DAUPHIN ISLAND PILOT STUDY

COLOR CHANGE OF BLACK WARRIOR -TOMBIGBEE WATERWAY (BWT) SAND PLACED ALONG THE SHORELINE OF EASTERN DAUPHIN ISLAND, ALABAMA

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1.0 Introduction

This report documents efforts to monitor color change of sand from the Black Warrior - Tombigbee Waterway (BWT) placed along the shoreline of eastern Dauphin Island, Alabama. The primary objective of this pilot study was to determine if geochemical and mechanical processes along the coast were sufficient to remove iron oxide surface coatings naturally occurring on the river sand. Removal of the surface coating during natural processes of abrasion from sediment transport, chemical dissolution by salt water, and/or bleaching due to exposure to ultraviolet radiation (i.e., sunlight exposure) could render the sand compatible for beaches and barrier islands.

Sand used for beach and island restoration must be similar to native sediment with respect to gradation, angularity, color, percentage of fines, and carbonate content. These properties affect the engineering performance, solar absorption, and aesthetic characteristics of sand along the coast, which ultimately dictate the success of many restoration projects. Several studies including Thompson Engineering (2001,2002), Baehr (2010), and Williams (2011) document that much of the dredged river sand stored adjacent to the BWT in upland placement sites is similar to the native sediment found along the Alabama and Mississippi coast with respect to mineralogy, gradation, angularity, percentage of fine sediments (clays and silts), and carbonate content. However, the characteristic pale brown color of the sediment has prevented the river sand from being considered a compatible source for use in coastal restoration.

Sand for restoration efforts is typically obtained from dredging offshore deposits. These sources often are preferred due to logistics and cost. However, careful consideration must be given to use of inlet shoals and nearshore sources as they may result in impacts to adjacent shorelines. Identified offshore sand deposits west of Mobile Bay (Twichell, et. al., 2011) are primarily found in relic fluvial deposits located a considerable distance offshore, in close proximity to pipeline infrastructure, and/or contain significant overburden of fine sediments which increase the difficulty and costs to obtain. With sustained erosion along much of Alabama and Mississippi coastal areas and increasing awareness of potential impacts of relative sea level rise, the demand on these limited offshore resources will increase. Finding renewable sand sources that support economic and environmentally sustainable solutions is a critical component of coastal restoration.

Dredging records between 1996 and 2012 from the United States Army Corps of Engineers, Mobile District (USACE) indicate that approximately 490,000 cubic yards (cy) of sediment was dredged on an average annual basis from the federal navigation channel along the Black Warrior and lower Tombigbee River systems (Figure 1). This material is placed in a combination of within-banks and diked upland placement sites. A recent inventory conducted as part of the Mississippi Coastal Improvements Comprehensive Plan (USACE, 2009) estimated that approximately 12.6 million cy of sand may be stored within some of the larger upland placement sites along the BWT. This value increases to nearly 30 million cy when considering sites along the Tennessee-Tombigbee River system. Over the years, diminishing storage capacity, primarily in upland placement sites, has resulted in the need for acquisition of additional within-banks and upland areas. The sand stored adjacent to the BWT in existing dredged material placement sites

could provide a much needed source for the coast should it meet suitability criteria. Use of this sand would in turn help restore storage capacity for dredged material removed from these navigation channels.

2.0 Study Area

2.1 Black Warrior-Tombigbee Waterway (BWT). The BWT was authorized by Congress in various River and Harbor Acts from 1884 -1986 for the primary purpose of navigation. Construction of the project to existing dimensions (9 feet deep by 200 feet wide from the mouth of the Tombigbee River 45 miles above Mobile, Alabama to the vicinity of Birmingham, Alabama) was completed in 1938. Other project purposes include hydroelectric power, public recreation, regulation of stream flow, water quality, fish and wildlife conservation, and fish and wildlife mitigation. The waterway provides a link from the Black Warrior River Basin to the port of Mobile, as well as connecting to other crucial inland waterways on the Ohio and Mississippi Rivers through the Tennessee-Tombigbee Waterway.

Sand for this study was obtained from the Lower Princes dredged material placement site, located along the banks of the Lower Tombigbee approximately 91 miles upriver from Mobile, Alabama (Figure 1). This site is one of several placement sites used for storage of dredged material removed from the BWT. Studies by Smith (1995), Thompson Engineering (2001,2002), Baehr (2010), and Williams (2011) indicate that sand deposits from the BWT are composed primarily of sand-sized quartz with an iron oxide coating that gives the sediment its characteristic pale light yellow to very pale brown color (Munsell Soil Color Chart dry color code 10 YR 7/3). Other existing minerals in the dredged sediments have not been found to significantly affect the overall color.

2.2 East End Dauphin Island. Dauphin Island is approximately 15 miles long and is the easternmost island in a chain of five barrier islands bordering the southern extent of the Mississippi Sound. Dauphin Island's southern shoreline consists of sandy beaches with an average berm crest elevation of roughly 4.6 feet National American Vertical Datum 1988 (NAVD88) (Byrnes et al., 2010). Native sand along Dauphin Island as well as the Mississippi barrier islands is composed primarily of sand-sized quartz, predominantly pale white to light grey in color (Appendix C, Figure C-1).

The eastern end of Dauphin Island in the vicinity of the project includes low profile beaches backed by segmented dune ridges and fronted by Pelican Bay and the Gulf of Mexico. The eastern tip of Dauphin Island near Fort Gaines is stabilized by a revetment and a series of groins built prior to 1909. Review of U.S. Coastal and Geodetic Survey maps and historical aerial photography indicate that the eight westernmost groin structures were connected to the shore in 1960. However, sand had eroded from behind the structures by 1992 and today are located approximately 340 to 490 feet seaward of the current shoreline.

Lamb (1987) illustrated that the easternmost mile of Dauphin Island shoreline goes through cycles of recession and accretion, which were believed to be dependent on the position and configuration of Sand Island and Pelican Island. Recent studies by South Coast Engineers,

Coastal Planning and Engineering, and Coastal Tech (Dixon et al., 2011) indicate that shoreline recession along the eastern end since 1980 has primarily been due to the migration of Pelican and Sand Island to the west-northwest. Dixon et al., 2011 indicates the average shoreline recession between 1980 and 2010 along Dauphin Island east of Pelican Island has been approximately 9 feet per year. Erosion occurs primarily along the easternmost mile, and fluctuating accretion and erosion occurs along that next mile and a half of shoreline. Volumetric change analysis as presented in Dixon et. al, 2011 during the same time period indicates similar trends in erosion and accretion (Figure 2). Numerous studies have documented various magnitudes of transport for this region. Byrnes et. al, 2010 found that directly west of Mobile Pass, the net longshore transport rates were approximately 100,000 to 150,000 cy/year to the west. This study further noted the absence of easterly transport for this section due to strong wave refraction over the ebb-tidal delta, which results in redirection of waves to the west, regardless of offshore direction. Garcia, 1977 documented historical total net longshore sediment transport rate at Dauphin Island of 196,000 cubic yards per year (cy/yr). Observed shoreline trends and model based results as documented in WRScompass, 2010 found that the average annual transport rate for the section of Dauphin Island to the east of Pelican Island to be approximately 40,000 to 60,000 cy/yr to the west.

Figure 1: Black Warrior Tombigbee Waterway and Lower Princes Location Map

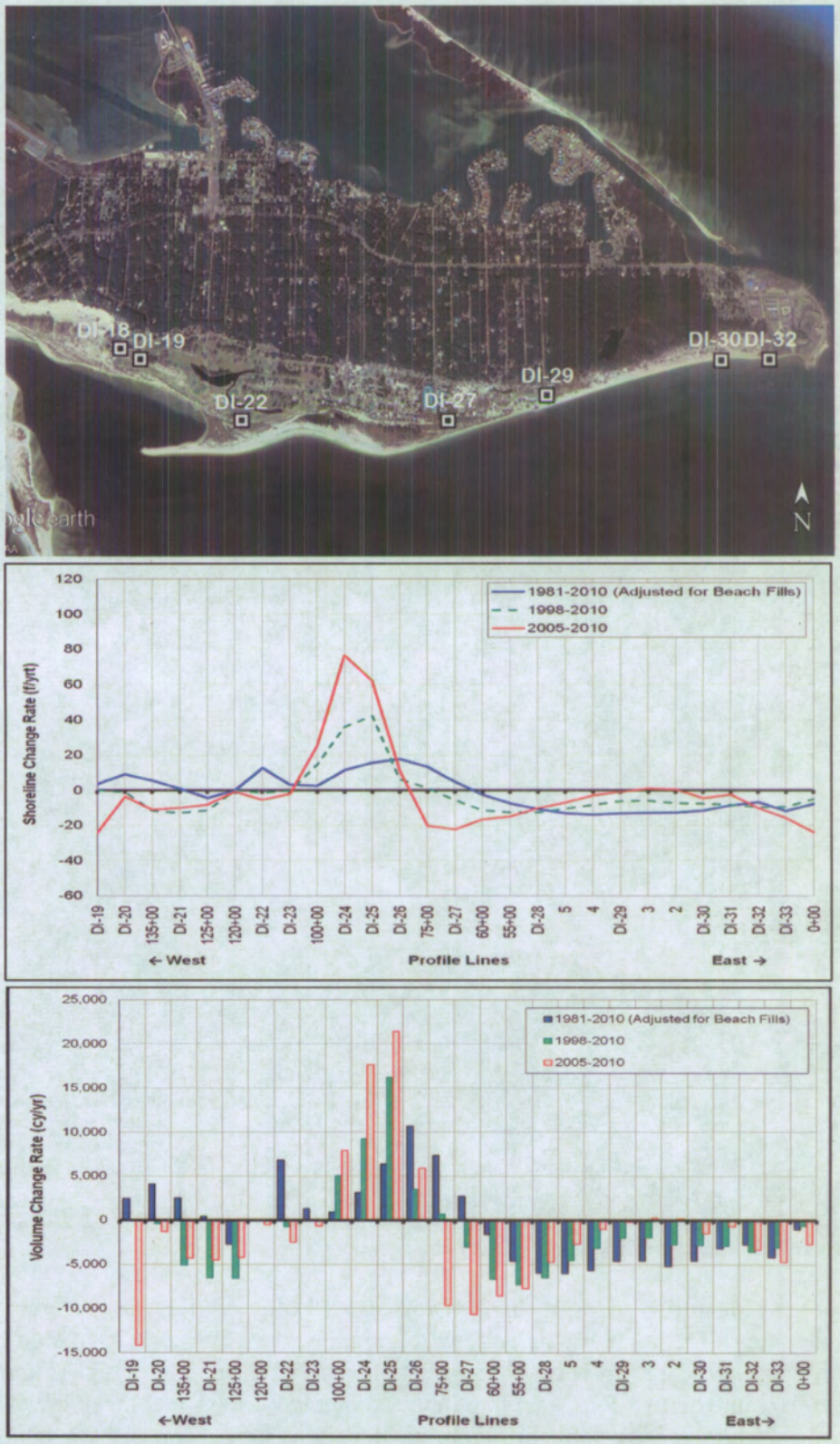

Figure 2: Dauphin Island Shoreline and Volumetric Change 1980-2010 (Dixon et al., 2011)

3.0 Methodology

The pilot study began in May 2011 and concluded in June 2012. The project consisted of placing approximately 5,000 cubic yards of sand along the southern shoreline of eastern Dauphin Island (Figure 3), and then monitoring its movement and color change over the course of one year. Sand was obtained by mechanical excavation and trucking of dredged material from the BWT stored within the Lower Princes dredged material placement site (Figure 1). Approximately 1,500 cys was placed adjacent to the seawall between the two southwestern groins adjacent to Fort Gaines (survey stakes DI-01-11 and DI-08-11), and approximately 3,500 cy was placed along the southern shoreline of Dauphin Island just west of the seawall between survey stakes DI-09-11 and DI-16-11 (Figure 3). Placement occurred from 31 May to 6 June 2011.

Figure 3: East End Dauphin Island Sand Placement and Survey Limits

3.1 Topographic and Hydrographic Surveys. On 18 May 2011, a pre-placement (baseline) real time kinematic (RTK) topographic and hydrographic survey was conducted along 53 transects spaced roughly 50 feet apart between survey stakes DI-01-11 and DI-21-11 (Figure 3). Surveys extended from the berm out to a depth of approximately - 4 to -5 feet mean lower low water (MLLW). These surveys established baseline elevations for the two placement areas on the beach, as well as mapping the seafloor to monitor movement of sediment. Immediately

following sand placement, a post construction survey was performed. The remaining post-construction monitoring surveys were conducted on a weekly, then bi-monthly basis over the first three months. From September 2011 to June 2012, monthly topographic and bathymetric surveys were conducted. Some delays and limitations due to inclement weather prohibited hydrographic surveys in October 2011 and January and February 2012. Following Tropical Storm Lee in September 2011, ten additional transect lines with 100 foot spacing alongshore were added, extending the survey to DI-31-11 (Figure 3) to better monitor the westward movement of sand.

