Plans & Specs – Level Offshore Sand Search Investigation, South Peninsula Volusia County, Florida U.S.A.

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1.0 Abstract

After analysis of the *reconnaissance-level* data (Coastal Tech 2005) acquired offshore of Volusia County, Florida, segments of three linear shoals were subjected to a *plans and specs-level investigation*. The plans and specs-level investigation was designed to (1) further quantify shoal sedimentology and stratigraphy, (2) assess compatibility with south peninsula native beaches, and (3) delineate potential borrow areas. The field component of this investigation was conducted during the last four months of 2005 and included acquisition of 91 three-inch diameter vibracores, 155 line miles of bathymetry and magnetometer survey data, and 309 line miles of side-scan sonar data.

Three potential borrow areas have been identified proximal to the south peninsula of Volusia County: B11-3, B12-1, and B13-3. COASTAL TECH has evaluated this material as suitable for use as fill to nourish south peninsula native beaches based upon the following: (1) potential borrow area volume estimates, (2) compatibility analysis, and (3) initial fill volume estimates as provided by Taylor Engineering (Michael Krecic, personal communication 2006).

The following sand resource utilization scenario is recommended by COASTAL TECH:

- New Smyrna Beach – Recommended primary target is B11-3 (2,450,000 yd^3) to nourish northern part of native beach segment; secondary target is B12-1 (750,000 yd^3) to nourish southern part of native beach segment.
- Turtle Mound – Recommended primary target is B12-1 (760,000 yd^3) to nourish northern part of native beach segment; secondary target is B13-3 (780,000 yd^3) to nourish southern part of native beach segment.

2.0 Offshore Borrow Area Investigation

2.1 Description of project

In 1975[1], Meisburger and Field conducted a regional survey of potential offshore borrow areas seaward of the Volusia County (County). Numerous linear sand shoals, with a local relief on the order of 20 feet, were documented adjacent to County beaches. These features were reported to consist of moderately-to-well-sorted, fine-to-coarse-grained

[1] Geomorphology, shallow structure, and sediments of the Florida inner continental shelf, Cape Canaveral to Georgia. USACE CERC Technical Memorandum No. 45, Ft. Belvoir, VA.

quartz sand and shell.

During the initial phase of this investigation, COASTAL TECH evaluated all available offshore data and identified eleven (11) of these shoals as appropriate for consideration as potential borrow areas for nourishment of County beaches. At the direction of the Florida Department of Environmental Protection, COASTAL TECH subjected nine (9) of these shoals to a reconnaissance-level geotechnical investigation as reported in Coastal Tech (2005[2]).

After analysis of the reconnaissance-level data, segments of three shoals were subjected to a plans and specs-level investigation: (1) B11-3, (2) B12-1, and (3) B13-3 (Figure 1). This investigation was designed to (1) further quantify shoal sedimentology and stratigraphy, (2) assess compatibility with south peninsula native beaches, and (3) delineate potential borrow areas. The field component of this investigation was conducted during the last four months of 2005 and included acquisition of 91 three-inch diameter vibracores, 155 line miles of bathymetry and magnetometer survey data, and 309 line miles of side-scan sonar data.

2.2 Vibracore field plan

The plans and specs-level field plan for vibracore acquisition was based primarily upon unpublished DEP standards for offshore sand search investigations. Vibracore locations were draped over each of the three sand shoals in a grid pattern with spacing generally equal to 1,000 ft. Vibracore length and spatial distribution were selected to ensure stratigraphic closure at the base and lateral margins of each sand shoal. The actual number, location, and length of plans and specs-level vibracores was subject to "on the fly" modification based upon a real-time assessment of sedimentology, stratigraphy, borrow-area geometry, and cumulative estimate of potential borrow area volume. A summary of all plans and specs-level vibracores successfully acquired by Alpine Ocean Seismic Survey is shown in Figures 2 through 4.

3.0 Sediment and Core Analysis

3.1 Sediment analysis

A total of 155 sediment samples were obtained from the top of all Plans & Specs-Level vibracores containing at least 2 ft of sand. Each sample was subjected to FDEP compliant laboratory methods to quantify: (1) grain size, (2) composition, and (3) color. The following grain-size parameters were then determined: (1) weight percent gravel, sand, fines (expressed using a #200 and #230 screen), (2) mean grain size, and (3)

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[2] Volusia County Sand Search – Geotechnical Investigations Task 2: Reconnaissance Level – County Wide Offshore Investigation Final Report. August 2005.

standard deviation or sorting. Each sediment sample was also subjected to a descriptive classification using USC terminology. When a sediment sample contained less than 5% fines, this classification was automatically generated by the gINT™ application. The classification of samples containing fines in excess of 5% was based on visual examination by a qualified laboratory technician.

