FEASIBILITY REPORT

AND

ENVIRONMENTAL IMPACT STATEMENT

COASTAL STORM DAMAGE REDUCTION PROJECT

SURF CITY AND NORTH TOPSAIL BEACH

NORTH CAROLINA

Appendix E

Sand Compatibility Analysis

Appendix E: Sand Compatibility Analysis

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Appendix E: Sand Compatibility Analysis

1. Introduction. Sands making up the native beach are generally hydraulically sorted with the coarser grain sizes concentrated in the foreshore region, where wave energy is the greatest, and the finer grain sizes located in the offshore areas seaward of the surf zone. In order for the borrow material to be compatible with the native beach sand, the borrow material must contain essentially all of the same grain sizes that exist on the active beach profile of the project area. In this regard, the active beach profile is generally defined in engineering terms as the portion of the profile from the top of the beach berm seaward to depths where significant sand transport by wave energy is negligible. At Topsail Island, the active beach profile appears to end in a water depth of approximately 25 feet below National American Vertical Datum (NAVD). Note that sediment movement in water depths greater than 25 feet below NAVD is known to occur. However, the rate of sediment movement in these deeper depths is relatively small compared to rate of movement in the shallower depths and are therefore of minor importance in the day to day and year to year behavior of the beach profile.

2. Definitions. Definitions are included to provide better understanding of the terminology used in this appendix.

   Active zone. The zone that extends from the top of the beach berm seaward to depths where sediment transport induced by waves is negligible.

   Beach berm. A nearly horizontal part of the beach or backshore formed by the deposit of material by wave action.

   Datum. Any permanent line, plane, or surface, used as a reference datum to which reference datums are referred.

   Foreshore. The part of the shore, lying between the crest of the seaward berm (or upper limit of wave wash at high tide) and the ordinary low water mark, that is ordinarily traversed by the uprush and backrush of the waves as the tides rise and fall.

   Grain size. Refers to the mean or effective diameter of individual mineral grains or particles. Grain size analysis passes particles through a series of sieves with known

mesh sizes to determine the grain size based on the amount of particles retained or passing a sieve.

Mean high water (MHW). The average height of high waters over a 19-year period. For shorter periods of observations, corrections are applied to eliminate known variations and reduce the results to the equivalent of a mean 19-year value.

Mean low water (MLW).   The average height of low waters over a 19-year period. For shorter periods of observations, corrections are applied to eliminate known variations and reduce the results to the equivalent of a mean 19-year value.

Mean sea level (MSL). The average height of the surface of the sea for all the stages of the tide over a 19-year period, usually determined from hourly height readings. Not necessarily equal to mean tide level. It is also the average water level that would exist in the absence of tides.

Offshore. The zone extending from the shoreface to the edge of the continental shelf.

Overfill ratio. Used to evaluate the compatibility of sediments and to relate the volume of borrow site sediment required for a project to perform comparably with native beach sand.

Phi scale. A common method to represent grain size distribution. The scale is a logarithmic transformation of the Wentworth grade scale for size classifications of sediment grains based on the negative logarithm to the base 2 of the particle diameter. A phi value is dimensionless and has equivalent millimeter values.

Vibracore. A drill machine driven by a vibrating head assembly to collect sediment samples. Ocean sediment samples are collected by lowering the machine from a floating vessel to the ocean floor.

3. **Grain Size Nomenclature.** Note that the mean grain sizes of the native and borrow area materials are reported in both millimeters (mm) and phi (φ) units in this report where phi is related to the grain size as follows:

$$\varphi = -\ln(d)/\ln(2)$$

where:
d = grain size in millimeters (mm)
ln = natural log

Since the distribution of the sand samples can generally be represented as log-normal distributions, the standard deviations and variances of the particle size distributions are reported in phi units.

4. **Native Beach Sampling and Results.** The characteristics of the native beach material at Topsail Island were determined through an extensive sampling program conducted by the USACE in 2003. Samples were collected from the beach along transects approximately 5,000 feet apart (see figure A-1). Only transects 7 through 16 exist within the boundaries for the Surf City/North Topsail Beach project and were evaluated to determine the native beach characteristics. Grab samples were collected by the USACE in 2003 from the along each transect at the surface at the following elevations: Toe of the Dune, Crest of the Berm, Mean High Water (MHW), Mean Sea Level (MSL), Mean Low Water (MLW), and twelve (12) samples collected seaward of MLW starting at elevation -3 feet and continuing at 2 foot depth increments from -4 to -24 feet.

The State of North Carolina implemented new rules in 2007 governing sediment compatibility for beach nourishment. The rules are titled "Technical Standards for Beach Fill Projects" and are found in 15A North Carolina Administrative Code (NCAC) 07H.0312. These rules specify that characterization of the native beach material requires a minimum of thirteen (13) samples be collected along each transect with an equal number of samples collected landward and seaward of mean low water (MLW). Because this rule was implemented after the sampling program at Topsail Island was conducted by USACE, the current data set for transects 7 through 12 contain only four landward samples of MLW. In 2007, Coastal Planning & Engineering of North Carolina, Inc. (CPE-NC) collected two (2) additional samples landward of the MLW from the dune and mid-berm (~ +3 to +5 ft NAVD) along each transect line 13 through 16 to meet this requirement for the North Topsail Beach

non-Federal Shore Protection Project. The CPE-NC data for transect lines 13 through 16 has been incorporated into this evaluation performed for the Surf City/North Topsail Beach Federal Shore Protection Project. To comply with the beach fill standard, two (2) additional samples will be required to be collected landward of MLW for each transect line 7 through 12 prior to construction of this project. To be consistent with the samples collected by CPE-NC along transect lines 13 through 16, these additional samples along transect lines 7 through 12 will be collected from the dune and mid-berm (~ +3 to +5 ft NAVD).

To comply with the beach fill standards, only 6 of the 12 samples collected seaward of MLW were combined with the MLW sample and samples landward of MLW to develop the composite characteristics of the native beach material to be used in the compatibility analysis of the borrow material. The grain size distribution of each sample was determined by standard sieve analysis, from which the mean and standard deviation of the grain size distribution of each sample were determined. The samples at each transect line were combined to develop the composite characteristics of the native beach material to be used in the compatibility analysis of the borrow material.

Active Beach Profile Zone

The vertical datum used for the collection of the native beach samples by USACE in 2003 was the National Geodetic Vertical Datum of 1929 (NGVD '29). The beach fill standards implemented by North Carolina in 2007 adopted the North American Vertical Datum of 1988 (NAVD '88) as the vertical datum. Therefore, the vertical elevation for near shore samples collected by USACE has been converted to NAVD for consistency in this appendix. The mean grain size and standard deviation of the native samples collected along the transect lines in regards to depth is illustrated on figure E-1. The mean grain size variation with depth is typical of other beaches in North Carolina where coarser material is present in the foreshore area ranging from mean high water (+1.1 NAVD) to around -4 to -5 feet NAVD. The mean grain size gradually decreases seaward from this point. The standard deviation of the particle size distribution is larger at the same depths where the coarser material is present in the foreshore to around -4 to -5 feet NAVD. The standard deviation is gradually smaller seaward of this point.

Composite Characteristics of Native Beach Material

The grain size distribution of each of the samples collected from the transect lines were combined and the average grain size distribution and standard deviation for each transect determined. The individual transect line characteristics are summarized in table E-1. The average grain size distribution and standard deviation for the 10 transect lines (7-16) were then combined to determine the composite grain size distribution and standard deviation for the Surf City/North Topsail Beach study area, which are summarized in table E-2. The composite mean grain size for the Surf City/North Topsail Beach study area is 2.15 phi (0.23 mm) with a standard deviation of 0.71 phi (0.61 mm).

The mean grain size and standard deviation of each transect line is plotted on figure E-2. The mean grain size for each transect is relatively similar with the exception of transect line 8, which is slightly coarser and the largest percentage of shell present. The standard deviation is also largest at transect line 8 indicating the material is less sorted in this area than along the other transects. Generally, the material appears to be relatively well sorted throughout the study area as illustrated by the small standard deviation with the exception of transect line 8.

5. **Borrow Material Sampling and Results.** The search for borrow material was concentrated in the ocean waters off Topsail Island beginning approximately 1 mile offshore and in water depths of 33 feet Mean Lower Low Water (MLLW) and extending seaward to approximately 6 miles offshore. Details of this offshore search for beach compatible material is described in Appendix C, Geotechnical Analyses, and consisted of a combination of seismic and sonar surveys followed by the collection of vibracores at 369 locations. Boring logs were developed for each vibracore based on visual classifications of the material in the cores. The sand layers in each vibracore were sampled for grain size analysis. The results of the grain size analysis of the vibracore material combined with the seismic bottom profile data, was used to delineate the boundaries of potential offshore borrow areas. Composite grain size characteristics of the material in each of these potential borrow areas were computed for comparison with the composite characteristics of the native beach material.

Borrow Material Vibracores

The investigation was conducted in two major phases. Phase one consisted of the collection of over 315 miles of seismic subbottom profiles performed offshore of

Topsail Island, with 173 miles of these miles for the Surf City/North Topsail Beach project. Phase 2 involved the collection of 369 vibracores offshore of Topsail Island, with 208 of these vibracores for the Surf City/North Topsail Beach project. The search area and the seismic lines surveyed in this effort for the entire Topsail Island are discussed in detail in the Geophysical Report in Attachment 1 to Appendix C, Geotechnical Analyses. The seismic survey data was analyzed to determine areas where beach quality material of sufficient depth appeared likely.

