TAYLOR ENGINEERING, INC.

Eglin AFB / Okaloosa County / Destin Sand Source Investigation- Okaloosa County, FL

October 2009

Eglin AFB/Okaloosa County/Destin Sand Source Investigation
Okaloosa County, Florida

Prepared for:

Florida Department of Environmental Protection

by:

Taylor Engineering, Inc.
10151 Deerwood Park Blvd., Bldg. 300, Suite 300
Jacksonville, FL 32256
(904) 731-7040

C2006-097, C2007-004, and C2007-023

October 2009

TABLE OF CONTENTS

APPENDICES

N.B. Due to the size of the appendices, they are included in electronic form on the enclosed CD.

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

1.1 Purpose

Taylor Engineering, Inc. conducted this study to define potential sand sources for beach management activities in Eglin Air Force Base (AFB), Okaloosa Island, and City of Destin. This study represents a cooperative effort between Eglin AFB and Okaloosa County to apply funding resources, realize cost savings, and define a suitable sand source for regional beach restoration projects.

1.2 Site Description

The current study investigated the state waters offshore Okaloosa County. The waters offshore Okaloosa County extend from the Santa Rosa County boundary to the Walton County boundary. Notably, Eglin AFB covers 17 miles of shoreline between the Santa Rosa County boundary and East Pass; Okaloosa Island, a three-mile long Gulf front beach community of Okaloosa County, interrupts the Eglin AFB property approximately three to six miles west of East Pass; and Destin, an incorporated city within Okaloosa County, extends from East Pass to the Walton County boundary. The boundary between state and federal waters lies 9 nautical miles offshore. Figure 1.1 shows the study area and the potential offshore sand sources discussed further in this report. These potential sources include a nearshore relic ebb tidal delta (OKA) centered approximately one mile offshore and three miles west of East Pass and an offshore relic shoreline (OKB) centered approximately eight miles offshore and less than one mile east of East pass. OKB lies at the southwest end of the 15-mile long northeast-southwest oriented ridge, centered about seven miles offshore eastern Okaloosa County.

1.3 Report Organization

Following this introduction, Chapter 2 discusses the scope of work. Chapter 3 describes the native beach sand characteristics within the study area and discusses acceptable sand source sediment characteristics. Chapters 4 and 5 present the data and analysis concerning sediment from potential borrow areas. Chapter 6 discusses the potential borrow sources and recommends a borrow site design. Chapter 7 concludes the report. Appendix A contains native beach data, Appendix B contains *Okaloosa County, Florida, Sand Source Investigation: Geophysical and Geotechnical Data Analysis*. (Stone & Associates, 2006), Appendix C contains *Eglin AFB, Okaloosa County, and Destin Sand Source Investigation* (American Vibracore Services, 2008), and Appendix D contains *Remote Sensing Survey, Diver Evaluation, and Identification of Submerged Resources for Eglin AFB/Okaloosa County/Destin Sand Source* (Panamerican Consultants, 2008).

TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD., BLDG. 300, STE. 300
JACKSONVILLE, FLORIDA 32256
CERTIFICATE OF AUTHORIZATION # 4815

Figure 1.1
Okaloosa County Potential Sand Source Location Map
Okaloosa County, Florida

PROJECT	C2007-023
DRAWN BY	JCH
DATE	AUG 2008

2.0 PROGRAM DEFINITION

2.1 Program Scope

This sand source investigation aimed to identify approximately 10,000,000 cubic yards (cy) of beach quality sand from an offshore source to serve regional beach restoration projects. Okaloosa County intends to restore 4.5 miles of beach including the 2.8-mile long Okaloosa Island segment from Florida Department of Environmental Protection (FDEP) reference monument R-1 to R-15 and the 1.7-mile long western Destin segment from R-17 to R-25.5. Eglin AFB intends to restore approximately 5.1 miles of beach including the beach segments V-508.5 – V-521.5 (2.5 miles), V-547 – V-553.8 (1.3 miles), and V-604.5 – V-611.5 (1.3 miles). The data collection programs discussed below assumed the final borrow site(s) would, in total, comprise approximately two square miles and allow an average 5-ft dredge cut.

This investigation began with a review of existing data to identify prospective borrow areas and identify the need for additional geophysical and geotechnical data. With several other sand source investigations completed or ongoing within or near the current study area (see Section 2.2), this literature and data review allowed the current study to tap all available resources and prevented the study from duplicating previous data collection efforts. This data review helped identify three prospective sites — a northeast-southwest oriented ridge centered approximately seven miles offshore Destin, the nearshore area extending about one to five miles offshore Eglin AFB and Okaloosa Island from the Santa Rosa County boundary to East Pass, and the nearshore area extending about one to five miles offshore Destin from East Pass to the Walton County boundary.

Following the data review phase, the reconnaissance data collection and analysis phase broadly explored the three above-mentioned prospective sites to evaluate their sand source potential and identify specific sub-sites with the greatest probability of containing beach quality sand. Two stages comprised the reconnaissance phase. First, collection and analysis of a sub-bottom seismic survey provided geophysical information of the sub-bottom sediment strata and helped identify logical locations for vibracore drilling. Second, collection and analysis of widely spaced 20-ft long vibracores provided specific geotechnical information about the sediment grain size distribution, percent fines, composition (carbonate and organic content), and color, and confirmed the geophysical signature ascertained by the sub-bottom seismic survey. Notably, the above-mentioned sediment characteristics determine the sediment’s compatibility with native beach sand and, therefore, suitability for use in beach nourishment. The reconnaissance data collection and analysis approximated the characteristics (locations, size, composition, and color) of sediment resources available within the study area and identified potential borrow sites warranting further investigation.

The subsequent detailed data collection and analysis phase conducted additional surveys, based on a high resolution survey and vibracore collection grid within the potential borrow sites identified in the reconnaissance phase, to define borrow sites. This phase consisted of a sub-bottom seismic (CHIRP) survey to identify the continuity of sediment strata in the borrow site(s), vibracore collection to characterize the sediment characteristics, a cultural resource survey (side-scan sonar and magnetometer surveys) to identify environmental features and obstructions and historical resources to avoid during dredging, and a bathymetry survey to provide data needed to determine the volume of beach quality sand in the borrow site(s). Collection and analysis of the above-mentioned data provided the necessary information for borrow site design.

Finally, the borrow site design phase used the results of the reconnaissance and detailed phase data collection and analysis phases to define the geometry (e.g., lateral boundaries and excavation depths) of the borrow site(s). Comparison of the borrow sediment characteristics to the native beach sand characteristics helped determine the borrow sediment compatibility with the native beach sand.

2.2 Review of Existing Data

2.2.1 Offshore Sediment Resources

Data previously collected and analyzed during the Walton County\Destin Sand Source Investigation (Stone and Roberts, 2001 – 2002) and the Walton County Sand Source Investigation (Stone, 2006) provided valuable information concerning potential offshore sand sources in the study area. Results of the reconnaissance and detailed level sub-bottom seismic surveys and vibracore collection from the previous studies, discussed below, helped define a data collection and analysis program for the current study.

The Walton County\Destin Sand Source Investigation identified the East Pass ebb tidal shoal vicinity as the optimal sand source for the Walton County\Destin Beach Restoration Project; Walton County and Destin used this borrow site during project construction between February 2006 and June 2007. Though the detailed phase of this study focused on the borrow area, the reconnaissance phase identified the previously-mentioned offshore sand ridge as a potential sand source with beach quality sand similar to the native beach in terms of grain size and composition but with a slightly darker in situ sand color. Note, Alpine Ocean Seismic Survey, Inc. conducted the seismic surveys and vibracore collection; Stone & Associates analyzed the geophysical and geotechnical data; Taylor Engineering conducted the color analysis.

The Walton County Sand Source Investigation evaluated the countywide nearshore region approximately one to five miles offshore and further investigated the offshore ridge. Results indicated the nearshore region contained beach quality sand in a few small pockets insufficient to supply the required beach fill volume. Results also indicated the offshore ridge contained a large volume of beach quality sand with similar grain size and content to the native beach but with a slightly darker in situ sand color. Importantly, this study recognized that no offshore sand deposits of significant size with in situ sand color identical to the native beach exist offshore Walton County. The study identified a borrow area in the northeast portion of the offshore ridge to serve the Walton County 30A Corridor Beach Restoration Project. Note, Alpine Ocean Seismic Survey collected vibracores; Sonographics, Inc. conducted the sub-bottom seismic surveys; Stone & Associates analyzed the geophysical and geotechnical data; Taylor Engineering completed the color analysis.

2.2.2 Native Beach Data

In conjunction with the Walton County\Destin Beach Management Feasibility Study (Taylor Engineering, 2003), the Okaloosa Island Beach Management Feasibility Study (Taylor Engineering, 2007), and the permitting process for the Eglin AFB Beach Restoration Project, Taylor Engineering collected and analyzed native beach sand samples from the proposed project areas in Eglin AFB, Okaloosa Island, and western Destin. The results of grain size, composition, and color tests helped characterize the native beach for this study (see Chapter 3).

3.0 NATIVE BEACH CHARACTERIZATION

Beach management activities that artificially place sand on the beach from upland or offshore sources must use sand similar to the native beach sand to maintain the beach's integrity. As such, this investigation characterized the native beach sand to establish acceptable borrow material criteria.

As mentioned in Section 2.2, previous studies collected and analyzed the native beach sand to determine the grain size distributions, composition, and color at representative locations. Taylor Engineering collected sand samples from the dune vegetation, dune toe, mid-berm, mean high water (MHW), and mean low water (MLW) positions at approximately one-mile intervals throughout Destin in 2003, Okaloosa Island in 2006, and Eglin AFB in 2007. Ellis & Associates, Inc. tested the native samples in the laboratory and determined the carbonate content and grain size distribution for each one. Taylor Engineering compared each moist sand sample to Munsell color charts (explained in Section 3.3) to determine its color classification. Notably, the grain size distribution tests originally conducted on the Destin and Okaloosa Island samples did not conform to current FDEP standards; thus, Ellis & Associates retested the samples. This report documents the updated results that conform to current standards. Appendix A contains reports by Ellis & Associates with the native beach data used in this study.

3.1 Carbonate Content Analysis

Ellis & Associates conducted acid digestion tests on the native beach sand samples to determine the carbonate percentage. The results, shown in Table 3.1, confirm that the native beach sand contains predominantly quartzitic sand with minimal carbonates. Overall, the three project areas contain similar quantities of carbonates.

Table 3.1 Carbonate Content of Native Beach Sand

Sample No.	Calcium Carbonate Content (%)				
	Dune Vegetation	**Dune Toe**	**Mid-Berm**	**MHW**	**MLW**
Eglin AFB					
V-501	0.00	0.06	0.00	0.01	0.01
V-506	0.00	0.00	0.00	0.03	0.04
V-511	0.00	0.00	0.00	0.00	0.09
V-517	0.00	0.00	0.00	0.01	0.00
V-522	0.00	0.00	0.00	0.01	0.03
V-527	0.00	0.00	0.00	0.00	0.00
V-532	0.00	0.00	0.00	0.00	0.00
V-537	0.00	0.00	0.00	0.00	0.00
V-543	0.00	0.00	0.07	0.00	0.00
V-548	0.00	0.00	0.0	0.00	0.00
V-608	0.09	0.00	0.00	0.00	0.00
V-614	0.00	0.00	0.00	0.11	0.13
V-618	0.00	0.00	0.00	0.02	0.10
Average	***0.01***	***0.00***	***0.01***	***0.01***	***0.03***
Okaloosa Island					
R-1	-	-	0.00	0.00	0.00
R-6	-	-	0.00	0.00	0.00
R-11	0.00	0.00	0.00	0.00	0.00
R-16	0.00	0.00	0.00	0.00	0.00
Average	***0.00***	***0.00***	***0.00***	***0.00***	***0.00***
Destin					
R-17	0.12	0.15	0.05	0.04	0.50
R-20	0.32	0.27	0.14	0.12	0.27
R-25	0.30	0.08	0.78	0.69	0.42
R-30	0.01	0.40	0.21	0.09	0.05
Average	***0.19***	***0.90***	***0.30***	***0.24***	***0.31***

3.2 Grain Size Analysis

Ellis & Associates performed sieve tests on the native beach sand samples to determine grain size distributions. Sieve tests included U.S. Standard Sieve sizes 3/4”, 5/8”, 3.5, 4, 5, 7, 10, 14, 18, 25, 35, 45, 60, 80, 120, 170, and 230. Ellis & Associates provided Taylor Engineering with the weight percentage of each sample retained by each sieve. After converting U.S. Standard Sieve sizes into phi values, Taylor Engineering used the moments method to calculate mean grain sizes and sorting. Table 3.2 presents mean grain sizes and sorting representative of each transect, and Table 3.3 shows the mean grain sizes and sorting representative of each sampling location averaged across all transects. The overall mean grain sizes in Eglin AFB, Okaloosa Island, and Destin equal 1.48 phi (0.36 mm), 1.51 phi (0.35 mm), and 1.68 phi (0.31 mm).

Figures 3.1 – 3.4 represent the mean grain sizes contained in Tables 3.2 and 3.3. The vertical bars in these figures represent sorting. Figure 3.1 shows little variation in the native beach grain size throughout the project areas. The material consists of well- to moderately well-sorted medium sand (grain size between 1 and 2 phi). Figures 3.2 – 3.4 show that the subaerial beaches have smaller mean grain sizes than the intertidal zones. The subaerial beach mean grain size equals 1.52 phi (0.35 mm) in Eglin AFB, 1.65 phi (0.32 mm) in Okaloosa Island, and 1.74 phi (0.30 mm) in Destin. The intertidal mean grain sizes in Eglin AFB, Okaloosa Island, and Destin equal 1.43 phi (0.37 mm), 1.37 phi (0.39 mm), and 1.68 phi (0.31 mm).

The final component of grain size analysis is the percent fines. Fines pass through U.S. Standard Sieve size 230, and so measure less than 0.06 mm. Sediment with a grain size smaller than 0.06 mm is classified as silt, so this report uses the terms “percent fines” and “silt content” interchangeably. Borrow area material must have silt content similar to that of the native beach sand to maintain the beach’s integrity. Table 3.4 contains the percent fines, which range from 0.0% to 0.24%.

Overall the native beaches of Eglin AFB, Okaloosa Island, and Destin contain similar mean grain sizes; thus, the three project areas could potentially share a common borrow area. However, determining accurate overfill ratios requires compatibility analyses with the native beach sand of each individual project area.

Table 3.2 Mean Grain Size and Sorting of the Native Beach by Monument

Monument	Mean Grain Size (phi)	Mean Grain Size (mm)	Sorting (phi)
Eglin AFB			
V-501	1.50	0.35	0.44
V-506	1.45	0.37	0.52
V-511	1.41	0.38	0.46
V-517	1.54	0.34	0.45
V-522	1.23	0.43	0.46
V-527	1.39	0.38	0.43
V-532	1.57	0.34	0.42
V-537	1.46	0.36	0.44
V-543	1.47	0.36	0.47
V-548	1.57	0.34	0.42
V-608	1.42	0.37	0.66
V-614	1.52	0.35	0.47
V-618	1.73	0.30	0.53
Average	***1.48***	***0.36***	***0.48***
Okaloosa Island			
R-1	1.49	0.36	0.57
R-6	1.35	0.39	0.61
R-11	1.45	0.37	0.46
R-16	1.68	0.31	0.40
Average	***1.51***	***0.35***	***0.56***
Destin			
R-17	1.76	0.29	0.42
R-20	1.79	0.29	0.44
R-25	1.66	0.32	0.42
R-30	1.69	0.31	0.43
R-40	1.70	0.31	0.43
R-45	1.52	0.35	0.47
Average	***1.68***	***0.31***	***0.44***

Table 3.3 Mean Grain Size and Sorting of the Native Beach Sand by Sample Location

Location	**Mean Grain Size (phi)**	**Mean Grain Size (mm)**	**Sorting (phi)**
Eglin AFB			
Dune Veg	1.51	0.35	0.47
Dune Toe	1.45	0.37	0.48
Mid-Berm	1.61	0.33	0.40
MHW	1.44	0.37	0.48
MLW	1.41	0.38	0.52
Average	***1.48***	***0.36***	***0.48***
Okaloosa Island			
Dune Veg	1.56	0.34	0.41
Dune Toe	1.78	0.29	0.35
Mid-Berm	1.63	0.32	0.51
MHW	1.56	0.34	0.42
MLW	1.18	0.44	0.54
Average	***1.51***	***0.35***	***0.51***
Destin			
Dune Veg	1.76	0.30	0.50
Dune Toe	1.70	0.31	0.39
Mid-Berm	1.77	0.29	0.36
MHW	1.62	0.33	0.44
-3ft	1.55	0.34	0.46
Average	***1.68***	***0.31***	***0.44***

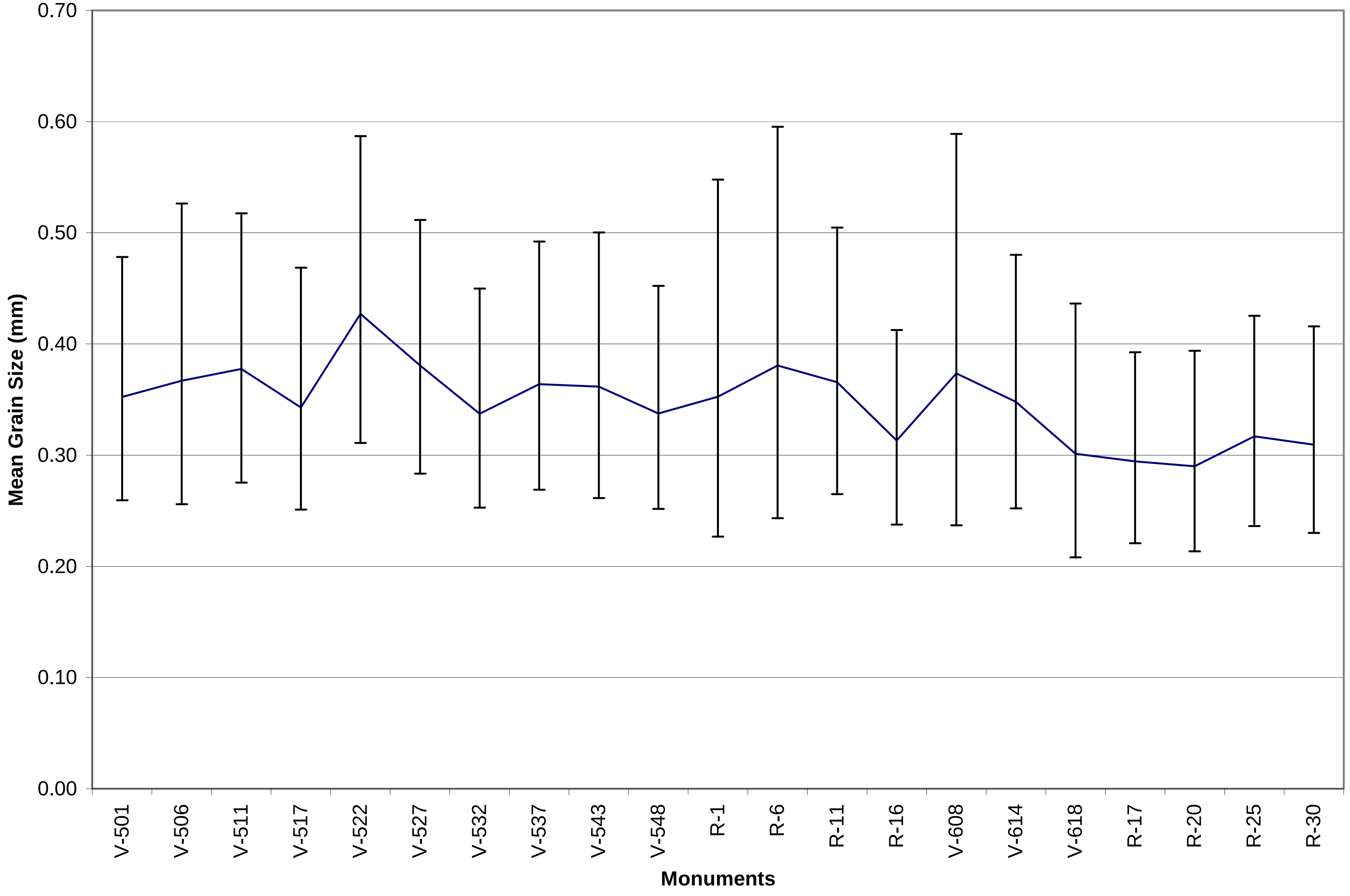


Figure 3.1 Mean and Standard Deviation of Native Sand in Eglin AFB, Okaloosa Island, and Western Destin