Table 1: Sampling and Survey Event Schedule. Sand sampling was conducted during topographic surveys

SAMPLING EVENT	SAMPLING SCHEDULE	ACTUAL SURVEY DATE	
		Topo	Hydro
Baseline Sampling Event Before Sand Placement	Immediately Before Placement	5/18/2011	5/18/2011
1 - Immediately After Placement	Immediately After Placement	6/6/2011	6/13/2011
2 - 1st Weekly	1 week After Placement	6/16/2011	6/16/2011
3 - 2nd Weekly	2 weeks After Placement	6/27/2011	6/27/2011
4 - 3rd Weekly	3 weeks After Placement	7/6/2011	7/6/2011
5 - 1st Bi-Monthly	5 weeks After Placement	7/19/2011	7/19/2011
6 - 2nd Bi-Monthly	7 weeks After Placement	8/3/2011	8/22/2011
7 - 1st Monthly	1 month after Event #7	9/8/2011	9/14/2011
8 - 2nd Monthly	1 month after Event #8	10/12/2011	Not Conducted
9 - 3rd Monthly	1 month after Event #9	11/30/2011	12/16/2011
10 - 4th Monthly	1 month after Event #10	1/9/2012	Not Conducted
11 - 5th Monthly	1 month after Event #11	No Survey conducted	Not Conducted
12 - 6th Monthly	1 month after Event #12	3/6/2012	3/5/2012
13 - 7th Monthly	1 month after Event #13	4/11/2012	4/11/2012
14 - 8th Monthly	1 month after Event #14	5/11/2012	5/11/2012
15 - 9th Monthly	1 month after Event #15	6/13/2012	6/13/2012

Following survey data collection, digitized soundings were used to create digital elevation models during each survey period in Table 1. The Triangulated Irregular Network (TIN) method was used to form surfaces of continuous connected triangular places based on irregular points (Petrie, 1991). TIN model surfaces were used for calculating all topographic and bathymetric volumes and changes contained in Appendix B, with the exception of the October and December 2011 and January and February 2012 surveys. These surveys did not contain bathymetry data due to weather conditions, and therefore, were not used in the topographic and bathymetric volumes and change analysis. All topographic surveys were used to extract the mean high water (MHW) position based on National Oceanic and Atmospheric Administration

(NOAA) published Benchmark Sheet for Dauphin Island, AL Station 8735180 Epoch (1983-2001) of 1.18 feet MLLW for shoreline change analysis utilizing the Digital Shoreline Analysis System version 4.3 (DSAS). DSAS is an extension that enhances the normal functionality of ESRI ArcGIS software and enables users to calculate shoreline rate-of-change statistics from a time series of multiple shoreline locations (USGS, 2005).

3.2 Munsell Color Sampling. Following sand placement on 31 May to 6 June 2011, sand sampling events were conducted in conjunction with topographic and bathymetric surveys along 21 transects (Figure 3). As with the surveys, sand sampling was initially conducted on a weekly, then bi-monthly, and then monthly basis until one year post-placement (Table 1). Each transect contained three sediment sample locations: one 10 feet shoreward of the water line, one at the water line, and one 10 feet seaward of the water line (Figure 4). Monthly photo documentation of the area also was conducted during the survey and sampling events (Appendix D). Samples were analyzed for color and classified using the Munsell Color Order System. Sediment samples were analyzed against a white background with consistent lighting to minimize variability in the assessment. Appendix C contains each sampling event's Munsell Color classification for the sand samples.

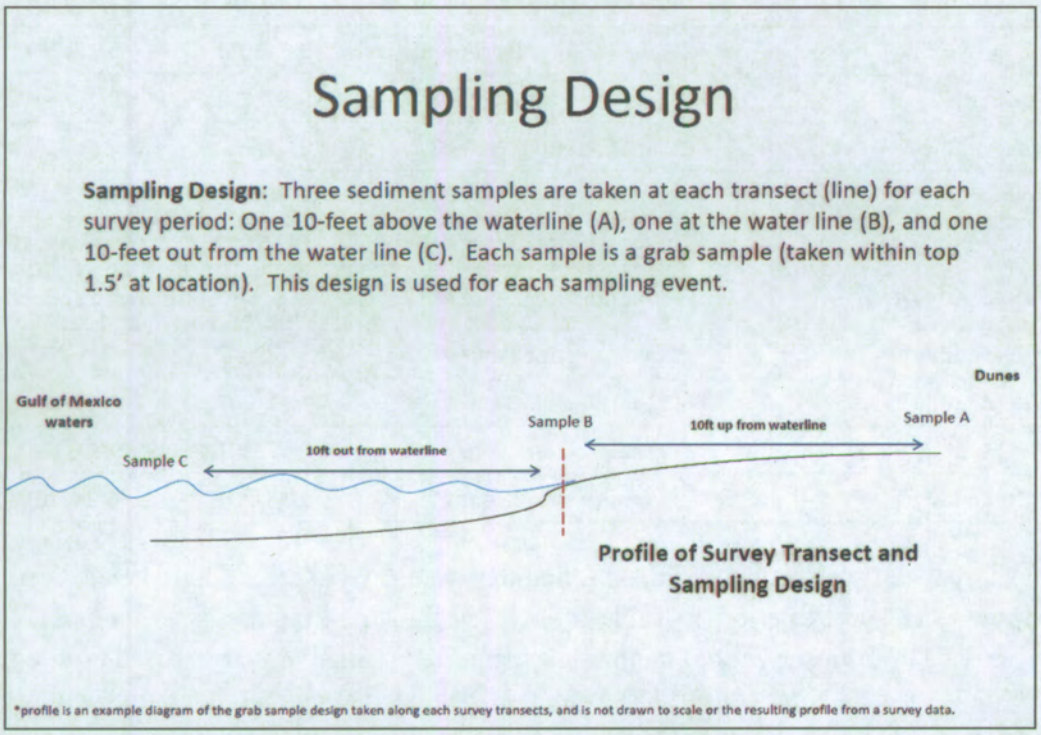

Figure 4: Sand Color Sampling Design

4.0 Discussion

4.1 Shoreline and Volume Change

4.1.1 Dauphin Island East End Groin Field Placement. Appendix A, Figures A-1 to A-6, present the MHW shoreline positions relative to a fixed baseline for each survey. Appendix B contains plots of the MHW shoreline positions and bathymetric change overlaid on 2012 aerial photographs providing convenient qualitative comparison of project evolution.

Comparison of the 18 May 2011 baseline survey and 06 June 2011 post-construction survey revealed that sand placement of approximately 1,500 cy advanced the shoreline seaward on average 3 feet with a maximum advancement of approximately 5 feet between DI-4-11 and DI-5-11. A comparison of the 06 June 2011 post-construction placement through August 2011 illustrates project evolution over the first three months after construction. MHW shoreline change relative to post-construction conditions ranged from recession of 4 feet near DI-7-11 to a shoreline advance of 3 feet near DI-2-11. Shoreline and bathymetric change indicate movement of sand during this period was to the east within the limits of the two groin structures. Volumetric changes between the post-placement survey and 22 August 2011 survey indicates only minor losses of approximately 250 cy.

Tropical Storm Lee influenced the project area 4-5 September 2011. Post-storm surveys collected 8-14 September 2011 revealed that the majority of placed sand had remained within the limits of the project between the two groin structures. Average MHW shoreline change relative to post-construction conditions documented recession of approximately 1 foot. Topographic and bathymetric change showed berm elevation lowering for most of the placement. Volumetric changes between the post-construction survey and 14 September 2011 survey indicate only minor losses of approximately 270 cy.

Cumulative MHW shoreline changes through 12 October 2011 illustrate retreat of 12.2 feet near DI-1-11 to a shoreline advance of 13 feet near DI-8-11 relative to post construction conditions. Shoreline change indicates movement of sand during this period to the west within the limits of the two groin structures. No volumetric change estimates were performed during this time because bathymetric surveys were not available.

A comparison through 30 November 2011 reveals the evolution of the project six months after construction. The average MHW shoreline change relative to post construction conditions was retreat of approximately 1 foot. Review of shoreline change indicates sand movement following the October survey was primarily to the east. No volumetric change estimates were performed during this time period because of a two week lag between topographic and bathymetric surveys.

Changes in the MHW between post construction and 9 January 2012 ranged from a landward retreat of 5 feet near DI-1-11 to shoreline advance of 6 feet near DI-8-11. Shoreline change indicates movement of sand during this period was slightly to the west within the limits of the two groin structures. No volumetric change analysis was performed during this time period because bathymetric data were not available.

An evaluation of shoreline change through 06 March 2012 reveals MHW shoreline relative to post construction conditions retreated 4 feet near DI-3-11 and advanced 7 feet near DI-8-11. Review of shoreline change indicates movement of sand during this period was to the west within the limits of the two groin structures. Volumetric changes between the post construction survey and March 2012 survey indicates only minor losses of approximately 200 cy.

A comparison through 11 April 2012 reveals the evolution of the project ten months after construction. In the project area, the MHW shoreline change relative to post construction conditions ranged from a landward retreat of 2 feet near DI-3-11 to a seaward advancement of 3 feet near DI-8-11. Volumetric changes between the post construction and 11 April 2012 survey indicates only minor losses of approximately 370 cy.

Comparison through 11 May 2012 shows the MHW shoreline change relative to post construction conditions ranged from a landward retreat of 2 feet near DI-3-11 to a seaward advancement of 2 feet near DI-8-11. The movement of sand during this time period was slightly to the west within the limits of the two groin structures. Volumetric changes between the post construction survey and 11 May 2012 survey indicate only minor losses of approximately 115 cy.

Cumulative changes through 13 June 2012 illustrate the average MHW shoreline change relative to post construction conditions was landward retreat of approximately 1 foot. Volumetric changes between the post construction survey and 13 June 2012 survey indicates only minor losses of approximately 15 cy.

4.1.2 Dauphin Island East End Shoreline Placement. Appendix A Figures A-7 to A-12 present the MHW shoreline positions relative to a fixed baseline for each survey. Appendix B contains plots of the MHW shoreline positions and bathymetric change overlaid on 2012 aerial photographs, which provide a convenient qualitative comparison of project evolution.

Comparison of the 18 May 2011 baseline and 06 June 2011 post-construction survey reveals the placement of approximately 3,500 cy advanced the shoreline seaward on average 9.5 feet within the placement limits of DI-09-11 to DI-16-11 with the maximum advancement of approximately 25 feet occurring near DI-13-11. A comparison through August 2011 reveals the evolution of the project over the first three months after construction. In the project area, the MHW shoreline change relative to post construction conditions ranged from recession of 13 feet near DI-9-11 to shoreline advance of 12 feet near DI-15-11. Review of shoreline and bathymetric change indicates longshore movement of sand during this time period was primarily to the west extending to the limits of survey stake DI-20-11. Shoreline advancements were observed as far west as DI-21-11 due both to westward longshore transport and onshore movement of sand bars during summer wave climate conditions. Volumetric changes between the post construction survey and August 2011 survey indicates net accretion of approximately 5,600 cy within the survey limits, with the majority of the accretion occurring in the nearshore west of DI-20-11.

Tropical Storm Lee influenced the project area 4-5 September 2011. In the project area, MHW shoreline change relative to post construction conditions ranged from recession of 18 feet near DI-10-11 to a seaward advancement of 8 feet near DI-16-11. Review of shoreline and

bathymetric change indicates dominant longshore movement of sand to the west with continuous spreading of the sand westward past survey stake DI-20-11. Volumetric changes between the June post construction survey and September 2011 survey indicates accretion on the order of approximately 2,200 cy within the survey limits. This is less than the accretion seen in the 22 August 2011 volumetric change analysis indicating erosion of some of the material in the nearshore had occurred during the storm.

Cumulative changes through 12 October 2011 illustrate MHW shoreline change relative to post construction conditions ranged from retreat of 19 feet near DI-11-11 to shoreline advance of 6 feet near DI-16-11. Review of shoreline change indicates movement of sand during this time period was to the west. No volumetric change estimates were performed due to lack of bathymetric data.

A comparison through December 2011 reveals the evolution of the project six months after construction. MHW shoreline change relative to post-construction conditions ranged from recession of 25 feet near DI-11-11 to shoreline advance of 5 feet near DI-17-11. Review of shoreline change indicates movement of sand was to the west. No volumetric change estimates were performed due to a two week lag between topographic and bathymetric surveys.

Between 06 June 2011 and 09 January 2012 MHW shoreline change ranged from retreat of 23 feet near DI-11-11 to advancement of 6 feet just west of survey stake DI-20-11. This trend in shoreline change indicates dominant longshore movement of sand west, with continuous spreading of the sand past survey stake DI-20-11. Volumetric changes were not performed during this time period due to lack of bathymetric data.

An evaluation of shoreline change through 06 March 2012 reveals the MHW shoreline change relative to post-construction conditions retreated of 22 feet near DI-11-11 and advanced 7 feet approximately 1,300 feet west of survey stake DI-20-11. Review of shoreline change indicates movement of sand during this time period was to the west. Volumetric changes between the post-placement survey and 06 March 2012 survey indicated accretion on the order of approximately 1,000 cy within the survey limits.

A comparison through 11 April 2012 reveals the evolution of the project ten months after construction. MHW shoreline change relative to post-construction conditions ranged from recession of 24 feet near DI-11-11 to a shoreline advance of 3 feet approximately 500 feet west of survey stake DI-20-11. Review of shoreline change indicates movement of sand during this period was to the west. Volumetric changes between the post construction and 11 April 2012 survey indicates overall erosion on order of approximately 4,000 cy within the survey limits. This indicates that transport of material had occurred outside the limits of the post construction survey. This is supported by the shoreline change envelope shown in Appendix A, Figure A-13 that indicates continued advancement west of survey stake DI-21-11.

A comparison of the post construction conditions through 11 May 2012 reveals MHW shoreline change relative to post-construction conditions ranged from retreat of 22 feet just east of DI-10-11 to advances of 2 feet near DI-18-11. Review of shoreline change indicates movement of sand during this period was to the west. Volumetric changes between the post-construction survey

and 5 May 2012 survey indicated overall erosion on order of approximately 3,400 cy within the survey limits. This indicates that transport of material had occurred outside the limits of the post construction survey. This is supported by the shoreline change envelope shown in Appendix A, Figure A-13 that shows continued advancement west of survey stake DI-21-11.