Based on the interpretation of the seismic data, a vibracore drilling plan was developed to determine the characteristics of the subbottom material. In this regard, the seismic data only provides information on the layering of material and does not provide information of the granular characteristics of the material. The vibracores consist of vibrating a 20-foot long plastic core into the ocean bottom. The plastic core is then split and the material characteristics in the core visually classified. Material collected in the core was sampled and the size distribution of that material was determined through standard sieve analysis. In general, the cores were sampled in two-foot intervals or more frequently if a significant difference in the character of the material was visually apparent. The locations of the vibracores collected for the Topsail Beach study area are shown on figure A-1. Logs of each of the vibracores are provided in Attachment 2 to Appendix C, Geotechnical Analyses. In addition, laboratory data for grain size analysis from each sample is provided in Attachment 3 to Appendix C.

Borrow Site Vibracore Analysis

An initial compatibility analysis was conducted of the vibracore logs and sample lab data in 2004. This analysis identified fourteen preliminary borrow areas (G, H, I, J, K, L, M, N, O, P, Q, R, S, and T) for the Surf City/North Topsail Beach project (See Appendix A, Figure A-1). Mid-Atlantic Technology and Environmental Research, Inc completed an archeological resources survey (magnetometer and side-scan sonar) of the preliminary borrow areas in 2005. The survey identified the presence of hard bottom in and around several of the preliminary borrow areas. Due to the presence of significant hard bottom in borrow areas I, K, and M, these borrow areas were eliminated as potential borrow sources.

The grain size characteristics of all of the samples collected from each of the cores within the remaining potential borrow areas are given in tables E-3 through E-18. The grain size characteristics of the borrow area samples were used to develop weighted average composite grain size distribution representative of all of the

material in each of the borrow areas. The weighting was based on the thickness of the core represented by a particular sample in each core from which a weighted composite distribution for each core was determined. The weighted average core distributions were used to compute the overall composite characteristics for the entire borrow area. To comply with the NC beach fill standards, tables E-3 through E-18 also identify the amount of fine-grained sediment, defined as smaller than 0.062 mm (#230 sieve), the amount of granular sediment, defined as smaller than 4.76 mm (#4 sieve) and greater than or equal to 2.0 mm (#10 sieve), and the amount of gravel, defined as greater than or equal to 4.76 mm (#4 sieve). The final weighted composite characteristics for each of the borrow areas are given in tables E-19 to E-34.

6. **Overfill Ratio.** The suitability of the borrow material for placement on the beach is based on the overfill ratio. The overfill ratio is computed by numerically comparing the size distribution characteristics of the native beach sand with that in the borrow area and includes an adjustment for the percent of fines in the borrow area. The overfill ratio is primarily based on the assumption that the borrow material will undergo sorting and winnowing once exposed to waves and currents in the littoral zone, with the resulting sorted distribution approaching that of the native sand.

   Since borrow material will rarely match the native material exactly, the amount of borrow material needed to result in a net cubic yard of beach fill material will generally be greater than one cubic yard. The excess material needed to yield one net cubic yard of material in place on the beach profile is the overfill ratio. The overfill ratio is defined as the ratio of the volume of borrow material needed to yield one net cubic yard of fill material. For example, if 1.5 cubic yards of fill material is needed to yield one net yard in place, the overfill factor would equal 1.5. The numerical procedure for computing the overfill ratio is contained in a suite of computer programs contained in the Automated Coastal Engineering System (ACES) produced by the U.S. Army Coastal Engineering Research Center. The procedure is also described in the U.S. Army Coastal Engineering Manual EM-1110-2-1100 Part V (July 2003). A summary of the native beach and borrow characteristics, as well as, the computed overfill ratios is shown in table E-35.

7. **Compatibility and Borrow Sources.** The compatibility analysis compares the grain size of the "native or reference beach" with the material in the proposed borrow material. The overfill ratio is the primary indicator of the compatibility of the borrow material to the beach material, with a value of 1.00 indicating that one cubic yard of borrow material is needed to match one cubic yard of beach material. An overfill

ratio of up to 1.5 is generally considered acceptable as a match of compatibility. Table E-35 illustrates the overfill ratios for potential borrow areas for the Surf City/North Topsail Beach project.

Prior to implementation of the NC beach fill rules in 2007, eleven (11) offshore borrow areas were identified for the Surf City/North Topsail Beach project and included G, H, J, L, N, O, P, Q, R, S, and T. After re-evaluation of the borrow areas using the new beach fill standards, borrow area R was determined to be well above the silt criteria and was not evaluated further. Excluding borrow area R, the compatibility analysis indicated the overfill ratio for the remaining 10 borrow areas were all below 1.5. Because additional characterization for all borrow areas will be conducted during the design phase, borrow area R has not been included in the volume calculations for material available for the project, but has been retained for future evaluation. With the exclusion of borrow area R, the total estimated volume in the remaining ten borrow areas (G, H, J, L, N, O, P, Q, S, and T) is approximately 27.59 million cubic yards (yd^3), which is insufficient to meet the required volume for the NED plan of 32.3 million yd^3.

To address the deficiency of available material for the Surf City/North Topsail Beach project, the six borrow areas identified for the Topsail Beach Federal shore protection project (A, B, C, D, E, and F) were considered. The estimated amount of compatible material in these borrow areas exceeds the Topsail Beach Federal and non-Federal project requirements by approximately 9.68 million yd^3. Therefore, these borrow areas have been included in the compatibility analysis conducted for the Surf City/North Topsail Beach project in this appendix. The overfill ratios for these six borrow areas are also all below 1.5 with the exception of borrow area C., which was 1.56. Because the overfill ratio for borrow area C was only slightly above 1.5, it has been retained for further evaluation when additional characterization is conducted during the design phase. The additional estimated amount of compatible material in the Topsail Beach borrow areas (A, B, C, D, E, and F) which exceeds the Topsail Beach project requirements (approximately 9.29 million yd^3) combined with the estimated volume (27.59 million yd^3) in borrow areas G, H, J, L, N, O, P, Q, S, and T meets the NED project requirements (32.3 million yd^3).

The composite mean grain size of material in the native beach material and borrow areas is illustrated in table E-35. The composite mean grain size for the borrow areas is typically within 0.03 millimeters of the native beach sand (0.23 mm), with the exceptions of borrow areas F, N, S, and T. The mean grain size for these borrow

areas is larger than the native beach material with mean grain sizes of 0.47 mm, 0.28 mm, 0.32 mm, and 0.29 mm respectively.

The NC beach fill standards require compatibility of the native beach with borrow sources in regards to the percentage of silt (< 0.062 mm), granular sediment, (< 4.76 mm and $\geq$ 2.0 mm), gravel ($\geq$ 4.76 mm), and calcium carbonate. A visual estimate of shell content can be used in lieu of carbonate weight percent for samples collected prior to the effective date of beach fill rules which applies to the Surf City/North Topsail Beach project. The standards require that percent silt, granular sediment, and gravel in borrow material not exceed the amount found in the native beach plus 5% and the percent carbonate in borrow material not exceed the amount found in the native beach plus 15%. These characteristics for the native beach and borrow material are illustrated in table E-35. The analysis for the native beach material indicates the silt, granular sediment, and gravel content are 1.2%, 1.1%, and 0.5% respectively. The visual shell content for the native beach is 9%. After incorporating the tolerance permitted by the beach fill standards, the silt, granular sediment, gravel, and shell content permitted for borrow areas to be used for the Surf City/North Topsail Beach are less than 6.2%, 6.1%, 5.5%, and 24% respectively.

All of the borrow areas comply with the beach fill standards in regards to the percentage of silt with the exception of borrow areas A (6.6%) and L (6.3%). Both of these borrow areas exceed the standard slightly by 0.4 and 0.1% respectively. All of the borrow areas comply with the beach fill standards in regards to the percentage of granular sediment with the exception of borrow areas F (7.0%) and S (6.6%), which exceed the standard by 0.9 and 0.5% respectively. All of the borrow areas comply with the beach fill standards in regards to the percentage of gravel sediment with the exception of borrow areas F (8.5%) and P (6.6%), which exceed the standard by 3 and 1.1% respectively. All of the borrow areas comply with the beach fill standards in regards to the percentage of shell content (carbonate). Because all borrow areas will be further characterized during the design phase of this project, borrow areas in which the standards were exceeded for the various characteristic (A, F, L, S, and P) have been retained. Additional vibracores will be performed to comply with the beach fill standards of 1 core/acre or 1,000 foot spacing. This additional data will be incorporated into the existing borrow area data to produce the final characteristics of each borrow source, which will be evaluated using the NC beach fill standards to determine compliance.