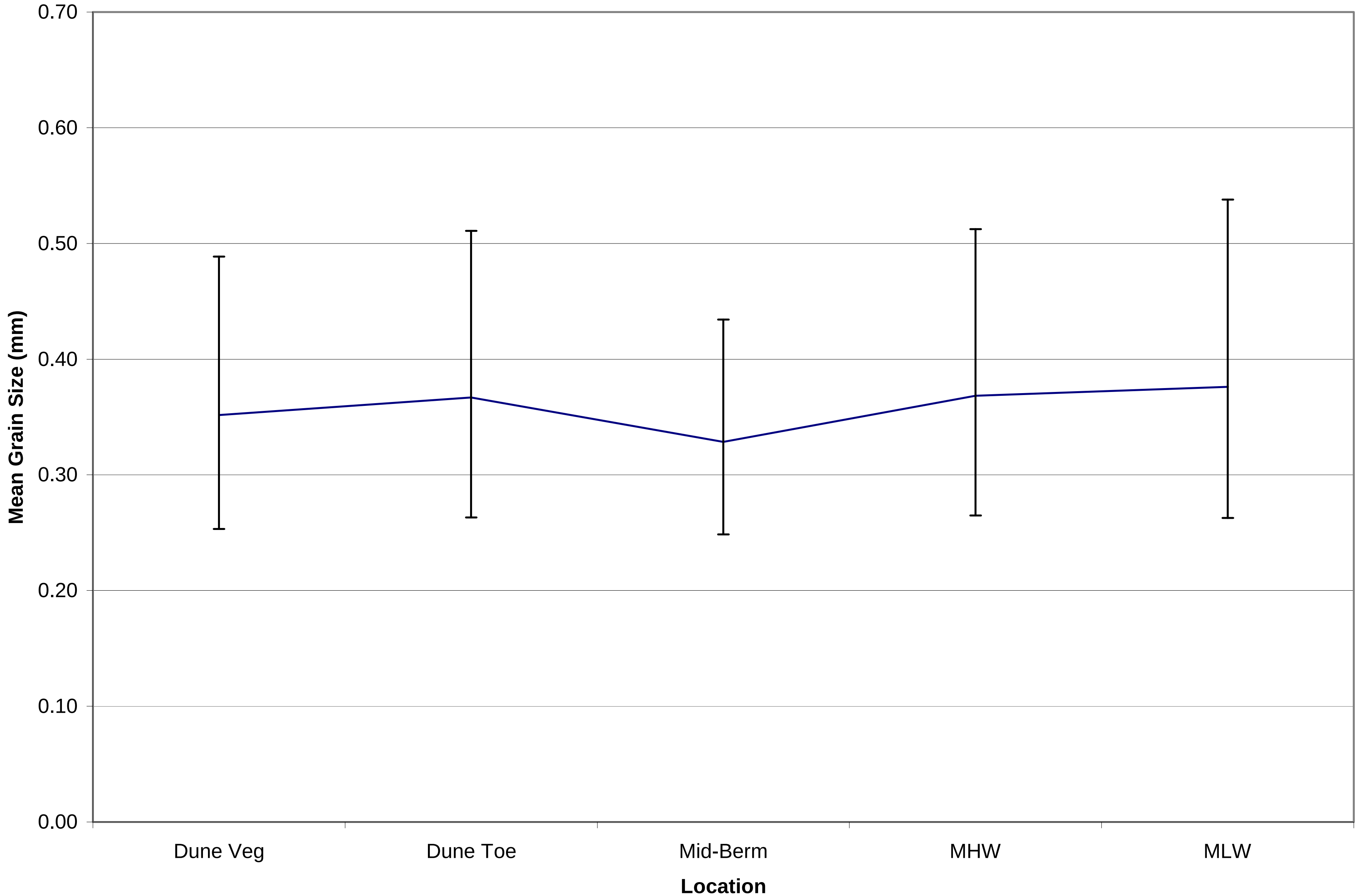


Figure 3.2 Mean and Standard Deviation of Native Sand by Sample Location in Eglin AFB

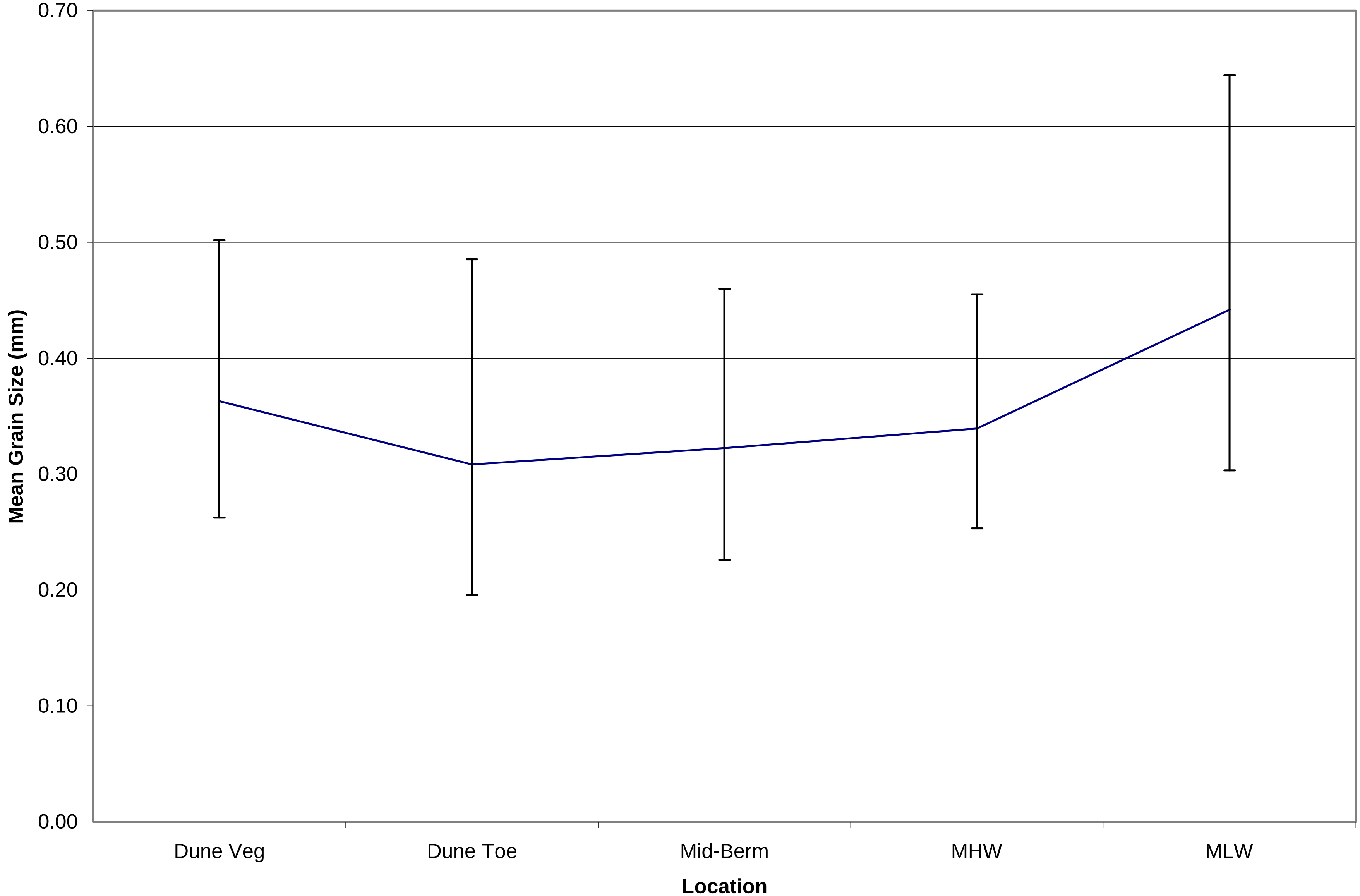


Figure 3.3 Mean and Standard Deviation of Native Sand by Sample Location in Okaloosa Island

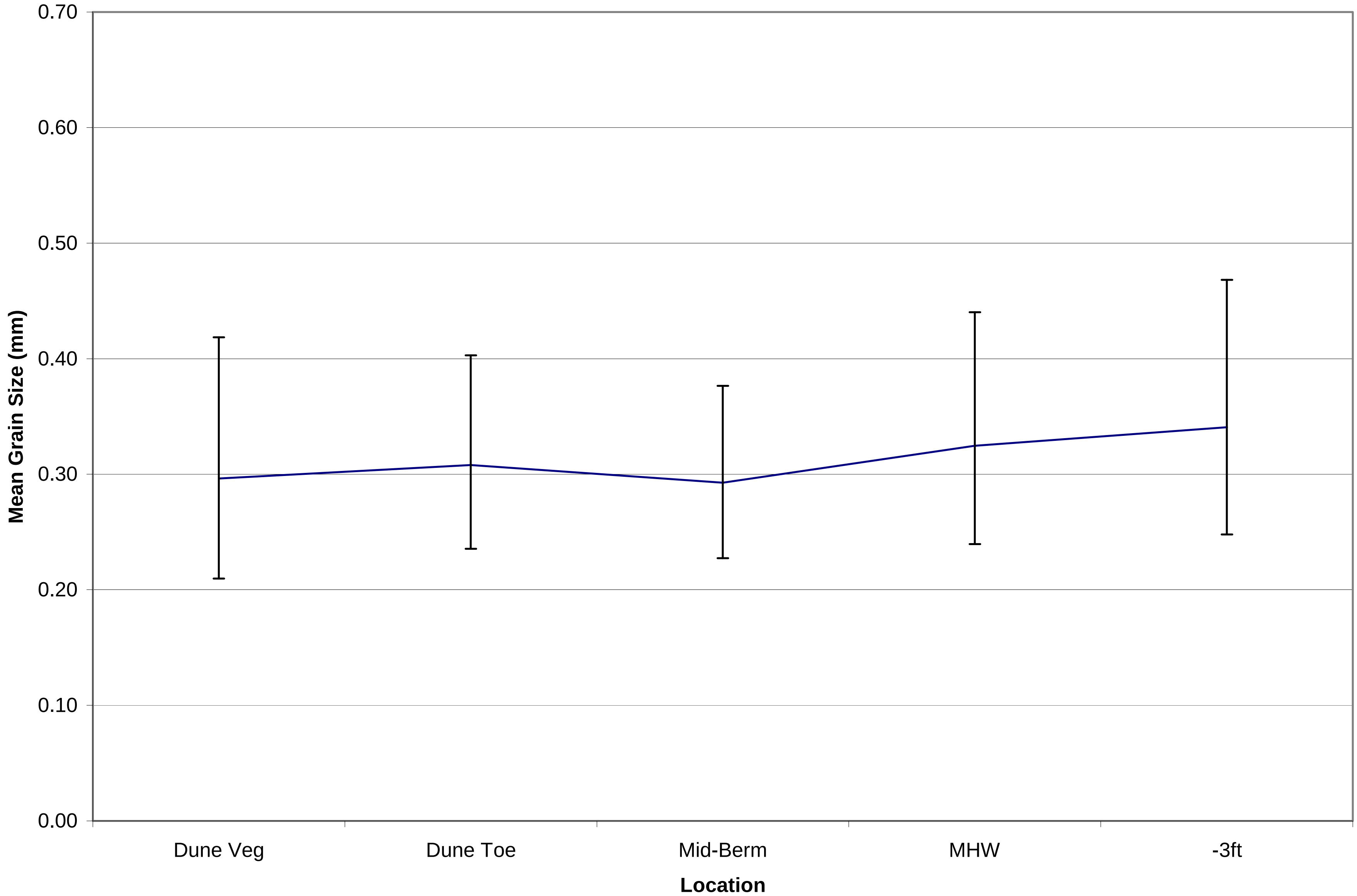


Figure 3.4 Mean and Standard Deviation of Native Sand by Sample Location in Western Destin

Table 3.4 Percent Fines in All Native Beach Samples

Monument	Percent Fines (Percent Passing Sieve No. 230)				
Eglin AFB					
	Dune Veg	**Dune Toe**	**Mid-Berm**	**MHW**	**MLW**
V-501	0.06	0.00	0.03	0.08	0.07
V-506	0.08	0.15	0.01	0.04	0.02
V-511	0.08	0.05	0.06	0.00	0.00
V-517	0.10	0.09	0.05	0.01	0.00
V-522	0.07	0.10	0.04	0.07	0.03
V-527	0.02	0.06	0.01	0.04	0.02
V-532	0.04	0.08	0.01	0.05	0.06
V-537	0.02	0.02	0.03	0.01	0.01
V-543	0.06	0.03	0.03	0.01	0.02
V-548	0.02	0.03	0.01	0.01	0.02
V-608	0.03	0.05	0.02	0.03	0.10
V-614	0.01	0.05	0.02	0.03	0.13
V-618	0.01	0.04	0.06	0.09	0.10
Average	***0.05***	***0.06***	***0.03***	***0.04***	***0.04***
Okaloosa Island					
	Dune Veg	**Dune Toe**	**Mid-Berm**	**MHW**	**MLW**
R-1	-	-	0.14	0.03	0.05
R-6	-	-	0.17	0.01	0.04
R-11	0.11	0.11	0.10	0.01	0.03
R-16	0.12	0.09	0.10	0.01	0.03
Average	***0.15***	***0.16***	***0.13***	***0.02***	***0.04***
Western Destin					
	Dune Veg	**Dune Toe**	**Mid-Berm**	**MHW**	**-3ft**
R-17	0.24	0.02	-	0.02	0.05
R-20	0.12	-	0.02	0.05	0.04
R-25	0.11	0.10	0.13	0.03	0.11
R-30	0.05	0.05	0.02	0.14	0.02
R-40	0.24	0.09	0.02	-	0.03
R-45	0.08	0.12	0.06	0.07	0.13
Average	***0.14***	***0.08***	***0.05***	***0.06***	***0.06***

3.3 Color Analysis

Residents and visitors cherish the beaches of Okaloosa County for their very white clean sand. Thus, renourishment activity must address maintenance of the native beach sand color. This section discusses the color of the native beach sand samples, which represent five locations — the dune vegetation, dune toe, mid-berm, MHW shoreline, and MLW positions — at shore-perpendicular transects spaced approximately one mile apart.

The color analysis used the Munsell Soil Color Charts distributed by Munsell Color. The Munsell system describes color by three characteristics: hue, value, and chroma. The hue notation of a color indicates its relation to red, yellow, green, blue, and purple. The Munsell symbol for hue is the letter abbreviation of the color of the rainbow (R for red, Y for yellow, YR for yellow-red) preceded by numbers ranging from 0 to 10. Within each letter range, the hue becomes more yellow and less red as the numbers increase. The value notation indicates its lightness. The Munsell symbol for value spans from 0 for absolute black to 10 for absolute white. Thus, a value of 5 falls visually midway between absolute white and absolute black. Finally, the chroma notation indicates strength, or departure from a neutral of the same lightness. The Munsell symbol for chroma consists of numbers increasing from 0 for neutral gray to a maximum of 20. This maximum is never really approached in soil. The Munsell notation for defining color is written as hue, value, chroma with a space between the hue letter and the succeeding value number, and a diagonal between the two numbers for value and chroma. Thus, the notation for a color of hue 5YR, value 5, chroma 6, is 5YR 5/6, a yellowish-red.

The color analysis determined the Munsell color classification of all the native beach sand samples in Okaloosa County. Taylor Engineering described the majority of them as Munsell Color 5Y 8/1 (white) and described several other samples as 5Y 7/1. Notably, the native beach, having been exposed to sunlight and weathering over long periods of time, is lighter in color than in situ potential borrow materials identified in previous sand source investigations (see Section 2.2).

To help establish acceptable borrow material color criteria, the current study evaluated the effects of sun bleaching on sediment color. The color test exposed 40 potential offshore borrow material samples — representing various core borings collected during the detail phase of the investigation (Chapter 5) — to the Florida sun between 12/7/2007 and 3/17/2008 (99 days). Of the 40 samples, 23 began as value 7 and 13 began as value 6. The samples represented various vibracore depths, ranging between 0 ft and 18 ft. The test results, presented in Table 3.5, indicate that all samples with a Munsell value/chroma of 7/1, 7/2, or 7/3 turned white or nearly white (value of 8) due to weathering within 99 days of placement.

Approximately 85% of placed sand with a Munsell value/chroma of 6/1, 6/2, or 6/3 lightened in value to at least 7 within that same period.

Table 3.5 Effects of Sun Bleaching over 99 Days on the Munsell Colors of 40 Vibracore Samples

Moist Initial Color	Total Number	Value Increase After Bleaching				Chroma Decrease After Bleaching		
		2	1	0	-1	2	1	0
All 6 & 7	36	4	30	1	1	1	25	10
All 7	23	0	23	0	0	1	14	8
All 6	13	4	7	1	1	0	11	2
5Y 7/1	6	0	6	0	0	0	0	6
5Y 7/2	15	0	15	0	0	0	13	2
5Y 6/2	11	4	6	1	0	0	11	0

Importantly, the weathering analysis discussed above likely underestimates the level of lightening the beach fill will experience for two reasons. First, the borrow material will undergo a rigorous washing affect through particle abrasion as the sand travels through the dredge pipes during dredge loading and offloading. Second, wind and waves will weather the beach fill. The weathering analysis did not account for such weathering actions.

3.4 Acceptable Borrow Material Characteristics

Collecting the results of Sections 3.1 – 3.3, Taylor Engineering created the borrow sediment guidelines shown in Table 3.6. Designing a borrow site with sediment that adheres to these parameters should ensure the compatibility of the borrow area sediment with that of the native beach sand. Table 3.6 presents summary data from 108 native beach sediment samples taken from Eglin Air Force Base, Okaloosa Island, and west Destin.

Table 3.6 Sediment Characteristics

Sediment Parameter	Native Beach Limits	Borrow Area Acceptable Material Limits
Silt Content	0.0 – 0.2%	0.0 – 2.5%
Shell Content	0.0 – 0.8%	0.0 – 5.0%
Mean Grain Size	0.24 – 0.52 mm	0.24 - 0.52 mm
Allowable Moist Munsell Color	5Y 8/1 or lighter	5Y 6/2 or lighter[1]

[1] Borrow areas may contain a portion of sand with an in-situ Munsell value of 6; however, the placed beach fill shall have a Munsell value of 7.