COASTAL TECH utilized the Loss on Ignition method (Dean 1974[3]) to quantify the following compositional attributes of each sediment sample: (1) weight percent total organic matter, (2) weight percent "carbonate" (i.e., shells, limestone clasts), and (3) weight percent non-combustible (a.k.a. quartz or siliciclastic). Sediment color was quantified using the Munsell Book of Colors by visually comparing a moist (~15 wt% water) sample to myriad color chips under indirect insulation. Laboratory results of borrow area sediment sample analysis are summarized in Table 2.

3.2 Summary of core analysis

The sedimentology of samples collected from potential borrow areas B11-3, B12-1, and B13-3 is summarized in Table 2. Composite analysis of all data indicate the sand consists of a white to light gray, moderately sorted, fine-grained quartz sand (SP) with some (~10%) shell.

Stratigraphic analysis suggests the beach compatible sand extends to a depth of approximately 60 ft, below which a non-compatible layer of muddy sand (SM) is present.

4.0 Bathymetric Survey

Morgan & Eklund, Inc. performed the bathymetric survey in December 2005. Prior to performing the survey, two Coastal Leasing submersible tide gauges were installed just inside of Ponce Inlet. Elevations (referenced to NAVD 88) were established on the two gauges using published National Geodetic Survey (NGS) vertical control points. (i.e. benchmarks). The gauged water surface elevations were ultimately used to reduce the survey sounding data to elevations. All profile lines through each of the three borrow areas were spaced at 200' intervals (measured north to south) and soundings were collected at 50' intervals along the profile line.

Quality control checks for the bathymetry included (1) internal comparison between Morgan & Eklund data collected along the same line at different times and (2) comparing Morgan & Eklund bottom elevation data to

[3] Dean, W.E., 1974. Determination of carbonate and organic matter in calcareous sediments and sedimentary rocks by loss on ignition: comparison with other methods. Journal of Sedimentary Petrology, v. 44, p. 242-248.

Alpine Ocean Seismic Survey bathymetric and core boring elevation data, both collected during the reconnaissance-level phase of this investigation. Some vertical offsets were noticed when comparing Morgan & Eklund bottom elevation data to that collected by Alpine Ocean Seismic Survey. After re-computing Alpine's bathymetry (originally tide corrected using data from the NOAA Mayport tide station) using the Port Canaveral Tide Station data, a comparison between data sets indicated the two bathymetric data sets and core boring elevations all compared very well.

Morgan & Eklund also identified some changes in offshore shoal bathymetry which appeared to be real and recommend a pre-dredge bathymetric survey be performed. COASTAL TECH quantified these changes by comparing the initial bathymetric survey of Alpine to that acquired by Morgan & Eklund using only those tracklines where the two data sets were nearly coincident (i.e., on the 1000 ft centers of Alpine. When the bathymetric profile of Morgan & Eklund dipped below that of Alpine, the area of divergence was estimated and recorded as erosional. When the profile of Morgan & Eklund rose above that of Alpine, the area of divergence was estimated and recorded as accretional. For the purpose of this investigation, these data are assumed to provide a general indication of real trends in bathymetric change, although it is also possible the observed differences are an artifact of distinct collection and post-acquisition processing methods applied by two distinct survey firms.

The net change in area (i.e., area of erosion less area of accretion) was then recorded for each profile. The total change in area was also recorded for each potential borrow area and the results expressed as the ratio between net erosion and net accretion (i.e. E:A; see Table 1).

5.0 Borrow Area Delineation and Compatibility Analysis

5.1 Borrow area delineation

The lateral limits or boundary of each potential borrow area was initially constructed to include areas with a minimum of 2 ft of beach compatible sand (SP). Each potential borrow area includes one or more cells defined by a distinct maximum depth of cut (Figures 2 to 4). All maximum depth of cut elevations were established at least 2 ft above the basal elevation of beach compatible sand layer to provide a buffer separating this material from the underlying non-compatible sediment. Thereafter the volume of sediment associated with each potential borrow area was computed using Eagle Point™ software.

Volume estimates for each of the three potential borrow areas are shown in Table 1; this includes preliminary values generated using reconnaissance-level investigation data and revised values based upon the plans and specs-level investigation described herein. Note reconnaissance-level estimates suggested as much as 10,200,000 yd^3 of sand were contained in potential borrow areas B11-3, B12-1, and B13-3,

while the data obtained during the plans and spec-level investigation suggest 4,900,000 yd^3 are available. This reduction in reserve volume estimates is a consequence of three factors: (1) reconnaissance-level bathymetric survey (@1000 ft centers) did not accurately reflect the complexity of seabed relief, (2) passage of tropical and winter storms significantly altered shoal bathymetry, as described by Morgan and Eklund (above) and quantified in Table 1 and/or (3) local relief in the elevation of the contact between "compatible" and "non-compatible" sediment frequently exceeded 5 feet within a specific potential borrow area.

