 - R24	0.99	0.75	75.6%	2
3	R24 - R41	3.30	0.00	0.0%	9
4	R41 - R48	1.46	1.46	100.0%	4
5	R48 - R55	1.49	1.27	85.3%	4
6	R55 - R64	1.59	0.97	60.8%	1
7	R64 - R78	2.87	0.21	7.3%	7
8	R78 - R98	3.87	3.10	80.1%	3
9	R98 - R106	1.78	0.10	5.5%	10
10	R106 - R127	4.04	2.27	56.0%	7
Total		25.32	14.05	55.5%	-

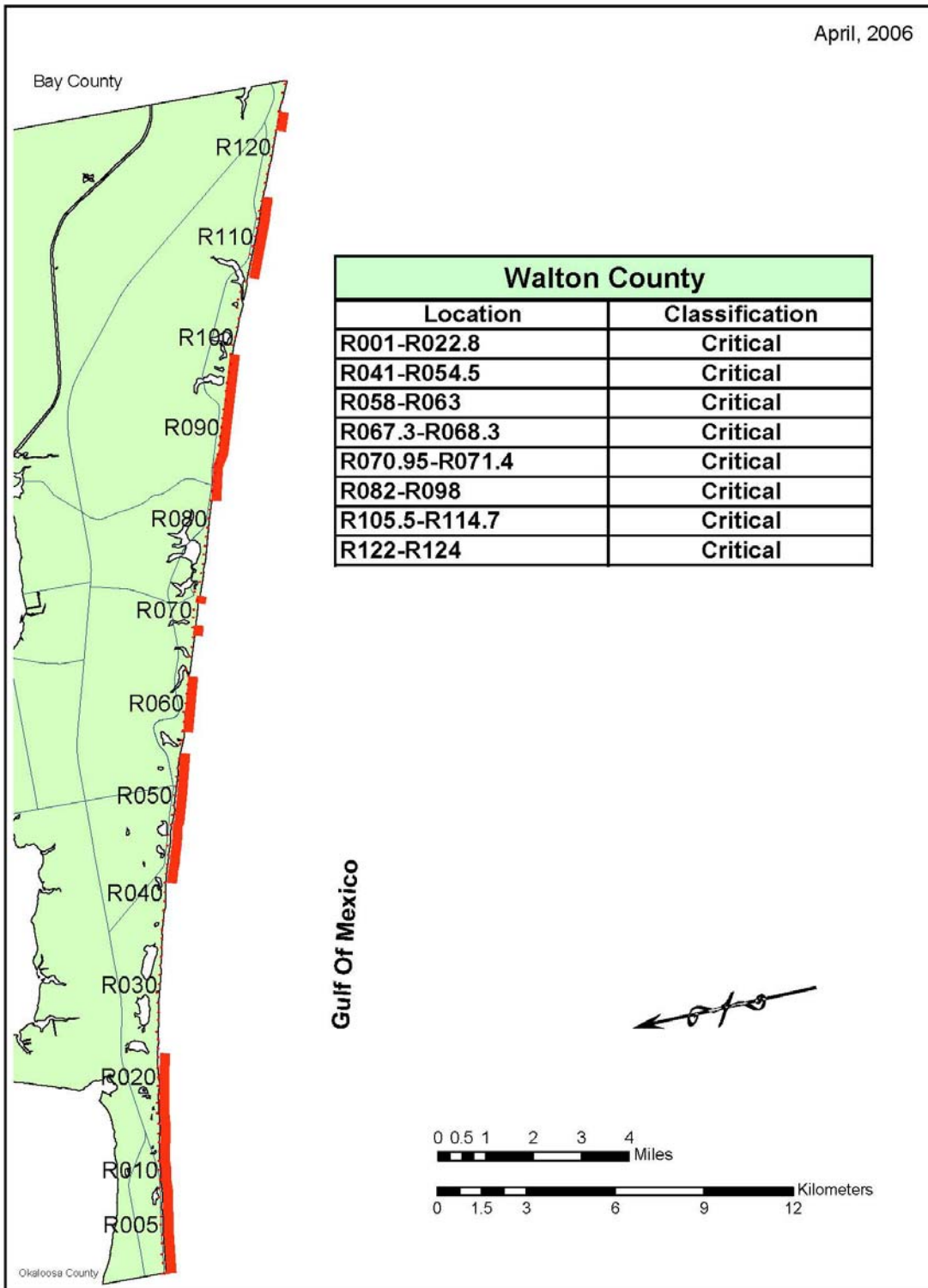


Figure 4.1 Walton County Critical Erosion Areas (FDEP 2006)