4.0 RECONNAISSANCE PHASE DATA COLLECTION AND ANALYSIS

The review of existing data, discussed in Chapter 2, identified three prospective sites — a northeast-southwest oriented ridge centered approximately seven miles offshore Destin, the nearshore segment extending one to five miles offshore Eglin AFB and Okaloosa Island from the Santa Rosa County boundary to East Pass, and the nearshore area extending one to five miles offshore Destin from East Pass to the Walton County boundary. The reconnaissance data collection and analysis phase broadly explored these three prospective sites to evaluate their sand source potential and identify specific sub-sites with the greatest probability of containing beach quality sand.

Two stages comprised the reconnaissance phase. First, collection and analysis of a sub-bottom seismic survey provided geophysical information of the sub-bottom sediment strata and helped identify logical locations for vibracore drilling. Second, collection and analysis of widely spaced 20-ft-long vibracores provided specific geotechnical information about the sediment grain size distribution, percent fines, composition (carbonate and organic content), and color, and confirmed the geophysical signature ascertained by the sub-bottom seismic survey. In total, the reconnaissance phase collected 70 cores throughout the nearshore areas of Eglin AFB, Okaloosa Island, and Destin and 8 cores along the offshore sand ridge. The above data collection and analysis efforts provided a rough approximation of the characteristics (locations, size, composition, and color) of sediment resources available within the study area and identified potential borrow sites warranting further investigation.

4.1 Analysis of Reconnaissance Phase Geophysical Data

Sonographics conducted the reconnaissance phase sub-bottom seismic data collection. Sonographics used an EdgeTech 512i towfish and Full Spectrum Sub-Bottom (FSSB) Topside Unit profiling system to collect high resolution seismic reflection profiles within the study areas. The X-Star Full Spectrum Sonar, a wide-band FM sub-bottom profiler, generates cross-sectional images of the seabed and collects digital normal incidence reflection data over many frequency ranges. Stone & Associates calibrated these data to the reconnaissance phase vibracores to interpret subsurface stratification and sand thickness. Figure 4.1 shows the approximate track line locations of the seismic survey. Notably, a previous sand source investigation for Walton County provided sub-bottom seismic survey data of the offshore sand ridge.

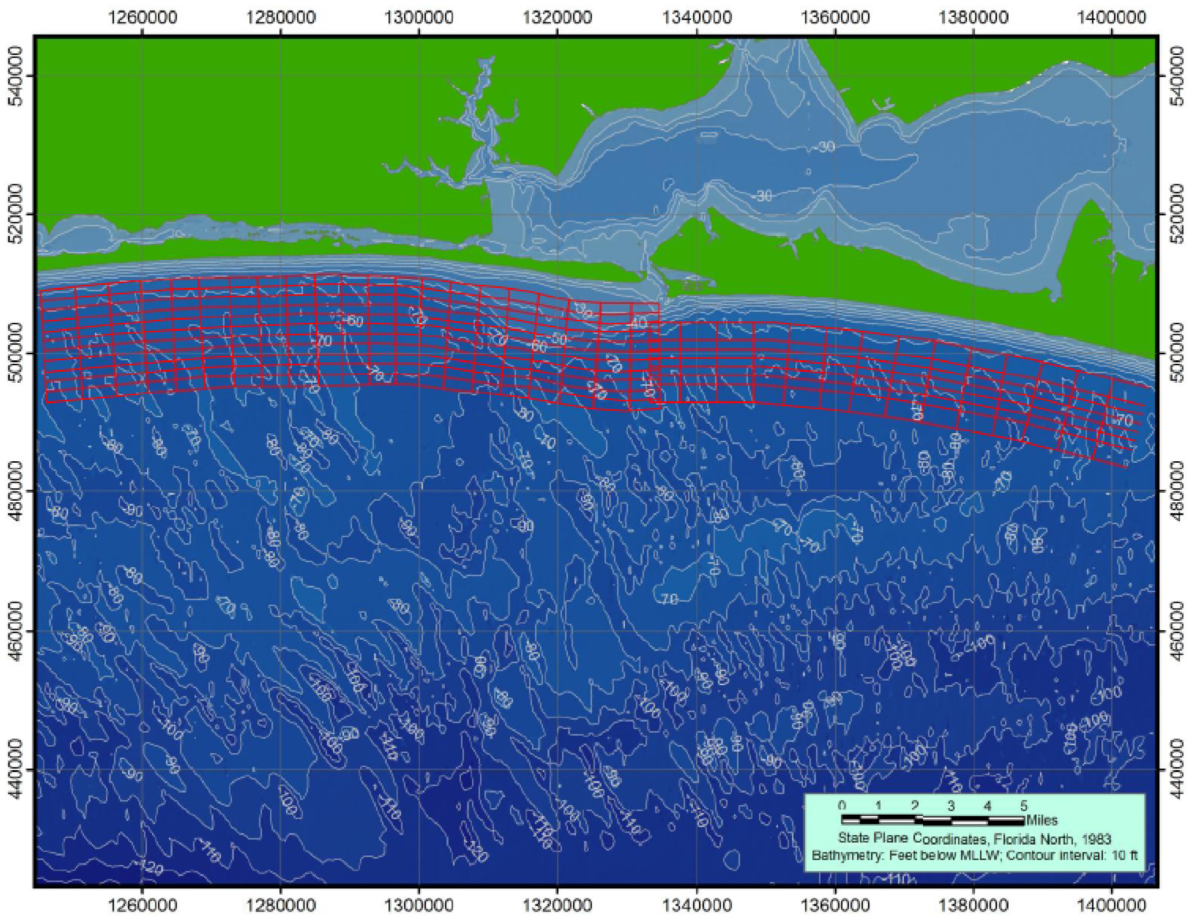


Figure 4.1 Reconnaissance Phase Seismic Line Locations Offshore Okaloosa County

Figure 4.2, an example image produced in the seismic survey, shows the reflections from the scan line near core boring OK-34, on the inner-shelf southwest of East Pass. These subsurface strata data, combined with corresponding geotechnical data, helped interpret borrow area stratification and sand thickness. Stone & Associates (2007), included in Appendix B, observed many vibracores from this area that confirmed thick sequences of high quality sand. This sand appears compatible in color and size with requirements for local beach nourishment projects.

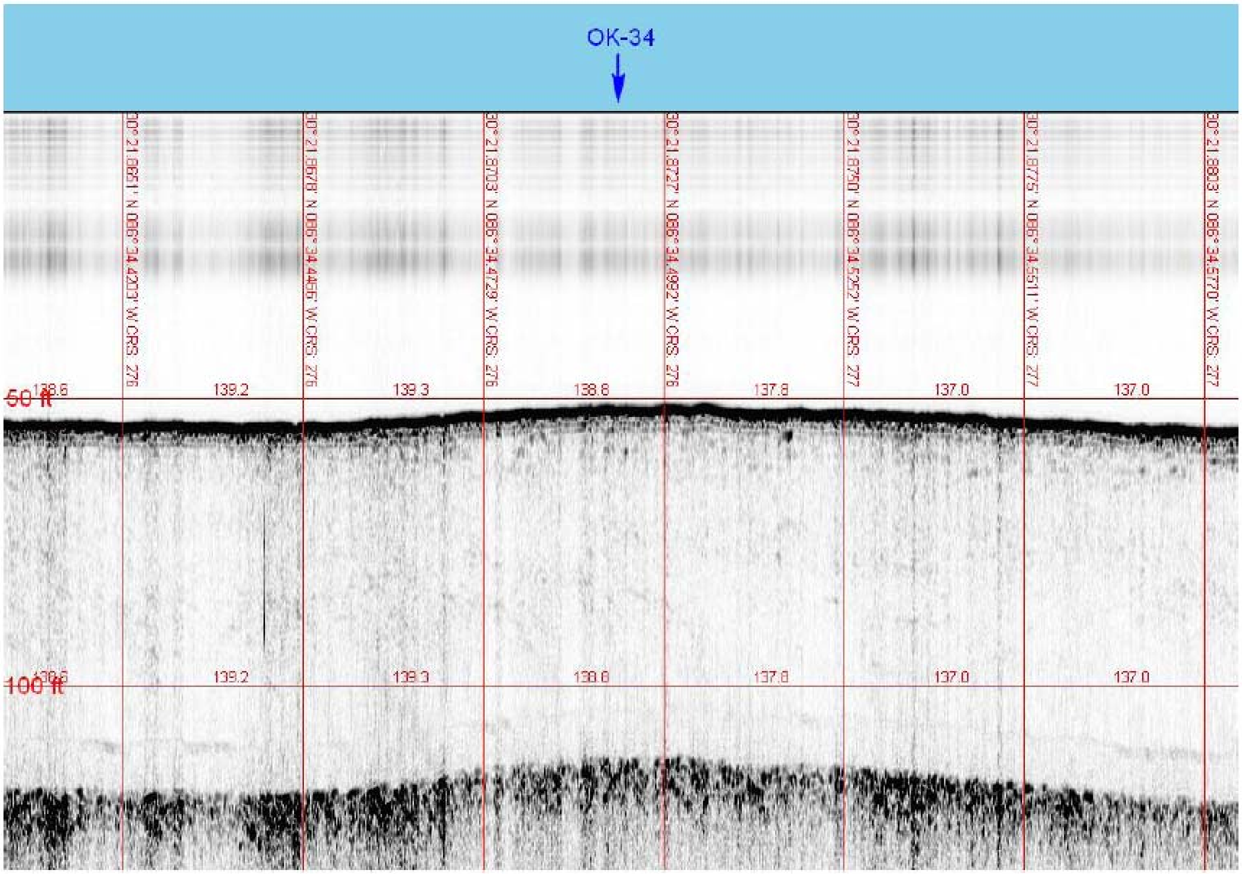
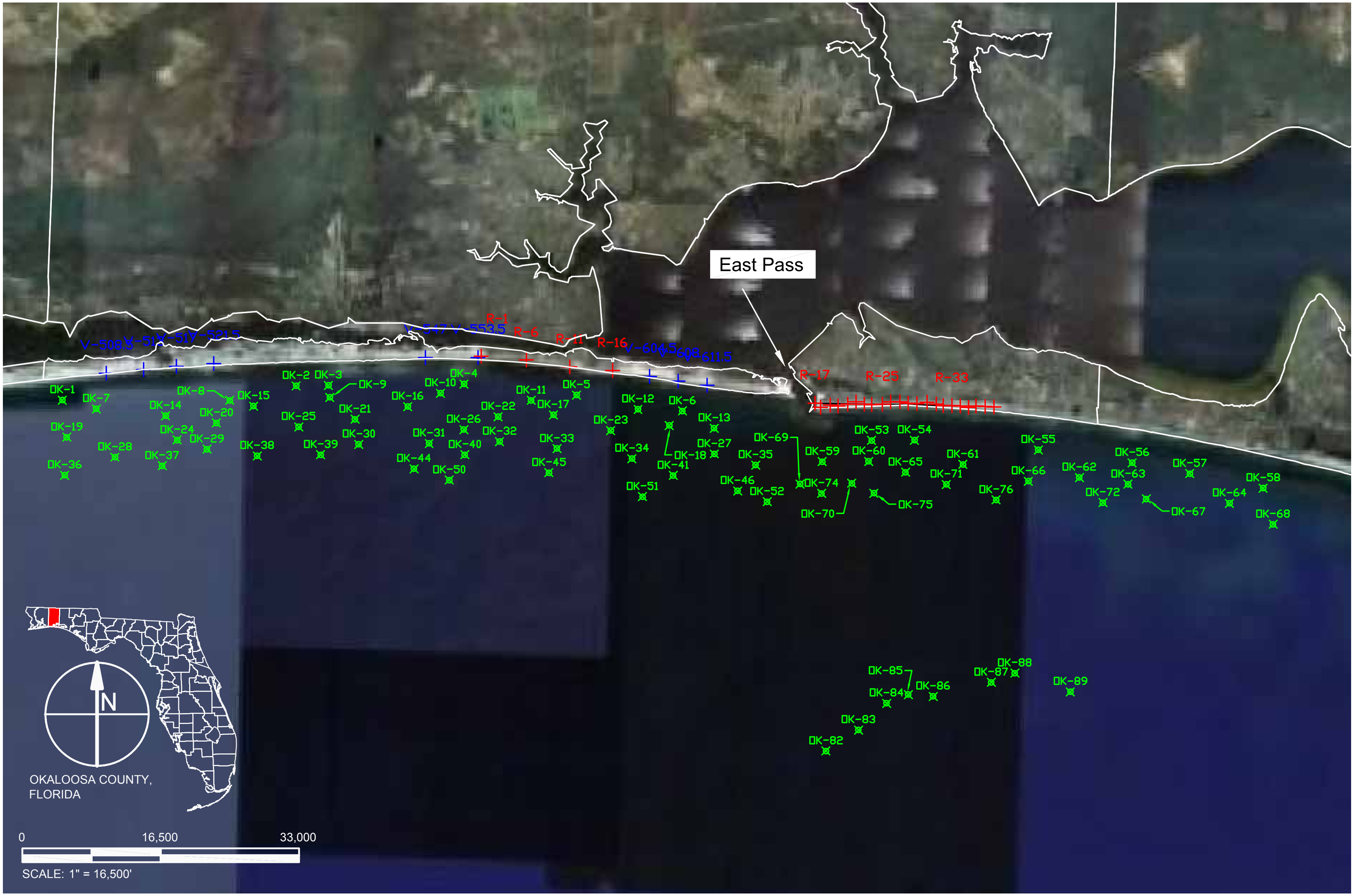


Figure 4.2 Example Image from the Reconnaissance Phase Seismic Survey

4.2 Analysis of Reconnaissance Phase Geotechnical Data

Based on the geophysical information collected on the sediment strata, selected vibracore locations provided corresponding geotechnical data. Alpine collected 78 reconnaissance phase vibracores from the locations shown in Figure 4.3 and Table 4.1. Stone & Associates received these vibracores from Alpine, sampled them at 1.5 ft intervals, and quantified each sample's grain size and composition characteristics using sieve and chemical testing. Taylor Engineering identified Munsell Color classifications associated with these same samples.



TAYLOR ENGINEERING INC. 10151 DEERWOOD PARK BLVD., BLDG. 300, STE. 300 JACKSONVILLE, FLORIDA 32256 CERTIFICATE OF AUTHORIZATION # 4815	Figure 4.3 Location of the Reconnaissance Phase Vibracores Okaloosa County, Florida	PROJECT C2007-023 DRAWN BY JCH DATE AUG 2008

Table 4.1 Reconnaissance Phase Vibracore Coordinates

Phase I Core ID	Location (State Plane, Florida North, NAD83)		Phase I Core ID	Location (State Plane, Florida North, NAD83)	
	Easting	Northing		Easting	Northing
Eglin AFB and Okaloosa Island Nearshore Zone					
OK-1	1245562.29	509247.52	**OK-25**	1274001.36	506035.91
OK-2	1273710.28	510968.58	**OK-26**	1293899.59	505685.04
OK-3	1277606.38	511018.86	**OK-27**	1324077.5	502763.54
OK-4	1293915.50	511189.74	**OK-28**	1251869.78	502374.01
OK-5	1307473.72	509871.58	**OK-29**	1262950.5	503330.5
OK-6	1320231.63	507941.42	**OK-30**	1281234.73	503925.4
OK-7	1249630.81	508192.47	**OK-31**	1289716.06	504030.39
OK-8	1265716.29	509212.5	**OK-32**	1298194.77	504251.38
OK-9	1277768.04	509589.12	**OK-33**	1305119.93	503402.84
OK-10	1291090.26	510082.44	**OK-34**	1314135.98	502203.22
OK-11	1302012.77	509212.5	**OK-35**	1329062.62	501422.56
OK-12	1314874.71	508128.29	**OK-36**	1245833.09	500193.37
OK-13	1324044.88	505870.02	**OK-37**	1257583.75	501332.51
OK-14	1257990.96	507366.35	**OK-38**	1269011.79	502529.18
OK-15	1268571.85	508521.76	**OK-39**	1276643.2	502680.09
OK-16	1287152.48	508472.02	**OK-40**	1294010.05	502677.12
OK-17	1304694.17	507470.65	**OK-41**	1319105.34	500165.35
OK-18	1318648.43	506196.3	**OK-44**	1287905.72	500984.55
OK-19	1246076.05	504779.31	**OK-45**	1304144.67	500511.01
OK-20	1264102.44	506498.12	**OK-46**	1326875.8	498307.81
OK-21	1280801.96	506933.43	**OK-50**	1292144.2	499616.01
OK-22	1298020.57	507247.54	**OK-51**	1315410.67	497605.37
OK-23	1311583.6	505580.87	**OK-52**	1330434.35	496998.06
OK-24	1259373.86	504438.38			
Destin Nearshore Zone					
OK-53	1343019.45	504394.99	**OK-65**	1347105.17	500561.6
OK-54	1348185.79	504410.22	**OK-66**	1361908.78	499464.1
OK-55	1363103.67	503256.96	**OK-67**	1376102.75	497337.82
OK-56	1374387.01	501683.31	**OK-68**	1391361.99	494283.38
OK-57	1381331.46	500377.15	**OK-69**	1334410.67	499135.67
OK-58	1390179.06	498649.99	**OK-70**	1340616.18	499224.47
OK-59	1337082.3	501841.21	**OK-71**	1352012.26	499086.21
OK-60	1342669.72	501848	**OK-72**	1370875.12	496887.4
OK-61	1354018.57	501497.9	**OK-74**	1336985.14	498009.98
OK-62	1368039.93	499928.39	**OK-75**	1343303.06	498019.04
OK-63	1373885.06	499101.43	**OK-76**	1358010.49	497213.33
OK-64	1386115.35	496811.29			
Offshore Ridge					
OK-82	1337508.61	466955.56	**OK-86**	1350427.25	473524.9
OK-83	1341425.29	469473.19	**OK-87**	1357436.64	475222.24
OK-84	1344817.23	472681.97	**OK-88**	1360258	476343
OK-85	1347425.88	473743.05	**OK-89**	1366952.12	474089.19

Before sieving the sediment samples, Stone & Associates extracted the shells from each sample to determine its carbonate content. As documented in Stone & Associates (2007), the majority of samples contained a small amount of shell, measuring less than 5% by weight of each sample. Several samples contained more than 5% shell as listed in Table 4.2.

Table 4.2 Vibracore Samples Exceeding 5% Shell Content

Core	Depth (ft)	% Shell	Core	Depth (ft)	% Shell
OK-1	1.5'	6.7%	OK-39	1.5'	12.4%
OK-3	1.5'	5.1%		3'	10.9%
OK-4	6'	7.1%	OK-52	0'	11.2%
OK-8	1.5'	11.9%		1.5'	9.4%
OK-12	7.5'	10.5%		6'	12.3%
OK-14	0'	6.2%		10.5'	10.5%
OK-15	4.5'	7.0%	OK-54	1.5'	6.9%
OK-16	0'	6.5%	OK-59	3'	5.4%
OK-19	1.5'	11.4%	OK-61	1.5'	7.0%
	6'	9.6%		3'	5.5%
OK-21	1.5'	5.1%	OK-62	1.5'	15.9%
	4.5'	5.0%		3'	9.7%
OK-22	0'	5.0%	OK-64	1.5'	19.5%
OK-25	1.5'	8.7%	OK-65	1.5'	7.7%
OK-28	1.5'	7.2%		3'	5.5%
OK-30	1.5'	7.3%	OK-66	3'	5.2%
	9'	8.3%	OK-67	0'	10.3%
OK-35	0'	7.6%		1.5'	10.0%
OK-36	1.5'	18.5%		3'	6.4%

Next, Stone & Associates dried the carbonate-free samples and used an ultrasonic siever to calculate the grain size distribute by weight for each sample. The smallest sieve size measured 0.06 mm (4.00 phi), or U.S. standard sieve size 230. Only silt passed through this sieve. A total of 450 samples came from the 78 reconnaissance phase vibracores, and only 1 of them contained more than 5% silt by weight. The largest silt content, 6.7%, occurred in OK-31 at a depth of 10.5 ft. Table 4.3 combines the results from all of the samples to show fines percentages by vibracore. Table 4.4 presents the mean grain size and sorting, based on the moments method, of the sediment in each of the reconnaissance phase vibracores. Table 4.4 also presents the predominant Munsell color of the sand in vibracores located within the two potential borrow areas discussed below.