5.2 Compatibility analysis

Compatibility analysis is based upon a comparison between the sedimentology of native beaches and each potential borrow area. The comparison was conducted using two methods: (1) qualitative analysis of sediment composition and color and (2) analysis of composite granularmetrics using gradation data and ACES (USACE 1992).

5.2.1 South Peninsula native beach sedimentology

Taylor Engineering provided COASTAL TECH with nested-sieve granularmetrics and carbonate content derived from southern peninsula native beach samples. Based upon analysis of the Taylor Engineering native beach data, COASTAL TECH has delineated two distinct south peninsula shoreline segments (Figure 5): (1) New Smyrna Beach and (2) Turtle Mound. The New Smyrna Beach native beach regime extends between monuments R150 and R180. It consists of poorly graded, fine-grained quartz sand. The Turtle Mound native beach regime extends from R185 to R210. The beach in this area consists of poorly graded, fine-grained shelly quartz sand (summer) to poorly graded, medium-grained quartz-rich skeletal sand (winter).

5.2.2 Sediment color and composition

Compatibility assessment based upon sediment color and composition was qualitatively evaluated by a registered professional geologist using descriptive statistics and professional judgment (Table 2). Both native beach and potential borrow area sediment is white to light gray and therefore the compatibility of color is obvious.

The relative abundance of carbonate suggests potential borrow area B11-3 is most compatible with the New Smyrna Beach segment (8.5 wt% vs. 4.2 wt%). Potential borrow area 13-3 appears most compatible with the Turtle Mound segment (15.1 wt% vs. 13.7 wt%), although potential borrow area 12-1 is also similar (10.3 wt% vs. 13.7 wt%).

5.2.3 Composite granularmetrics

Granularmetric compatibility is based upon (1) visual examination of composite descriptive statistics and associated gradation curves and (2) analytical output of the USACE ACES program (Table 2).

Inspection of grain-size class suggests the New Smyrna Beach and potential borrow area B11-3 sediment consists of a moderately well sorted, fine-grained quartz sand, with <1 wt% gravel and fines (i.e., <200 screen). The Turtle Mound and potential borrow areas B12-1 and B13-3 consist of moderately well sorted, fine-grained shelly quartz sand, with <1 wt% gravel and fines.

The New Smyrna Beach segment contains the least amount of gravel (0.04 wt%) and therefore potential borrow area B11-3 (0.22 wt%) is most compatible, while potential borrow areas B12-1 (0.27 wt%) and B13-3 (0.61 wt%) contain sand most compatible to the Turtle Mound native beach segment (0.14 wt%). These compatibility assignments are supported by observations of mean grain size, sorting, and grain-size gradation curves. New Smyrna Beach contains the finest and best sorted sand (0.17 mm; 0.51 sorting); as does potential borrow area B11-3 (0.21 mm; 0.76 sorting). The Turtle Mound segment is slightly coarser and more poorly sorted (0.23 mm; 0.97 sorting), as are potential borrow areas B12-1 (0.27 mm; 0.78 sorting) and B13-3 (0.26 mm; 0.91 sorting). Finally, inspection of the coarse tail of all composite gradation curves suggest New Smyrna Beach is most similar to the sand in potential borrow area B11-3, while the sand in potential borrow area B13-3 is most similar to the Turtle Mound beach segment.

Using the USACE ACES program, overfill ratios were calculated for each potential borrow area and corresponding native beach (Table 2). Results confirm compatibility of B11-3 with New Smyrna Beach segment and B13-3 with Turtle Mound segment of native beach. Potential borrow area B12-1 appears compatible to both native beach segments.

7.0 Final Geotechnical Recommendations

Three potential borrow areas have been identified proximal to the south peninsula of Volusia County: B11-3, B12-1, and B13-3. Recommendations regarding the use of this material as fill to nourish south peninsula native beaches are based upon (1) potential borrow area volume estimates (Table 1), (2) results of the compatibility analysis (Table 2), and (3) initial fill volume estimates provided

by Taylor Engineering (Michael Krecic, personal communication 2006). These data are summarized in Table 3.

COASTAL TECH therefore recommends the following sand resource utilization scenario:

- New Smyrna Beach – Recommended primary target is B11-3 (2,450,000 yd^3) to nourish northern part of native beach segment; secondary target is B12-1 (750,000 yd^3) to nourish southern part of native beach segment.
- Turtle Mound – Recommended primary target is B12-1 (760,000 yd^3 [normalized; see Table 3]) to nourish northern part of native beach segment; secondary target is B13-3 (780,000 yd^3) to nourish southern part of native beach segment.