Cumulative changes through 13 June 2012 illustrates MHW shoreline change relative to post-construction conditions ranged from recession of 22 feet near DI-11-11 to advance of 6 feet approximately 500 feet west of survey stake DI-20-11. Review of shoreline change indicates movement of sand during this period was to the west. Volumetric changes between the post-construction and 13 June 2012 survey indicated overall erosion on the order of approximately 1,000 cy within the survey limits. This as well as shoreline change indicates, that transport of material had occurred outside the limits of the post-construction survey. This erosion is slightly less than 05 May 2012. Review of the bathymetric change maps indicate that this reduction could be due to onshore movement of sand bars.

4.2 Munsell Color Change

4.2.1 Dauphin Island East End Groin Field Placement. Appendix C (Tables C1 to C-30) presents the wet and dry Munsell color for each sand sample. Color coding of the Munsell Color classification in the tables provides a convenient qualitative comparison of color change. As shown in these tables, post placement sampling indicates that the pale brown to yellowish brown sand is dispersed over the sampling field between DI-1-11 to DI-8-11 during the first few sampling events with continued darkening of the sampling sets through July 2011. By 03 August 2011 there is a shift in Munsell hues made up predominantly of yellow and reds (10YR) to a more dominant yellow hue (2.5Y). Slight reductions in the overall sampling chroma values are observed post 3 August 2011 indicating a lessening in color saturation.

Table 3 highlights the color change from initial sampling event following placement to its final sampling event for each sampling point. The first sampling event following the initial placement of the river sand in the study area was on 06 June 2011. Therefore, it was used in this table as the baseline for color change of the river sand. The superscripts beside the Munsell color classification identify the samples that were not collected during the initial or final sampling events. As shown in Appendix C and Table 3 over the course of a year color change for river sand placement went from a wet Munsell color predominantly light yellowish brown to a light gray and a dry Munsell color of predominantly pale brown to white.

Table 3: Dauphin Island East End Groin Placement
Color change from first sampling event to last sampling event

Sample	6/06/2011 Wet Color	6/06/2012 Wet Color	Wet Color Change	6/13/2011 Dry Color	6/13/2012 Dry Color	Dry Color Change
DI-1A-11	2.5Y 6/3	2.5Y 7/2.5	From Light Yellowish Brown to Light Gray	2.5Y 7/3	2.5Y 8/1	From Pale Brown to White
DI-1B-11	2.5Y 6/3	2.5Y 7/2.5	From Light Yellowish Brown to Light Gray	2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-1C-11	2.5Y 6/3	2.5Y 7/2.5	From Light Yellowish Brown to Light Brown	2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-2A-11	10YR 7/3	2.5Y 7/2.5	From Very Pale Brown to Light Gray	2.5Y 7/3	2.5Y 8/1	From Pale Brown to White
DI-2B-11	2.5Y 6/3	2.5Y 7/2.5	From Light Yellowish Brown to Light Gray	2.5Y 7/3	2.5Y 8/1	From Pale Brown to White
DI-2C-11	2.5Y 7/3	2.5Y 7/2.5	From Pale Brown to Light Gray	2.5Y 7/3	2.5Y 8/1	From Pale Brown to White
DI-3A-11	10YR 6/4	2.5Y 7/2.5	From Light Yellowish Brown to Light Gray	2.5Y 7/3	2.5Y 8/1	From Pale Brown to White
DI-3B-11	10YR 7/3	2.5Y 7/2.5	From Very Pale Brown to Light Gray	2.5Y 7/3	2.5Y 8/1	From Pale Brown to White
DI-3C-11	10YR 6/4	2.5Y 7/2.5	From Light Yellowish Brown to Light Gray	2.5Y 7/3	2.5Y 8/1	From Pale Brown to White
DI-4A-11	10YR 6/3	2.5Y 7/2.5	From Pale Brown to Light Gray	2.5Y 7/3	2.5Y 8/1	From Pale Brown to White
DI-4B-11	10YR 6/3	2.5Y 7/2.5	From Pale Brown to Light Gray	2.5Y 7/3	2.5Y 8/1	From Pale Brown to White
DI-4C-11	10YR 6/3	2.5Y 7/2.5	From Pale Brown to Light Gray	2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-5A-11	2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	2.5Y 7/3	2.5Y 8/1	From Pale Brown to White
DI-5B-11	10YR 6/3	2.5Y 7/2	From Pale Brown to Light Gray	2.5Y 7/3	2.5Y 8/1	From Pale Brown to White
DI-5C-11	10YR 6/3	2.5Y 7/2	From Pale Brown to Light Gray	2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-6A-11	10YR 6/3	2.5Y 7/2	From Pale Brown to Light Gray	2.5Y 7/3	2.5Y 8/1	From Pale Brown to White
DI-6B-11	2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	2.5Y 7/3	2.5Y 8/1	From Pale Brown to White
DI-6C-11	2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	2.5Y 7/4	2.5Y 8/1	From Pale Brown to White
DI-7A-11	10YR 6/3	[1]2.5Y 7/2	From Pale Brown to Light Gray	2.5Y 7/3	[1]2.5Y 8/1	From Pale Brown to White
DI-7B-11	2.5Y 6/3	[1]2.5Y 7/2	From Light Yellowish Brown to Light Gray	2.5Y 7/3	[1]2.5Y 8/1	From Very Pale Brown to White
DI-7C-11	2.5Y 7/3	[1]2.5Y 7/2	From Pale Brown to Light Gray	2.5Y 7/3	[1]2.5Y 8/1	From Pale Brown to White
DI-8A-11	10YR 6/3	[1]2.5Y 7/2	From Pale Brown to Light Gray	2.5Y 7/3	[1]2.5Y 8/1	From Pale Brown to White
DI-8B-11	10YR 6/3	[1]2.5Y 7/2	From Pale Brown to Light Gray	2.5Y 7/3	[1]2.5Y 8/1	From Pale Brown to White
DI-8C-11	2.5Y 6/3	[1]2.5Y 7/2	From Light Yellowish Brown to Light Gray	2.5Y 7/2	[1]2.5Y 8/1	From Light Gray to White

[1] The sample date for this transect was 11 MAY 2012

4.2.2 Dauphin Island East End Shoreline Placement. Appendix C (Tables C-31 to C-60) presents the wet and dry Munsell color for each survey. Munsell colors in the tables provide a convenient qualitative comparison of color change with time. As shown in these tables, post-placement sampling indicates that the pale brown to yellowish brown sand is dispersed over the sampling field to sample station DI-20-11during the first few sampling events with continued darkening of the sampling sets observed through July 2011. By the 03 August 2011 sampling event there is a

shift in Munsell hues made up predominately of yellow and reds (10YR) to a more dominant yellow hue (2.5Y). Even with the large accretion observed in the nearshore bathymetric change during the summer months, light brown color sand was observed as far west as DI-31-11 by 30 November 2011 with the continued spreading of material to the west as observed in the shoreline and topographic and bathymetric changes discussed in section 4.1.2. By January 2012 predominant light brown colors were observed along the sampling with lightening to light grays primarily observed in the easternmost samples. Based on shoreline, topographic, and bathymetric changes discussed most placed sand had migrated from this region, which likely contributed to the observed lightening during this survey period in the samples east of DI-12-11. Observed lightening of the material in the nearshore samples in the April survey was illustrated along the entire surveyed area. Continued lightening of the material was observed in the remainder of the sampling events.

Table 4 highlights the color change from each sampling point's initial sampling event to its final sampling event. The first sampling event collected after initial placement of the river sand in the study area was 06 June 2011. Therefore, it was used in this table as the baseline for color change of the river sand. Transects DI-22-11 thru DI-30-11 were added in October 2011 after Tropical Storm Lee. Their baseline sampling event occurred on 12 October 2011. DI-31-11 was not sampled initially until the 30 November 2011 sampling event. The final sampling event for the majority of the transects was the 13 June 2012 event. The superscripts beside the Munsell color classification identify the samples that were not collected during the initial or final sampling events. As discussed in the shoreline, topographic, and bathymetric changes analysis in section 4.1.2. the placed river sand had been transported west of DI-20-11 by April 2012. The color change observed in Table 4 for stations east of DI-20-11 are likely a result of the placed river sand transporting westward. Furthermore, by review of the westward sand migration as illustrated in Appendix A, B and C the river sand had not transported as far west as DI-21-11 at the time of the baseline survey in October 2011. The placed river sand was not observed along this stretch of the survey until the November 2011 survey. Based on this the most appropriate comparison of color change in Table 4 is to compare the initial color of river sand placed between DI-08-11 and DI-16-11 on 06 June 2011 to the final color of sand samples west of DI-21-11 collected on 13 June 2012. As shown in Appendix C and summary Table 4, color change, over the course of a year within the limits of the survey went from a wet Munsell color predominately pale brown to a light grey and a dry Munsell color of predominantly pale brown to white.

Table 4: Dauphin Island East End Shoreline Placement
Color change from first sampling event to last sampling event

Sample	6/06/2011 Wet Color	6/06/2012 Wet Color	Wet Color Change	6/13/2011 Dry Color	6/13/2012 Dry Color	Dry Color Change
DI-9A-11	10YR 5/4	[1]2.5Y 5/4	From Yellowish Brown to Light Olive Brown	*10YR 6/4*	[6]2.5Y 6/3	Light Yellowish Brown- Pale Brown
DI-9B-11	2.5Y 6/3	[1]2.5Y 6/4	From Light Yellowish Brown to Light Yellowish Brown	*2.5Y 7/3*	[6]2.5Y 6/3	From Pale Brown to Pale Brown
DI-9C-11	10YR 5/4	[1]2.5Y 6/2	From Yellowish Brown to Light Brownish Gray	*2.5Y 7/4*	[6]2.5Y 7/2	From Pale Brown to Light Gray
DI-10A-11	2.5Y 6/3	[2]2.5Y 5/3	From Light Yellowish Brown to Light Olive Brown	*2.5Y 7/4*	[2]2.5Y 7/3	From Pale Brown to Very Pale Brown
DI-10B-11	10YR 6/3	[2]2.5Y 5/3	From Pale Brown to Light Olive Brown	*2.5Y 7/3*	[2]2.5Y 7/3	From Pale Brown to Very Pale Brown
DI-10C-11	2.5Y 7/4	[2]2.5Y 5/3	From Pale Brown to Light Olive Brown	*2.5Y 7/4*	[2]2.5Y 6/3	From Pale Brown to Pale Brown
DI-11A-11	2.5Y 6/3	[4]10YR 6/3	From Light Yellowish Brown to Pale Brown	*2.5Y 7/3*	[4]2.5Y 7/2	From Pale Brown to Light Gray
DI-11B-11	10YR 6/4	[4]2.5Y 5/3	From Light Yellowish Brown to Light Olive Brown	*10YR 7/4*	[4]2.5Y 7/2	From Very Pale Brown to Light Gray
DI-11C-11	10YR 6/3	[4]2.5Y 6/1	From Pale Brown to Gray	*2.5Y 7/4*	[4]2.5Y 7/2	From Pale Brown to Light Gray
DI-12A-11	2.5Y 7/2	2.5Y 7/2	From Light Gray to Light Gray	*2.5Y 7/3*	2.5Y 8/1	From Pale Brown to White
DI-12B-11	10YR 7/3	2.5Y 7/2	From Very Pale Brown to Light Gray	*2.5Y 7/3*	2.5Y 8/1	From Pale Brown to White
DI-12C-11	10YR 7/4	2.5Y 7/2	From Very Pale Brown to Light Gray	*2.5Y 7/3*	2.5Y 8/1	From Pale Brown to White
DI-13A-11	10YR 7/4	2.5Y 7/2	From Vary Pale Brown to Light Gray	*2.5Y 7/3*	2.5Y 8/1	From Pale Brown to White
DI-13B-11	10YR 7/4	2.5Y 7/2	From Vary Pale Brown to Light Gray	*2.5Y 7/3*	2.5Y 8/1	From Pale Brown to White
DI-13C-11	10YR 7/4	2.5Y 7/2	From Vary Pale Brown to Light Gray	*2.5Y 7/3*	2.5Y 8/1	From Pale Brown to White
DI-14A-11	2.5Y 7/3	2.5Y 7/1.5	From Pale Brown to Light Gray	*10YR 7/3*	2.5Y 7.5/1	From Very Pale Brown to White
DI-14B-11	2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	*10YR 7/3*	2.5Y 7.5/1	From Very Pale Brown to White
DI-14C-11	10YR 6/4	2.5Y 7/2	From Light Yellowish Brown to Light Gray	*2.5Y 7/3*	2.5Y 8/1	From Pale Brown to White
DI-15A-11	2.5Y 7/4	2.5Y 7/2	From Pale Brown to Light Gray	*2.5Y 7/4*	2.5Y 8/1	From Pale Brown to White
DI-15B-11	10YR 7/4	2.5Y 6.5/2	From Pale Brown to Light Gray	*2.5Y 7/3*	2.5Y 7.5/1	From Pale Brown to White
DI-15C-11	2.5Y 7/2	2.5Y 6.5/2	From Pale Brown to Light Gray	*2.5Y 7/3*	2.5Y 7.5/1	From Pale Brown to White
DI-16A-11	2.5Y 7/4	2.5Y 7/2.5	From Pale Brown to Pale Brown	*2.5Y 7/3*	2.5Y 7.5/1	From Pale Brown to White
DI-16B-11	2.5Y 7/3	2.5Y 7/2.5	From Pale Brown to Pale Brown	*2.5Y 7/3*	2.5Y 7.5/1	From Pale Brown to White
DI-16C-11	2.5Y 7/3	2.5Y 7/2.5	From Pale Brown to Pale Brown	*2.5Y 7/3*	2.5Y 7.5/1	From Pale Brown to White
DI-17A-11	2.5Y 7/3	2.5Y 7/2	From Pale Brown to Light Gray	*2.5Y 7/2*	2.5Y 7.5/1	From Light Gray to White
DI-17B-11	2.5Y 7/3	2.5Y 7/2	From Pale Brown to Light Gray	*2.5Y 7/2*	2.5Y 7.5/1	From Light Gray to White
DI-17C-11	2.5Y 7/3	2.5Y 7/2	From Pale Brown to Light Gray	*2.5Y 8/1*	2.5Y 8/1	From White to White
DI-18A-11	2.5Y 7/4	2.5Y 7/2	From Pale Brown to Light Gray	*2.5Y 7/2*	2.5Y 8/1	From Light Gray to White
DI-18B-11	2.5Y 7/3	2.5Y 7/2	From Pale Brown to Light Gray	*2.5Y 7/2*	2.5Y 8/1	From Light Gray to White