Table 4.3 Silt Content in the Reconnaissance Phase Vibracores

Core ID	Silt Content	Core ID	Silt Content	Core ID	Silt Content	Core ID	Silt Content
OK-1	0.19%	OK-20	0.10%	OK-41	0.07%	OK-66	0.15%
OK-2	0.30%	OK-21	0.39%	OK-44	0.14%	OK-67	0.10%
OK-3	0.41%	OK-22	0.56%	OK-45	0.36%	OK-68	0.30%
OK-4	0.26%	OK-23	0.30%	OK-46	0.04%	OK-69	0.31%
OK-5	0.07%	OK-24	0.10%	OK-50	0.11%	OK-70	0.11%
OK-6	0.04%	OK-25	0.42%	OK-51	0.13%	OK-71	0.25%
OK-7	0.27%	OK-26	0.64%	OK-52	0.18%	OK-72	0.24%
OK-8	0.23%	OK-27	0.34%	OK-53	0.06%	OK-74	0.22%
OK-9	0.09%	OK-28	0.04%	OK-54	0.35%	OK-75	0.14%
OK-10	0.11%	OK-29	0.25%	OK-55	0.30%	OK-76	0.12%
OK-11	0.02%	OK-30	0.18%	OK-57	0.27%	OK-82	0.14%
OK-12	0.05%	OK-31	1.06%	OK-58	0.02%	OK-83	0.26%
OK-13	0.16%	OK-32	0.94%	OK-59	0.20%	OK-84	0.21%
OK-14	0.14%	OK-34	0.32%	OK-60	0.42%	OK-85	0.07%
OK-15	0.09%	OK-35	0.02%	OK-61	0.56%	OK-86	0.31%
OK-16	0.19%	OK-36	0.24%	OK-62	0.20%	OK-87	0.09%
OK-17	0.30%	OK-37	0.09%	OK-63	0.28%	OK-88	0.14%
OK-18	0.04%	OK-39	0.55%	OK-64	0.09%	OK-89	0.14%
OK-19	0.28%	OK-40	0.26%	OK-65	0.63%		

Figure 4.4 presents two potential borrow area sites Stone & Associates proposed. The results of the reconnaissance phase data collection and analyses revealed two potential borrow sites: a paleo ebb-tide deposit southwest of East Pass (OKA) and a transgressive sand shoal southeast of East Pass (OKB). The paleo ebb-tide deposit includes vibracores OK-6, OK-12, OK-13, OK-18, OK-23, OK-27, and OK-41. The majority of these vibracores lie on 30 – 50 ft isobaths. The transgressive sand shoal includes vibracores OK-82, OK-83, OK-84, OK-85, OK-86, OK-87, OK-88, and OK-89 all of which lie on the 70 ft isobath. Based on these results, Taylor Engineering chose OKA and OKB as suitable sites for the detailed phase of the sand search.

Table 4.4 Reconnaissance Phase Vibracore Grain Size and Color Data

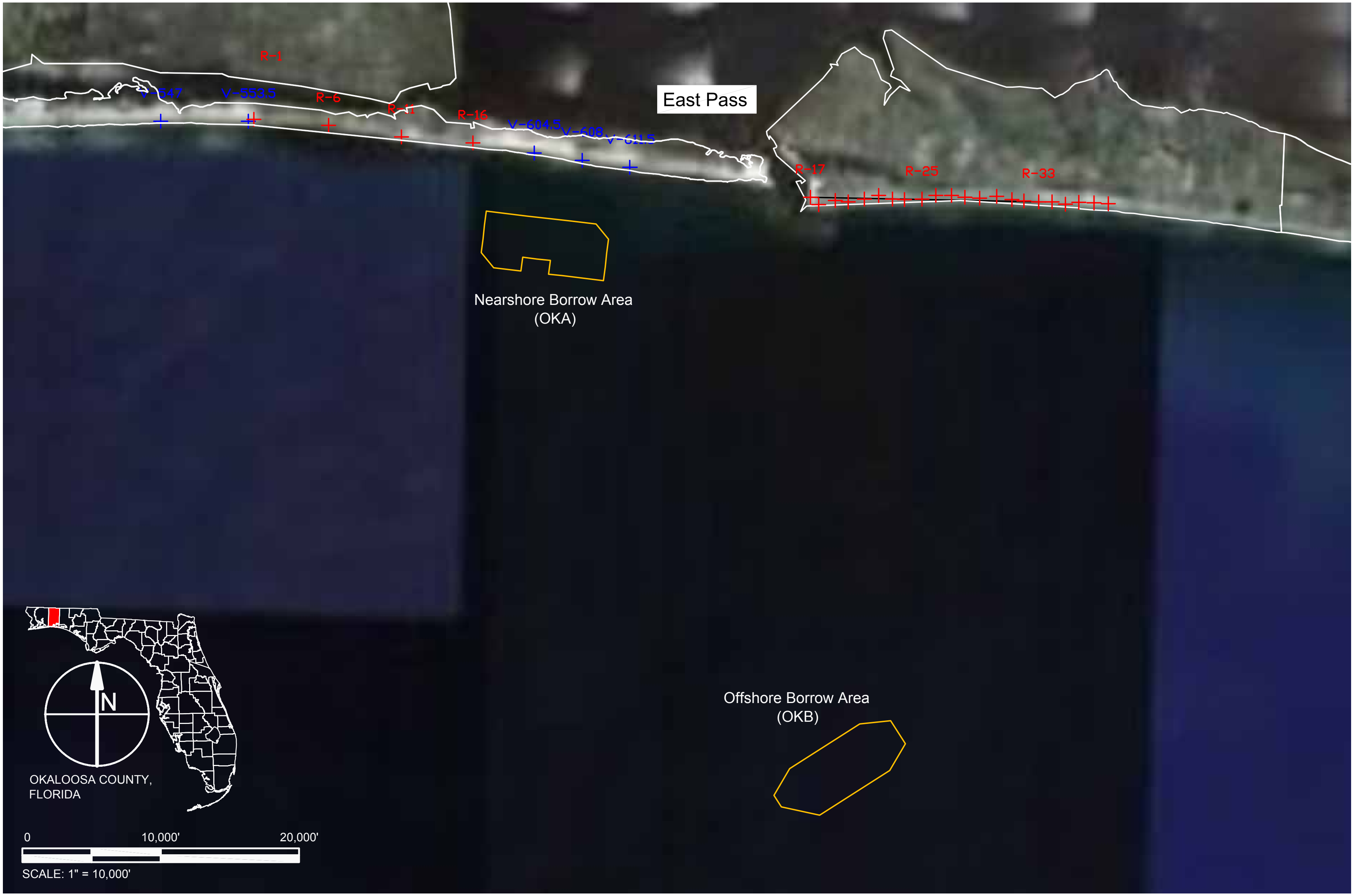
Phase I Core ID	Mean Grain Size (phi)	Mean Grain Size (mm)	Sorting (phi)	Predominant Munsell Color of Cores with Beach Quality Sand
OK-1	1.38	0.39	0.83	N/A
OK-2	1.64	0.32	0.71	N/A
OK-3	0.99	0.50	0.69	N/A
OK-4	1.24	0.42	0.78	N/A
OK-5	1.16	0.45	0.68	N/A
OK-6	1.06	0.48	0.62	5Y 7/2

Table 4.4 Reconnaissance Phase Vibracore Grain Size and Color Data

Phase I Core ID	Mean Grain Size (phi)	Mean Grain Size (mm)	Sorting (phi)	Predominant Munsell Color of Cores with Beach Quality Sand
OK-7	1.18	0.44	0.82	N/A
OK-8	1.20	0.44	0.73	N/A
OK-9	1.11	0.46	0.66	N/A
OK-10	1.20	0.43	0.70	N/A
OK-11	1.85	0.28	0.63	N/A
OK-12	1.11	0.46	0.67	5Y 7/2
OK-13	1.43	0.37	0.55	5Y 7/2
OK-14	1.20	0.44	0.69	N/A
OK-15	1.22	0.43	0.70	N/A
OK-16	1.46	0.36	0.77	N/A
OK-17	1.77	0.29	0.74	N/A
OK-18	1.38	0.39	0.62	5Y 7/2
OK-19	1.00	0.50	0.75	N/A
OK-20	1.63	0.32	0.73	N/A
OK-21	0.93	0.52	0.70	N/A
OK-22	0.98	0.51	0.90	N/A
OK-23	1.47	0.36	0.67	5Y 7/2
OK-24	0.98	0.51	0.64	N/A
OK-25	1.33	0.40	0.72	N/A
OK-26	1.67	0.31	0.81	N/A
OK-27	1.46	0.36	0.65	5Y 7/2
OK-28	1.15	0.45	0.69	N/A
OK-29	0.95	0.52	0.64	N/A
OK-30	1.08	0.47	0.68	N/A
OK-31	1.14	0.45	0.73	N/A
OK-32	1.84	0.28	0.85	N/A
OK-34	1.48	0.36	0.70	N/A
OK-35	0.79	0.58	0.69	N/A
OK-36	1.24	0.42	0.73	N/A
OK-37	0.95	0.52	0.66	N/A
OK-39	1.32	0.40	0.87	N/A
OK-40	1.11	0.46	0.73	N/A
OK-41	0.91	0.53	0.77	5Y 7/2
OK-44	1.15	0.45	0.78	N/A
OK-45	1.19	0.44	0.63	N/A
OK-46	0.95	0.52	0.74	N/A
OK-50	0.95	0.52	0.63	N/A

Table 4.4 Reconnaissance Phase Vibracore Grain Size and Color Data

Phase I Core ID	Mean Grain Size (phi)	Mean Grain Size (mm)	Sorting (phi)	Predominant Munsell Color of Cores with Beach Quality Sand
OK-51	1.30	0.41	0.77	N/A
OK-52	1.00	0.50	0.75	N/A
OK-53	1.36	0.39	0.80	N/A
OK-54	1.67	0.32	0.80	N/A
OK-55	1.55	0.34	0.72	N/A
OK-57	1.05	0.48	0.69	N/A
OK-58	0.88	0.54	0.73	N/A
OK-59	0.87	0.55	0.78	N/A
OK-60	1.05	0.48	0.91	N/A
OK-61	1.03	0.49	0.91	N/A
OK-62	1.22	0.43	0.91	N/A
OK-63	0.86	0.55	0.73	N/A
OK-64	1.02	0.49	0.89	N/A
OK-65	1.31	0.40	0.94	N/A
OK-66	1.08	0.47	0.70	N/A
OK-67	0.96	0.51	0.72	N/A
OK-68	1.59	0.33	0.80	N/A
OK-69	1.08	0.47	1.01	N/A
OK-70	1.22	0.43	0.79	N/A
OK-71	1.34	0.40	0.93	N/A
OK-72	0.86	0.55	0.76	N/A
OK-74	1.47	0.36	0.84	N/A
OK-75	0.77	0.59	0.73	N/A
OK-76	0.97	0.51	0.73	N/A
OK-82	1.22	0.43	0.63	5Y 7/2
OK-83	1.29	0.41	0.63	5Y 7/2
OK-84	1.72	0.30	0.60	5Y 7/2
OK-85	1.25	0.42	0.64	5Y 7/2
OK-86	1.40	0.38	0.63	5Y 7/2
OK-87	1.36	0.39	0.66	5Y 7/2
OK-88	1.33	0.40	0.65	5Y 7/2
OK-89	1.63	0.32	0.64	5Y 7/2



TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD., BLDG. 300, STE. 300
JACKSONVILLE, FLORIDA 32256
CERTIFICATE OF AUTHORIZATION # 4815

Figure 4.4
Proposed Borrow Area Locations
Okaloosa County, Florida

PROJECT	C2007-023
DRAWN BY	JCH
DATE	AUG 2008

5.0 DETAILED PHASE DATA COLLECTION AND ANALYSIS

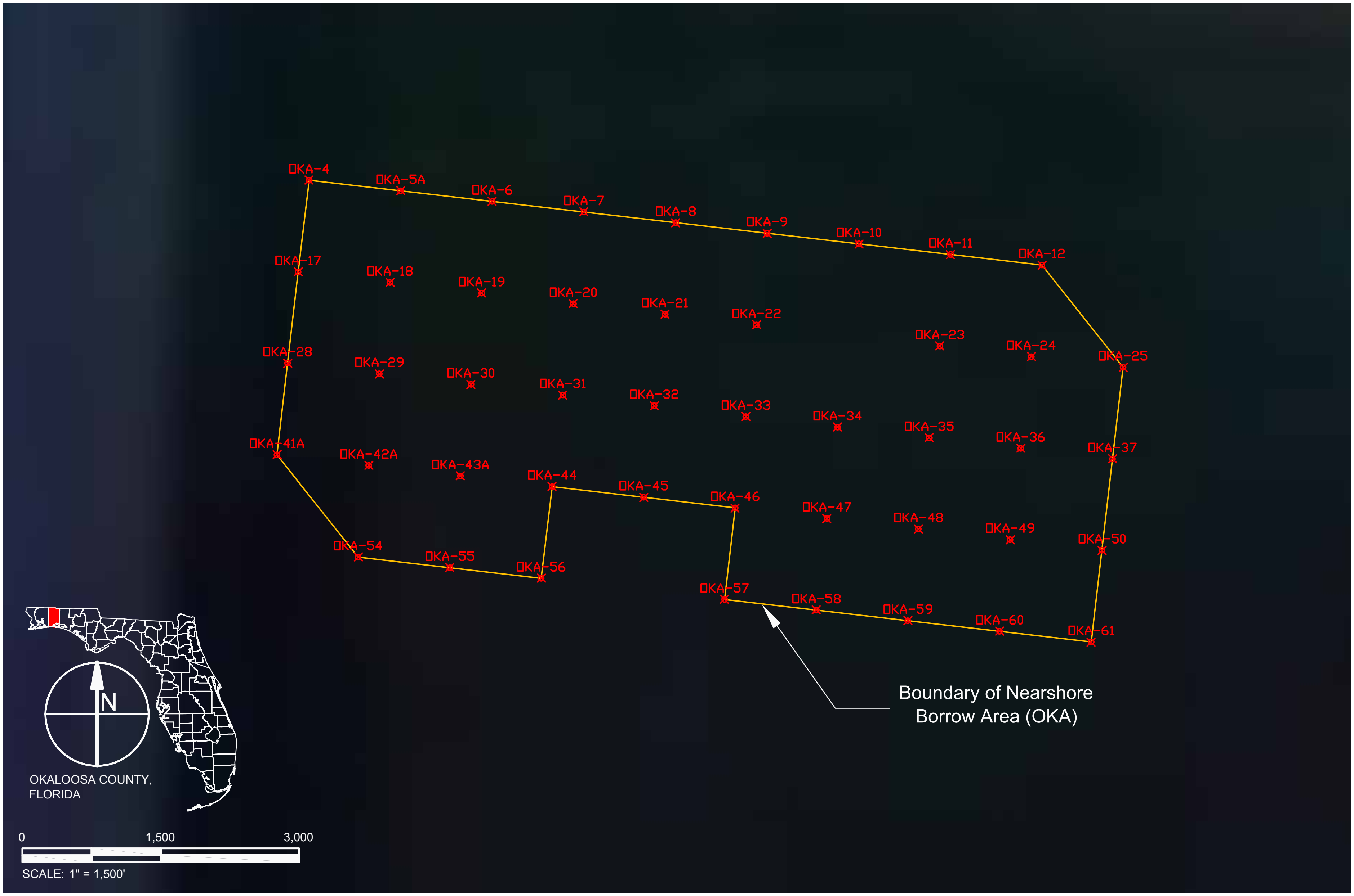
The reconnaissance phase identified two potential borrow sites that warranted further investigation. The detailed phase focused further data collection and analysis efforts on these potential sites to develop a borrow site design. The detailed phase consisted of several stages. First, AVS collected vibracores in the two potential borrow areas. Second, Sonographics conducted a sub-bottom seismic survey and a cultural resource survey; Panamerican analyzed the cultural resource survey data and diver-verified the results to determine the presence of any submerged cultural resources. Finally, Morgan & Eklund, Inc. (Morgan) collected bathymetry data. The DVD that accompanies this report contains all relevant survey data and reports from the above subcontractors.

5.1 Vibracore Collection and Analysis

AVS collected and analyzed 90 detailed phase vibracores in two potential borrow areas (OKA and OKB). Figures 5.1 and 5.2 show the locations of the 90 detailed phase vibracores and Tables 5.1 and 5.2 contain the coordinates and starting elevations of these vibracores. The detailed phase vibracores lie approximately in 1,000 ft square grids, with the nearshore area grid axis shore parallel and the offshore area grid axis aligned along the axis of the northeast-southwest ridge.

To characterize the potential borrow material, AVS developed lithologic logs of each core, collected samples — 718 in total — from each distinct geological stratum in the vibracores, sieved each sample to determine grain size distributions, and tested the carbonate content of representative samples. Appendix C contains the results. Tables 5.3 and 5.4 summarize the mean grain size and sorting for each detailed phase vibracore in areas OKA and OKB, and Tables 5.5 and 5.6 present the representative carbonate contents. Notably, AVS visually estimated the shell content of 93 representative borrow area samples; of these, AVS calculated the carbonate content via acid digestion of 51 samples. Visual shell content ranged from 0% to 19%, and the mean equaled 2% for both OKA and OKB. Carbonate content ranged from 0.0% to 14.5% by weight, and the mean equaled 3.9% and 5.1% in OKA and OKB. The calculated carbonate content exceeded the visual shell observation in nearly all samples that were tested for both characteristics. These results suggest small shell fragments and/or sediment other than shell comprise the carbonate content.