Note initial fill volume estimate for Turtle Mound (OR = 1.0) is 3,100,000 yd^3, while available fill (OR = 1.0) is estimated at 1,540,000 yd^3 (Table 3). Therefore, an additional 1,560,000 yd^3 is required to meet the design criteria of Taylor Engineering. The rationale for the occurrence of this deficit is described in Sections 4.0 and 5.1 (above). COASTAL TECH (2005) has already identified compatible sand reserves offshore of Volusia County which could be utilized as fill for the southern end of Turtle Mound or any other critically eroding beach (i.e., Daytona Beach) in Volusia County.

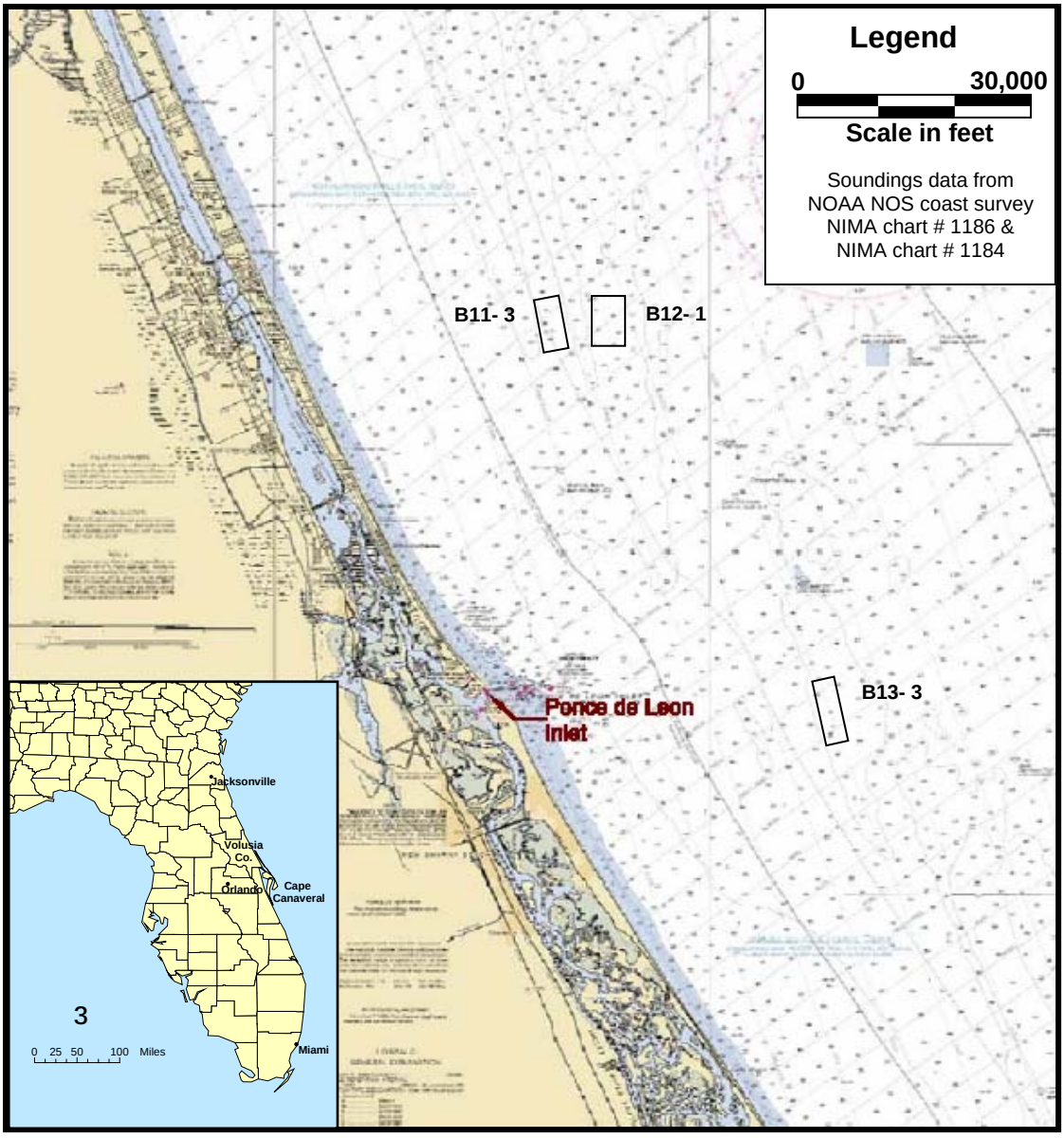

Figure 1 – Plans & specs-level potential borrow area locations

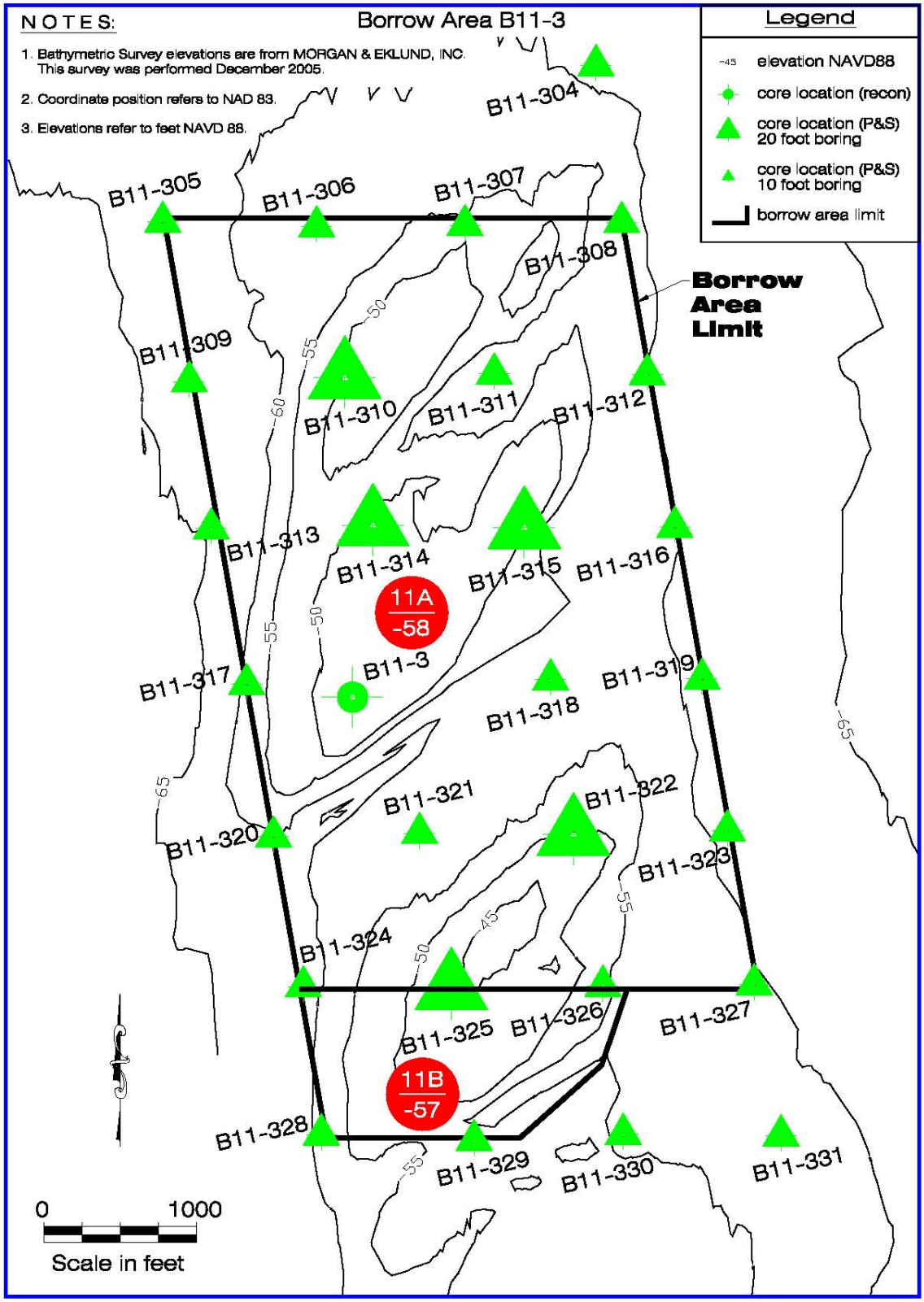