Sample	6/06/2011 Wet Color	6/06/2012 Wet Color	Wet Color Change	6/06/2011 Dry Color	6/13/2012 Dry Color	Dry Color Change
DI-18C-11	2.5Y 7/3	2.5Y 7/2	From Pale Brown to Light Gray	2.5Y 8/1	2.5Y 8/1	From White to White
DI-19A-11	2.5Y 7/3	2.5Y 7/2	From Pale Brown to Light Gray	2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-19B-11	2.5Y 7/3	2.5Y 7/2	From Pale Brown to Light Gray	2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-19C-11	2.5Y 7/2	2.5Y 7/2	From Light Gray to Light Gray	2.5Y 8/1	2.5Y 8/1	From White to White
DI-20A-11	2.5Y 7/3	2.5Y 7/2	From Pale Brown to Light Gray	2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-20B-11	2.5Y 7/3	2.5Y 7/2	From Pale Brown to Light Gray	2.5Y 8/1	2.5Y 8/1	From White to White
DI-20C-11	2.5Y 7/2	2.5Y 6.5/1	From Pale Brown to Light Gray	2.5Y 8/1	5Y 7.5/1	From White to White
DI-21A-11	2.5Y 7/2	2.5Y 7/2	From Light Gray to Light Gray	2.5Y 8/1	2.5Y 8/1	From White to White
DI-21B-11	2.5Y 7/2	2.5Y 7/2	From Light Gray to Light Gray	2.5Y 8/1	2.5Y 8/1	From White to White
DI-21C-11	2.5Y 7/2	2.5Y 7/2	From Light Gray to Light Gray	2.5Y 8/1	2.5Y 8/1	From White to White
DI-22A-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/3	2.5Y 8/1	From Very Pale Brown to White
DI-22B-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/3	2.5Y 8/1	From Very Pale Brown to White
DI-22C-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/3	2.5Y 8/1	From Very Pale Brown to White
DI-23A-11	[1] 5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/3	2.5Y 8/1	From Very Pale Brown to White
DI-23B-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/3	2.5Y 8/1	From Very Pale Brown to White
DI-23C-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-24A-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-24B-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-24C-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/1	2.5Y 8/1	From Light Gray to White
DI-25A-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-25B-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-25C-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-26A-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-26B-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-26C-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-27A-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-27B-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-27C-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-28A-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-28B-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White

Sample	6/06/2011 Wet Color	6/06/2012 Wet Color	Wet Color Change	6/13/2011 Dry Color	6/13/2012 Dry Color	Dry Color Change
DI-28C-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-29A-11	[1] 2.5Y 5/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-29B-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-29C-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-30A-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-30B-11	[1] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White
DI-30C-11	[1] 2.5Y 6/2	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[1] 2.5Y 7/1	2.5Y 8/1	From Light Gray to White
DI-31A-11	[2] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[2] 2.5Y 7/3	2.5Y 8/1	From Very Pale Brown to White
DI-31B-11	[2] 2.5Y 5/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[2] 2.5Y 7/3	2.5Y 8/1	From Very Pale Brown to White
DI-31C-11	[2] 2.5Y 6/3	2.5Y 7/2	From Light Yellowish Brown to Light Gray	[2] 2.5Y 7/2	2.5Y 8/1	From Light Gray to White

1 The sample date for this transect was 12 OCT 2011 2 The sample date for this transect was 30 Nov 2011

5.0 Conclusions and Recommendations

Many studies [Thompson Engineering (2001,2002), Baehr (2010), Williams (2011)] have documented that much of the dredged river sand stored adjacent to the BWT in upland placement sites is similar to the native sediment found along the Alabama and Mississippi coast with respect to mineralogy, gradation, angularity, percentage of fine sediments (clays and silts), and carbonate content. However, the characteristic pale brown color of the sediment has prevented the river sand from being considered a compatible source for use in coastal restoration, because its color is not an exact match to the native sand. Lack of studies documenting the change in sand color in response to natural coastal processes has allowed this misconception to perpetuate.

This study placed roughly 5,000 cy of sand from the BWT along the shoreline of Dauphin Island and monitored sand movement and color change to determine if natural processes of abrasion from sediment transport, chemical dissolution by salt water, and/or bleaching due to exposure to ultraviolet radiation (i.e., sunlight) were sufficient to remove the iron oxide coating that gives river sand its characteristic pale brown color. Based on the results of this study there is a clear shift in munsell hues made up predominantly of yellow and reds (10YR) to a more dominant yellow hue (2.5Y) as well as a slight reduction in chroma values indicating a lessening in color saturation within the first 3 months after placement. Notable color change to values compatible and in some instances slightly lighter than the native sediments along the beaches and barrier islands of Alabama and Mississippi occurs within 8 months after placement.

This study was not able to distinguish which natural processes contributed most to the observed change. Therefore, placing material in other less energetic areas of the profile, such as within the dune system may not result in the same observed rate of color change. However, the study was able to show that in a moderately energetic coastal environment where sediment movement occurs, weathering was able to sufficiently change grain color for iron-stained river sand.

The sand stored adjacent to the BWT in existing dredged material placement sites could provide a much needed source for coastal restoration needs. With sustained erosion along coastal areas and increasing awareness of potential impacts of relative sea level rise, the demand on existing limited offshore sand resources will increase. Finding a renewable source of sand such as the BWT dredged that supports economic and environmentally sustainable solutions (e.g. river sand) could be a critical component of coastal restoration strategies.

6.0 References

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APPENDIX A SHORELINE CHANGE

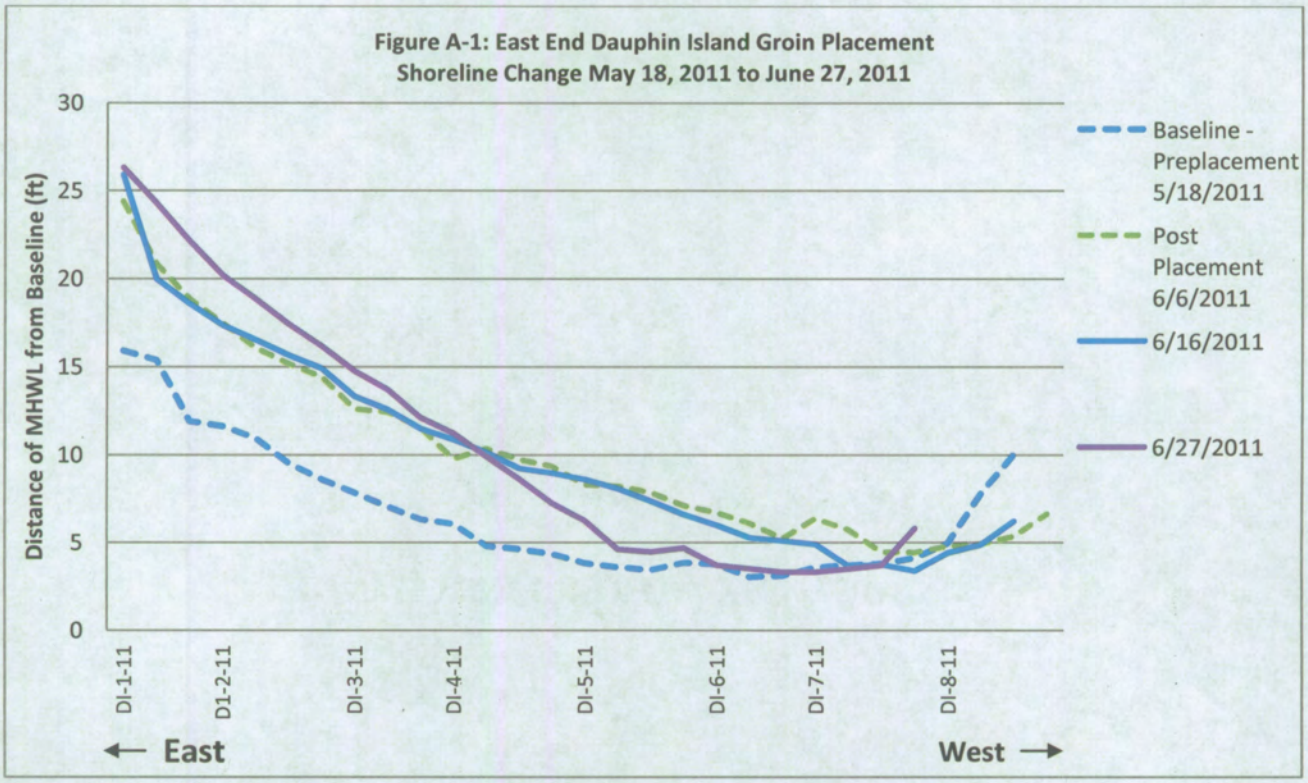


Figure A-1: East End Dauphin Island Groin Placement
Shoreline Change May 18, 2011 to June 27, 2011
Distance of MHWL from Baseline (ft)
30
25
20
15
10
5
0
DI-1-11
D1-2-11
DI-3-11
DI-4-11
DI-5-11
DI-6-11
DI-7-11
DI-8-11
← East
West →
Baseline - Preplacement 5/18/2011
Post Placement 6/6/2011
6/16/2011
6/27/2011

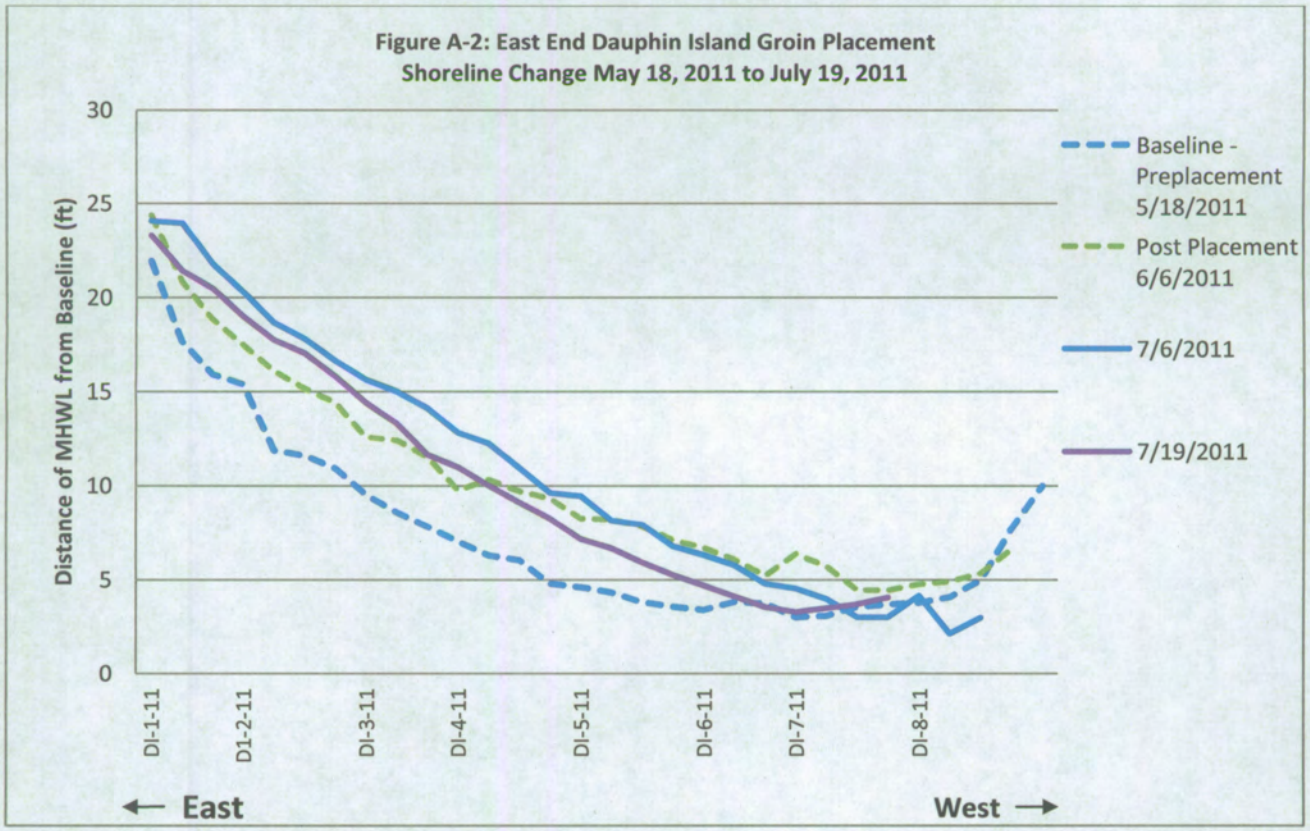


Figure A-2: East End Dauphin Island Groin Placement
Shoreline Change May 18, 2011 to July 19, 2011
Distance of MHWL from Baseline (ft)
30
25
20
15
10
5
0
DI-1-11
D1-2-11
DI-3-11
DI-4-11
DI-5-11
DI-6-11
DI-7-11
DI-8-11
← East
West →
Baseline - Preplacement 5/18/2011
Post Placement 6/6/2011
7/6/2011
7/19/2011