5.0 PRELIMINARY PROJECT DESIGNS

Chapter 4.0 discussed a scoring system, which assimilated pertinent information obtained through the MHW shoreline and beach volume analyses, the risk assessment on shorefront structures, and field inspections to determine the relative need for beach management activity throughout the county. The results indicated that the unhealthy beach conditions characteristic of all reaches warrant beach or dune management. As such, this chapter undertakes an analysis of several potential project designs. The analysis applied the FDEP Coastal Construction Control Line (CCCL) numerical model (Chiu and Dean, 1984) to the design templates to help predict the level of storm protection each design provides. The analysis progressed with the goal of providing the same level of storm protection to all reaches throughout the county. Notably, construction of the Walton County/Destin Beach Restoration Project is currently underway in Reach 1 and 2; thus, the analysis excluded these reaches.

The potential project designs evaluated include dune restoration, small-scale beach restoration, and large-scale beach restoration. The dune restoration design specifies a 30-ft wide dune crest tying into the existing +16 ft NGVD contour and a 1V:4H dune face slope extending to the existing beach; the construction volume approximates 11 cy/ft. The small-scale and large-scale beach restoration designs mimic the construction template of the Walton County/Destin Beach Restoration Project. The specific design elements include (1) a berm extending from the 8 ft NGVD contour with the seaward-most 100 ft sloping 1V:100H to 7 ft NGVD, (2) a foreshore construction slope extending 1V:15H from the berm to the existing bottom, and (3) a 20-ft wide dune crest tying into the existing 12 ft NGVD contour with a 1V:4H dune face slope extending to the construction berm. The small-scale beach restoration design includes a 120-ft wide berm with a construction volume approximating 40 cy/ft, whereas the large-scale design includes a 200-ft wide berm with a construction volume approximating 80 cy/ft. Figure 5.1 compares the project designs. Notably the design of the Walton County/Destin Beach Restoration Project includes a 180-ft wide berm and an approximate construction volume of 80 cy/ft.

Applying the FDEP Coastal Construction Control Line (CCCL) numerical model (Chiu and Dean, 1984) to each design template simulated storm-induced erosion for 10-, 20-, 50-, and 100-year return period storms. Inputs to the model include the beach profile and storm surge hydrograph. The beach profile included the design templates superimposed on the composite beach profiles previously discussed in Section 3.2. Dean et al. (1988) provide the peak storm surge hydrographs for each return period storm as shown in Table 3.1 (Section 3.2). For this analysis, a project design provides a given level of storm protection when the landward limit of storm erosion remains seaward of the back of the design template. Figures 5.2 – 5.4,

which illustrate the storm erosion modeling results in Reach 4 for the three project designs, demonstrate this concept. The dune restoration design (Figure 5.2) provides less than 10-year return period storm protection, as the storm erosion profiles extend landward of the dune template. The small-scale beach restoration design (Figure 5.3) provides 20-year return period storm protection; the 20-year storm erosion limit remains seaward of the back of fill, but the 50-year storm erosion limit extends landward of the back of fill. The large-scale beach restoration design (Figure 5.4) provides 100-year return period storm protection, as the eroded profiles remain seaward of the back of the beach fill template. Appendix F contains the storm erosion modeling results for the three project designs in all reaches.

Table 5.1 summarizes the level of storm protection provided by each design and the required construction volumes. The dune restoration design provides minimal protection, as the simulated 10-year return period storm eroded the pre-storm profile in all reaches. The small-scale beach restoration project withstood the simulated 20-year storm in all reaches. The large-scale beach restoration project nearly provided 100-year storm protection in all reaches; only Reach 7 and 10 eroded into the pre-storm profile.