Figure 2 – B11-3 dredge cell boundaries with proposed maximum depth of cut

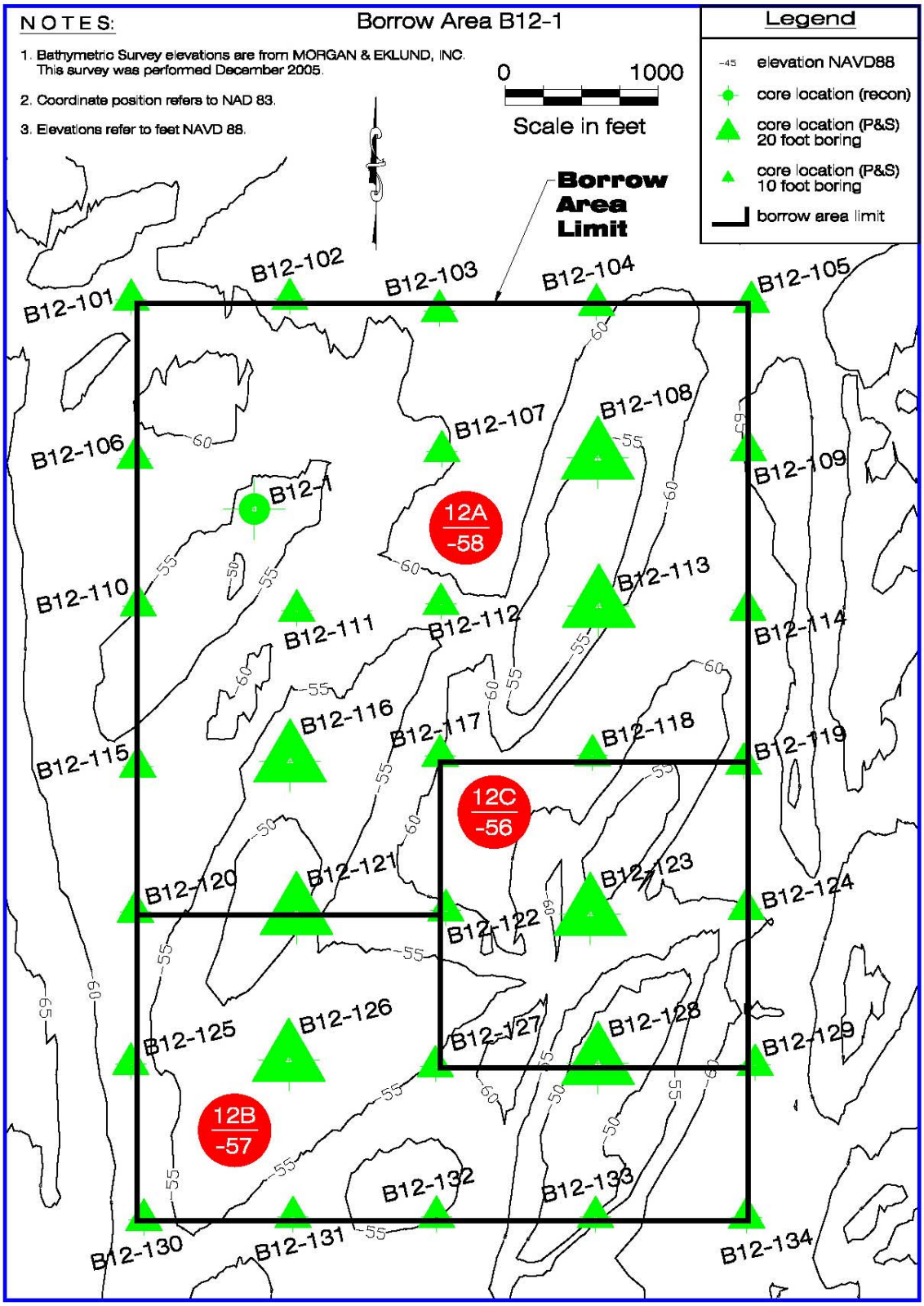

Figure 3 – B12-1 dredge cell boundaries with proposed maximum depth of cut

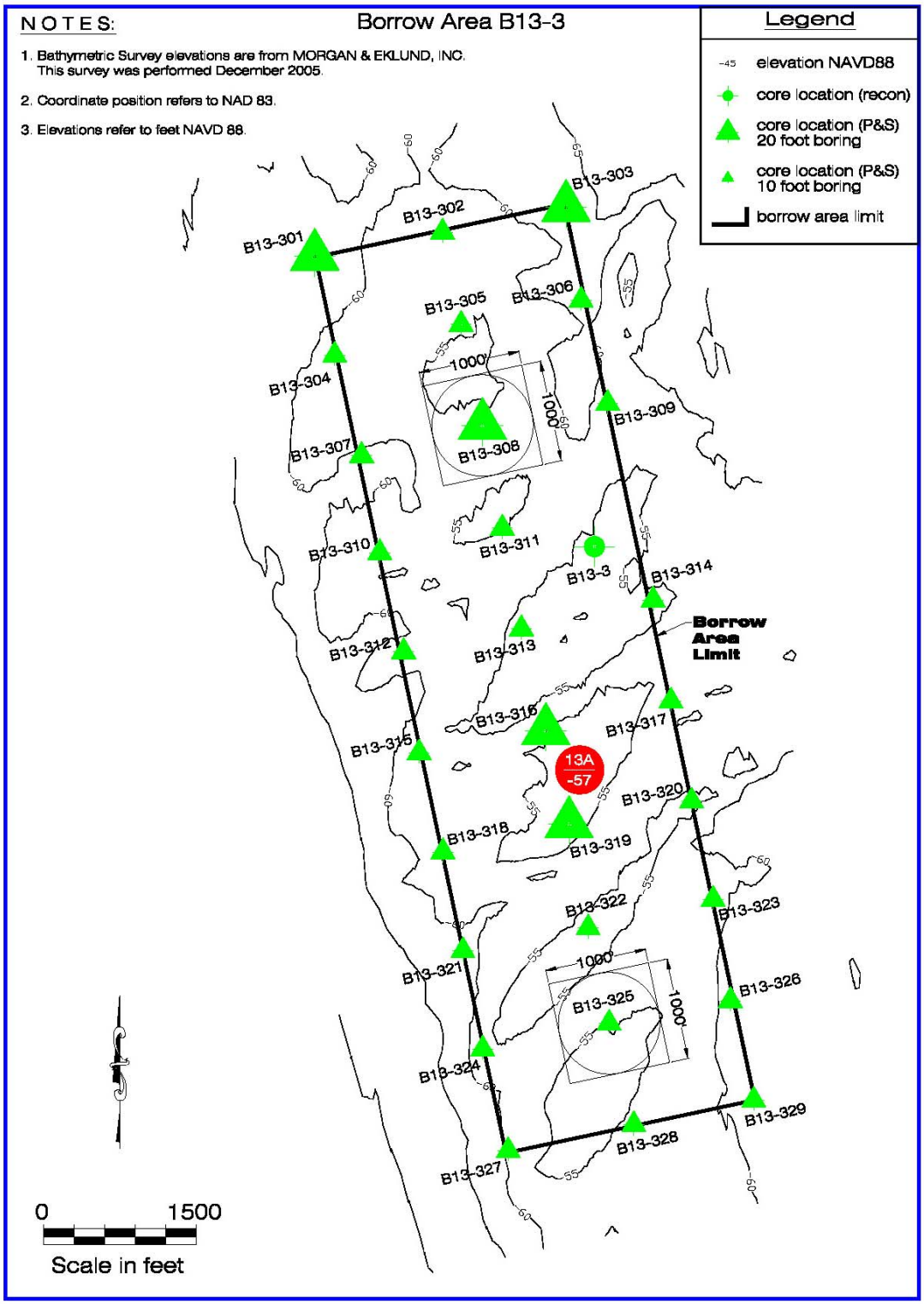

Figure 4 – B13-3 dredge cell boundaries with proposed maximum depth of cut; note two 1000 ft^2 by 1000 ft^2 "no dredge" cells centered on non-compatible sediment