Figure E-1: Average Mean and Standard Deviation Versus Sample Depth
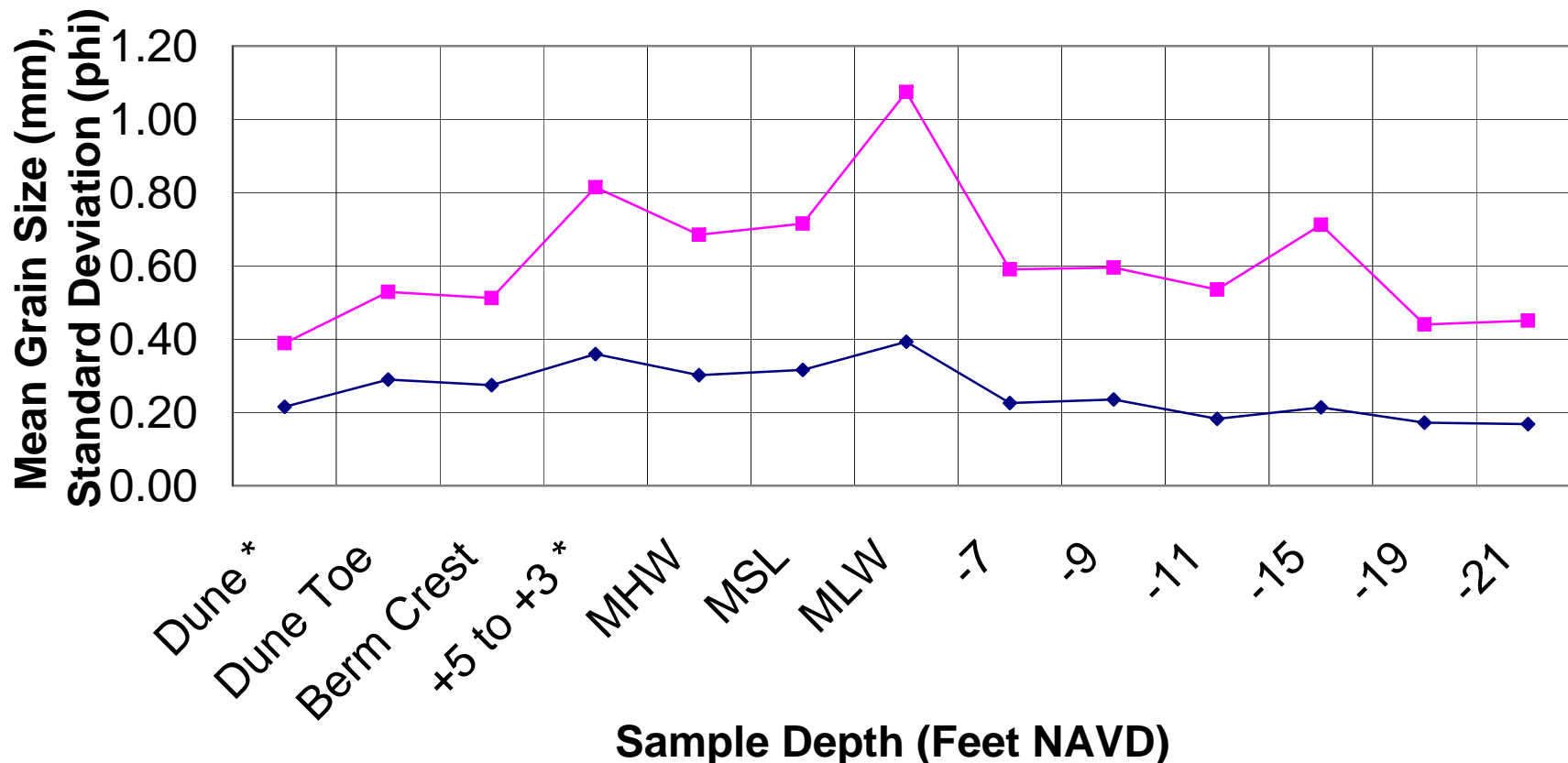
Figure E-2: Mean Grain Size and Standard Deviation for Transect Lines
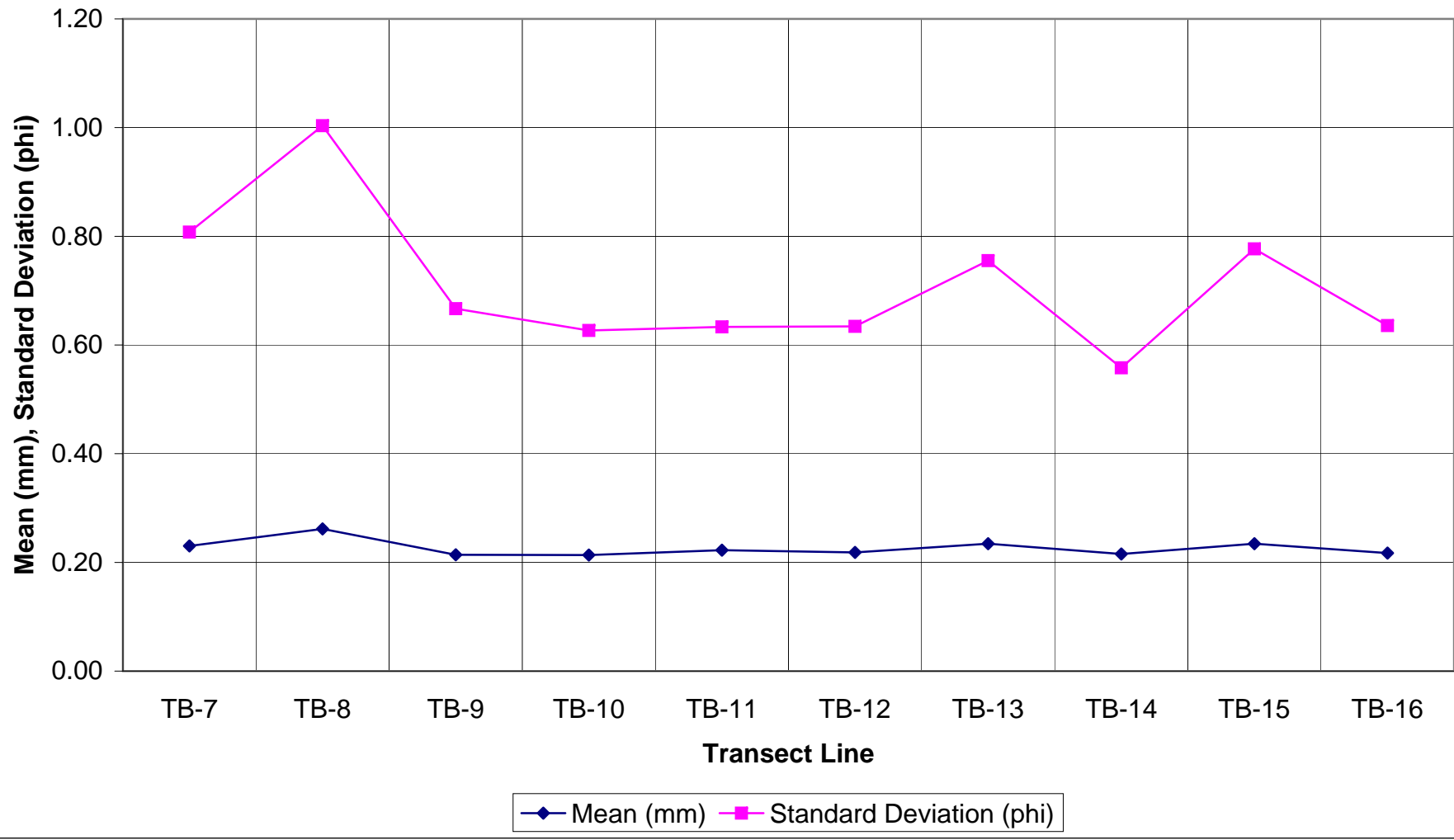
Table E-1
<u>Native Beach Samples</u>