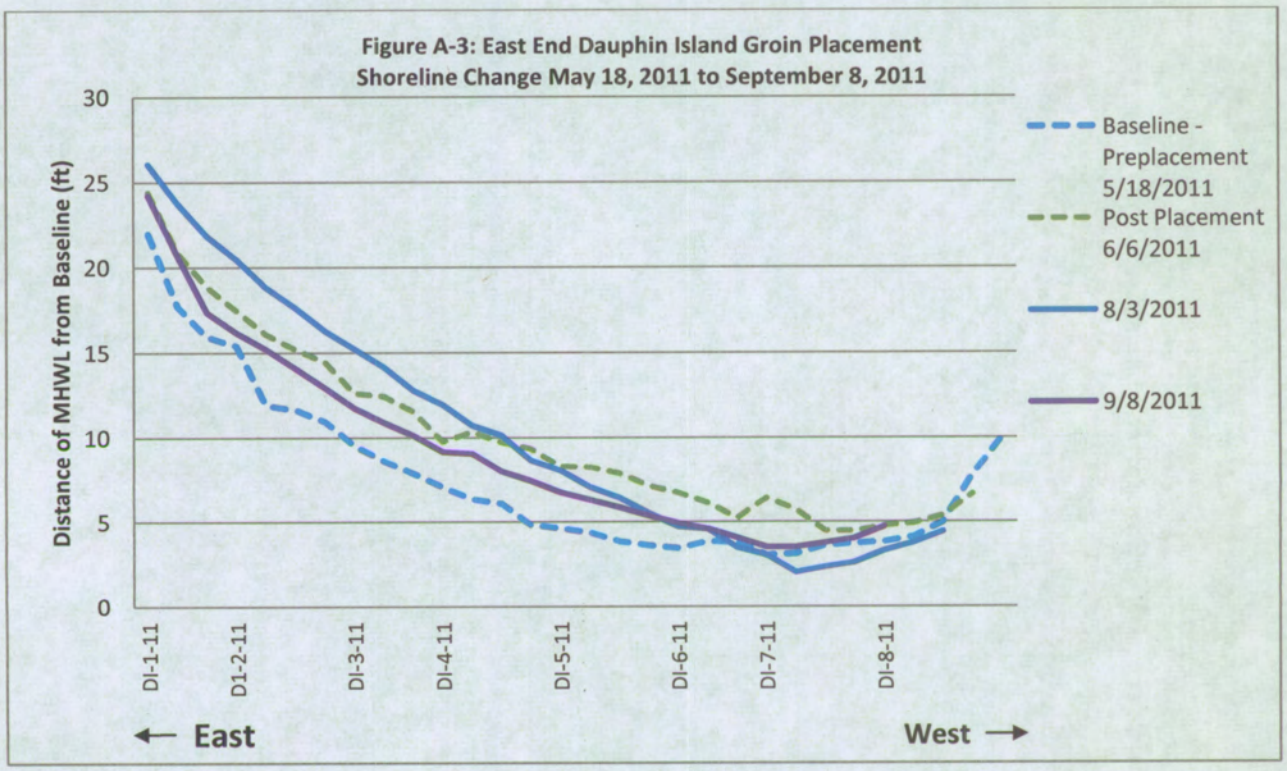


Figure A-3: East End Dauphin Island Groin Placement
Shoreline Change May 18, 2011 to September 8, 2011
Distance of MHWL from Baseline (ft)
30
25
20
15
10
5
0
DI-1-11
D1-2-11
DI-3-11
DI-4-11
DI-5-11
DI-6-11
DI-7-11
DI-8-11
← East
West →
Baseline - Preplacement 5/18/2011
Post Placement 6/6/2011
8/3/2011
9/8/2011

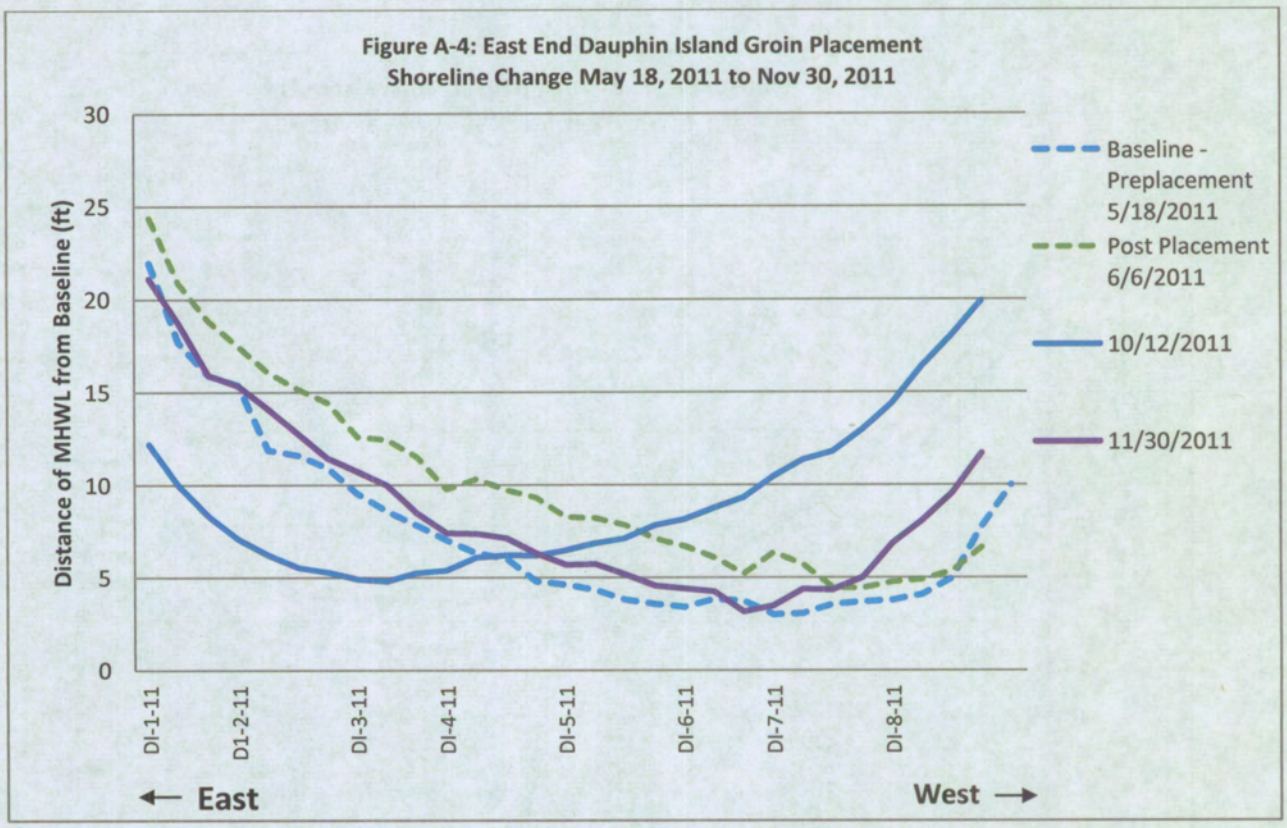


Figure A-4: East End Dauphin Island Groin Placement
Shoreline Change May 18, 2011 to Nov 30, 2011
Distance of MHWL from Baseline (ft)
30
25
20
15
10
5
0
DI-1-11
D1-2-11
DI-3-11
DI-4-11
DI-5-11
DI-6-11
DI-7-11
DI-8-11
← East
West →
Baseline - Preplacement 5/18/2011
Post Placement 6/6/2011
10/12/2011
11/30/2011

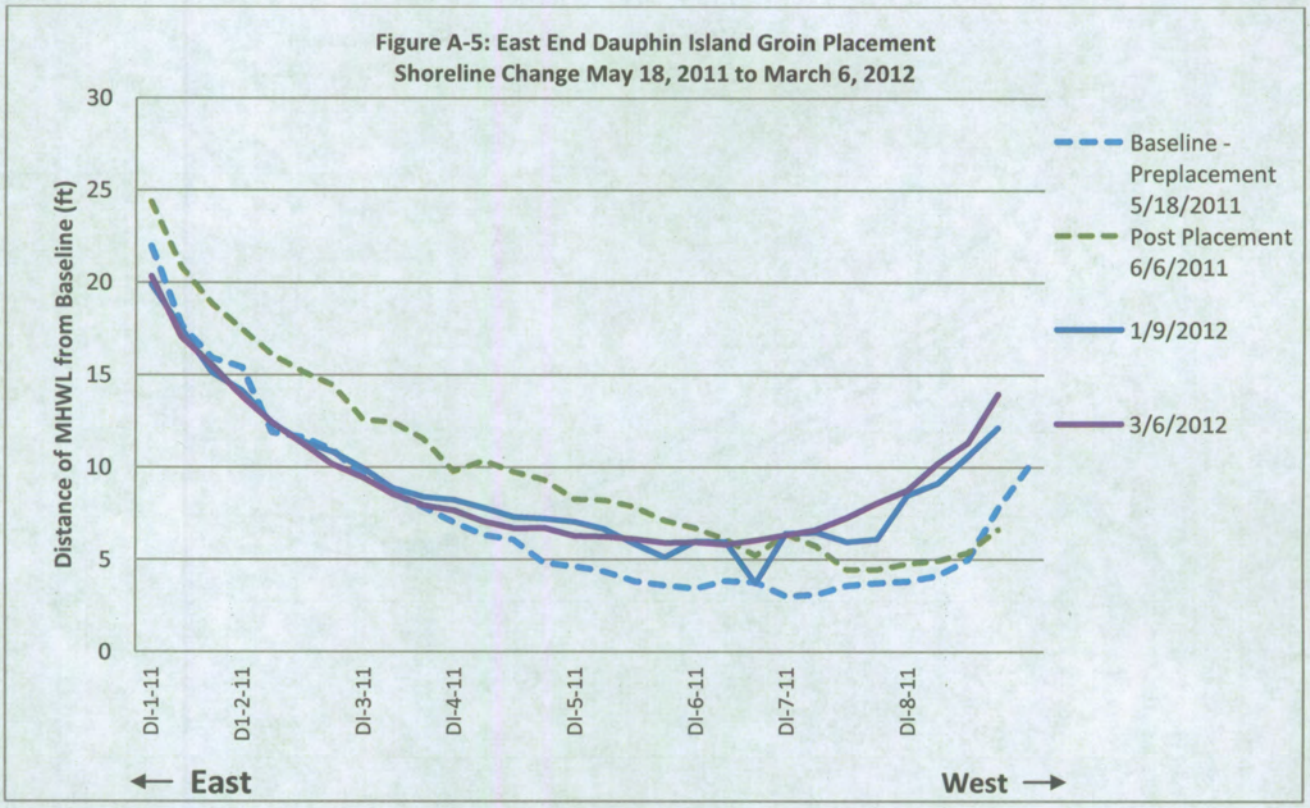


Figure A-5: East End Dauphin Island Groin Placement
Shoreline Change May 18, 2011 to March 6, 2012
Distance of MHWL from Baseline (ft)
30
25
20
15
10
5
0
DI-1-11
D1-2-11
DI-3-11
DI-4-11
DI-5-11
DI-6-11
DI-7-11
DI-8-11
East
West
Baseline - Preplacement 5/18/2011
Post Placement 6/6/2011
1/9/2012
3/6/2012