The feasibility of constructing the potential projects depends on sufficient funding and availability of sufficient quantities of beach compatible sand for fill material. Locating sand sources for the potential projects requires further field investigations and data analysis to define the quality and quantity of available sand resources; however, preliminary results of the ongoing Walton County Sand Source Investigation (conducted by Taylor Engineering) are encouraging for potential countywide projects.

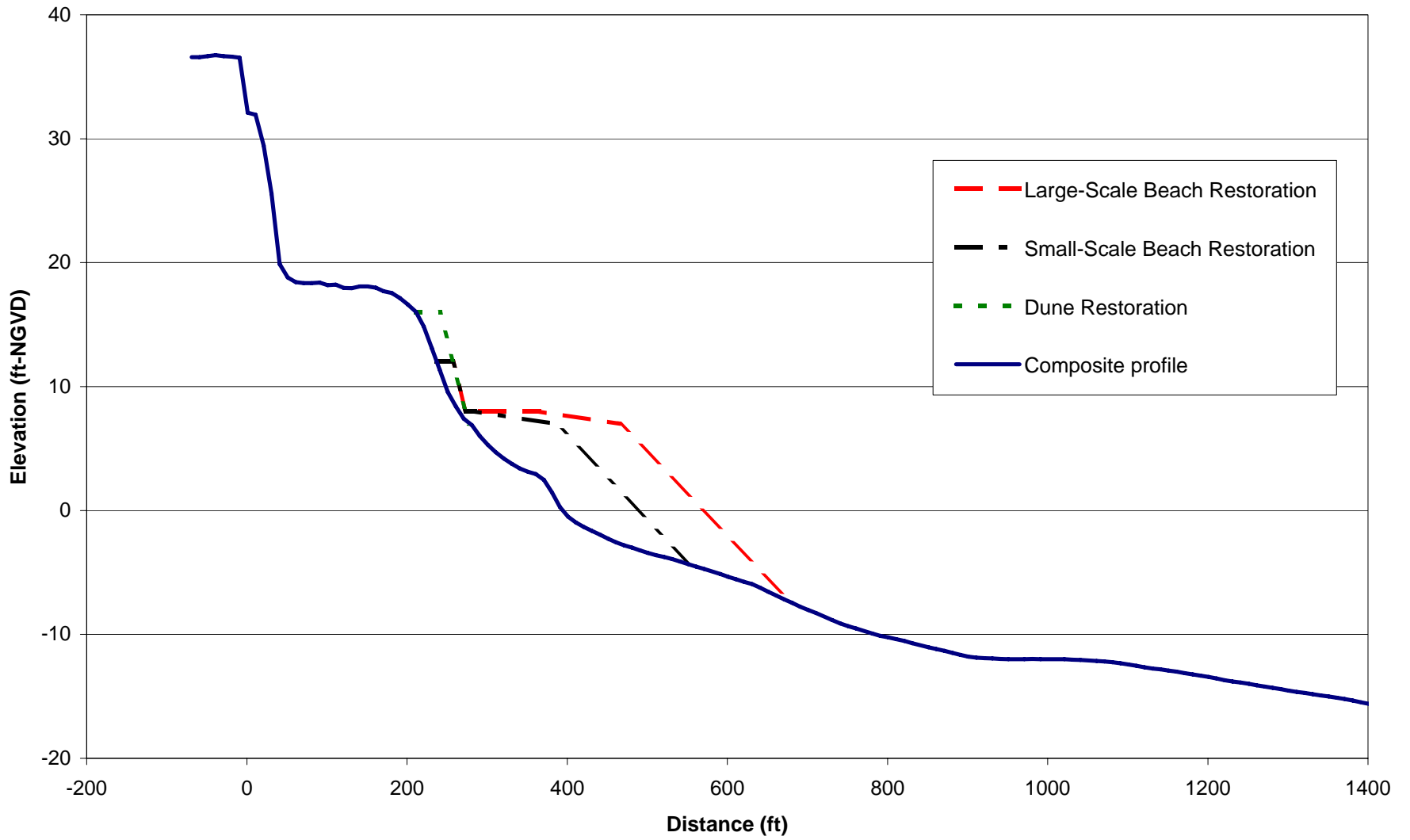


Figure 5.1 Preliminary Project Designs

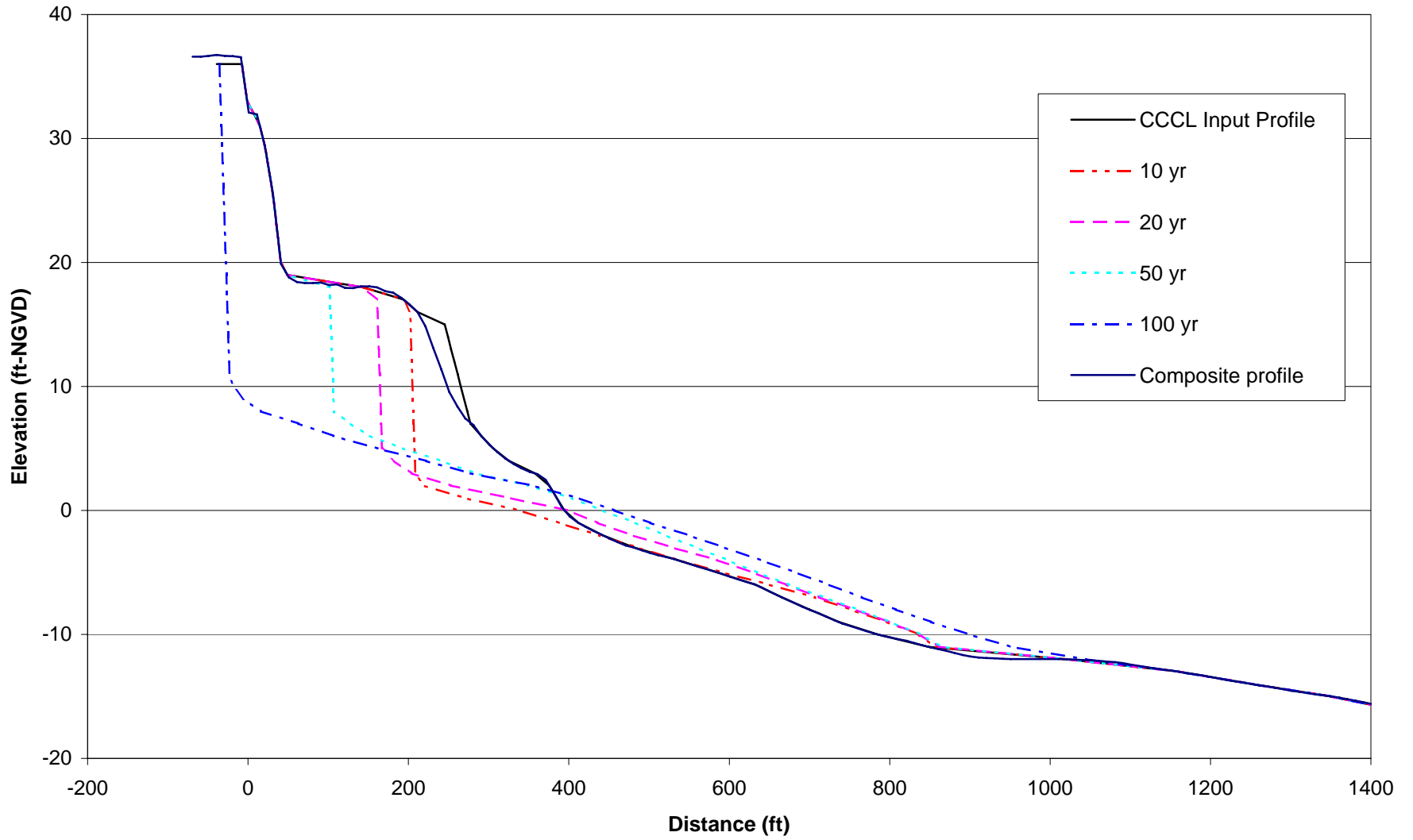


Figure 5.2 Dune Restoration Storm Erosion Profiles for Reach 4

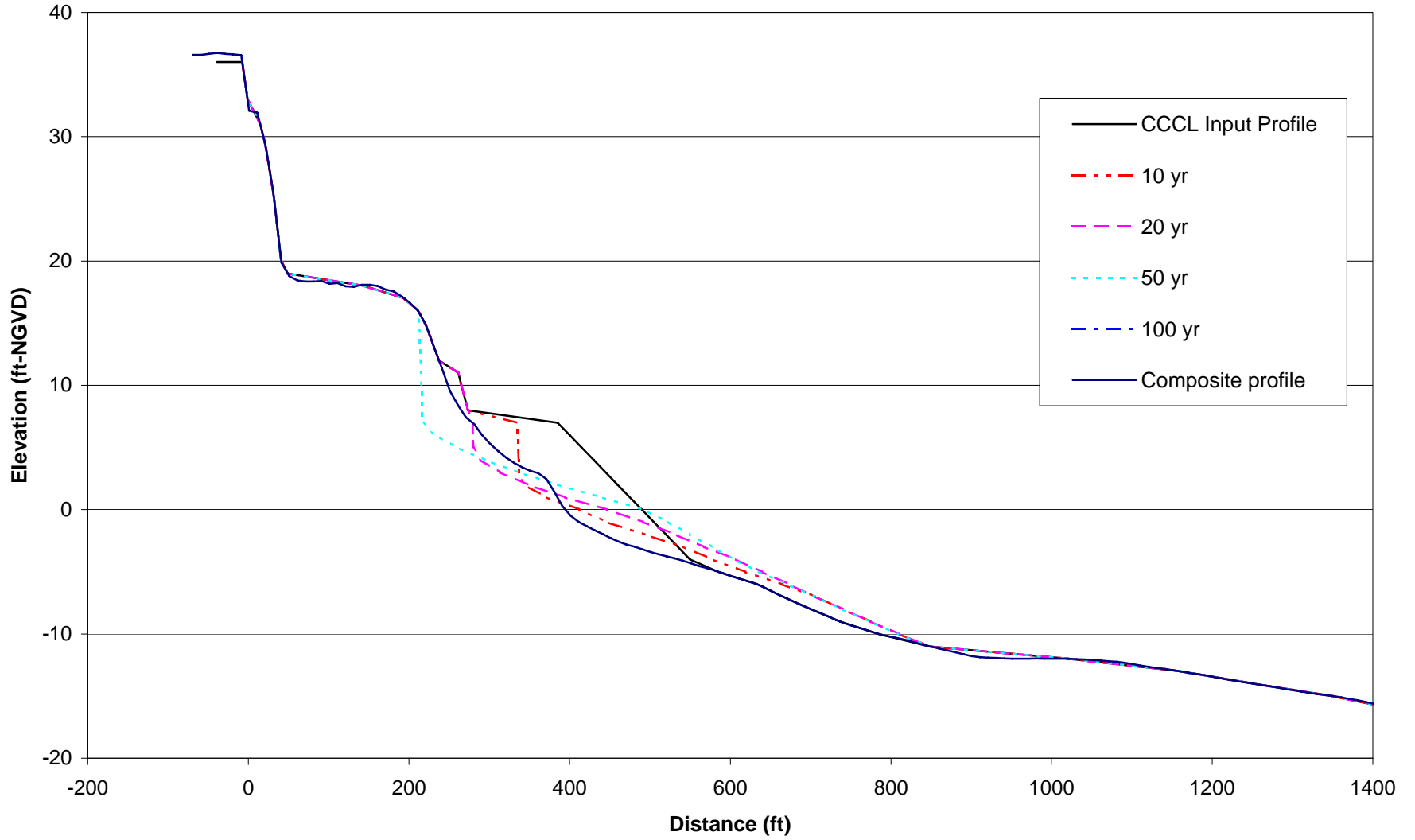


Figure 5.3 Small-Scale Beach Restoration Storm Erosion Profiles for Reach 4

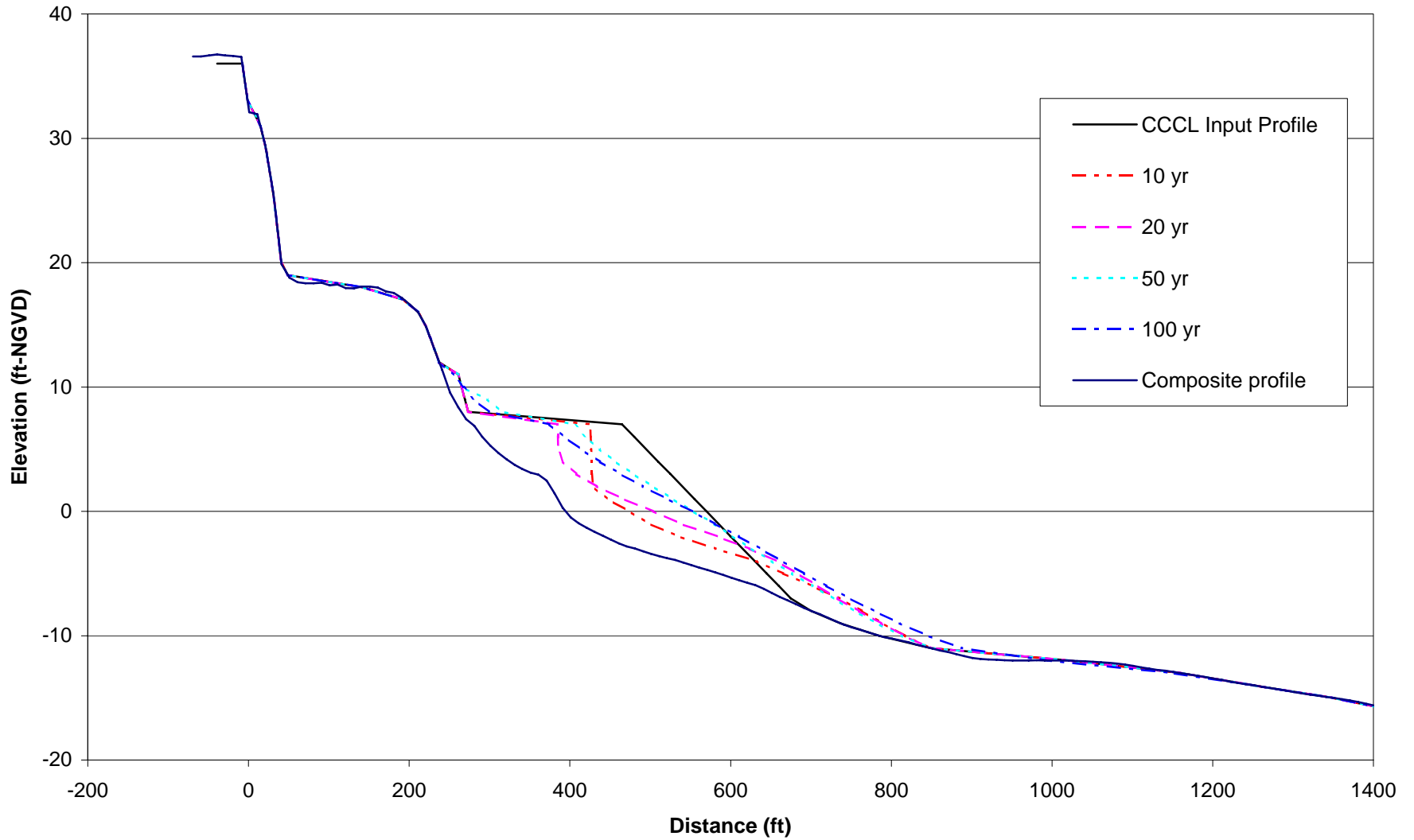


Figure 5.4 Large-Scale Beach Restoration Storm Erosion Profiles for Reach 4

Table 5.1 Preliminary Project Designs

Reach	Monuments	Construction Volume (cy)			Storm Protection Provided		
		Dune Restoration	Small-Scale Beach Restoration	Large-Scale Beach Restoration	Dune Restoration	Small-Scale Beach Restoration	Large-Scale Beach Restoration