Sample Description	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TRANSECT LINE TB-7								
TB-7-TOE	1.89	0.27	0.69	0.62	7.0	0.3	0.9	17
TB-7-CREST	1.53	0.35	0.89	0.54	0.9	0.3	0.0	24
TB-7-MHW	1.61	0.33	0.72	0.61	0.5	0.2	0.0	22
TB-7-MSL	1.47	0.36	1.00	0.50	1.1	0.1	0.0	32
TB-7-MLW	1.37	0.39	1.23	0.43	1.0	3.5	0.2	19
TB-7-6	2.52	0.17	0.41	0.76	1.3	0.1	0.0	5
TB-7-8	2.62	0.16	0.40	0.76	1.0	0.1	0.0	13
TB-7-12	2.43	0.19	0.46	0.73	1.1	0.6	0.1	8
TB-7-14	2.57	0.17	0.47	0.72	1.8	2.0	0.1	5
TB-7-18	2.52	0.17	0.42	0.75	1.3	0.0	1.0	5
TB-7-20	2.61	0.16	0.42	0.75	2.1	0.0	0.0	2
TRANSECT LINE TB-8								
TB-8-TOE	0.93	0.52	0.59	0.67	0.5	0.1	0.0	35
TB-8-CREST	1.50	0.35	0.40	0.76	1.2	4.4	1.4	20
TB-8-MHW	1.59	0.33	0.92	0.53	1.3	3.1	0.2	17
TB-8-MSL	1.53	0.35	0.81	0.57	0.6	0.2	0.0	20
TB-8-MLW	0.52	0.70	1.97	0.26	0.8	18.3	7.9	30
TB-8-6	2.01	0.25	0.65	0.64	1.0	0.3	0.0	13
TB-8-8	2.54	0.17	0.47	0.72	0.8	0.2	0.0	7
TB-8-12	2.49	0.18	0.44	0.74	1.4	0.1	0.0	6
TB-8-14	2.52	0.17	0.46	0.73	1.2	2.4	0.2	4
TB-8-18	2.57	0.17	0.41	0.75	1.7	0.0	0.0	6
TB-8-20	2.64	0.16	0.44	0.74	2.0	0.1	0.0	7
TRANSECT LINE TB-9								
TB-9-TOE	2.08	0.24	0.42	0.75	0.8	0.1	0.0	5
TB-9-CREST	2.17	0.22	0.40	0.76	0.9	0.0	0.0	6
TB-9-MHW	1.72	0.30	0.81	0.57	1.4	3.0	0.0	15
TB-9-MSL	1.44	0.37	1.19	0.44	0.7	2.3	0.0	18
TB-9-MLW	0.52	0.70	2.08	0.24	0.9	27.3	6.1	20
TB-9-6	2.43	0.19	0.44	0.74	1.3	0.1	0.0	9
TB-9-8	2.51	0.17	0.45	0.73	1.0	0.1	0.0	8
TB-9-12	2.48	0.18	0.55	0.68	1.6	2.2	0.0	9
TB-9-14	2.53	0.17	0.44	0.74	1.3	0.5	0.4	5
TB-9-18	2.57	0.17	0.43	0.74	1.9	0.1	0.0	3
TB-9-20	2.64	0.16	0.41	0.75	2.3	0.1	0.0	3
TRANSECT LINE TB-10								
TB-10-TOE	1.36	0.39	1.04	0.49	0.6	2.8	0.0	13
TB-10-CREST	1.87	0.27	0.55	0.68	0.8	0.0	0.0	12
TB-10-MHW	2.04	0.24	0.44	0.74	1.2	0.0	0.0	7
TB-10-MSL	2.04	0.24	0.47	0.72	1.1	0.1	0.0	6
TB-10-MLW	1.79	0.29	0.90	0.54	1.0	0.5	0.2	16
TB-10-6	2.59	0.17	0.39	0.76	1.4	0.0	0.0	5
TB-10-8	2.61	0.16	0.49	0.71	1.6	0.1	0.0	4
TB-10-12	2.52	0.17	0.51	0.70	1.8	0.2	0.0	5
TB-10-14	2.41	0.19	0.53	0.69	1.8	2.1	0.7	7
TB-10-18	2.45	0.18	0.42	0.75	2.2	0.5	0.3	4
TB-10-20	2.49	0.18	0.44	0.74	2.8	0.1	0.1	5

Table E-1
Native Beach Samples (continued)

Sample Description	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TRANSECT LINE TB-11								
TB-11-TOE	1.98	0.25	0.40	0.76	0.6	0.1	0.0	5
TB-11-CREST	2.10	0.23	0.39	0.76	0.3	0.0	0.0	5
TB-11-MHW	1.45	0.37	1.07	0.48	0.8	1.6	0.0	13
TB-11-MSL	1.35	0.39	1.08	0.47	0.6	0.1	0.2	30
TB-11-MLW	1.79	0.29	0.74	0.60	1.3	0.3	0.0	15
TB-11-6	2.34	0.20	0.46	0.72	1.1	0.3	0.0	6
TB-11-8	1.53	0.35	0.47	0.72	0.6	0.3	0.0	5
TB-11-12	1.62	0.32	0.53	0.69	1.3	0.4	0.1	7
TB-11-14	1.63	0.32	0.43	0.74	1.4	2.1	0.2	8
TB-11-18	1.70	0.31	0.42	0.75	1.5	0.3	0.1	4
TB-11-20	1.67	0.31	0.42	0.75	1.2	0.2	0.9	6
TRANSECT LINE TB-12								
TB-12-TOE	1.98	0.25	0.43	0.74	0.5	0.0	0.0	4
TB-12-CREST	2.10	0.23	0.43	0.74	0.1	0.0	0.0	6
TB-12-MHW	2.01	0.25	0.51	0.70	0.7	0.0	0.0	10
TB-12-MSL	1.92	0.26	0.43	0.74	0.5	0.0	0.0	7
TB-12-MLW	1.29	0.41	1.19	0.44	1.7	3.2	1.1	31
TB-12-6	2.43	0.19	0.44	0.74	0.8	0.4	0.0	5
TB-12-8	2.44	0.18	0.41	0.75	0.0	1.0	0.0	6
TB-12-12	2.47	0.18	0.48	0.72	1.6	0.6	0.8	7
TB-12-14	0.89	0.54	2.71	0.15	0.9	4.3	17.8	28
TB-12-18	2.60	0.16	0.41	0.75	2.2	0.0	0.0	4
TB-12-20	2.52	0.17	0.46	0.73	1.6	0.7	0.1	6
TRANSECT LINE TB-13								
TB-13-DUNE *	2.17	0.22	0.42	0.75	0.3	0.0	0.0	0
TB-13-TOE	1.99	0.25	0.48	0.72	0.8	0.1	0.0	10
TB-13-CREST	1.65	0.32	0.70	0.61	1.1	0.0	0.1	14
TB-13 +5 *	1.06	0.48	1.04	0.49	0.6	0.0	2.4	0
TB-13-MHW	1.71	0.31	0.68	0.63	0.5	0.0	0.1	12
TB-13-MSL	1.72	0.30	0.68	0.63	0.0	0.0	0.0	15
TB-13-MLW	1.92	0.26	0.58	0.67	1.2	0.0	0.0	12
TB-13-6	2.48	0.18	0.49	0.71	0.9	0.3	0.0	5
TB-13-8	2.43	0.19	0.56	0.68	1.0	0.3	0.0	6
TB-13-12	2.50	0.18	0.52	0.70	2.3	0.6	0.1	6
TB-13-14	2.53	0.17	0.57	0.67	2.7	0.4	0.0	6
TB-13-18	2.54	0.17	0.50	0.71	2.0	0.4	0.0	4
TB-13-20	2.60	0.17	0.50	0.70	2.6	0.1	0.0	5
TRANSECT LINE TB-14								
TB-14-DUNE *	2.35	0.20	0.36	0.78	0.21	0.0	0.0	0
TB-14-TOE	2.11	0.23	0.37	0.77	0.4	0.2	0.0	5
TB-14-CREST	1.76	0.30	0.64	0.64	0.4	0.2	0.0	9
TB-14 +3 *	2.28	0.21	0.32	0.80	0.8	0.0	0.0	0
TB-14-MHW	1.99	0.25	0.43	0.74	0.5	0.0	0.0	6
TB-14-MSL	1.94	0.26	0.44	0.74	0.4	0.0	0.0	6
TB-14-MLW	1.78	0.29	0.63	0.65	1.4	0.0	0.0	13
TB-14-6	2.40	0.19	0.51	0.70	1.0	0.2	0.0	6
TB-14-8	2.35	0.20	0.53	0.69	0.3	0.1	0.0	5
TB-14-12	2.38	0.19	0.57	0.67	1.2	0.4	0.6	5
TB-14-14	2.43	0.19	0.44	0.74	0.8	0.3	0.0	4
TB-14-18	2.50	0.18	0.44	0.74	1.7	0.3	0.0	2
TB-14-20	2.59	0.17	0.46	0.73	2.3	0.3	0.0	3

* Samples were collected by CPE-NC Inc for the North Topsail Non-Federal Shore Protection Project in 2007.

Table E-1
Native Beach Samples (continued)

Sample Description	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TRANSECT LINE TB-15								
TB-15-DUNE *	2.28	0.21	0.35	0.79	0.2	0.0	0.0	0
TB-15-TOE	2.10	0.23	0.48	0.72	0.5	0.0	0.0	6
TB-15-CREST	2.19	0.22	0.32	0.80	0.1	0.0	0.0	2
TB-15 +3 *	0.86	0.55	1.58	0.33	0.5	0.1	0.0	0
TB-15-MHW	1.87	0.27	0.56	0.68	0.4	0.0	0.0	3
TB-15-MSL	1.82	0.28	0.65	0.64	0.9	0.0	0.0	6
TB-15-MLW	1.77	0.29	0.86	0.55	0.9	0.2	0.0	10
TB-15-6	2.52	0.17	0.47	0.72	1.0	0.1	0.0	3
TB-15-8	0.58	0.67	1.23	0.43	1.1	8.5	2.7	28
TB-15-12	2.55	0.17	0.57	0.67	2.2	0.5	0.4	4
TB-15-14	2.56	0.17	0.53	0.69	1.9	1.3	0.8	3
TB-15-18	2.63	0.16	0.47	0.72	2.5	0.0	0.0	1
TB-15-20	2.65	0.16	0.46	0.73	2.3	0.0	0.0	3
TRANSECT LINE TB-16								
TB-16-DUNE *	2.08	0.24	0.43	0.74	0.2	0.0	0.0	0
TB-16-TOE	2.10	0.23	0.38	0.77	0.2	0.0	0.0	4
TB-16-CREST	2.09	0.24	0.40	0.76	0.1	0.0	0.0	4
TB-16 +4 *	2.31	0.20	0.32	0.80	0.5	0.0	0.0	0
TB-16-MHW	1.79	0.29	0.71	0.61	0.1	0.6	0.0	9
TB-16-MSL	2.00	0.25	0.42	0.75	0.6	0.0	0.0	5
TB-16-MLW	2.00	0.25	0.56	0.68	1.1	2.7	0.5	7
TB-16-6	0.84	0.56	1.63	0.32	0.4	10.5	0.4	27
TB-16-8	2.02	0.25	0.96	0.51	0.9	1.1	0.5	12
TB-16-12	2.42	0.19	0.71	0.61	1.5	1.5	0.3	7
TB-16-14	2.64	0.16	0.55	0.68	1.8	1.5	0.0	4
TB-16-18	2.67	0.16	0.48	0.72	1.1	0.0	0.0	3
TB-16-20	2.71	0.15	0.49	0.71	2.2	0.0	0.0	3

* Samples were collected by CPE-NC Inc for the North Topsail Non-Federal Shore Protection Project in 2007.