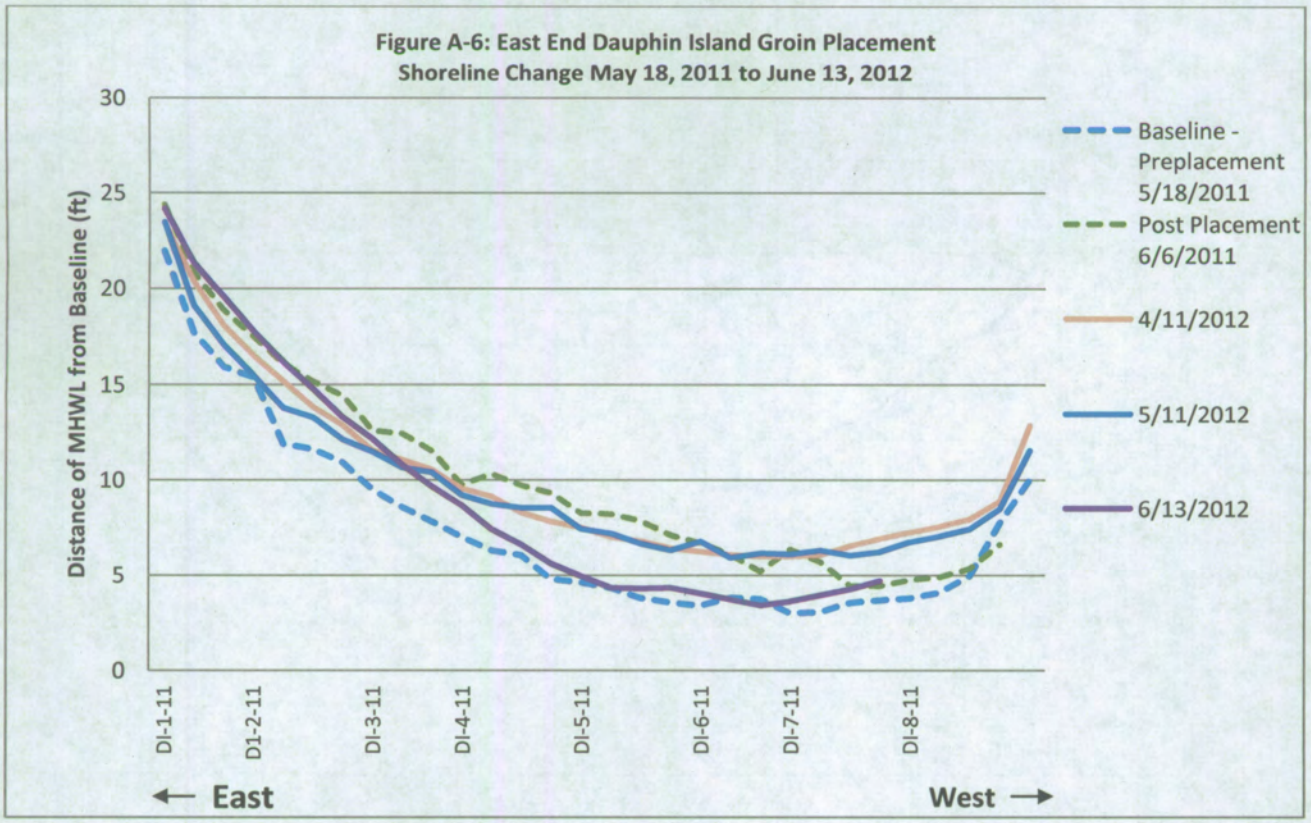


Figure A-6: East End Dauphin Island Groin Placement
Shoreline Change May 18, 2011 to June 13, 2012
Distance of MHWL from Baseline (ft)
30
25
20
15
10
5
0
DI-1-11
D1-2-11
DI-3-11
DI-4-11
DI-5-11
DI-6-11
DI-7-11
DI-8-11
East
West
Baseline - Preplacement 5/18/2011
Post Placement 6/6/2011
4/11/2012
5/11/2012
6/13/2012

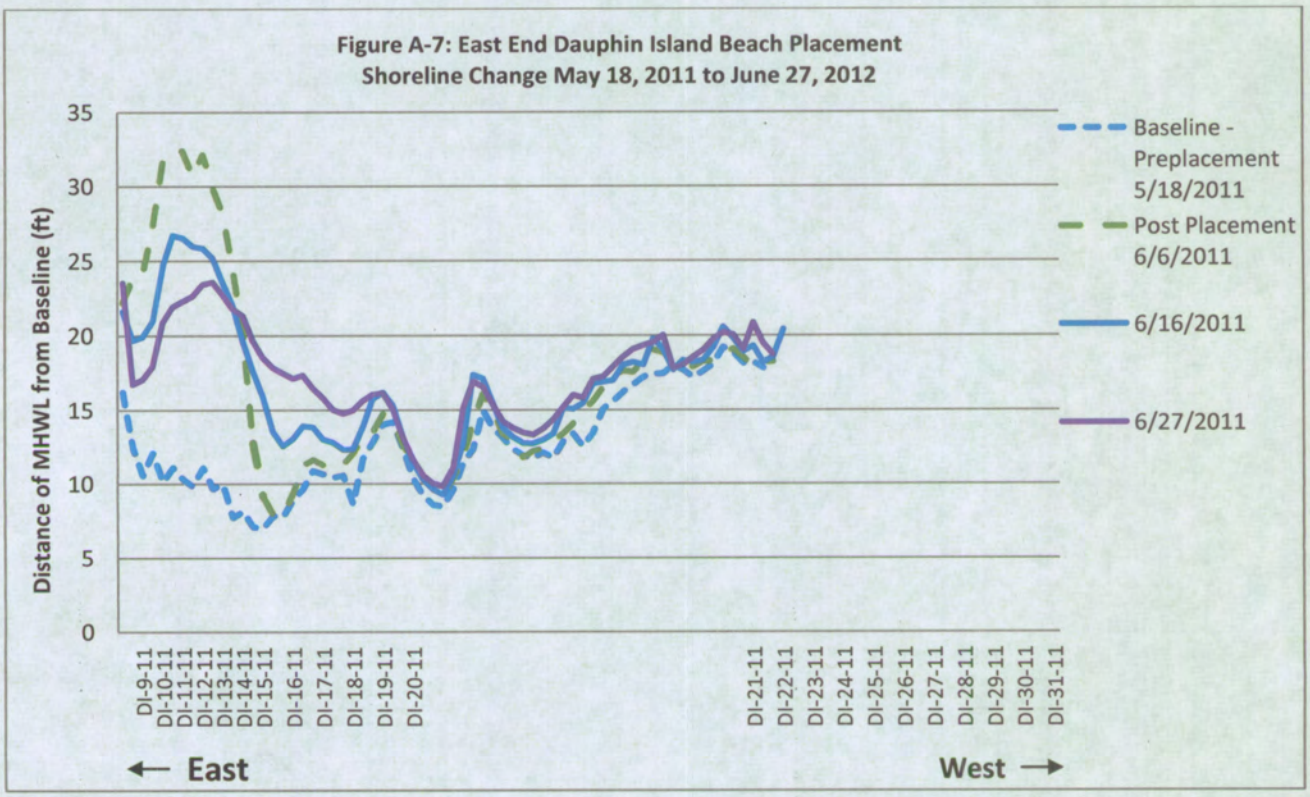


Figure A-7: East End Dauphin Island Beach Placement
Shoreline Change May 18, 2011 to June 27, 2012
Distance of MHWL from Baseline (ft)
35
30
25
20
15
10
5
0
DI-9-11
DI-10-11
DI-11-11
DI-12-11
DI-13-11
DI-14-11
DI-15-11
DI-16-11
DI-17-11
DI-18-11
DI-19-11
DI-20-11
DI-21-11
DI-22-11
DI-23-11
DI-24-11
DI-25-11
DI-26-11
DI-27-11
DI-28-11
DI-29-11
DI-30-11
DI-31-11
← East
West →
Baseline - Preplacement 5/18/2011
Post Placement 6/6/2011
6/16/2011
6/27/2011

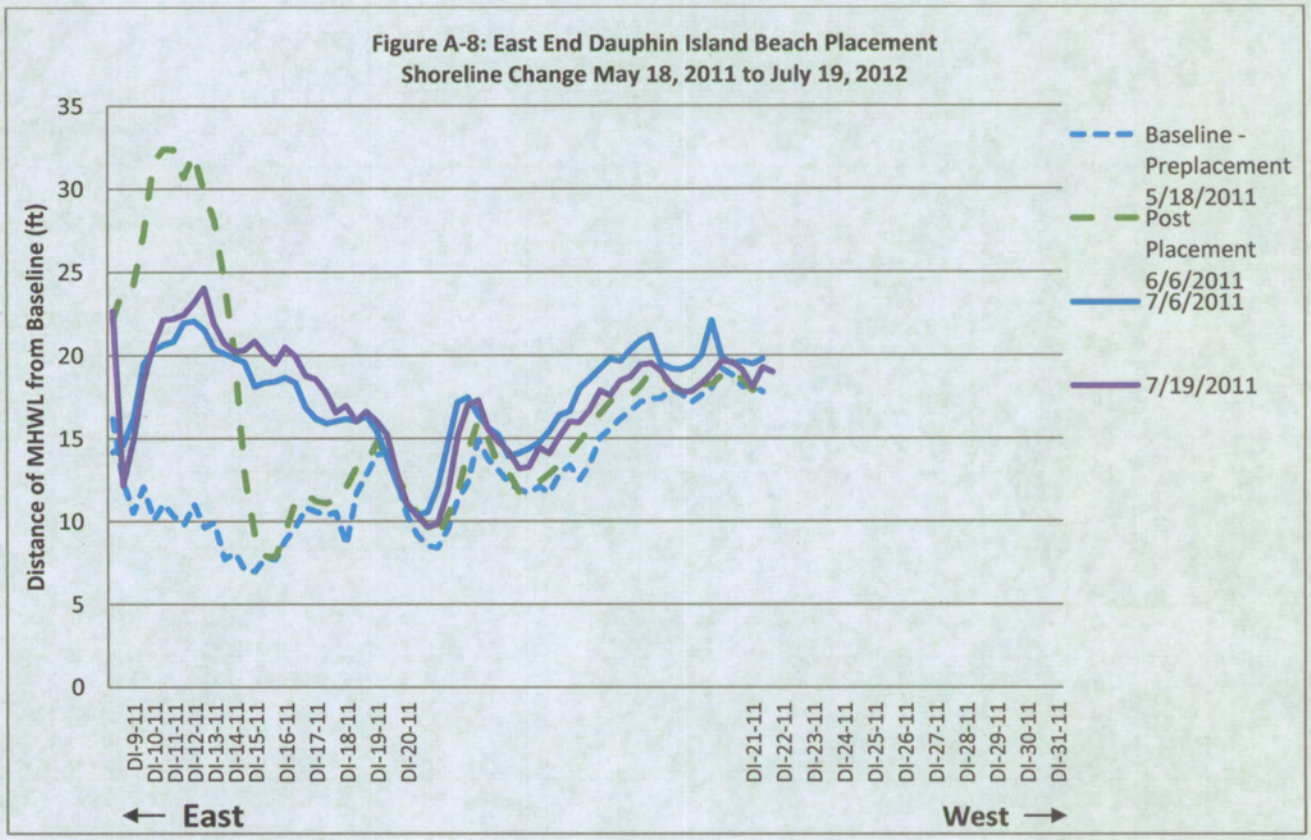


Figure A-8: East End Dauphin Island Beach Placement
Shoreline Change May 18, 2011 to July 19, 2012
Distance of MHWL from Baseline (ft)
35
30
25
20
15
10
5
0
DI-9-11
DI-10-11
DI-11-11
DI-12-11
DI-13-11
DI-14-11
DI-15-11
DI-16-11
DI-17-11
DI-18-11
DI-19-11
DI-20-11
DI-21-11
DI-22-11
DI-23-11
DI-24-11
DI-25-11
DI-26-11
DI-27-11
DI-28-11
DI-29-11
DI-30-11
DI-31-11
← East
West →
Baseline - Preplacement 5/18/2011
Post Placement 6/6/2011
7/6/2011
7/19/2011

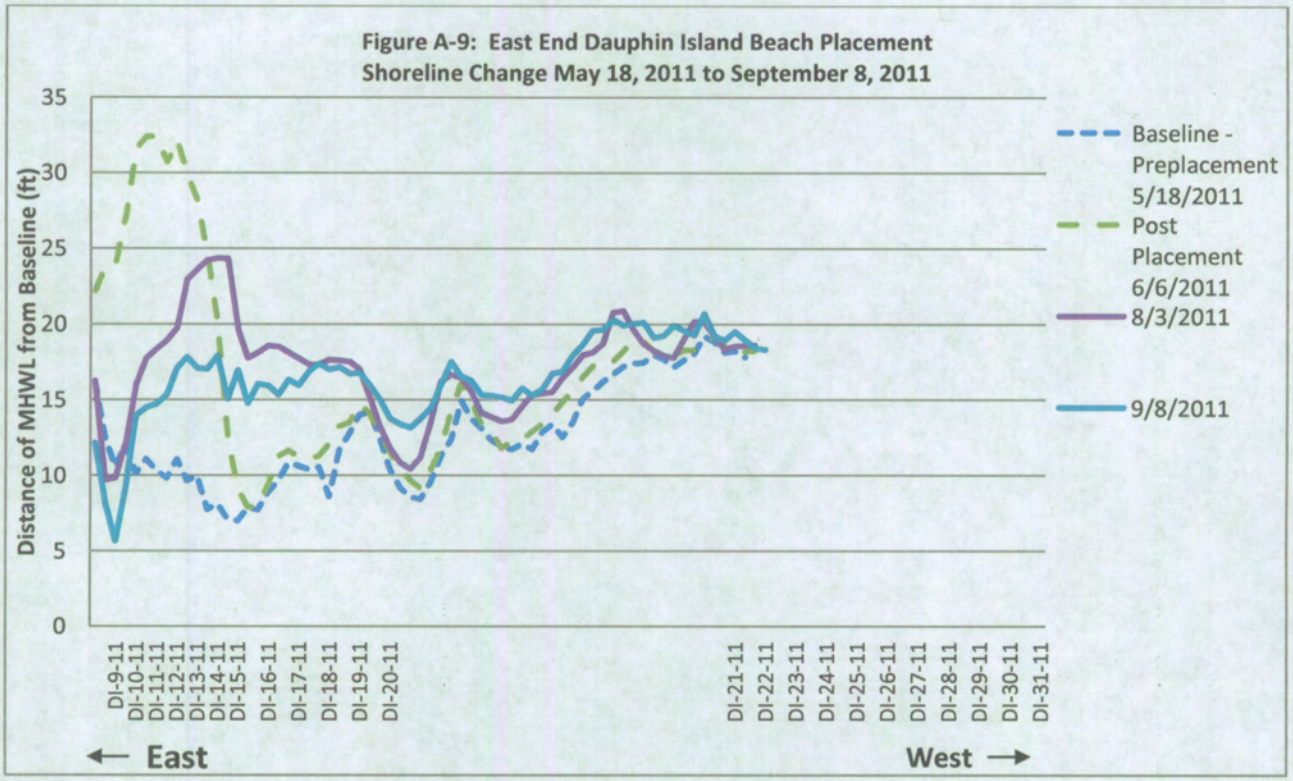


Figure A-9: East End Dauphin Island Beach Placement
Shoreline Change May 18, 2011 to September 8, 2011
Distance of MHWL from Baseline (ft)
35
30
25
20
15
10
5
0
DI-9-11
DI-10-11
DI-11-11
DI-12-11
DI-13-11
DI-14-11
DI-15-11
DI-16-11
DI-17-11
DI-18-11
DI-19-11
DI-20-11
DI-21-11
DI-22-11
DI-23-11
DI-24-11
DI-25-11
DI-26-11
DI-27-11
DI-28-11
DI-29-11
DI-30-11
DI-31-11
← East
West →
Baseline - Preplacement 5/18/2011
Post Placement 6/6/2011
8/3/2011
9/8/2011