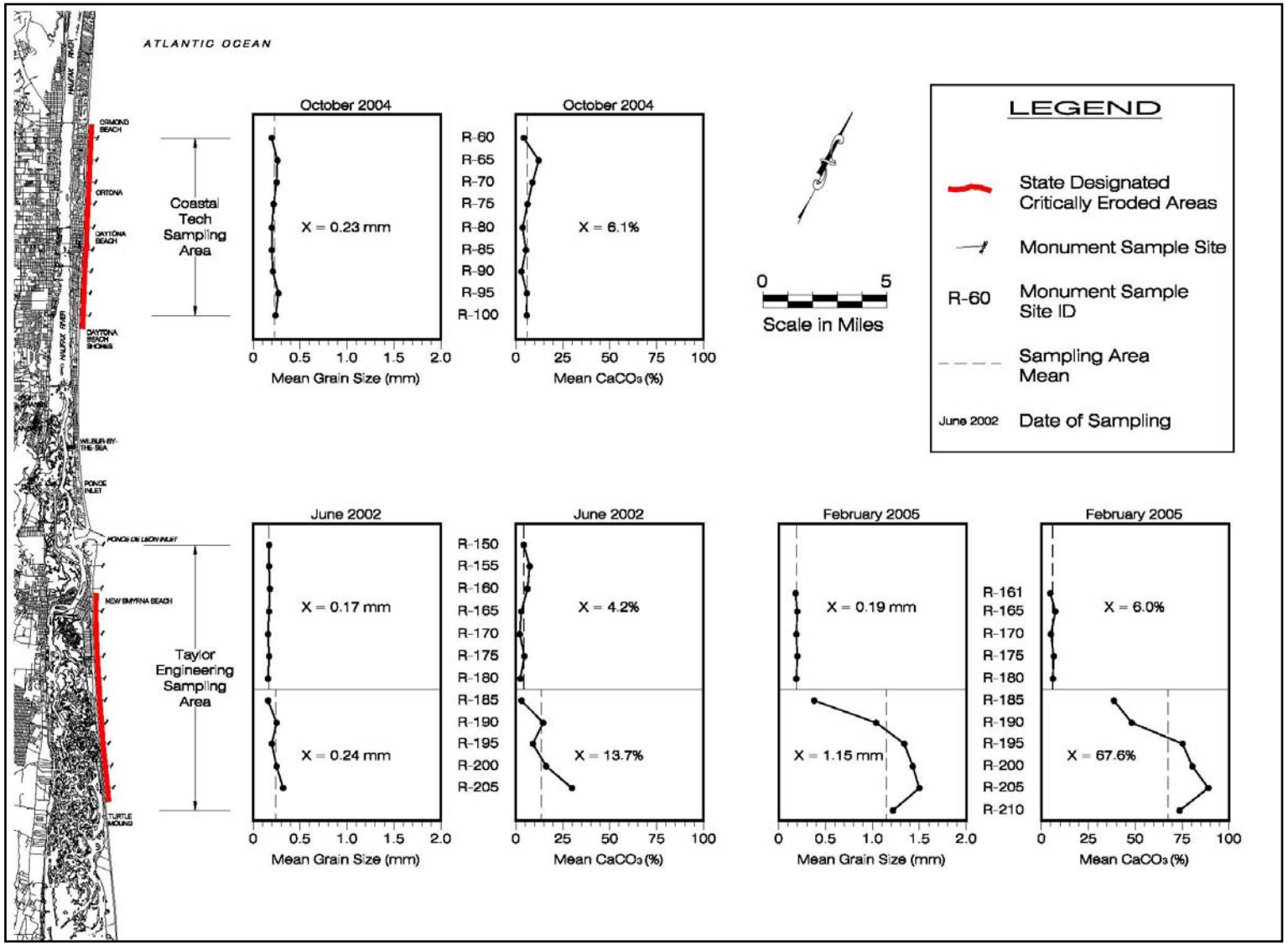

Figure 5 – Native beach sedimentology

Table 1 – Potential borrow area volume estimates

Proposed Borrow Area	**Plans and Specs**				**Reconnaissance**		**Origin of Volume Reduction**	
	Cell Designation	*MDC[(1)] (ft; NAVD88)*	*Cell Volume Estimates (yds^3)*	*Total Volume (yds^3)*	*MDC (ft; NAVD88)*	*Total Volume (yds^3)*	*Bathymetric Change (E:A)*	*Decrease in MDC*
B11-3	A	-58	2,100,000	2,450,000	-57	3,300,000	1.25[(2)]	not significant
	B	-57	350,000					
B12-1	A	-58	825,000	1,720,000	-57	1,900,000	not significant	not significant
	B	-57	725,000					
	C	-56	170,000					
B13-3	-	-57	778,000	778,000	-60	5,000,000	14.25[(3)]	≥2 mcy[(4)]
			Total	**4,948,000**	**Total**	**10,200,000**		

[(1)]Maximum Depth of Cut

[(2)]Erosion exceeded accretion by 25%

[(3)]Erosion was 14 times accretion

[(4)]Minimum estimate; does not include sand in two "no dredge" cells (see Figure 4)

Table 2 – Summary of sediment compatibility attributes

Location	**Composition (%wt)**		**Munsell Value**		**Granularmetrics**						
					Size Class (%wt)			Descriptive Statistics			
Native Beach[1] [2]	*Carbonate*	*Quartz*	*Verbal*	*Numeric*	*Gravel*	*Sand*	*<#200*	*Mean (mm)*	*Std. Dev (phi)*		
NSB	4.2	4.2	white to lt. gray	10YR 8/1 - 10YR 7/1	0.04	99.43	0.53	0.17	0.51		