Table E-2
Composite Characteristics for Native Beach

Transect Line	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TB-7	2.12	0.23	0.81	0.57	1.7	0.7	0.2	14
TB-8	1.93	0.26	1.00	0.50	1.1	2.7	0.9	15
TB-9	2.22	0.21	0.67	0.63	1.3	3.2	0.6	9
TB-10	2.23	0.21	0.63	0.65	1.8	0.6	0.1	8
TB-11	2.17	0.22	0.63	0.64	1.0	0.5	0.1	9
TB-12	2.20	0.22	0.63	0.64	1.0	0.9	1.8	10
TB-13	2.09	0.23	0.76	0.59	1.2	0.4	1.2	7
TB-14	2.22	0.22	0.56	0.68	0.9	0.1	0.0	5
TB-15	2.09	0.23	0.78	0.58	1.1	0.8	0.3	5
TB-16	2.20	0.22	0.64	0.64	0.8	1.4	0.1	7
Native Beach Composite Data	**2.15**	**0.23**	**0.71**	**0.61**	**1.2**	**1.1**	**0.5**	**9**

Table E-3
Borings for Borrow Area G

Boring Number	Layer Number	Layer Depth (ft) Top	Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-254	1	-49	-51	2	2.45	0.18	0.43	0.74	1.6	0.3	0.0	3
	2	-51	-53	2	1.81	0.29	1.59	0.33	14.0	5.7	5.1	9
	3	-53	-54	1	1.33	0.40	1.62	0.33	6.8	5.4	8.8	1
		EL -49 to -54		D= 5	2.09	0.23	0.90	0.54	7.6	3.5	3.8	5
TI-03-V-256	1	-47.3	-48.8	1.5	2.09	0.23	0.62	0.65	1.0	0.8	1.6	7
	2	-48.8	-49.3	0.5	2.08	0.24	0.63	0.65	1.1	0.9	3.0	7
		EL -47.3 to -49.3		D=2	2.09	0.23	0.62	0.65	1.1	0.8	2.0	7
TI-03-V-257	1	-47.5	-50	2.5	1.92	0.26	1.09	0.47	2.4	3.2	8.4	15
	2	-50	-50.5	0.5	2.48	0.18	0.96	0.52	11.1	1.7	1.1	6
		EL -47.5 to -50.5		D= 3	2.04	0.24	0.97	0.51	3.9	2.9	7.2	14
TI-03-V-258	1	-46.5	-47.8	1.3	1.31	0.40	1.83	0.28	1.2	3.4	12.4	18
	2	-47.8	-49.3	1.5	0.75	0.60	2.70	0.15	4.2	10.0	18.5	37
		EL -46.5 to -49.3		D= 2.8	0.89	0.54	2.48	0.18	2.8	6.9	15.7	28
TI-03-V-275	1	-47.7	-50	2.3	2.65	0.16	0.60	0.66	9.3	0.9	2.9	6
	2	-50	-53.2	3.2	2.57	0.17	0.40	0.76	4.2	0.0	0.0	2
	3	-53.2	-55.5	0	2.87	0.14	0.71	0.61	14.4	0.2	0.0	2
	4	-55.5	-56	0	2.37	0.19	1.82	0.28	16.2	5.4	5.5	7
		EL -47.7 to -53.2		D=5.5	2.58	0.17	0.43	0.74	6.3	0.4	1.2	4

Table E-4
Borings for Borrow Area H

Boring Number	Layer Number	Layer Depth (ft) Top	Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-260	1	-44.4	-46	1.6	1.85	0.28	0.99	0.50	1.3	2.7	5.9	14
	2	-46	-46.6	0.6	2.61	0.16	0.55	0.68	9.6	0.8	0.6	3
		EL -44.4 to -46.6		D= 2.2	2.07	0.24	0.87	0.55	3.6	2.2	4.5	11

Boring Number	Layer Number	Layer Depth (ft) Top	Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-273	1	-45.2	-47.5	2.3	2.23	0.21	0.60	0.66	2.2	2.0	1.8	7
	2	-47.5	-50	2.5	2.30	0.20	0.52	0.70	2.0	0.6	0.0	4
	3	-50	-52	0	2.56	0.17	0.39	0.76	4.4	0.6	0.1	3
	4	-52	-54	0	2.76	0.15	0.23	0.86	2.7	0.0	0.0	1
	5	-54	-55.7	0	2.58	0.17	0.36	0.78	2.1	0.0	0.0	1
	6	-55.7	-56.2	0	2.56	0.17	0.37	0.77	2.4	0.0	0.0	0
		EL -45.2 to -50		D=4.8	2.27	0.21	0.55	0.68	2.1	1.3	0.9	5

Table E-5
Borings for Borrow Area J

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-98	1	-45.5	-48.3	2.8	2.13	0.23	0.73	0.60	5.2	1.3	0.5	11
	2	-48.3	-51	0	4.28	0.05	3.78	0.07	22.1	5.2	1.5	15
	3	-51	-53	0	2.67	0.16	0.79	0.58	15.6	3.0	0.4	10
	4	-53	-55.5	0	3.63	0.08	2.09	0.23	18.6	1.5	0.6	6
	5	-55.5	-58	0	2.48	0.18	0.45	0.73	9.4	2.2	0.4	7
	6	-58	-61	0	2.50	0.18	0.40	0.76	6.6	0.1	0.0	3
	7	-61	-64	0	2.50	0.18	0.41	0.75	8.0	0.5	0.0	4
	8	-64	-65.5	0	2.57	0.17	0.48	0.71	12.6	0.1	0.0	2
		EL -45.5 to -48.3		D= 2.8	2.13	0.23	0.73	0.60	5.2	1.3	0.5	11
TI-03-V-99	1	-46.7	-50	3.3	2.46	0.18	0.44	0.73	9.6	1.3	0.1	6.0
	2	-50	-53	3	2.45	0.18	0.47	0.72	11.4	2.1	0.3	8.0
	3	-53	-55	2	2.43	0.18	0.40	0.76	6.2	0.4	0.2	4.0
	4	-55	-58.5	0	3.05	0.12	1.33	0.40	16.8	2.2	0.9	9.0
	5	-58.5	-61	0	2.48	0.18	0.40	0.76	6.4	0.3	0.0	3.0
	6	-61	-63	0	2.53	0.17	0.42	0.75	10.7	0.1	0.0	2.0
	7	-63	-66.2	0	2.49	0.18	0.40	0.76	7.6	0.0	0.0	2.0
	8	-66.2	-66.7	0	2.50	0.18	0.41	0.75	8.8	0.1	0.0	1.0
		EL -46.7 to -55		D=8.3	2.45	0.18	0.44	0.74	9.5	1.4	0.2	6.2
TI-03-V-102	1	-45	-47	2	1.70	0.31	1.23	0.43	2.4	5.8	1.7	19
	2	-47	-48	1	2.22	0.21	0.63	0.65	2.3	1.9	0.4	11
	3	-48	-51	0	2.51	0.18	0.78	0.58	14.4	3.4	0.8	12
	4	-51	-54	0	2.52	0.17	0.42	0.75	9.7	0.4	0.1	3
	5	-54	-57	0	2.52	0.17	0.42	0.75	10.1	0.0	0.0	2
	6	-57	-59.3	2.3	2.60	0.17	0.51	0.70	12.6	0.1	0.0	2
		EL -45 to -48		D=3	1.86	0.27	1.05	0.48	2.3	4.5	1.3	16

Table E-5
Borings for Borrow Area J (cont.)