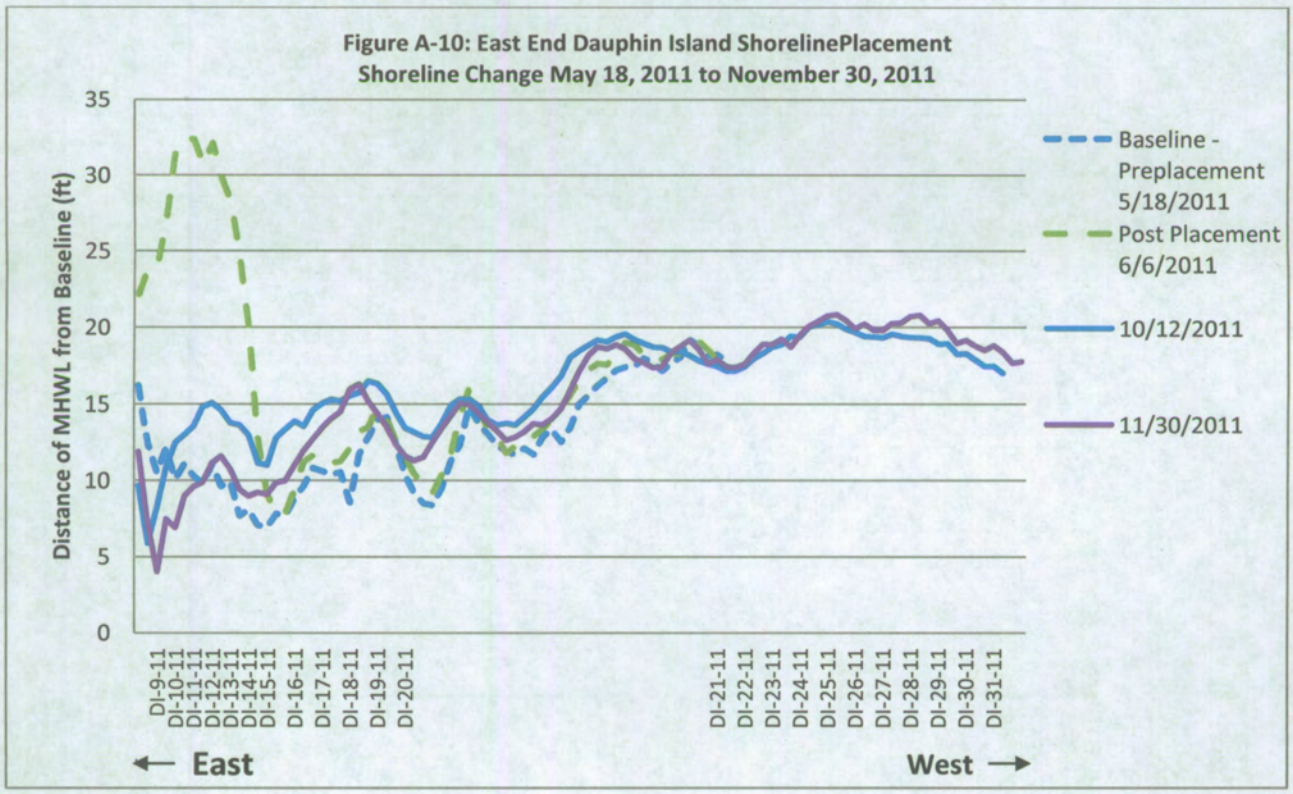


Figure A-10: East End Dauphin Island ShorelinePlacement
Shoreline Change May 18, 2011 to November 30, 2011
Distance of MHWL from Baseline (ft)
35
30
25
20
15
10
5
0
DI-9-11
DI-10-11
DI-11-11
DI-12-11
DI-13-11
DI-14-11
DI-15-11
DI-16-11
DI-17-11
DI-18-11
DI-19-11
DI-20-11
DI-21-11
DI-22-11
DI-23-11
DI-24-11
DI-25-11
DI-26-11
DI-27-11
DI-28-11
DI-29-11
DI-30-11
DI-31-11
← East
West →
Baseline - Preplacement 5/18/2011
Post Placement 6/6/2011
10/12/2011
11/30/2011

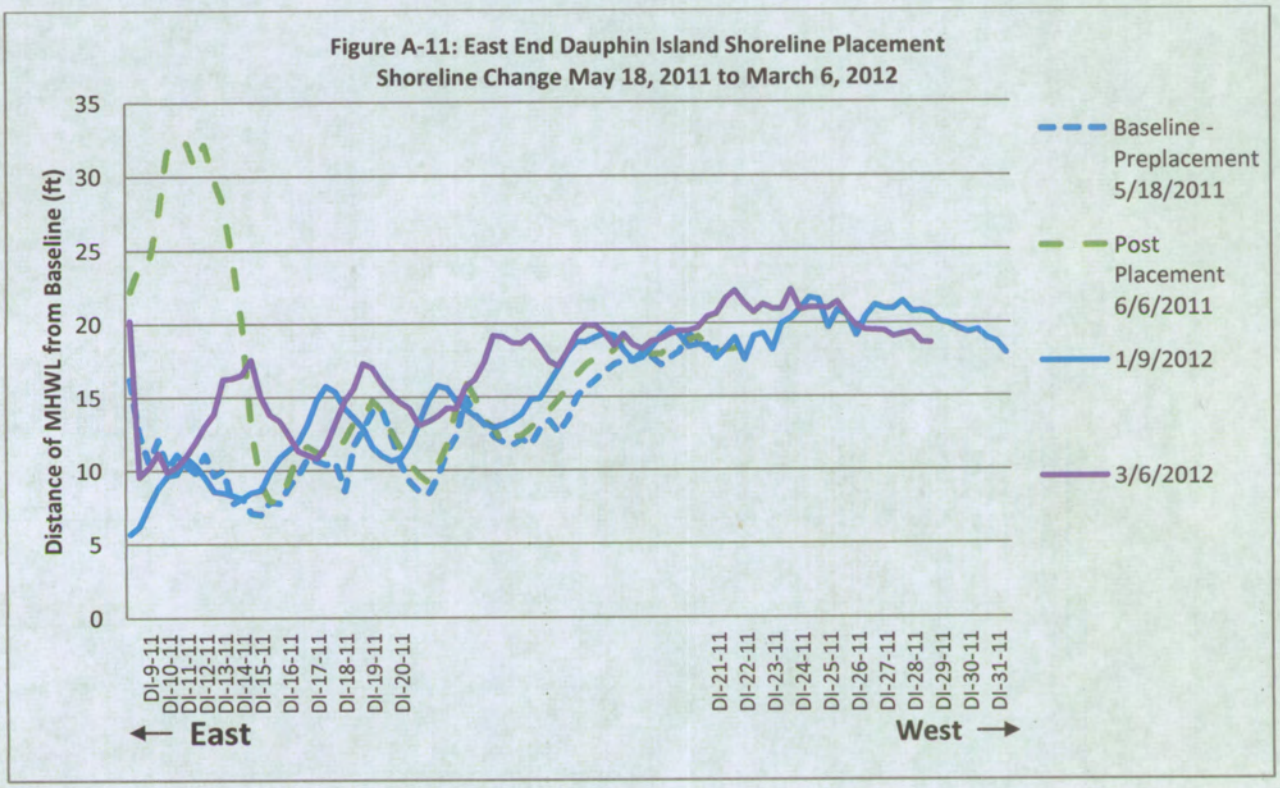


Figure A-11: East End Dauphin Island Shoreline Placement
Shoreline Change May 18, 2011 to March 6, 2012
Distance of MHWL from Baseline (ft)
35
30
25
20
15
10
5
0
DI-9-11
DI-10-11
DI-11-11
DI-12-11
DI-13-11
DI-14-11
DI-15-11
DI-16-11
DI-17-11
DI-18-11
DI-19-11
DI-20-11
DI-21-11
DI-22-11
DI-23-11
DI-24-11
DI-25-11
DI-26-11
DI-27-11
DI-28-11
DI-29-11
DI-30-11
DI-31-11
← East
West →
Baseline - Preplacement 5/18/2011
Post Placement 6/6/2011
1/9/2012
3/6/2012

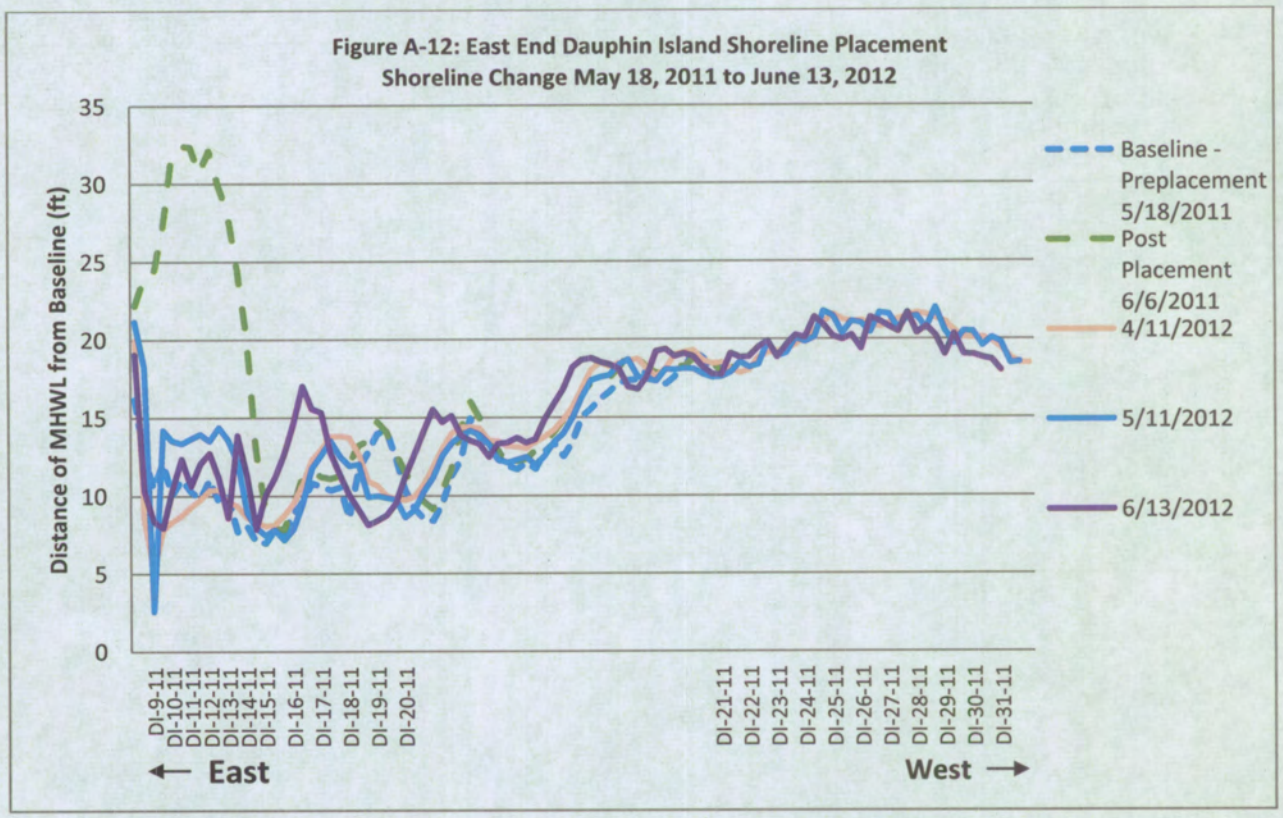


Figure A-12: East End Dauphin Island Shoreline Placement
Shoreline Change May 18, 2011 to June 13, 2012
Distance of MHWL from Baseline (ft)
35
30
25
20
15
10
5
0
DI-9-11
DI-10-11
DI-11-11
DI-12-11
DI-13-11
DI-14-11
DI-15-11
DI-16-11
DI-17-11
DI-18-11
DI-19-11
DI-20-11
DI-21-11
DI-22-11
DI-23-11
DI-24-11
DI-25-11
DI-26-11
DI-27-11
DI-28-11
DI-29-11
DI-30-11
DI-31-11
← East
West →
Baseline - Preplacement 5/18/2011
Post Placement 6/6/2011
4/11/2012
5/11/2012
6/13/2012