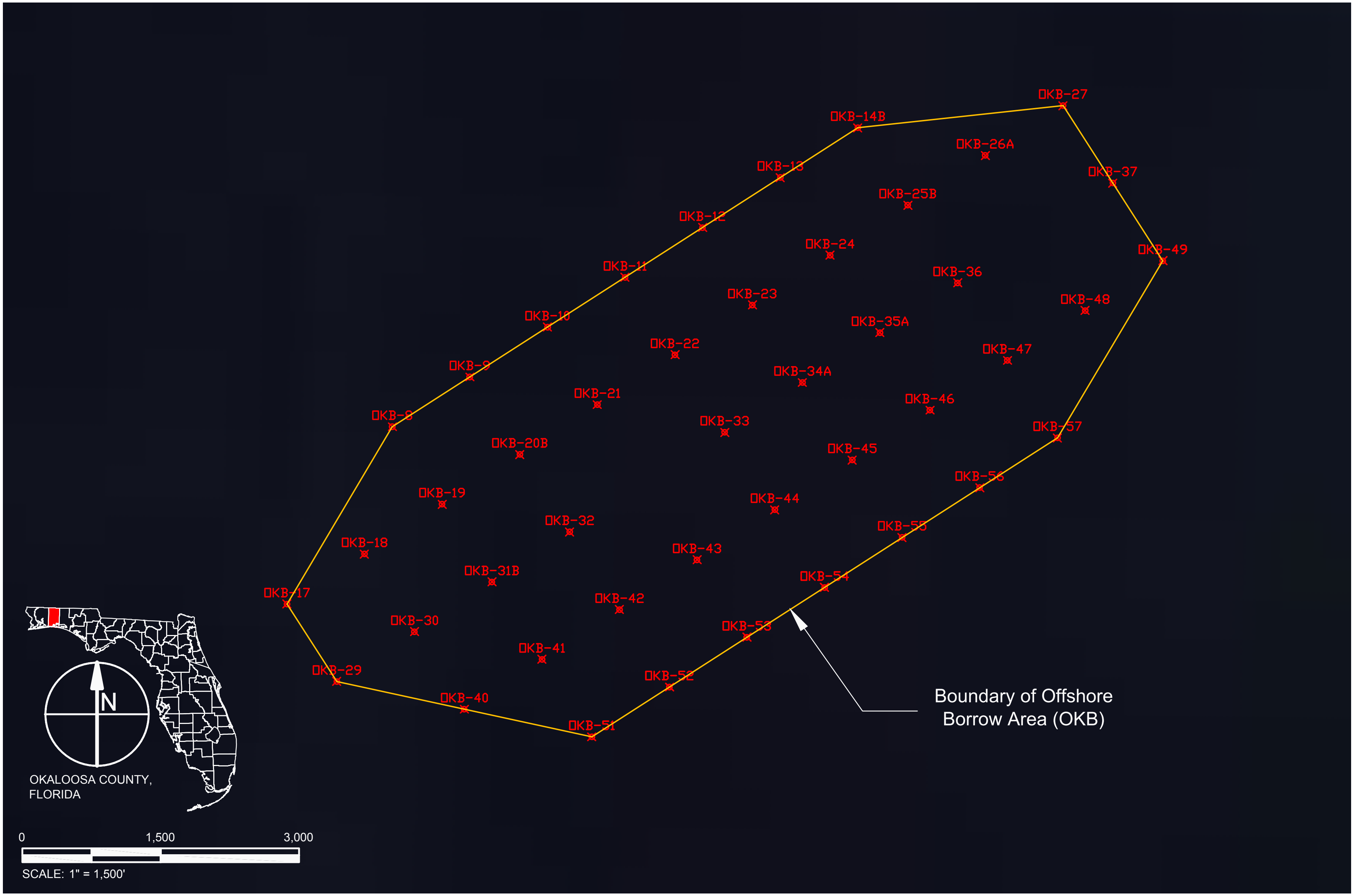
Taylor Engineering identified Munsell color classifications for each vibracore sample. Tables 5.7 and 5.8 contain the results of the detailed phase color analysis, showing the moist Munsell colors of the 718 vibracore samples. Tables 5.9 and 5.10 show the percent occurrence of colors within OKA and OKB.



TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD., BLDG. 300, STE. 300
JACKSONVILLE, FLORIDA 32256
CERTIFICATE OF AUTHORIZATION # 4815

Figure 5.1
Location of the Detailed Phase Vibracores - OKA
Okaloosa County, Florida

PROJECT	C2007-023
DRAWN BY	JCH
DATE	AUG 2008



TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD., BLDG. 300, STE. 300
JACKSONVILLE, FLORIDA 32256
CERTIFICATE OF AUTHORIZATION # 4815

Figure 5.2
Location of the Detailed Phase Vibracores - OKB
Okaloosa County, Florida

PROJECT	C2007-023
DRAWN BY	JCH
DATE	AUG 2008

Table 5.1 Coordinates and Starting Elevations of the Detailed Phase Vibracores, OKA

Core ID	Easting (ft-NAV83)	Northing (ft-NAD83)	Elevation of Top of Boring (ft-NAVD88)
OKA-4	1,312,804	507,882	-39.4
OKA-5A	1,313,797	507,766	-39.7
OKA-6	1,314,790	507,651	-37.7
OKA-7	1,315,784	507,536	-39.6
OKA-8	1,316,777	507,420	-38.6
OKA-9	1,317,770	507,305	-37.0
OKA-10	1,318,764	507,190	-37.6
OKA-11	1,319,757	507,074	-37.8
OKA-12	1,320,750	506,959	-39.8
OKA-17	1,312,688	506,888	-41.6
OKA-18	1,313,682	506,773	-43.0
OKA-19	1,314,675	506,658	-40.3
OKA-20	1,315,668	506,542	-41.8
OKA-21	1,316,662	506,427	-39.9
OKA-22	1,317,655	506,312	-38.5
OKA-23	1,319,642	506,081	-39.7
OKA-24	1,320,635	505,966	-41.3
OKA-25	1,321,628	505,850	-44.2
OKA-28	1,312,573	505,895	-44.2
OKA-29	1,313,566	505,780	-44.5
OKA-30	1,314,560	505,664	-43.3
OKA-31	1,315,553	505,549	-45.0
OKA-32	1,316,546	505,434	-42.1
OKA-33	1,317,540	505,318	-44.4
OKA-34	1,318,533	505,203	-40.3
OKA-35	1,319,526	505,088	-41.4
OKA-36	1,320,520	504,972	-43.1
OKA-37	1,321,513	504,857	-44.3
OKA-41A	1,312,458	504,902	-46.1
OKA-42A	1,313,451	504,786	-47.6
OKA-43A	1,314,444	504,671	-48.1
OKA-44	1,315,438	504,556	-46.5
OKA-45	1,316,431	504,440	-45.4
OKA-46	1,317,424	504,325	-47.3
OKA-47	1,318,418	504,210	-42.1
OKA-48	1,319,411	504,094	-42.5
OKA-49	1,320,404	503,979	-45.4
OKA-50	1,321,398	503,864	-44.8
OKA-54	1,313,336	503,793	-51.6
OKA-55	1,314,329	503,678	-51.6
OKA-56	1,315,322	503,562	-49.0
OKA-57	1,317,309	503,332	-47.8
OKA-58	1,318,302	503,216	-48.4
OKA-59	1,319,296	503,101	-47.8
OKA-60	1,320,289	502,986	-46.6
OKA-61	1,321,282	502,870	-48.9

Table 5.2 Coordinates and Starting Elevations of the Detailed Phase Vibracores, OKB

Core ID	Easting (ft-NAV83)	Northing (ft-NAD83)	Elevation of Top of Boring (ft-NAVD88)
OKB-8	1,334,745	467,557	-71.7
OKB-9	1,335,586	468,097	-69.9
OKB-10	1,336,427	468,638	-69.3
OKB-11	1,337,268	469,179	-70.9
OKB-12	1,338,110	469,719	-72.1
OKB-13	1,338,951	470,260	-70.0
OKB-14B	1,339,792	470,801	-71.4
OKB-17	1,333,603	465,634	-68.5
OKB-18	1,334,444	466,175	-69.2
OKB-19	1,335,285	466,715	-69.7
OKB-20B	1,336,127	467,256	-67.4
OKB-21	1,336,968	467,797	-68.0
OKB-22	1,337,809	468,338	-70.0
OKB-23	1,338,650	468,878	-69.2
OKB-24	1,339,492	469,419	-69.4
OKB-25B	1,340,333	469,960	-69.6
OKB-26A	1,341,174	470,500	-69.5
OKB-27	1,342,015	471,041	-70.0
OKB-29	1,334,144	464,793	-69.0
OKB-30	1,334,985	465,333	-68.6
OKB-31B	1,335,826	465,874	-69.4
OKB-32	1,336,667	466,415	-67.6
OKB-33	1,338,350	467,496	-68.9
OKB-34A	1,339,191	468,037	-68.9
OKB-35A	1,340,032	468,578	-69.2
OKB-36	1,340,873	469,118	-69.3
OKB-37	1,342,556	470,200	-70.7
OKB-40	1,335,526	464,492	-69.6
OKB-41	1,336,367	465,033	-69.9
OKB-42	1,337,208	465,574	-68.4
OKB-43	1,338,049	466,114	-67.7
OKB-44	1,338,891	466,655	-69.1
OKB-45	1,339,732	467,196	-69.6
OKB-46	1,340,573	467,737	-69.9
OKB-47	1,341,414	468,277	-69.2
OKB-48	1,342,255	468,818	-69.5
OKB-49	1,343,097	469,359	-71.7
OKB-51	1,336,908	464,192	-71.2
OKB-52	1,337,749	464,732	-70.1
OKB-53	1,338,590	465,273	-68.6
OKB-54	1,339,431	465,814	-69.9
OKB-55	1,340,272	466,355	-70.8
OKB-56	1,341,114	466,895	-71.2
OKB-57	1,341,955	467,436	-69.3
OK-82	1,337,509	466,956	-67.2
OK-83	1,341,425	469,473	-68.7

Table 5.3 Mean Grain Size and Sorting of the Detailed Phase Vibracores, OKA

Phase II Core ID	Mean Grain Size (phi)	Mean Grain Size (mm)	Sorting (phi)	Sorting (mm)
OKA-4	1.83	0.28	0.69	0.14
OKA-5A	1.61	0.33	0.75	0.18
OKA-6	1.52	0.35	0.76	0.19
OKA-7	1.3	0.41	0.76	0.22
OKA-8	1.36	0.39	0.85	0.24
OKA-9	1.31	0.4	0.92	0.27
OKA-10	1.48	0.36	0.72	0.18
OKA-11	1.47	0.36	0.95	0.26
OKA-12	1.16	0.45	0.84	0.27
OKA-17	2	0.25	0.63	0.11
OKA-18	1.7	0.31	0.94	0.22
OKA-19	1.79	0.29	0.77	0.16
OKA-20	1.69	0.31	0.78	0.18
OKA-21	1.47	0.36	0.77	0.2
OKA-22	1.37	0.39	1.13	0.33
OKA-23	1.86	0.28	0.72	0.14
OKA-24	1.57	0.34	0.82	0.2
OKA-25	1.7	0.31	0.74	0.17
OKA-28	1.85	0.28	0.94	0.2
OKA-29	2	0.25	0.61	0.11
OKA-30	1.99	0.25	0.48	0.09
OKA-31	2.07	0.24	0.52	0.09
OKA-32	1.9	0.27	0.64	0.12
OKA-33	1.72	0.3	0.76	0.17
OKA-34	1.67	0.31	0.63	0.14
OKA-35	1.48	0.36	0.77	0.2
OKA-36	1.37	0.39	0.91	0.26
OKA-37	1.39	0.38	0.7	0.19
OKA-41A	1.86	0.28	0.82	0.16
OKA-42A	1.94	0.26	0.75	0.14
OKA-43A	1.82	0.28	0.59	0.12
OKA-44	1.85	0.28	0.61	0.12
OKA-45	1.83	0.28	0.54	0.11
OKA-46	1.81	0.29	0.49	0.1
OKA-47	1.69	0.31	0.59	0.13
OKA-48	1.48	0.36	0.92	0.25

Table 5.3 Mean Grain Size and Sorting of the Detailed Phase Vibracores, OKA

Phase II Core ID	Mean Grain Size (phi)	Mean Grain Size (mm)	Sorting (phi)	Sorting (mm)
OKA-49	1.63	0.32	0.59	0.14
OKA-50	1.31	0.4	0.71	0.21
OKA-54	1.93	0.26	0.98	0.19
OKA-55	1.85	0.28	0.98	0.2
OKA-56	1.84	0.28	0.81	0.16
OKA-57	1.76	0.29	0.5	0.1
OKA-58	1.85	0.28	0.79	0.16
OKA-59	1.91	0.27	0.58	0.11
OKA-60	1.71	0.31	0.62	0.14
OKA-61	1.94	0.26	0.57	0.1
Average	1.69	0.32	0.88	0.17

Table 5.4 Mean Grain Size and Sorting of the Detailed Phase Vibracores, OKB

Phase II Core ID	Mean Grain Size (phi)	Mean Grain Size (mm)	Sorting (phi)	Sorting (mm)
OKB-8	1.95	0.26	0.83	0.16
OKB-9	1.9	0.27	0.84	0.17
OKB-10	1.92	0.26	0.72	0.14
OKB-11	1.99	0.25	0.78	0.14
OKB-12	1.96	0.26	0.74	0.14
OKB-13	1.91	0.27	0.8	0.15
OKB-14B	2.07	0.24	0.74	0.13
OKB-17	1.64	0.32	0.67	0.16
OKB-18	1.78	0.29	0.83	0.18
OKB-19	1.73	0.3	0.73	0.16
OKB-20B	1.65	0.32	0.77	0.18
OKB-21	1.64	0.32	0.77	0.18
OKB-22	1.96	0.26	0.88	0.17
OKB-23	1.88	0.27	1	0.2
OKB-24	1.88	0.27	0.68	0.13
OKB-25B	1.89	0.27	0.81	0.16
OKB-26A	1.92	0.26	0.79	0.15
OKB-27	1.95	0.26	0.8	0.15
OKB-29	1.68	0.31	0.7	0.16
OKB-30	1.71	0.3	0.82	0.18
OKB-31B	1.74	0.3	0.8	0.18

Table 5.4 Mean Grain Size and Sorting of the Detailed Phase Vibracores, OKB

Phase II Core ID	Mean Grain Size (phi)	Mean Grain Size (mm)	Sorting (phi)	Sorting (mm)
OKB-32	1.59	0.33	0.87	0.21
OKB-33	2.01	0.25	0.82	0.15
OKB-34A	1.82	0.28	0.9	0.19
OKB-35A	1.97	0.25	1.07	0.21
OKB-36	1.93	0.26	1.1	0.22
OKB-37	1.93	0.26	0.76	0.14
OKB-40	1.76	0.3	0.78	0.17
OKB-41	1.69	0.31	0.73	0.16
OKB-42	1.72	0.3	0.89	0.2
OKB-43	1.52	0.35	0.78	0.2
OKB-44	1.66	0.32	0.83	0.19
OKB-45	1.77	0.29	0.91	0.2
OKB-46	1.91	0.27	0.87	0.17
OKB-47	1.96	0.26	0.81	0.15
OKB-48	1.91	0.27	0.93	0.19
OKB-49	2.06	0.24	0.9	0.16
OKB-51	1.83	0.28	0.9	0.19
OKB-52	1.73	0.3	0.98	0.22
OKB-53	2	0.25	0.81	0.15
OKB-54	1.73	0.3	0.92	0.21
OKB-55	1.88	0.27	0.83	0.16
OKB-56	1.75	0.3	0.86	0.19
OKB-57	1.76	0.3	0.87	0.19
Average	1.83	0.28	0.88	0.17

Table 5.5 Carbonate and Shell Content, OKA

Core	Depth (ft)	Carbonate	Shell
OKA-4	1.0	3.6%	1%
OKA-4	4.0	-	0%
OKA-4	8.0	2.1%	0%
OKA-4	10.5	-	1%
OKA-8	1.0	3.8%	1%
OKA-8	3.0	-	8%
OKA-8	5.0	2.5%	1%
OKA-8	8.5	-	0%
OKA-8	12.0	4.6%	2%
OKA-12	0.8	6.1%	4%
OKA-12	3.0	-	1%
OKA-12	5.0	1.8%	0%
OKA-12	7.0	-	0%
OKA-12	8.5	0.9%	0%
OKA-19	0.5	14.5%	15%
OKA-19	3.0	-	0%
OKA-19	6.0	3.7%	0%
OKA-19	8.0	-	1%
OKA-23	0.3	2.2%	1%
OKA-23	0.7	-	1%
OKA-23	2.0	7.6%	3%
OKA-23	3.0	-	13%
OKA-23	6.0	4.4%	0%
OKA-23	9.5	-	1%
OKA-28	1.0	2.7%	0%
OKA-28	4.0	-	6%
OKA-28	5.0	4.0%	1%
OKA-32	0.2	4.2%	2%
OKA-32	2.0	-	0%
OKA-32	4.0	2.5%	9%
OKA-32	6.0	-	0%
OKA-36	0.5	2.9%	2%
OKA-36	2.0	-	3%
OKA-36	3.1	2.7%	1%
OKA-36	6.1	-	0%
OKA-43A	1.0	2.1%	0%
OKA-47	1.0	1.0%	1%
OKA-47	3.0	-	0%
OKA-47	6.0	4.5%	0%
OKA-60	0.5	3.2%	0%
OKA-60	3.0	3.7%	1%
OKB-9	1.0	6.3%	1%
OKB-9	3.0	-	1%
OKB-9	7.0	3.6%	1%
Average		3.9%	2%

Table 5.6 Carbonate and Shell Content, OKB

Core	Depth (ft)	Carbonate	Shell
OKB-9	1.0	6.3%	1%
OKB-9	3.0	-	1%
OKB-9	7.0	3.6%	1%
OKB-9	11.0	-	0%
OKB-13	1.0	2.9%	0%
OKB-13	4.0	-	5%
OKB-13	9.0	3.5%	0%
OKB-13	12.0	-	6%
OKB-18	1.0	3.3%	1%
OKB-18	3.0	-	1%
OKB-18	5.0	3.3%	0%
OKB-18	9.0	-	2%
OKB-22	1.0	3.3%	1%
OKB-22	4.0	-	0%
OKB-22	8.0	4.6%	0%
OKB-26A	1.0	2.2%	1%
OKB-26A	3.0	-	0%
OKB-26A	6.0	3.9%	1%
OKB-26A	9.0	-	1%
OKB-32	1.0	-	1%
OKB-32	3.0	3.4%	1%
OKB-32	7.0	-	1%
OKB-32	10.0	2.4%	1%
OKB-32	12.0	-	1%
OKB-32	13.5	10.9%	2%
OKB-32	15.0	-	1%
OKB-35A	1.0	5.7%	3%
OKB-35A	4.0	-	1%
OKB-35A	7.0	19.9%	19%
OKB-35A	9.0	-	2%
OKB-40	1.0	3.9%	3%
OKB-40	3.0	-	1%
OKB-40	6.0	2.8%	0%
OKB-40	9.0	-	1%
OKB-44	2.0	6.3%	5%
OKB-44	4.0	-	1%
OKB-44	6.0	3.7%	1%
OKB-44	10.0	-	10%
OKB-48	1.0	8.2%	11%
OKB-48	3.0	-	1%
OKB-48	5.0	4.0%	1%
OKB-52	3.0	3.7%	1%
OKB-52	6.0	-	1%
OKB-52	9.0	8.6%	3%
OKB-52	11.5	-	3%
OKB-56	1.0	3.2%	3%
OKB-56	3.0	-	2%
OKB-56	5.0	4.8%	1%
OKB-56	8.0	-	1%
Average		5.1%	2%