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-103	1	-47.4	-50	2.6	2.29	0.20	0.58	0.67	2.8	1.6	0.2	10
	2	-50	-53	0	2.57	0.17	0.59	0.67	13.5	1.7	0.6	8
	3	-53	-55	0	3.17	0.11	1.40	0.38	18.0	0.4	0.0	3
	4	-55	-57	0	2.42	0.19	4.39	0.05	26.0	4.6	15.2	1
	5	-57	-59	0	3.65	0.08	1.66	0.32	32.8	3.5	1.7	2
	6	-59	-59.7	0	3.45	0.09	0.97	0.51	26.9	1.2	0.0	4
		EL -47.4 to -50		D=2.6	2.29	0.20	0.58	0.67	2.8	1.6	0.2	10
TI-03-V-270A	1	-46.3	-48.3	2	2.00	0.25	0.81	0.57	1.5	3.0	1.1	9
	2	-48.3	-50.5	0	3.19	0.11	0.78	0.58	17.7	0.1	0.1	1
	3	-50.5	-52.5	0	3.28	0.10	0.73	0.60	18.6	0.1	0.0	1
	4	-52.5	-54.8	0	3.21	0.11	0.72	0.61	16.9	0.5	0.0	1
		EL -46.3 to -48.3		D=2	2.00	0.25	0.81	0.57	1.5	3.0	1.1	9
TI-03-V-281	1	-44	-45.5	1.5	1.73	0.30	0.99	0.50	1.5	4.4	1.9	15
	2	-45.5	-47.4	1.9	2.20	0.22	0.54	0.69	1.1	1.0	0.2	6
	3	-47.4	-49	0	1.95	0.26	1.94	0.26	15.6	8.2	3.3	19
	4	-49	-51	0	3.29	0.10	2.55	0.17	19.1	5.9	1.8	13
	5	-51	-53	0	2.38	0.19	1.02	0.49	14.7	3.4	6.1	11
	6	-53	-55.2	0	3.27	0.10	1.69	0.31	18.4	2.8	1.7	11
	7	-55.2	-55.7	0	3.06	0.12	1.36	0.39	17.5	3.0	1.5	10
		EL -44 to -47.4		D=3.4	2.02	0.25	0.72	0.61	1.2	2.5	1.0	10
TI-03-V-283	1	-42.4	-44	1.6	1.58	0.34	1.16	0.45	2.2	5.3	2.8	10
	2	-44	-45.6	1.6	2.15	0.22	0.57	0.67	2.0	2.1	0.8	7
	3	-45.6	-48.5	0	1.87	0.27	1.82	0.28	15.3	8.4	3.1	17
	4	-48.5	-51	0	3.35	0.10	1.75	0.30	18.8	2.2	0.2	3
	5	-51	-53.5	0	2.64	0.16	0.72	0.61	14.7	2.9	2.6	8
	6	-53.5	-54.6	0	2.55	0.17	0.56	0.68	12.9	2.6	0.5	5
		EL -42.4 to -45.6		D=3.2	1.87	0.27	0.88	0.54	2.1	3.7	1.8	9

Table E-5
Borings for Borrow Area J (cont.)

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-286	1	-42	-44.2	2.2	1.89	0.27	0.90	0.53	2.6	1.8	3.3	11
	2	-44.2	-46	1.8	1.26	0.42	2.24	0.21	12.3	7.0	11.7	17
	3	-46	-49	0	2.15	0.23	2.00	0.25	16.1	5.7	7.4	12
	4	-49	-51.5	0	-0.21	1.15	4.86	0.03	15.8	9.6	33.4	1
	5	-51.5	-54	0	1.98	0.25	3.62	0.08	23.1	16.3	10.6	1
	6	-54	-55	0	-0.39	1.31	4.71	0.04	15.3	5.3	41.3	1
		EL -42 to -46		D=4	1.85	0.28	1.15	0.45	7.0	1.8	3.3	14

Table E-6
Borings for Borrow Area L

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-91	1	-46.8	-48	1.2	2.00	0.25	0.78	0.58	1.4	1.8	1.1	7
	2	-48	-50.3	2.3	1.26	0.42	2.61	0.16	10.1	5.7	14.1	26
		EL -46.8 to -50.3		D= 3.5	1.61	0.33	1.69	0.31	7.1	4.4	9.6	19
TI-03-V-93	1	-46.7	-49	2.3	2.15	0.23	0.83	0.56	8.5	3.8	0.8	15
	2	-49	-51	0	2.45	0.18	0.96	0.51	14.7	3.7	0.6	11
	3	-51	-53	0	2.54	0.17	0.49	0.71	11.8	0.9	0.3	4
	4	-53	-54.2	0	2.52	0.17	0.44	0.74	9.5	1.1	0.1	5
	5	-54.2	-57	0	2.62	0.16	0.56	0.68	12.7	0.4	0.0	3
	6	-57	-60	0	3.63	0.08	2.03	0.24	19.6	1.2	0.4	7
	7	-60	-63	0	3.66	0.08	2.08	0.24	20.3	1.1	0.4	2
	8	-63	-65.2	0	3.84	0.07	2.31	0.20	23.2	4.0	0.0	2
		EL -46.7 to -49		D=2.3	2.15	0.23	0.83	0.56	8.5	3.8	0.8	15
TI-03-V-95	1	-47	-50	3	2.49	0.18	0.45	0.73	9.8	1.6	0.3	8
	2	-50	-53	3	2.49	0.18	0.45	0.73	10.2	1.6	0.5	9
	3	-53	-56	3	2.49	0.18	0.41	0.75	7.4	0.7	0.0	5
	4	-56	-58	2	2.53	0.17	0.38	0.77	4.7	0.1	0.0	3
	5	-58	-60.8	2.8	2.54	0.17	0.42	0.75	8.8	0.2	0.0	3
	6	-60.8	-63.5	0	3.74	0.07	2.23	0.21	22.1	2.8	3.5	2
	7	-63.5	-64.3	0	2.33	0.20	4.41	0.05	23.8	9.6	15.1	1
		EL -47 to -60.8		D=13.8	2.50	0.18	0.42	0.75	8.4	0.9	0.2	6
TI-03-V-341	1	-44.2	-46.5	2.3	1.97	0.26	0.96	0.51	5.1	3.0	0.5	7
	2	-46.5	-48.5	2	2.31	0.20	0.71	0.61	7.8	1.9	1.0	5
	3	-48.5	-51	0	2.60	0.16	0.65	0.64	13.4	2.2	6.7	1
	4	-51	-53.5	0	2.54	0.17	0.45	0.73	10.5	1.2	1.4	2
	5	-53.5	-56	0	2.59	0.17	0.57	0.68	12.8	1.4	4.8	3
	6	-56	-58.2	0	0.61	0.65	3.20	0.11	10.7	5.6	26.3	5
		EL -44.2 to -48.5		D=4.3	2.12	0.23	0.88	0.54	6.3	2.5	0.7	6

Table E-6
Borings for Borrow Area L (cont.)

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-342	1	-44.3	-46.3	2	1.89	0.27	1.04	0.49	3.8	5.6	2.8	15
	2	-46.3	-48.5	0	1.97	0.26	1.46	0.36	12.7	6.4	1.4	14
	3	-48.5	-51.5	0	3.52	0.09	3.28	0.10	23.1	5.6	1.8	17
	4	-51.5	-54.5	0	1.92	0.26	1.81	0.28	14.5	7.8	1.6	11
	5	-54.5	-57	0	1.52	0.35	2.44	0.18	14.5	8.5	9.9	11
	6	-57	-59.1	0	2.78	0.15	1.28	0.41	16.4	4.5	3.6	4
	7	-59.1	-61	0	2.69	0.16	0.64	0.64	13.8	1.3	0.2	2
	8	-61	-63.5	0	2.63	0.16	0.49	0.71	10.5	1.5	0.1	3
	9	-63.5	-64.3	0	-1.18	2.27	3.63	0.08	7.6	6.8	48.4	2
		EL -44.3 to -46.3		D=2	1.89	0.27	1.04	0.49	3.8	5.6	2.8	15
TI-03-V-343	1	-46	-48	1.5	2.37	0.19	0.48	0.72	2.3	0.7	0.0	2
	2	-48	-50	1.5	2.23	0.21	0.62	0.65	1.3	1.7	0.8	5
	3	-50	-51	0	2.53	0.17	0.43	0.74	9.2	0.4	0.4	1
	4	-51	-54	0	2.65	0.16	0.55	0.68	12.7	0.2	0.0	2
	5	-54	-56.3	0	2.73	0.15	0.63	0.65	14.2	0.8	0.0	4
		EL -46 to -51		D=5	2.37	0.19	0.50	0.71	3.3	1.0	0.4	3
TI-03-V-344	1	-45.7	-47.5	1.8	0.74	0.60	2.31	0.20	1.4	8.2	14.4	22
	2	-47.5	-48	0.5	1.36	0.39	1.44	0.37	2.3	2.9	11.5	23
		EL -45.7 to -48		D=2.3	0.81	0.57	2.23	0.21	1.6	7.0	13.8	22
TI-03-V-345	1	-42.3	-44.5	2.2	1.70	0.31	0.93	0.52	1.6	2.0	1.1	14
	2	-44.5	-45.3	0.8	1.42	0.37	1.35	0.39	2.2	5.0	4.9	18
		EL -42.3 to -45.3		D=3	1.65	0.32	1.01	0.50	1.8	2.8	2.1	15
TI-03-V-346	1	-42.5	-44	1.5	1.74	0.30	1.14	0.45	3.6	3.8	3.9	13
	2	-44	-45.5	1.5	2.25	0.21	0.79	0.58	11.7	2.9	5.9	13
	3	-45.5	-47	0	2.56	0.17	0.58	0.67	13.0	1.6	2.0	1
	4	-47	-48.5	0	2.66	0.16	0.58	0.67	12.9	0.9	1.5	2
	5	-48.5	-51	0	0.77	0.59	2.92	0.13	13.7	5.8	20.0	1
	6	-51	-52	0	0.67	0.63	3.42	0.09	13.4	7.4	29.1	3
		EL -42.5 to -45.5		D=3	1.93	0.26	1.09	0.47	7.6	3.4	4.9	13

Table E-6
Borings for Borrow Area L (cont.)