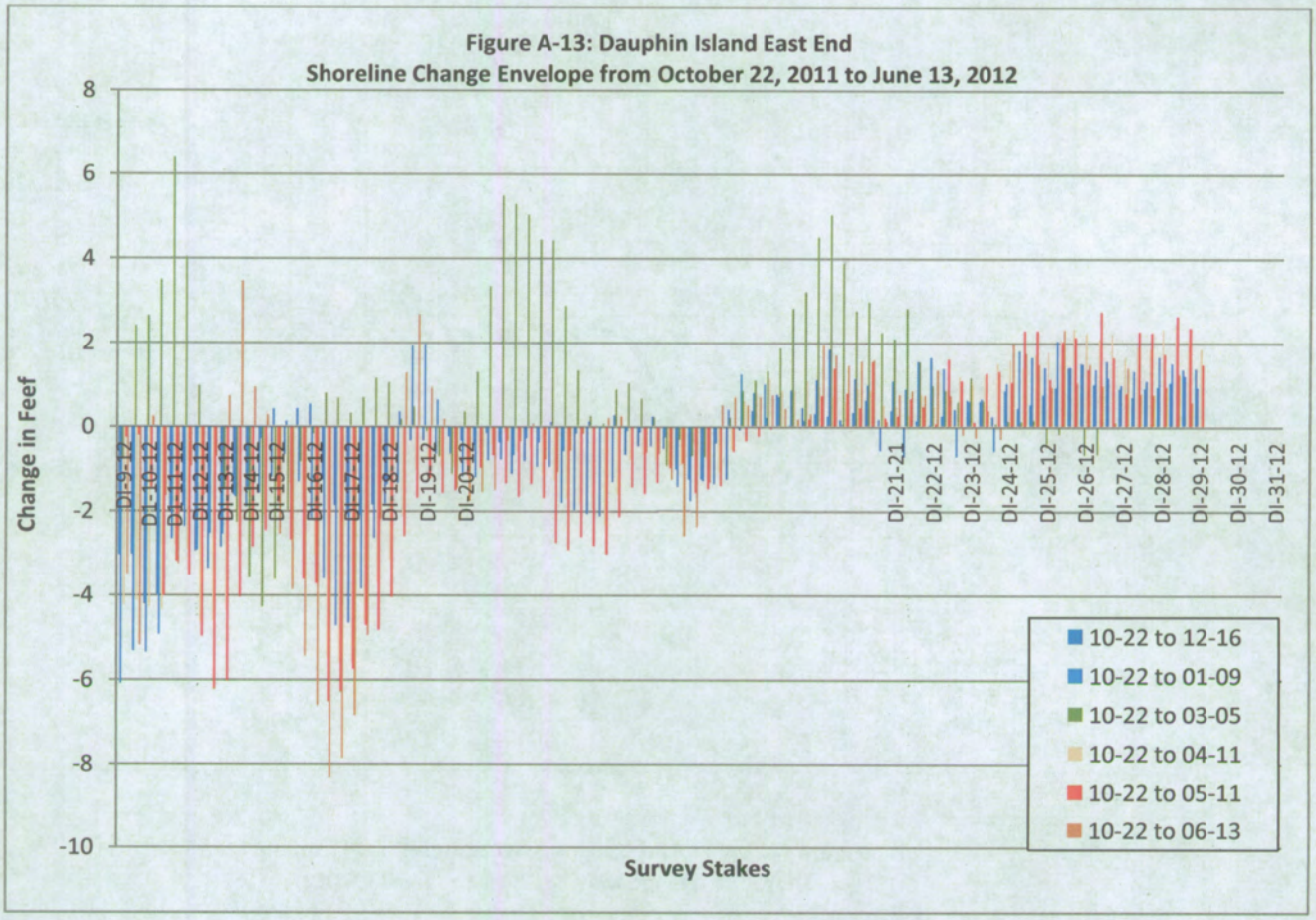


Figure A-13: Dauphin Island East End
Shoreline Change Envelope from October 22, 2011 to June 13, 2012
Change in Feef
8
6
4
2
0
-2
-4
-6
-8
-10
DI-9-12
DI-10-12
DI-11-12
DI-12-12
DI-13-12
DI-14-12
DI-15-12
DI-16-12
DI-17-12
DI-18-12
DI-19-12
DI-20-12
DI-21-21
DI-22-12
DI-23-12
DI-24-12
DI-25-12
DI-26-12
DI-27-12
DI-28-12
DI-29-12
DI-30-12
DI-31-12
Survey Stakes
10-22 to 12-16
10-22 to 01-09
10-22 to 03-05
10-22 to 04-11
10-22 to 05-11
10-22 to 06-13

APPENDIX B BATHYMETRIC CHANGE

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.18 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- Survey Stake

Depth Difference Analysis Results
Recent Survey: East End Groin Placement 060611
Base Survey: East End Groin Placement 051811
Net Accretion: 1540 cy

0 25 50 100 150 200 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.18 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 06/16/2011
- Survey Stake

Depth Difference Analysis Results
Recent Survey: East End Groin Placement 061611
Base Survey: East End Groin Placement 060611
Net Accretion: 640 cy

0 25 50 100 150 200 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.18 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 06/27/2011
- Survey Stake

Depth Difference Analysis Results
Recent Survey: East End Groin Placement 062711
Base Survey: East End Groin Placement 060611
Net Accretion: 500 cy

0 25 50 100 150 200 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

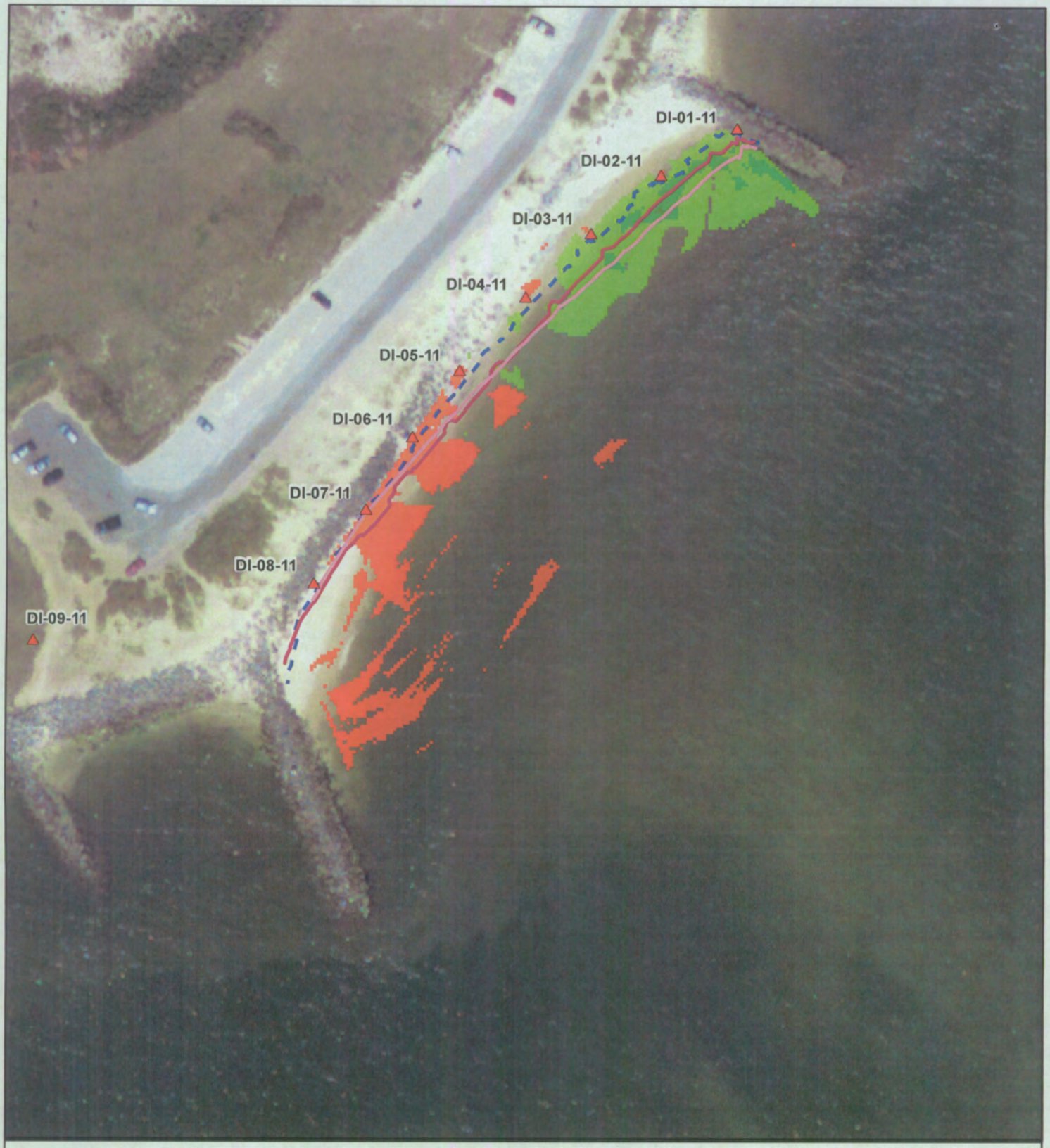
- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.18 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 07/06/2011
- Survey Stake

Depth Difference Analysis Results
Recent Survey: East End Groin Placement 070611
Base Survey: East End Groin Placement 060611
Net Accretion: 180 cy

0 25 50 100 150 200 Feet



Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.18 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 07/19/2011
- Survey Stake

Depth Difference Analysis Results
Recent Survey: East End Groin Placement 071911
Base Survey: East End Groin Placement 060611
Net Accretion: -101 cy

0 25 50 100 150 200 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.18 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 08/03/2011
- Survey Stake

Depth Difference Analysis Results
Recent Survey: East End Groin Placement 082211
Base Survey: East End Groin Placement 060611
Net Accretion: -250 cy

0 25 50 100 150 200 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.18 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 09/08/2011
- Survey Stake

Depth Difference Analysis Results
Recent Survey: East End Groin Placement 091411
Base Survey: East End Groin Placement 060611
Net Accretion: -270 cy

0 25 50 100 150 200 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.18 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 03/06/2012
- Survey Stake

Depth Difference Analysis Results
Recent Survey: East End Groin Placement 030512
Base Survey: East End Groin Placement 060611
Net Accretion: -200 cy

0 25 50 100 150 200 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.18 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 04/11/2012
- Survey Stake

Depth Difference Analysis Results
Recent Survey: East End Groin Placement 041112
Base Survey: East End Groin Placement 060611
Net Accretion: -370 cy

0 25 50 100 150 200 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.18 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 05/11/2012
- Survey Stake

Depth Difference Analysis Results
Recent Survey: East End Groin Placement 051112
Base Survey: East End Groin Placement 060611
Net Accretion: -115 cy

0 25 50 100 150 200 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.18 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 06/13/2012
- Survey Stake

Depth Difference Analysis Results
Recent Survey: East End Groin Placement 061312
Base Survey: East End Groin Placement 060611
Net Accretion: -15 cy

0 25 50 100 150 200 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.19 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- Survey Stake

Depth Difference Analysis Results
Recent Survey: Dauphin Island East End Shoreline Placement 060611
Base Survey: Dauphin Island East End Shoreline Placement 051811
Net Accretion: 5800 cy

0 125 250 500 750 1,000 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.19 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 06/16/2011
- Survey Stake

Depth Difference Analysis Results
Recent Survey: Dauphin Island East End Shoreline Placement 062811
Base Survey: Dauphin Island East End Shoreline Placement 060611
Net Accretion: 590 cy

0 125 250 500 750 1,000 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.19 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 06/27/2011
- Survey Stake

Depth Difference Analysis Results
Recent Survey: Dauphin Island East End Shoreline Placement 062711
Base Survey: Dauphin Island East End Shoreline Placement 060611
Net Accretion: 2420 cy

0 125 250 500 750 1,000 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.19 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 07/06/2011
- Survey Stake

Depth Difference Analysis Results
Recent Survey: Dauphin Island East End Shoreline Placement 070611
Base Survey: Dauphin Island East End Shoreline Placement 060611
Net Accretion: 5000 cy

0 125 250 500 750 1,000 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.19 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 07/19/2011
- Survey Stake

Depth Difference Analysis Results
Recent Survey: Dauphin Island East End Shoreline Placement 071911
Base Survey: Dauphin Island East End Shoreline Placement 060611
Net Accretion: 170 cy

0 125 250 500 750 1,000 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.19 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 08/03/2011
- Survey Stake

Depth Difference Analysis Results
Recent Survey: Dauphin Island East End Shoreline Placement 082211
Base Survey: Dauphin Island East End Shoreline Placement 060611
Net Accretion: 5630 cy

0 125 250 500 750 1,000 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.19 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 09/08/2011
- Survey Stake

Depth Difference Analysis Results
Recent Survey: Dauphin Island East End Shoreline Placement 091411
Base Survey: Dauphin Island East End Shoreline Placement 060611
Net Accretion: 5240 cy

0 125 250 500 750 1,000 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.19 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 03/06/2012
- Survey Stake

Depth Difference Analysis Results
Recent Survey: Dauphin Island East End Shoreline Placement 030512
Base Survey: Dauphin Island East End Shoreline Placement 060611
Net Accretion: 1030 cy

0 125 250 500 750 1,000 Feet

Dauphin Island Pilot Study

Depth Difference (feet)

- 3.5 - 5
- 2.5 - 3.5
- 1.5 - 2.5
- 0.5 - 1.5
- -0.5 - 0.5
- -1.5 - -0.5
- -2.5 - -1.5
- -2.5 - -3.5

Mean High Water Lines (1.19 feet MLLW)

- 05/18/2011 Baseline
- 06/06/2011 Post Placement
- 04/11/2012
- Survey Stake

Depth Difference Analysis Results
Recent Survey: Dauphin Island East End Shoreline Placement 041112
Base Survey: Dauphin Island East End Shoreline Placement 060611
Net Accretion: -4010 cy

0 125 250 500 750 1,000 Feet