Table 5.7 Soil Colors within the Detailed Phase Vibracores, OKA

Vibracore ID	Moist Munsell Color and Depth (ft) by Sample Number							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
OKA-4	1.0	4.0	8.0	10.5	12.5	14.0	17.0	19.0
	5Y 7/1	5Y 7/1	5Y 6/2	5Y 6/1	5Y 7/1	5Y 6/1	5Y 7/2	5Y 6/2
OKA-5A	1.0	3.0	5.0	8.0	12.0	15.0	17.0	18.5
	5Y 6/2	5Y 7/1	5Y 6/2	5Y 6/1	5Y 6/2	5Y 6/2	5Y 7/2	5Y 7/2
OKA-6	1.0	3.0	7.0	9.0	11.0	14.0	15.0	17.3
	5Y 6/3	5Y 6/2	5Y 7/2	5Y 6/1	5Y 6/1	5Y 6/1	5Y 6/2	5Y 6/2
OKA-7	1.0	3.0	4.6	8.0	10.0	13.0	16.0	19.0
	5Y 6/2	5Y 6/2	5Y 7/1	5Y 7/2	5Y 6/2	5Y 6/2	5Y 6/1	5Y 6/2
OKA-8	1.0	3.0	5.0	8.5	12.0	14.0	16.0	17.5
	5Y 7/2	5Y 7/2	5Y 7/1	5Y 7/1	5Y 6/2	5Y 6/2	5Y 6/1	5Y 7/1
OKA-9	1.0	3.5	4.5	7.0	8.0	11.0	15.0	17.5
	5Y 6/2	5Y 6/2	5Y 7/1	5Y 6/2	5Y 7/1	5Y 4/2	5Y 7/2	5Y 6/2
OKA-10	1.0	3.5	6.0	7.0	11.0	15.0	16.5	18.5
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/1	5Y 7/1	5Y 6/2	5Y 7/2
OKA-11	0.3	1.0	2.0	4.5	7.0	10.0	12.0	14.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/2
OKA-12	0.8	3.0	5.0	7.0	8.5	10.5	15.0	20.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/3	5Y 7/2
OKA-17	0.6	3.0	5.0	8.0	11.0	14.0	16.0	19.0
	5Y 7/1	5Y 7/1	5Y 7/1	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/2
OKA-18	1.0	3.0	5.0	6.6	8.6	12.0	14.0	17.0
	5Y 6/2	5Y 6/2	5Y 6/1	5Y 6/2	5Y 7/1	5Y 6/1	5Y 6/1	5Y 6/3
OKA-19	0.5	3.0	6.0	8.0	12.0	14.0	17.0	19.0
	5Y 6/2	5Y 6/2	5Y 5/1	5Y 7/2	5Y 7/1	5Y 6/1	5Y 6/2	5Y 6/2
OKA-20	0.5	1.0	3.0	6.0	9.0	11.0	14.0	16.0
	5Y 6/3	5Y 7/1	5Y 7/1	5Y 7/1	5Y 7/1	5Y 7/1	5Y 7/1	5Y 7/2
OKA-21	0.3	0.7	2.0	5.0	8.0	11.0	14.0	17.0
	5Y 7/3	5Y 7/2	5Y 7/2	5Y 7/1	5Y 7/1	5Y 7/2	5Y 7/2	5Y 6/2
OKA-22	0.5	2.2	3.0	8.0	11.0	13.0	16.0	19.0
	5Y 6/2	5Y 7/2	5Y 7/2	5Y 6/2	5Y 6/2	5Y 5/1	5Y 7/2	5Y 7/2
OKA-23	0.3	0.7	2.0	3.0	6.0	9.5	15.5	18.0
	5Y 6/3	5Y 6/3	5Y 6/2	5Y 6/2	5Y 7/2	5Y 7/2	5Y 8/1	5Y 6/2
OKA-24	0.7	1.5	4.0	8.1	10.5	13.0	15.5	17.0
	5Y 6/2	5Y 6/2	5Y 7/2	5Y 6/1	5Y 7/2	5Y 7/2	5Y 6/2	5Y 7/2
OKA-25	1.0	4.0	10.0	13.0	14.5	17.0	19.3	20.0
	5Y 6/3	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/1	5Y 6/1	5Y 7/2	5Y 7/2
OKA-28	1.0	4.0	5.0	7.0	10.0	12.0	14.0	16.0
	5Y 7/3	5Y 7/2	5Y 7/2	5Y 7/3	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2

Table 5.7 Soil Colors within the Detailed Phase Vibracores, OKA

Vibracore ID	Moist Munsell Color and Depth (ft) by Sample Number							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
OKA-29	0.5	1.0	3.0	6.0	11.0	16.3	18.0	19.3
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/2	5Y 7/1	5Y 5/1	5Y 6/1	5Y 4/1
OKA-30	1.0	3.0	5.0	8.0	12.0	15.0	17.0	19.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 8/1	5Y 5/1	5Y 5/1	5Y 5/1
OKA-31	2.6	3.0	5.0	8.0	12.0	14.0	17.0	19.0
	5Y 7/2	5Y 7/1	5Y 7/1	5Y 6/1	5Y 7/1	5Y 6/1	5Y 6/1	5Y 6/1
OKA-32	0.2	2.0	4.0	6.0	10.0	14.0	16.0	18.0
	5Y 6/3	5Y 6/2	5Y 7/2	5Y 7/2	5Y 7/1	5Y 6/2	5Y 7/2	5Y 7/2
OKA-33	0.2	1.0	4.0	7.0	10.0	13.0	16.0	18.0
	5Y 6/2	5Y 6/1	5Y 7/1	5Y 6/2	5Y 6/2	5Y 6/1	5Y 6/2	5Y 6/3
OKA-34	2.0	4.0	6.0	8.0	9.0	10.0	13.0	18.0
	5Y 6/1	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/2	5Y 7/1	5Y 6/2	5Y 6/2
OKA-35	2.0	4.0	7.0	10.0	12.0	15.0	17.0	19.0
	5Y 6/1	5Y 7/2	5Y 7/2	5Y 8/1	5Y 7/2	5Y 6/1	5Y 6/2	5Y 6/2
OKA-36	0.5	2.0	3.1	6.0	11.0	14.0	16.0	19.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 7/1	5Y 7/1	5Y 6/1	5Y 6/1	5Y 6/1
OKA-37	1.0	3.0	5.5	7.0	9.0	11.0	14.0	17.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 7/1	5Y 7/1	5Y 7/1	5Y 6/1	5Y 6/1
OKA-41A	1.0	4.0	7.0	10.0	11.5	14.0	17.0	19.5
	5Y 6/2	5Y 7/2	5Y 7/2	5Y 6/2	5Y 6/1	5Y 6/2	5Y 6/2	5Y 6/1
OKA-42A	1.0	3.0	5.5	7.0	10.5	15.0	16.2	19.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2
OKA-43A	1.0	4.0	6.0	8.0	11.0	13.0	16.0	18.0
	5Y 7/2	5Y 7/1	5Y 7/1	5Y 7/1	5Y 7/1	5Y 7/1	5Y 6/1	5Y 6/2
OKA-44	1.0	4.0	5.0	8.0	10.0	13.0	16.0	19.0
	5Y 7/1	5Y 7/2	5Y 8/1	5Y 7/2	5Y 7/2	5Y 6/1	5Y 7/1	5Y 7/2
OKA-45	1.0	3.0	6.0	9.0	12.0	14.0	16.0	18.0
	5Y 7/1	5Y 7/1	5Y 7/1	5Y 7/2	5Y 7/1	5Y 8/1	5Y 8/1	5Y 7/1
OKA-46	1.0	3.0	6.0	10.0	12.0	15.0	17.0	18.5
	5Y 7/1	5Y 8/1	5Y 8/1	5Y 8/1	5Y 7/1	5Y 7/1	5Y 8/1	5Y 8/1
OKA-47	1.0	3.5	6.0	9.5	11.0	13.0	15.5	18.0
	5Y 7/1	5Y 7/2	5Y 7/1	5Y 6/1	5Y 8/2	5Y 8/2	5Y 8/1	5Y 7/3
OKA-48	1.0	3.0	5.0	9.0	12.0	14.5	15.0	18.3
	5Y 7/2	5Y 7/1	5Y 7/1	5Y 7/2	5Y 7/2	5Y 7/1	5Y 8/1	5Y 7/3
OKA-49	1.0	3.0	7.0	9.0	12.0	14.5	17.0	19.0
	5Y 7/2	5Y 7/2	5Y 8/1	5Y 8/1	5Y 8/1	5Y 8/1	5Y 7/2	5Y 8/1
OKA-50	1.0	3.0	6.0	9.0	10.0	13.0	16.0	18.0
	5Y 6/2	5Y 6/2	5Y 6/1	5Y 6/1	5Y 6/1	5Y 6/1	5Y 7/1	5Y 7/1

Table 5.7 Soil Colors within the Detailed Phase Vibracores, OKA

Vibracore ID	Moist Munsell Color and Depth (ft) by Sample Number							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
OKA-54	1.0	3.0	5.0	8.0	10.0	13.0	17.0	19.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 5/2	5Y 5/1	5Y 5/1	5Y 5/1
OKA-55	1.0	3.0	6.0	9.0	12.0	15.0	17.0	19.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 5/1	5Y 5/1	5Y 5/1
OKA-56	0.0	3.0	6.0	7.0	9.0	12.0	14.0	16.0
	5Y 6/2	5Y 6/2	5Y 6/1	5Y 6/1	5Y 6/1	5Y 6/2	5Y 6/2	5Y 6/2
OKA-57	1.0	3.0	5.0	7.0	10.0	13.0	15.0	18.0
	5Y 6/2	5Y 6/2	5Y 6/1	5Y 6/2	5Y 6/2	5Y 7/1	5Y 6/2	5Y 6/1
OKA-58	1.0	3.5	5.0	7.0	9.0	11.0	14.0	17.5
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 7/1	5Y 6/2	5Y 6/2
OKA-59	0.2	1.3	2.0	5.0	8.0	11.5	14.0	16.0
	5Y 6/3	5Y 6/2	5Y 6/1	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2
OKA-60	0.5	1.0	3.0	5.0	8.0	12.0	15.0	17.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 7/3	5Y 6/1	5Y 6/2
OKA-61	1.0	3.0	4.5	8.0	11.0	14.0	16.0	18.5
	5Y 6/2	5Y 7/2	5Y 7/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/3	5Y 6/2

Table 5.8 Soil Colors within the Detailed Phase Vibracores, OKB

Vibracore ID	Moist Munsell Color and Depth (ft) by Sample Number							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
OKB-8	2.0	4.0	6.0	8.0	12.0	15.0	17.0	19.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 5/2	5Y 5/2	5Y 3/1
OKB-9	1.0	3.0	7.0	11.0	13.0	15.0	17.0	19.5
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 5/2	5Y 3/1	5Y 3/1
OKB-10	1.0	3.0	5.0	7.0	12.0	15.0	16.0	19.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 5/2	5Y 3/1	5Y 3/1
OKB-11	2.0	4.0	7.0	9.0	11.0	14.0	17.0	18.5
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 5/2	5Y 3/2	5Y 3/2
OKB-12	1.0	3.0	5.0	7.0	10.0	13.0	17.0	19.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 5/2	5Y 3/2	5Y 3/1	5Y 3/1
OKB-13	1.0	4.0	9.0	12.0	14.0	15.0	17.0	19.0
	5Y 6/2	5Y 6/2	5Y 5/2	5Y 4/1	5Y 3/1	5Y 3/1	10YR 5/2	10YR 5/2
OKB-14B	1.0	3.0	5.0	7.0	10.0	12.0	17.0	20.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 5/2	5Y 5/2	5Y 3/1	5Y 3/1	5Y 4/2
OKB-17	1.0	4.0	7.0	10.0	12.7	14.0	18.0	20.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 5/2	5Y 7/2	5Y 7/2	10YR 5/2
OKB-18	1.0	3.0	5.0	9.0	12.0	15.0	17.0	19.0
	5Y 7/2	5Y 7/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	10YR 5/2
OKB-19	1.0	3.0	5.0	8.0	11.0	14.0	16.0	18.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/2
OKB-20B	1.0	3.0	5.0	8.0	11.0	13.0	16.0	18.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2
OKB-21	1.0	4.0	6.5	9.0	12.0	14.0	16.0	17.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/2	5Y 7/2	5Y 6/2
OKB-22	1.0	4.0	8.0	11.0	13.0	14.0	16.0	19.0
	5Y 7/2	5Y 8/1	5Y 7/2	5Y 6/2	5Y 6/2	10YR 5/2	10YR 5/2	10YR 4/1
OKB-23	1.0	3.0	6.0	10.0	13.0	15.0	17.0	19.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/2	10YR 5/2	10YR 4/1	10YR 4/1	10YR 4/2
OKB-24	1.0	4.0	6.0	7.0	9.0	12.0	14.0	16.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/2	5Y 6/2	5Y 7/2
OKB-25B	1.0	3.0	7.0	10.0	11.0	12.5	13.0	15.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/2	5Y 6/2	10YR 4/1
OKB-26A	1.0	3.0	6.0	9.0	12.0	15.0	17.0	19.0
	5Y 7/2	5Y 6/2	5Y 7/2	5Y 7/2	5Y 6/2	10YR 4/1	10YR 4/1	10YR 5/1

Table 5.8 Soil Colors within the Detailed Phase Vibracores, OKB

Vibracore ID	Moist Munsell Color and Depth (ft) by Sample Number							
	1	2	3	4	5	6	7	8
OKB-27	1.0	3.0	5.0	7.0	9.0	11.0	15.0	19.5
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/2	10YR 4/1	10YR 4/1	10YR 4/1
OKB-29	1.0	3.0	5.0	8.0	11.0	12.5	14.0	17.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 3/2	10YR 5/2	5Y 5/2
OKB-30	1.0	4.0	7.0	9.0	12.0	15.0	17.0	20.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/2	5Y 7/2	5Y 7/2	10YR 6/2	10YR 5/2
OKB-31B	1.0	4.0	6.0	8.0	10.0	12.0	14.0	15.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2
OKB-32	1.0	3.0	7.0	10.0	12.0	13.5	15.0	17.0
	5Y 7/2	5Y 6/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/2
OKB-33	1.0	3.0	7.0	10.0	12.0	15.0	17.0	19.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/2	5Y 7/2	5Y 6/2	10YR 4/2
OKB-34A	1.0	3.0	5.0	8.0	11.0	14.0	16.0	18.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	10YR 5/2
OKB-35A	1.0	4.0	7.0	9.0	11.5	13.0	16.0	18.0
	5Y 7/2	5Y 7/2	5Y 6/2	2.5Y 6/2	10YR 5/2	10YR 6/2	10YR 5/1	10YR 5/1
OKB-36	1.0	4.0	7.0	10.0	13.0	14.5	17.5	20.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/2	10YR 7/1	10YR 5/1	10YR 3/1
OKB-37	1.0	6.0	7.0	8.0	9.0	14.0	17.0	19.0
	5Y 7/2	5Y 7/2	10YR 6/2	10YR 5/2	10YR 4/1	10YR 4/1	10YR 3/1	10YR 3/1
OKB-40	1.0	3.0	6.0	9.0	12.0	14.0	16.0	18.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	10YR 4/2	10YR 3/1
OKB-41	0.6	3.0	6.0	8.0	10.0	12.0	14.0	17.0
	5Y 6/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	10YR 4/2	10YR 5/2	10YR 5/2
OKB-42	1.0	5.0	8.0	10.0	12.0	15.0	17.0	19.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/1	5Y 6/1	10YR 5/2	10YR 6/1
OKB-43	0.6	3.0	6.0	7.0	9.0	13.6	15.6	16.5
	5Y 7/2	5Y 6/2	5Y 7/2	5Y 7/2	5Y 7/1	10YR 6/2	10YR 5/2	10YR 5/1
OKB-44	2.0	4.0	6.0	10.0	15.0	17.0	18.0	20.0
	5Y 6/2	5Y 7/2	5Y 7/1	5Y 7/1	5Y 7/1	5Y 6/1	5Y 5/1	5Y 5/1

Table 5.8 Soil Colors within the Detailed Phase Vibracores, OKB

Vibracore ID	Moist Munsell Color and Depth (ft) by Sample Number							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
OKB-45	1.0	5.0	8.0	11.0	13.0	15.0	16.0	19.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 6/2	10YR 6/2	10YR 6/2	10YR 5/1
OKB-46	1.0	4.0	7.0	8.7	11.0	13.0	15.0	18.0
	5Y 6/2	5Y 7/2	5Y 7/2	10YR 4/2	10YR 4/2	10YR 5/1	10YR 5/1	10YR 6/1
OKB-47	1.0	5.0	8.0	11.0	15.0	16.5	18.0	19.5
	5Y 7/3	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	10YR 5/2	10YR 5/2	10YR 4/2
OKB-48	1.0	3.0	5.0	7.0	9.6	12.0	14.0	19.0
	5Y 7/2	5Y 6/2	5Y 7/1	5Y 7/2	10YR 6/2	10YR 5/2	10YR 4/2	10YR 6/1
OKB-49	1.0	3.0	6.0	8.0	10.0	13.0	15.5	19.0
	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/2	5Y 7/1	10YR 6/2	10YR 6/1	10YR 6/1
OKB-51	1.0	6.0	8.0	10.0	12.0	14.5	17.5	20.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 3/1	5Y 3/1	5Y 3/1	5Y 3/1	5Y 3/1
OKB-52	3.0	6.0	9.0	11.5	13.5	16.5	19.0	-
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 5/2	5Y 4/1	5Y 3/1	-
OKB-53	2.0	6.0	10.0	12.0	14.5	17.0	19.0	-
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 3/2	5Y 3/2	10YR 4/1	10YR 4/1	-
OKB-54	1.0	3.0	6.0	9.0	12.0	15.0	17.0	19.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 5/2	10YR 5/2	10YR 5/2	10YR 3/1
OKB-55	1.0	3.0	5.0	7.0	9.0	11.0	13.0	16.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 6/2	5Y 3/1	5Y 3/2
OKB-56	1.0	3.0	5.0	8.0	10.5	11.0	14.0	18.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 4/2	5Y 3/1	5Y 3/1	5Y 3/1	5Y 3/1
OKB-57	1.0	3.0	5.0	8.5	11.0	13.0	15.0	17.0
	5Y 6/2	5Y 6/2	5Y 6/2	5Y 3/1	5Y 3/1	5Y 3/1	5Y 3/2	5Y 3/2

Table 5.9 Percentage Occurrences of Each Munsell Color in Detailed Phase Study Area OKA

Color	No. Samples	Percentage
5Y 8/1	18	4.9%
5Y 8/2	2	0.5%
5Y 7/1	61	16.6%
5Y 7/2	93	25.3%
5Y 7/3	7	1.9%
5Y 6/1	46	12.5%
5Y 6/2	116	31.5%
5Y 6/3	10	2.7%
5Y 5/1	12	3.3%
5Y 5/2	1	0.3%
5Y 4/1	1	0.3%
5Y 4/2	1	0.3%
Total	368	100.0%

Table 5.10 Percentage Occurrences of Each Munsell Color in Detailed Phase Study Area OKB

Color	No. Samples	Percentage
5Y 8/1	1	0.3%
5Y 7/1	7	2.0%
10YR 7/1	1	0.3%
5Y 7/2	119	34.0%
5Y 7/3	1	0.3%
5Y 6/1	2	0.6%
10YR 6/1	5	1.4%
5Y 6/2	97	27.7%
2.5Y 6/2	1	0.3%
10YR 6/2	8	2.3%
5Y 5/1	2	0.6%
10YR 5/1	8	2.3%
5Y 5/2	13	3.7%
10YR 5/2	21	6.0%
5Y 4/1	2	0.6%
10YR 4/1	13	3.7%
5Y 4/2	2	0.6%
10YR 4/2	8	2.3%
5Y 3/1	25	7.1%
10YR 3/1	5	1.4%
Total	368	100.0%

Table 5.9 indicates that 5.4% of detailed phase core samples within OKA have excellent color (Munsell value 8); 43.8% have acceptable color (Munsell value 7); 46.7% have marginal color (Munsell value 6); and the remaining 4.1% have unacceptable color. Table 5.10 indicates that 0.3% of detailed phase core samples within OKB have excellent color (Munsell value 8); 36.6% have acceptable color (Munsell value 7); 32.3% have marginal color (Munsell value 6); and the remaining 30.9% have unacceptable color. Tables 5.7 and 5.8 suggest that the most promising area for good sand color lies in the south central region of OKA and in the north central region of OKB.