Boring Number	Layer Number	Layer Depth (ft) Top	Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-351	1	-44.5	-45.5	1	-0.43	1.34	2.67	0.16	2.2	14.6	27.9	28
	2	-45.5	-47.3	1.8	2.60	0.16	0.58	0.67	10.1	3.4	0.8	10
	3	-47.3	-49.5	0	3.08	0.12	1.28	0.41	17.7	2.0	0.4	5
	4	-49.5	-51.5	0	2.66	0.16	1.01	0.50	15.3	1.7	8.0	1
		EL -44.5 to -47.3		D=2.8	1.31	0.40	2.13	0.23	7.3	7.4	10.5	16

Table E-7
Borings for Borrow Area N

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-63	1	-45.9	-47	1.1	2.18	0.22	0.52	0.70	0.7	0.5	0.3	6
	2	-47	-48.9	1.9	1.82	0.28	0.99	0.50	1.5	3.2	7.5	18
		EL -45.9 to -48.9		D= 3	2.08	0.24	0.63	0.65	1.2	2.2	4.9	14
TI-03-V-65	1	-45.7	-47	1.3	2.29	0.20	0.47	0.72	1.2	0.3	0.0	6
	2	-47	-48.5	1.5	2.38	0.19	0.46	0.73	1.3	0.9	0.3	6
	3	-48.5	-50.5	2	2.39	0.19	0.40	0.76	2.0	0.6	1.5	9
	4	-50.5	-51.2	0.7	2.41	0.19	0.42	0.75	1.3	0.2	0.0	4
		EL -45.7 to -51.2		D=5.5	2.37	0.19	0.43	0.74	1.5	0.5	0.6	7
TI-03-V-68	1	-46.7	-48.5	1.8	2.38	0.19	0.46	0.73	1.4	0.9	0.2	5
	2	-48.5	-50.5	2	1.55	0.34	1.20	0.43	7.5	4.8	4.9	3
	3	-50.5	-52	1.5	0.24	0.85	2.86	0.14	10.0	4.9	19.5	1
	4	-52	-52.7	0.7	1.73	0.30	0.85	0.55	6.0	2.7	5.7	1
		EL -46.7 to -52.7		D=6	1.71	0.31	1.20	0.44	6.1	3.4	4.8	3
TI-03-V-69	1	-43.6	-45	1.4	2.05	0.24	0.73	0.60	0.7	2.3	3.3	13
	2	-45	-46.8	1.8	0.97	0.51	1.96	0.26	1.2	8.2	10.4	30
	3	-46.8	-47.3	0.5	0.61	0.66	2.67	0.16	2.1	6.0	18.5	34
		EL -43.6 to -47.3		D=3.7	1.31	0.40	1.71	0.31	1.1	5.7	8.8	24
TI-03-V-70	1	-44.8	-47	2.2	1.27	0.42	1.36	0.39	4.6	4.2	7.1	19
	2	-47	-47.8	0.8	1.06	0.48	1.99	0.25	10.6	11.3	6.4	29
	3	-47.8	-49.3	1.5	1.74	0.30	0.98	0.51	5.0	1.3	11.4	1
	4	-49.3	-49.8	0.5	1.74	0.30	1.32	0.40	10.5	3.6	8.7	8
		EL -44.8 to -49.8		D=5	1.33	0.40	1.46	0.36	6.3	4.4	8.4	14

Table E-7
Borings for Borrow Area N (cont.)

Boring Number	Layer Number	Layer Depth (ft) Top	Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-72	1	-43.6	-45.5	1.9	0.71	0.61	1.29	0.41	0.9	6.5	6.7	21
	2	-45.5	-46.4	0.9	0.04	0.97	2.63	0.16	1.5	7.7	19.9	15
		EL -43.6 to -46.4		D=2.8	0.54	0.69	1.64	0.32	1.1	6.9	10.9	19
TI-03-V-74	1	-46.2	-48	1.8	2.31	0.20	0.48	0.71	1.1	1.4	0.1	5
	2	-48	-50	2	2.38	0.19	0.50	0.71	2.3	0.9	0.3	7
	3	-50	-51.7	1.7	1.08	0.47	2.17	0.22	6.9	8.3	10.8	18
		EL -46.2 to -51.7		D=5.5	2.20	0.22	0.67	0.63	3.3	3.4	3.5	10
TI-03-V-77	1	-45.7	-48	2.3	2.23	0.21	0.57	0.67	1.4	1.5	0.9	7
	2	-48	-49.2	0	-0.30	1.23	2.82	0.14	8.8	15.4	26.8	16
		EL -45.7 to -48		D=2.3	2.23	0.21	0.57	0.67	1.4	1.5	0.9	7
TI-03-V-78	1	-44.8	-46.8	2	1.41	0.38	1.82	0.28	3.3	6.9	8.1	15
	2	-46.8	-48.3	1.5	2.73	0.15	0.42	0.75	7.5	0.1	0.0	2
	3	-48.3	-48.8	0.5	2.53	0.17	0.38	0.77	2.3	0.0	0.0	2
		EL -44.8 to -48.8		D=4	2.38	0.19	0.65	0.64	4.8	3.5	4.1	9
TI-03-V-79	1	-44.1	-46.4	2.3	2.03	0.24	0.60	0.66	1.6	0.5	0.1	8
	2	-46.4	-47.5	0	-0.44	1.35	2.27	0.21	6.4	15.5	38.4	2
		EL -44.5 to -46.4		D=2.3	2.03	0.24	0.60	0.66	1.6	0.5	0.1	8
TI-03-V-86	1	-44.3	-46.5	2.2	1.75	0.30	1.03	0.49	1.0	4.9	4.2	17
	2	-46.5	-48.5	2	2.36	0.20	0.46	0.72	2.0	0.7	1.2	6
	3	-48.5	-51	2.5	2.29	0.21	0.56	0.68	2.7	1.1	1.0	5
	4	-51	-53	2	1.77	0.29	0.76	0.59	2.1	3.0	0.3	8
	5	-53	-55.5	2.5	1.80	0.29	0.73	0.60	2.6	3.2	1.0	9
	6	-55.5	-58	2.5	0.92	0.53	1.82	0.28	8.0	8.0	8.8	6
	7	-58	-59.1	1.1	1.80	0.29	0.97	0.51	6.4	3.8	3.9	0
		EL -44.3 to -59.1		D=14.8	1.88	0.27	0.91	0.53	3.4	3.6	3.0	8

Table E-7
Borings for Borrow Area N (cont.)

Boring Number	Layer Number	Layer Depth (ft) Top	Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-87	1	-46.7	-49	2.3	2.06	0.24	0.84	0.56	7.9	1.4	0.0	3
	2	-49	-51	2	2.22	0.21	0.66	0.63	3.1	2.3	3.7	10
	3	-51	-52.5	1.5	0.40	0.76	3.00	0.12	6.0	3.9	24.8	2
	4	-52.5	-54	0	0.52	0.70	2.25	0.21	8.2	7.9	14.9	2
	5	-54	-55.2	0	-0.33	1.25	3.22	0.11	5.6	3.8	35.8	0
EL -46.7 to -52.5				D=5.8	1.88	0.27	1.09	0.47	5.8	2.4	7.7	5

Table E-8
Borings for Borrow Area O

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-83B	1	-42.9	-45	2.1	0.33	0.80	3.06	0.12	8.7	8.7	24.6	45
	2	-45	-48	3	0.36	0.78	2.89	0.13	8.0	9.0	23.2	46
	3	-48	-50	0	2.59	0.17	0.61	0.65	13.5	0.5	0.0	3
	4	-50	-51.4	0	2.57	0.17	0.59	0.66	12.8	0.6	1.4	1
	5	-51.4	-55	0	2.68	0.16	0.78	0.58	15.2	0.6	6.5	1
	6	-55	-58	0	2.49	0.18	0.44	0.74	9.1	0.5	0.1	4
	7	-58	-61	0	2.53	0.17	0.45	0.73	12.2	0.2	0.0	1
	8	-61	-62.9	0	2.56	0.17	0.54	0.69	12.8	0.5	7.4	4
		EL -42.9 to -48		D= 5.1	0.33	0.80	2.99	0.13	8.2	8.9	24.6	46
TI-03-V-85	1	-43.9	-46	2.1	2.10	0.23	0.79	0.58	7.4	3.0	1.4	5
	2	-46	-48.4	2.4	2.05	0.24	0.70	0.61	2.6	1.8	5.1	11
	3	-48.4	-51	0	1.95	0.26	1.15	0.45	9.0	1.6	10.2	1
	4	-51	-53	0	2.54	0.17	0.59	0.67	11.3	1.3	0.0	1
	5	-53	-56	0	2.67	0.16	0.70	0.62	14.5	0.4	0.2	1
	6	-56	-56.9	0	2.47	0.18	0.41	0.75	9.1	0.1	0.0	2
		EL -43.9 to -48.4		D= 4.5	2.07	0.24	0.74	0.60	4.8	2.4	3.5	8
TI-03-V-322	1	-41.9	-45	3.1	2.51	0.18	0.44	0.74	7.1	0.3	0.4	3
	2	-45	-48	0	2.70	0.15	0.48	0.72	11.2	0.6	0.0	3
	3	-48	-50	0	2.78	0.15	0.62	0.65	14.1	2.0	0.3	5
	4	-50	-52.7	0	3.03	0.12	1.12	0.46	16.9	3.4	1.6	9
	5	-52.7	-54	0	2.90	0.13	0.76	0.59	14.5	1.5	0.2	4
	6	-54	-55.4	0	0.14	0.91	4.27	0.05	9.1	3.1	25.4	3
		EL -41.9 to -45		D=3.1	2.51	0.18	0.44	0.74	7.1	0.3	0.4	3
TI-03-V-323	1	-40.6	-43.1	2.5	1.58	0.33	1.02	0.49	1.8	4.1	2.9	14
	2	-43.1	-45.5	2.4	2.46	0.18	0.43	0.74	8.0	0.4	0.5	3
	3	-45.5	-48	2.5	2.52	0.17	0.42	0.75	9.3	0.1	0.0	2
	4	-48	-50.5	2.5	2.55	0.17	0.42	0.75	8.6	0.6	0.1	2
	5	-50.5	-53	2.5	2.63	0.16	0.41	0.75	9.7	0.3	0.0	2
	6	-53	-53.7	0	2.73	0.15	0.59	0.66	13.2	1.0	0.3	4
		EL -40.6 to -53		D=12.4	2.46	0.18	0.46	0.73	7.5	1.1	0.7	5