1	R1 - R19	N/A	N/A	N/A	N/A	N/A	N/A
2	R19 - R24	N/A	N/A	N/A	N/A	N/A	N/A
3	R24 - R41	92,312	641,739	1,353,858	< 10-Yr	20-Yr	100-Yr
4	R41 - R48	46,568	314,024	627,369	< 10-Yr	20-Yr	100-Yr
5	R48 - R55	61,816	345,019	660,631	< 10-Yr	20-Yr	100-Yr
6	R55 - R64	80,872	355,502	674,989	< 10-Yr	20-Yr	100-Yr
7	R64 - R78	219,366	553,027	1,113,378	< 10-Yr	20-Yr	100-Yr
8	R78 - R98	158,227	828,453	1,610,707	< 10-Yr	20-Yr	100-Yr
9	R98 - R106	167,733	320,630	670,996	< 10-Yr	20-Yr	100-Yr
10	R106 - R127	245,501	932,925	1,804,430	< 10-Yr	20-Yr	100-Yr
Total	-	1,072,395	4,291,319	8,516,357	-	-	-

6.0 SUMMARY AND CONCLUSION

The 2004 and 2005 hurricane seasons brought strong onshore winds, storm surges, and large waves to Walton County's beaches. The most severe events, most notably Tropical Storm Irene and Hurricane Ivan during 2004 and Tropical Storm Arlene and Hurricane Dennis during 2005, caused severe erosion throughout the county. The current study aimed to assess Walton County's existing beach conditions, determine beach management requirements to protect shorefront development and infrastructure from future storm damage, and prepare preliminary project designs to provide equal storm protection countywide.