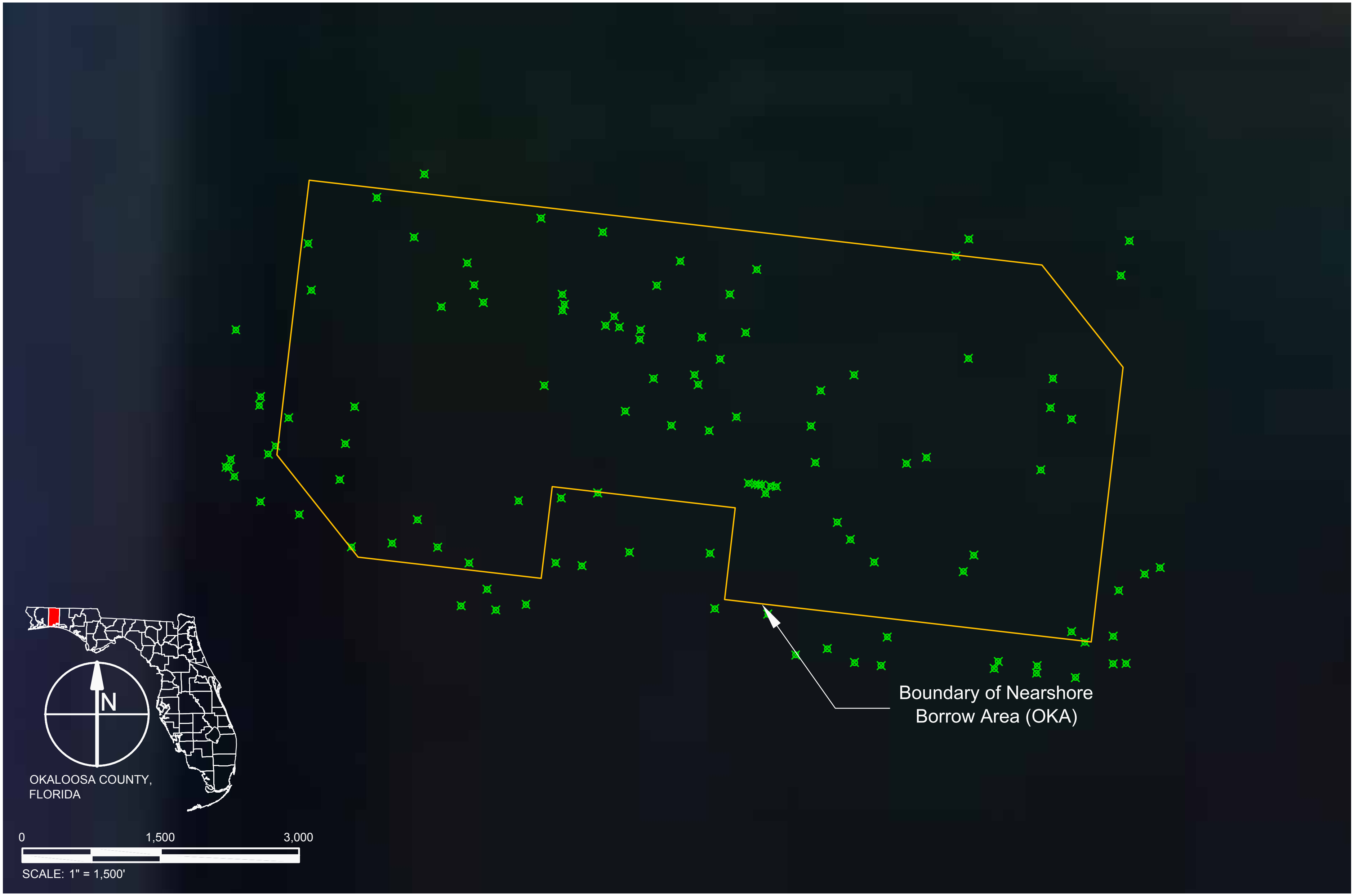
5.2 Sub-bottom Seismic and Cultural Resources Survey Collection and Analysis

Sonographics conducted remote sensing of the two proposed borrow areas on September 26 — 30, 2007. This survey employed a magnetometer, side-scan sonar, echosounder, and sub-bottom profiler. The survey tracklines, spaced 100 ft apart, covered approximately 3.0 square miles and 3.4 square miles in the nearshore and offshore areas. Sonographics recorded 114 magnetic anomalies in the nearshore area, 21 magnetic anomalies in the offshore area, and 10 and 3 sidescan sonar contacts in the nearshore and offshore areas. Figure 5.3 shows the magnetic anomalies and side-scan targets recorded during this investigation.

Panamerican reviewed the remote sensing survey to identify any sites within OKA and OKB perhaps eligible for listing on the National Register of Historic Places. Panamerican determined that of the 135 magnetic anomalies recorded by Sonographics, 13 anomalies within four clusters met the criteria for potentially significant submerged cultural resources. Table 5.11 provides the details on these potentially significant magnetic anomalies. Following divers' inspections, Panamerican concluded that none of the clusters contained submerged cultural resources likely eligible under the National Register of Historic Places. Appendix D contains *Remote Sensing Survey, Diver Evaluation, and Identification of Submerged Resources for Eglin AFB/Okaloosa County/Destin Sand Source* (Panamerican, 2008).

Table 5.11 Magnetic Anomalies in the Proposed Borrow Area

Cluster	Location (ft-NAD83, FL-N)		Comment	Significant
	Easting	Northing		
M12M18	1321037	503089	Welded plate with flange	No
M77M81	1316258	506247	Wire rope and chain	No
M26M27	1315599	503717	Large round piece of steel	No
M38M52	1311935	504686	Wire rope and 3 in. hawser	No



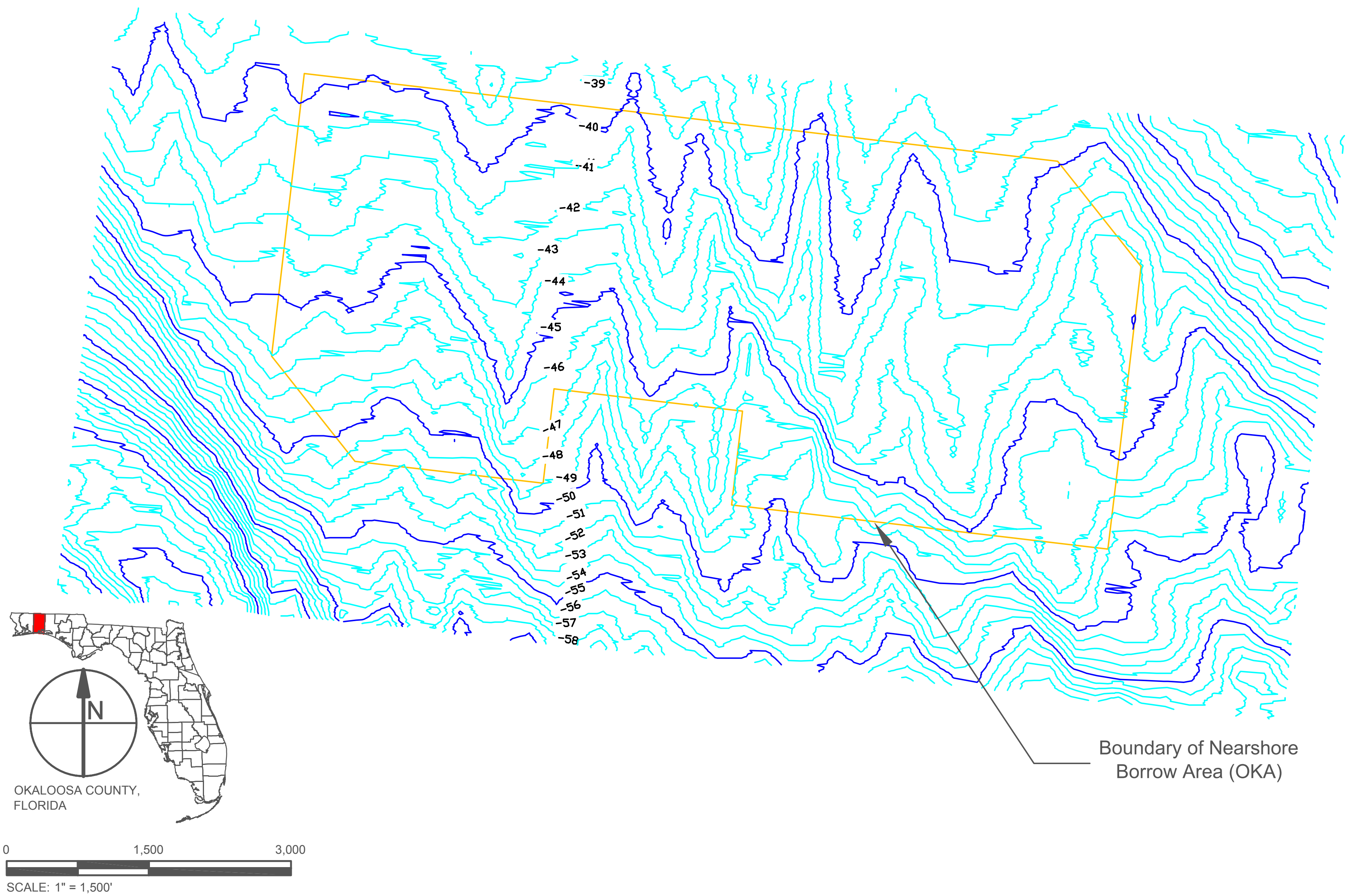
TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD., BLDG. 300, STE. 300
JACKSONVILLE, FLORIDA 32256
CERTIFICATE OF AUTHORIZATION # 4815

Figure 5.3
Magnetic Anomalies
Okaloosa County, Florida

PROJECT	C2007-023
DRAWN BY	JCH
DATE	AUG 2008

5.3 Bathymetric Survey

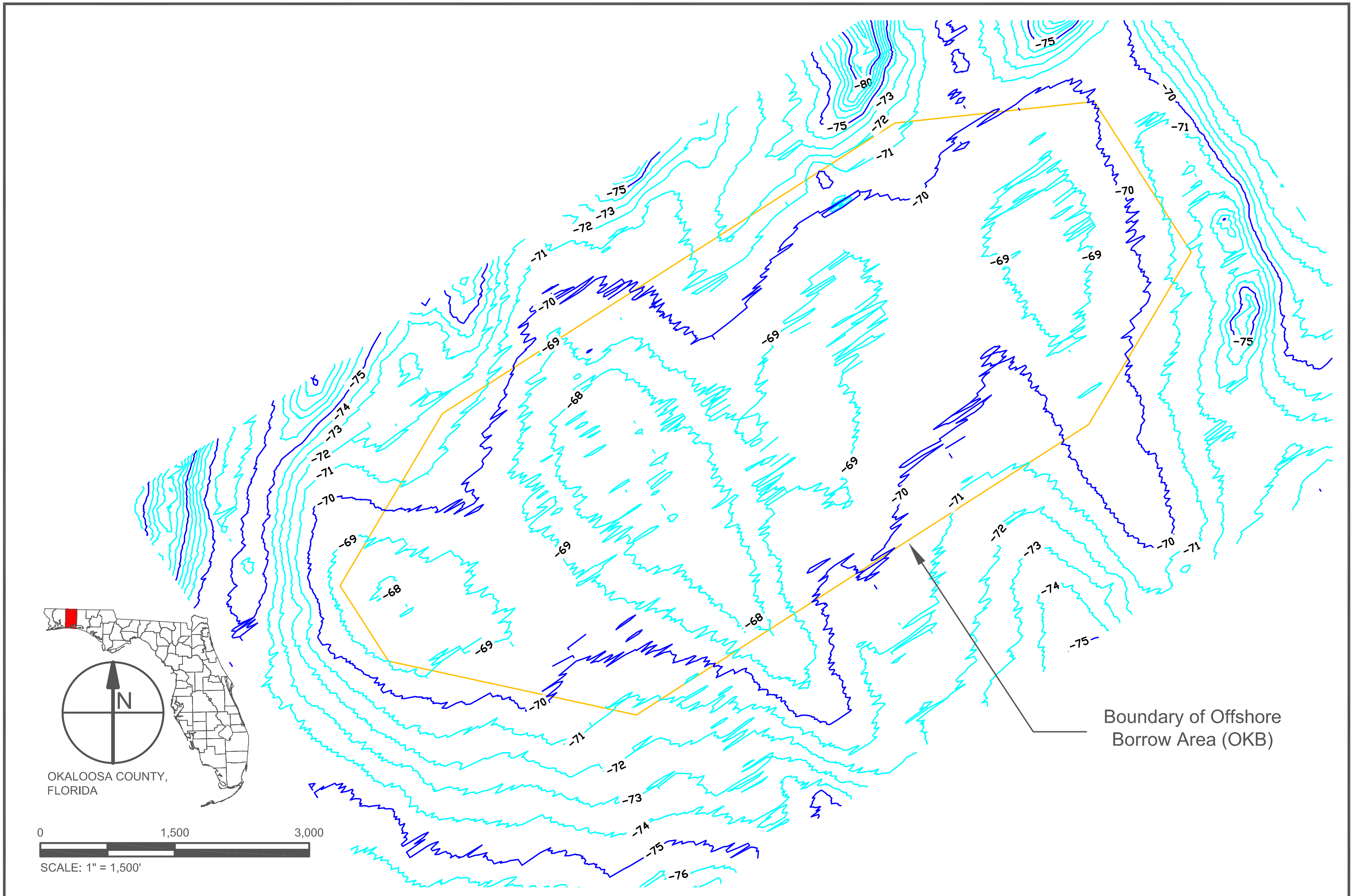
With the boundaries of the proposed borrow areas established, Morgan & Eklund collected bathymetric survey data of OKA and OKB in October 2007. The survey collected elevations at 30 ft intervals along transects spaced 250 ft apart over approximately 180 million square feet. Figures 5.4 and 5.5 show the contours of the ocean floor at the sites located in Figure 5.1 – 5.2.



TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD., BLDG. 300, STE. 300
JACKSONVILLE, FLORIDA 32256
CERTIFICATE OF AUTHORIZATION # 4815

Figure 5.4
April 2007 Morgan & Eklund Bathymetric Survey
Okaloosa County, Florida

PROJECT	C2007-023
DRAWN BY	JCH
DATE	AUG 2008



TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD., BLDG. 300, STE. 300
JACKSONVILLE, FLORIDA 32256
CERTIFICATE OF AUTHORIZATION # 4815

Figure 5.5
April 2007 Morgan & Eklund Bathymetric Survey - OKB
Okaloosa County, Florida

PROJECT	C2007-023
DRAWN BY	JCH
DATE	AUG 2008

6.0 BORROW AREA DESIGN

The results of the reconnaissance and detailed phases provided the data necessary for borrow area design. Taylor Engineering used the data to evaluate the material in both the nearshore and offshore borrow areas, OKA and OKB, and design the recommended dredging template for OKA. The design process consisted of several steps including defining the horizontal and vertical boundaries, determining the composite sand characteristics, and calculating the available borrow material volume as discussed in the following sections.

Notably, the design process indicated that the borrow areas contained substantially more volume than required for the proposed projects. Current practices and policies suggest a borrow area should contain approximately 150% of the required beach fill volume. As of the date of the this report, the current beach fill volume requirement for the three proposed beach restoration projects equals about 4,552,900 cy. Thus, this study develops a recommended borrow area template for permitting that provides approximately 7,539,700 cy, or 165% of the beach fill volume. This study also presents the maximum dredging depths and volumes of beach compatible sand and the associated composite characteristics in borrow areas OKA and OKB for future reference.

6.1 Borrow Area Boundaries

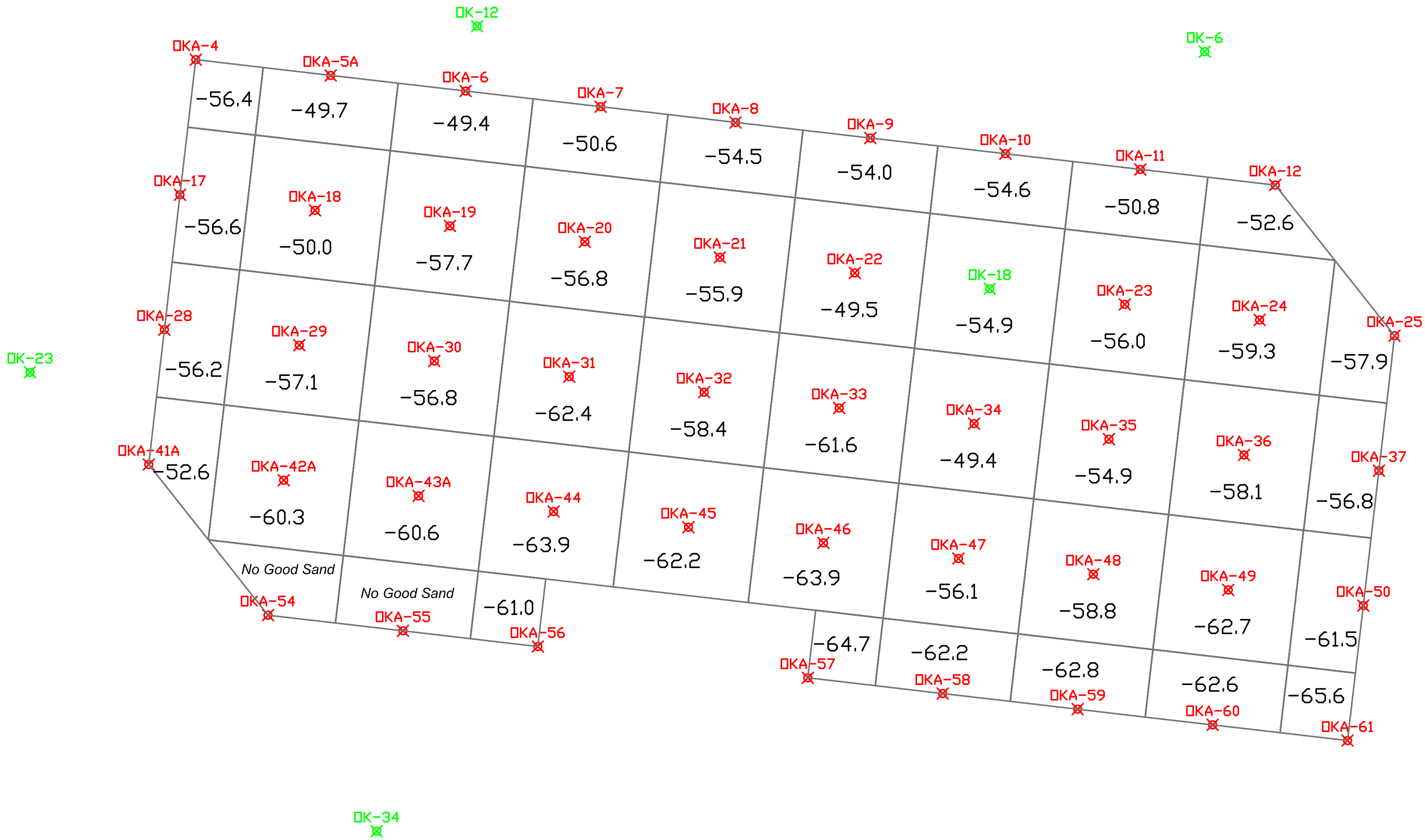
Taylor Engineering analyzed the reconnaissance and detailed phase sediment data to design the maximum dredge depths throughout the borrow area. Analysis results suggested maximum excavation as a depth 2-ft shallower than the maximum depth of beach compatible sand, defined as sand with a moist Munsell Color Classification lighter than or equal to 5Y 6/2 and composition and grain size similar to the native beach sand. The above definition of the maximum dredge depth provides a 2-ft buffer zone of beach compatible sand below the specified dredge depth to help prevent excavation of poor quality material. The first step of the borrow area design process requires determination of maximum dredge depths associated with each core. We then subtracted this from the surface elevation of the vibracore to calculate its elevation of maximum excavation. Next we determined the horizontal boundaries of each core’s area of influence based on the method of Thiessen polygons (also known as Voronoi diagrams and Dirichlet tessellations), where the boundaries of each polygon lie equidistant to adjacent cores. Figures 6.1 and 6.2 show the Thiessen polygons, or areas of influence, of each vibracore in OKA and OKB, along with the elevations of maximum excavation. Tables 6.1 and 6.2 contain the areas, in square feet, of the 93 Thiessen polygons associated with the reconnaissance and detailed phase vibracores within OKA and OKB. The combination of these polygons and their associated elevations of maximum excavation defines the borrow area boundary. Design of the dredge template applies these boundaries.