TM	13.7	86.3	white to lt. gray	10YR 8/1 - 10YR 7/1	0.14	99.19	0.67	0.23	0.97	**ACES Overfill Ratios**	
Potential Borrow Area										NSB	TM
B11-3	8.5	91.5	white to lt. gray	10YR 8/1 - 10YR 7/1	0.22	99.18	0.60	0.21	0.76	1.055	1.475
B12-1	10.3	89.7	white to lt. gray	10YR 8/1 - 10YR 7/1	0.27	99.35	0.38	0.22	0.78	1.048	1.273
B13-3	15.1	84.9	white to lt. gray	10YR 8/1 - 10YR 7/1	0.61	98.97	0.42	0.26	0.91	1.048	1.000

[1]Color inferred by comparison to north peninsula native beaches (i.e., Daytona Beach, R60-R100)

[2]NSB = New Smyrna Beach, TM = Turtle Mound

Table 3 – Native beach fill and potential borrow area volume summary; volume effect of magnetometer contacts in potential borrow areas has not been considered

Native Beach			**Potential Borrow Area Volume Estimate (yd^3)**				
Location	*Initial Fill Volume Estimate (yd^3)*		*B11-3*	*B12-1*		*B13-3*	*Total*
	OR = 1.0	OR = 1.1	OR = 1.1	OR = 1.0	OR = 1.1	OR = 1.0	
NSB		3,200,000	2,450,000		750,000[(1)]		3,200,000
TM	3,100,000			760,000[(2)]		780,000	1,540,000

[(1)]Total available is 1,720,000 yd^3; balance transferred to TM native beach

[(2)]Volume estimate based upon (a) B12-1 sand remaining (970,000 yd^3) after initial use of 750,000 yd^3 to nourish NSB and (b) normalization to OR = 1.0 using ACES data shown in Table 2