To help assess the beach changes, Taylor Engineering analyzed and compared beach profile data collected in September 2005, November 2004, May 2004, and December 1997 to quantify the recent storm impacts in terms of mean high water shoreline changes and beach volume changes. Supplementing the results of the above analysis, Taylor Engineering conducted a shorefront development risk analysis to help predict the impact to existing shorefront structures during a variety of return period storms. A specifically designed scoring system assimilated the results of the above two analysis to compare the conditions throughout the county and to help determine beach management requirements. Taylor Engineering incorporated results of the scoring system to develop preliminary project designs that provide storm protection for various return period storms.

Results of the scoring system indicated severely eroded reaches that offer minimal storm protection to gulf front structures; thus, actions in the form of beach and dune management — beach and dune restoration, sea oats plantings, sand fence installation, or dune traffic control — appear warranted throughout the study area. The scoring system developed a rank order list of reaches in need of beach management action. The ranking of the reaches generally correlates well with the percentage of critically eroded beach within each reach. Reach 6, the reach in most need of beach management action, contains 60.8% critically eroded beach. The next five reaches in need of beach management — Reaches 2, 8, 1, 4, and 5 — contain at least 75% critically eroded beach. Three of the four reaches with the least need of beach management action contain less than 10% critically eroded beach; of these four, only Reach 10 contains a considerable amount of critically eroded beach (56.0%). The above results generally indicate that beach management projects within reaches prioritized high by the scoring system are potentially eligible for state funding. Note that construction of the Walton County/Destin Beach Restoration Project is currently underway in Reach 1 and Reach 2. Development of future projects will require further examination of project boundaries and state funding criteria.

To conclude the study, Taylor Engineering incorporated results of the scoring system to develop preliminary project designs to provide equal storm protection throughout the county. The analysis included dune restoration, small-scale beach restoration (40 cy/ft), and large-scale beach restoration (80 cy/ft). Applying the FDEP Coastal Construction Control Line (CCCL) numerical model (Chiu and Dean, 1984) to each design template simulated storm-induced erosion for 10-, 20-, 50-, and 100-year return period storms. Model results indicate that the dune restoration design provides less than 10-year return period storm protection, and the small-scale and large-scale beach restoration projects provide 20-year and 100-year return period storm protection.

The feasibility of constructing beach restoration projects depends on sufficient funding and availability of sufficient quantities of beach compatible sand for fill material. Locating sand sources for the potential projects requires further field investigations and data analysis to define the quality and quantity of available sand resources; however, preliminary results of the ongoing Walton County Sand Source Investigation (conducted by Taylor Engineering) are encouraging for potential countywide projects.

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