Table 6.1 Areas of the OKA Thiessen Polygons in Figure 6.1

Phase II Core ID	Area of Associated Thiessen Polygon (sq ft)	Percentage of Total Area	Phase II Core ID	Area of Associated Thiessen Polygon (sq ft)	Percentage of Total Area
OK-18	1,000,382	2.9%	OKA-33	1,000,383	2.9%
OKA-4	250,183	0.7%	OKA-34	999,447	2.9%
OKA-5A	500,491	1.5%	OKA-35	1,000,382	2.9%
OKA-6	500,307	1.5%	OKA-36	1,000,382	2.9%
OKA-7	500,330	1.5%	OKA-37	499,637	1.5%
OKA-8	500,491	1.5%	OKA-41A	374,895	1.1%
OKA-9	500,308	1.5%	OKA-42A	999,828	2.9%
OKA-10	500,131	1.5%	OKA-43A	999,828	2.9%
OKA-11	500,287	1.5%	OKA-44	1,000,300	2.9%
OKA-12	374,680	1.1%	OKA-45	999,609	2.9%
OKA-17	500,191	1.5%	OKA-46	999,801	2.9%
OKA-18	999,828	2.9%	OKA-47	1,000,382	2.9%
OKA-19	999,828	2.9%	OKA-48	999,828	2.9%
OKA-20	1,000,382	2.9%	OKA-49	999,828	2.9%
OKA-21	999,828	2.9%	OKA-50	500,191	1.5%
OKA-22	1,000,024	2.9%	OKA-54A	374,680	1.1%
OKA-23	999,632	2.9%	OKA-55	500,287	1.5%
OKA-24	999,828	2.9%	OKA-56	250,158	0.7%
OKA-25	374,895	1.1%	OKA-57	250,096	0.7%
OKA-28	499,637	1.5%	OKA-58	500,242	1.5%
OKA-29	1,000,382	2.9%	OKA-59	500,307	1.5%
OKA-30	1,000,382	2.9%	OKA-60	500,491	1.5%
OKA-31	999,274	2.9%	OKA-61A	250,183	0.7%
OKA-32	1,000,382	2.9%	**TOTAL**	**34,003,248**	**100%**

Table 6.2 Areas of the OKB Thiessen Polygons in Figure 6.2

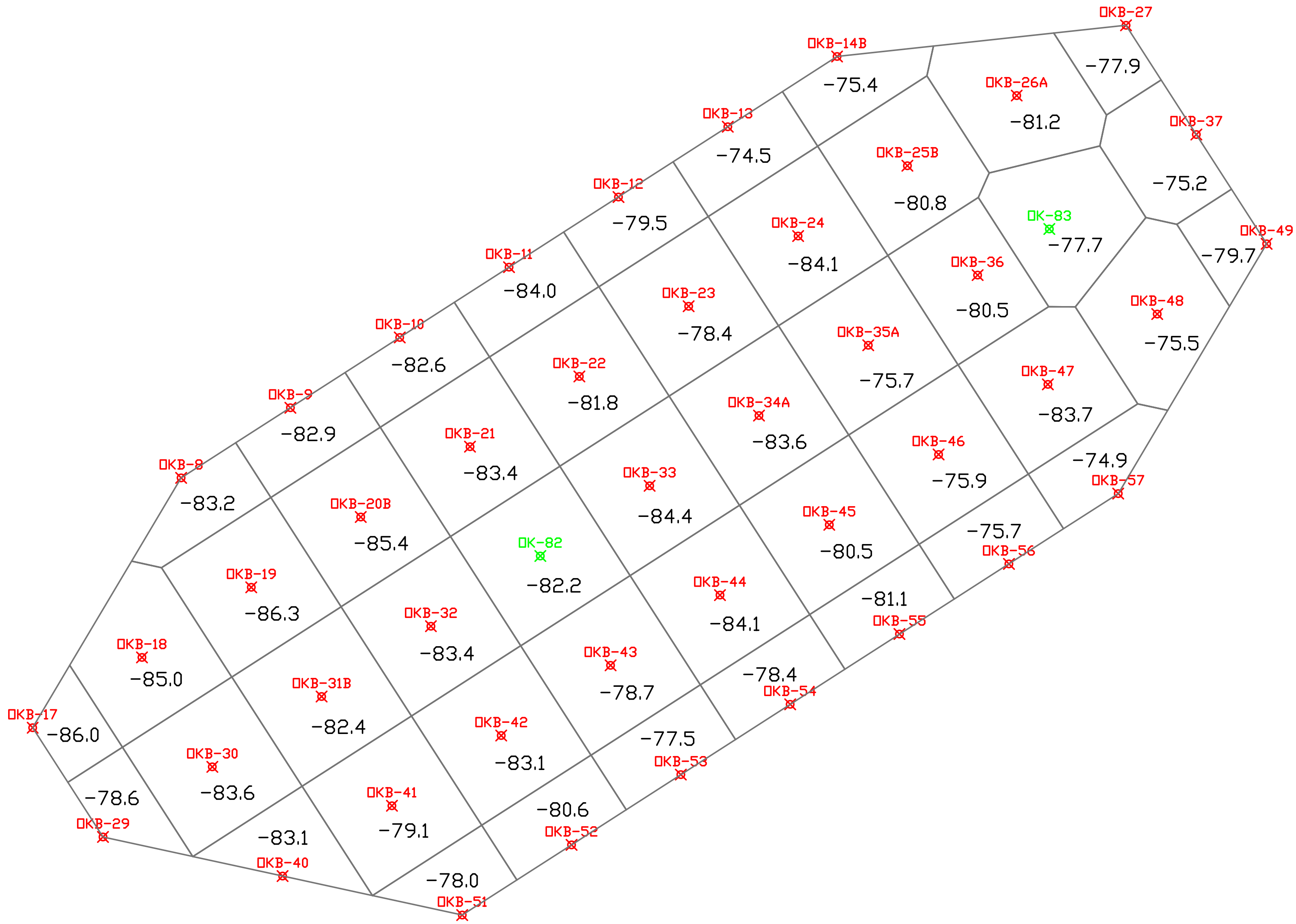
Phase II Core ID	Area of Assiciated Thiessen Polygon (sq ft)	Percentage of Total Area	Phase II Core ID	Area of Assiciated Thiessen Polygon (sq ft)	Percentage of Total Area
OK-82	1,000,262	2.9%	OKB-33	1,000,395	2.9%
OK-83	970,515	2.8%	OKB-34A	999,962	2.9%
OKB-8	458,303	1.3%	OKB-35A	999,422	2.9%
OKB-9	500,512	1.4%	OKB-36	828,250	2.4%
OKB-10	500,261	1.4%	OKB-37	642,457	1.8%
OKB-11	499,861	1.4%	OKB-40	499,808	1.4%
OKB-12	500,880	1.4%	OKB-41	999,962	2.9%
OKB-13	500,442	1.4%	OKB-42	1,000,112	2.9%
OKB-14B	458,294	1.3%	OKB-43	1,000,183	2.9%
OKB-17	312,428	0.9%	OKB-44	1,000,111	2.9%
OKB-18	978,956	2.8%	OKB-45	999,692	2.9%
OKB-19	1,000,263	2.9%	OKB-46	1,000,112	2.9%
OKB-20B	1,000,112	2.9%	OKB-47	990,009	2.8%
OKB-21	1,000,041	2.9%	OKB-48	1,019,092	2.9%
OKB-22	1,000,112	2.9%	OKB-49	312,692	0.9%
OKB-23	999,842	2.9%	OKB-51	375,061	1.1%
OKB-24	1,000,112	2.9%	OKB-52	500,099	1.4%
OKB-25B	990,093	2.8%	OKB-53	500,326	1.4%
OKB-26A	1,018,421	2.9%	OKB-54	500,402	1.4%
OKB-27	312,558	0.9%	OKB-55	500,995	1.4%
OKB-29	374,888	1.1%	OKB-56	500,261	1.4%
OKB-30	1,000,112	2.9%	OKB-57	458,423	1.3%
OKB-31B	999,962	2.9%	**TOTAL**	**35,004,886**	**100%**
OKB-32	999,830	2.9%			



TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD., BLDG. 300, STE. 300
JACKSONVILLE, FLORIDA 32256
CERTIFICATE OF AUTHORIZATION # 4815

Figure 6.1
Thiessen Polygons and Elevations of Maximum Excavation
for Each Vibracore in OKA
Okaloosa County, Florida

PROJECT	C2007-023
DRAWN BY	JCH
DATE	AUG 2008



TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD., BLDG. 300, STE. 300
JACKSONVILLE, FLORIDA 32256
CERTIFICATE OF AUTHORIZATION # 4815

Figure 6.2
Thiessen Polygons and Elevations of Maximum Excavation
for Each Vibracore in OKB
Okaloosa County, Florida

PROJECT	C2007-023
DRAWN BY	JCH
DATE	AUG 2008

6.2 Composite Characteristics

With the horizontal and vertical boundaries defined (Section 6.1), Taylor Engineering calculated composite borrow area statistics (i.e., mean grain size, sorting, silt content, and color) of the entire borrow area. These composite characteristics, which help assess the borrow material's compatibility to the native beach sand, represent weighted averages of the individual vibracore characteristics. Digital terrain modeling helped calculate the volume contribution of each vibracore sediment sample to the borrow area total. Then, Taylor Engineering weighted the sample's sediment data by its volume contribution. Finally, we combined the weighted characteristics from all contributing samples to calculate the borrow area composite statistics. This methodology applies the approximation that the characteristics of an individual sample apply vertically as far as half the distance to the next sample (or to a geological stratum change, if one occurs between the samples), and horizontally to the boundaries of its source vibracore's Thiessen polygon.

Table 6.3 summarizes the borrow area composite characteristics. Notably, of the 135 samples with silt content greater than 5% (Section 5.1), only 2 samples in OKA and 24 samples in OKB lay within the borrow area above the maximum dredge depths; the dredging process will blend these samples with other portions of the borrow area resulting in a composite with minimal silt content.

Table 6.3 Composite Characteristics of OKA and OKB

	OKA	**OKB**
Area (acres)	781	804
Total Available Volume (cy)	17,509,471	15,171,113
Mean Grain Size (phi)	1.70	1.73
Mean Grain Size (mm)	0.31	0.30
Median Grain Size, d_{50} (mm)	0.29	0.28
Sorting (phi)	0.76	0.77
Silt Percentage	1.4%	2.6%
Visual Shell Content	2%	2%
Carbonate Content	3.9%	5.1%
Color 5Y 6/3 or Lighter	99.0%	99.9%
Color 5Y 7/3 or Lighter	66.6%	70.8%
Color 5Y 8/2 or Lighter	9.4%	0.9%

Table 6.3 demonstrates that both potential borrow sites contain at least 300% of the required beach fill volume for all three projects. The composite characteristics fall within the boundaries established in Table 3.6, except for the carbonate content in OKB which exceeds the acceptable limit by 0.1%.

6.3 Proposed Dredging Template

Because the potential borrow areas OKA and OKB have very similar sizes, volumes, and composite properties, Taylor Engineering selected OKA as the borrow area for this project because its close proximity to the project sites and its shallower water depths will reduce dredging costs.

The design of the dredging template took into account several criteria. First, the final borrow area should contain approximately 150% of the required beach fill, or 6,829,350 cy. Second, it should conform as closely as possible in shape to a square with sides two miles in length, in conformation to USACE best dredging practice guidelines. Third, it should have as few changes in dredge elevation as possible to protect the environment and reduce dredging costs. Fourth, it should conserve offshore resources as far as possible, leaving behind beach-quality sediment in sufficient quantities for economic and technically feasible future extraction. Fifth, it should maximize the proportion of lightest-colored sand (5Y 7/2 and lighter) and minimize the proportion of darker sand (Munsell value 6). Sixth, it should have composite characteristics of mean grain size, silt content, and shell content within acceptable limits (those described in Table 3.6).

Table 6.4 presents the borrow area design statistics and compares them to the targets listed above. The proposed borrow area design, shown in Figure 6.3, achieves all of the above-mentioned design criteria to the greatest extent possible. Notably, development of a practical dredging plan that conserves resources yielded a total borrow area volume that exceeded 150% of the required beach fill.

Table 6.4 Composite Characteristics of Proposed Borrow Area Design

	Target	**Proposed Design**
Dredge Volume (cy)	6,829,350	7,539,700
Dimensions (miles)	2.0 x 2.0	1.7 x 0.8
Area (acres)	2,560	723
Number of Dredge Elevations	1	1
Color 5Y 7/2 or Lighter	100%	68%
Mean Grain Size (mm)	0.24 – 0.52	0.33
Silt Percentage	0.0 – 2.5%	1.3%
Carbonate Percentage	0.0 – 5.0%	3.8%

TAYLOR ENGINEERING INC.
10151 DEERWOOD PARK BLVD., BLDG. 300, STE. 300
JACKSONVILLE, FLORIDA 32256
CERTIFICATE OF AUTHORIZATION # 4815

Figure 6.3
Proposed Dredging Template
Okaloosa County, Florida

PROJECT	C2007-023
DRAWN BY	JCH
DATE	AUG 2008

7.0 SUMMARY

This study investigated the state waters offshore Okaloosa County — from the Santa Rosa County boundary to the Walton County boundary — to define sand sources for proposed beach restoration projects in Eglin Air Force Base (AFB), Okaloosa Island, and City of Destin.

With several other sand source investigations completed or ongoing within or near the current study area, this study began with a literature review to tap all available resources, prevent the study from duplicating previous data collection efforts, and help identify the need for additional geophysical and geotechnical data collection. This literature review identified three prospective sites with the greatest probability of containing beach quality sand for the current study to investigate; these sites included a northeast-southwest oriented ridge centered approximately seven miles offshore Destin, the nearshore area extending about one to five miles offshore Eglin AFB and Okaloosa Island from the Santa Rosa County boundary to East Pass, and the nearshore area extending about one to five miles offshore Destin from East Pass to the Walton County boundary.

Following the literature review, the reconnaissance data collection and analysis phase of this study broadly explored the three above-mentioned prospective sites to evaluate their sand source potential and identify specific sub-sites with the greatest probability of containing beach quality sand. Two stages comprised the reconnaissance phase. First, collection and analysis of sub-bottom seismic survey provided information of the sub-bottom sediment strata continuity and helped identify logical locations for vibracore drilling. Second, collection and analysis of widely spaced 20-ft long vibracores provided specific geotechnical information about the sediment grain size distribution, percent fines, composition (carbonate and organic content), and color and confirmed the geophysical signature ascertained by the sub-bottom seismic survey. The reconnaissance data collection and analysis efforts approximated the characteristics (locations, size, composition, and color) of sediment resources available within the study area and identified potential borrow sites warranting further investigation.

The subsequent detailed data collection and analysis phase included additional surveys within the potential borrow sites identified in the reconnaissance phase to define borrow sites conclusively. This phase consisted of high resolution sub-bottom seismic survey and vibracore collection, a bathymetry survey, and a cultural resource survey (side-scan sonar and magnetometer surveys). Collection and analysis of these survey data provided the necessary information for borrow site design.

Finally, the borrow site design phase used the results of the reconnaissance and detailed phase data collection and analysis phases to define the geometry (e.g., lateral boundaries and excavation depths) of the borrow site(s). Comparison of the borrow sediment characteristics to the native beach sand characteristics helped determine the borrow sediment compatibility with the native beach sand. This phase identified two potential sources — a nearshore relic ebb tidal delta (OKA) centered approximately one mile offshore and three miles west of East Pass and an offshore relic shoreline (OKB) centered approximately eight miles offshore and less than one mile east of East Pass that each contained sufficient quantities of beach quality sand for the proposed restoration projects.

The borrow site design process indicated that the borrow areas contained substantially more volume than required for the proposed projects. As of the date of this report, the current beach fill volume requirement for the three proposed beach restoration projects equals about 4,552,900 cy. This study developed a recommended borrow area template in OKA for permitting that provides approximately 7,539,700 cy, or 165% of the beach fill volume. This study also presented the maximum dredging depths and volumes of beach compatible sand and the associated composite characteristics in borrow areas OKA and OKB for future reference.

REFERENCES

American Vibracore Services. 2008. *Eglin AFB, Okaloosa County, and Destin Sand Source Investigation*. Delray, Beach, FL.

Panamerican Consultants, Inc. 2008. *Remote Sensing Survey, Diver Evaluation, and Identification of Submerged Resources for Eglin AFB/Okaloosa County/Destin Sand Source*. Memphis, TN.

Stone, G.W., Roberts, H.H., Liu, B., and Jose, F. 2006. *Walton County Sand Source Investigation Geophysical and Geotechnical Data Analysis Tasks 1 and 2*. Stone & Associates, Inc. Baton Rouge, LA.

Stone, G.W., Liu, B., and Jose, F. 2007. *Okaloosa County, Florida, Sand Source Investigation: Geophysical and Geotechnical Data Analysis.* Stone & Associates, Inc. Baton Rouge, LA.

Stone, G.W. and Roberts, H.H. 2001. *Review of Prospective Sand Target Areas: East Okaloosa and Walton Counties, Florida.* Stone & Associates, Inc. Baton Rouge, LA.

Stone, G.W. and Roberts, H.H. 2001. *Additional Reconnaissance for Prospective Sand Targets: City of Destin and Walton County, Florida.* Stone & Associates, Inc. Baton Rouge, LA.

Stone, G.W. and Roberts, H.H. *Review of Prospective Sand Target Areas: Destin, Florida.* Stone & Associates, Inc. Baton Rouge, LA.

Taylor Engineering, Inc. 2003. *Beach Management Feasibility Study, Walton County and Destin, Florida.* Jacksonville, FL.

Taylor Engineering, Inc. 2007. *Okaloosa Island Beach Management Feasibility Study, Okaloosa County, Florida.* Jacksonville, FL.

APPENDIX A

Native Beach Data

APPENDIX B

Stone & Associates Reconnaissance Phase Geophysical and Geotechnical Report

APPENDIX C

American Vibracore Services Detailed Phase Geophysical and Geotechnical Report

APPENDIX D

Panamerican Consultants Remote Sensing Survey Report