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-324	1	-41.6	-43.4	1.8	-0.79	1.73	3.30	0.10	1.4	8.7	38.2	24
	2	-43.4	-45	1.6	2.27	0.21	0.58	0.67	1.6	1.5	2.2	7
	3	-45	-47	2	2.48	0.18	0.40	0.76	7.1	0.3	0.0	2
	4	-47	-48.6	1.6	2.53	0.17	0.44	0.74	11.6	0.3	0.0	2
		EL -41.6 to -48.6		D=7	1.85	0.28	1.22	0.43	5.4	2.7	10.3	9
TI-03-V-325	1	-42.7	-44.7	2	2.31	0.20	0.59	0.66	4.5	2.7	1.9	9
	2	-44.7	-47	0	2.67	0.16	0.58	0.67	12.8	1.4	0.1	4
	3	-47	-49	0	2.64	0.16	0.57	0.67	11.8	3.2	0.0	8
	4	-49	-51.5	0	2.24	0.21	1.46	0.36	13.5	5.9	1.7	12
	5	-51.5	-53.5	0	2.78	0.15	0.60	0.66	11.4	0.1	0.1	1
	6	-53.5	-55.7	0	2.63	0.16	0.47	0.72	5.0	0.3	0.0	1
		EL -42.7 to -44.7		D=2	2.31	0.20	0.59	0.66	4.5	2.7	1.9	9
TI-03-V-326	1	-42.3	-44	1.7	2.29	0.20	0.56	0.68	3.2	0.9	0.4	6
	2	-44	-45.3	1.3	2.55	0.17	0.47	0.72	9.7	0.1	0.0	0
	3	-45.3	-48	2.7	2.52	0.17	0.44	0.74	7.0	0.1	0.0	0
	4	-48	-50.5	2.5	2.57	0.17	0.41	0.75	4.1	0.0	0.0	0
	5	-50.5	-52.3	1.8	2.56	0.17	0.42	0.75	4.3	0.0	0.0	1
	6	-52.3	-55	2.7	2.59	0.17	0.40	0.76	4.4	0.1	0.0	1
	7	-55	-57.5	0	3.05	0.12	0.54	0.69	10.6	0.0	0.0	1
	8	-57.5	-58.3	0	2.94	0.13	0.47	0.72	8.9	0.0	9.4	1
		EL -42.3 to -55		D=12.7	2.54	0.17	0.43	0.74	5.3	0.2	0.1	1
TI-03-V-327	1	-41	-43	2	1.48	0.36	1.62	0.33	1.9	6.4	6.2	18
	2	-43	-45	2	2.56	0.17	0.52	0.70	9.8	0.5	0.2	4
	3	-45	-47	0	2.81	0.14	0.77	0.58	15.0	0.6	0.2	2
	4	-47	-49.2	0	-0.79	1.72	3.20	0.11	6.6	11.6	42.7	2
	5	-49.2	-51	0	2.40	0.19	2.37	0.19	21.4	5.1	8.7	4
	6	-51	-53.5	0	3.42	0.09	1.03	0.49	25.8	0.9	0.2	2
	7	-53.5	-57	0	3.24	0.11	0.73	0.60	17.9	0.1	0.0	1
	8	-57	-57.5	0	3.21	0.11	0.75	0.59	17.2	0.3	0.0	3
		EL -41 to -45		D=4	2.22	0.22	0.76	0.59	5.9	3.4	3.2	11

Table E-9
Borings for Borrow Area P

Boring Number	Layer Number	Layer Depth (ft) Top	Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-317	1	-39.5	-40.8	1.3	-0.83	1.78	3.30	0.10	1.8	9.7	38.7	25
	2	-40.8	-44	3.2	1.94	0.26	1.25	0.42	8.3	1.0	0.0	6
	3	-44	-47	0	2.04	0.24	1.61	0.33	13.4	1.0	0.4	5
	4	-47	-50	0	1.99	0.25	1.67	0.31	11.7	3.7	1.3	11
	5	-50	-53	0	1.88	0.27	1.43	0.37	7.7	0.6	0.1	3
	6	-53	-55.5	0	1.88	0.27	1.42	0.37	6.5	0.1	0.0	2
		EL -39.5 to -44		D= 4.5	1.52	0.35	1.75	0.30	6.4	3.5	11.2	11
TI-03-V-318	1	-40.5	-42.5	2	1.99	0.25	0.72	0.61	1.4	1.4	0.6	8
	2	-42.5	-45.3	0	2.96	0.13	1.00	0.50	16.3	0.5	0.1	3
	3	-45.3	-47	0	2.45	0.18	0.52	0.70	6.2	0.1	0.0	1
	4	-47	-49.8	0	2.10	0.23	0.81	0.57	7.7	1.6	0.0	2
	5	-49.8	-50.5	0	4.18	0.06	3.09	0.12	42.8	0.5	0.0	2
	6	-50.5	-53	0	0.68	0.63	-0.17	1.12	2.2	0.5	0.0	1
	7	-53	-54.5	0	1.75	0.30	-0.84	1.80	5.9	0.1	0.0	1
		EL -40.5 to -42.5		D= 2	1.99	0.25	0.72	0.61	1.4	1.4	0.6	8
TI-03-V-320	1	-40.5	-42.4	1.9	-0.56	1.47	2.84	0.14	1.3	13.0	32.0	21
	2	-42.4	-45	2.6	2.34	0.20	0.49	0.71	7.7	0.9	0.0	4
	3	-45	-48	3	2.46	0.18	0.38	0.77	5.2	0.1	0.0	2
	4	-48	-51	3	2.52	0.17	0.41	0.75	8.0	0.1	0.3	2
	5	-51	-54	3	2.55	0.17	0.39	0.76	5.5	0.1	0.0	1
	6	-54	-54.5	0.5	2.59	0.17	0.40	0.76	8.2	0.9	0.0	3
		EL -40.5 to -51		D=10.5	2.23	0.21	0.66	0.63	5.9	2.0	5.9	5

Table E-10
Borings for Borrow Area Q

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-161	1	-35.4	-37.5	2.1	2.21	0.22	0.57	0.67	1.8	0.7	0.3	8
	2	-37.5	-39	1.5	2.00	0.25	1.00	0.50	6.1	3.4	6.9	11
	3	-39	-39.6	0.6	2.46	0.18	0.41	0.75	6.8	0.2	0.0	3
		EL -35.4 to -39.6		D= 4.2	2.23	0.21	0.61	0.65	4.1	1.6	2.6	8

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-162	1	-35.2	-37.5	2.3	1.60	0.33	1.58	0.33	4.0	6.0	5.1	19
	2	-37.5	-39.7	2.2	2.76	0.15	0.57	0.67	10.6	1.5	0.3	8
	3	-39.7	-41.2	1.5	2.41	0.19	0.40	0.76	7.0	0.2	0.0	1
		EL -35.2 to -41.2		D=6	2.35	0.20	0.70	0.62	7.2	2.9	2.1	10

Table E-11
Borings for Borrow Area S

Boring Number	Layer Number	Layer Depth (ft) Top	Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-46	1	-44.7	-47	2.3	0.17	0.89	2.09	0.23	3.3	15.6	12.7	47
	2	-47	-48	0	2.01	0.25	2.22	0.21	16.7	6.5	0.4	8
	3	-48	-50	0	-0.13	1.10	2.42	0.19	9.2	22.1	18.1	3
	4	-50	-53	0	-1.41	2.66	2.95	0.13	6.1	21.0	39.5	1
		EL -44.7 to -47		D= 2.3	0.17	0.89	2.09	0.23	3.3	15.6	12.7	47
TI-03-V-47	1	-44.5	-45.5	1	1.98	0.25	0.93	0.53	4.0	5.0	0.2	22
	2	-45.5	-47.3	1.8	-0.02	1.01	2.50	0.18	6.8	22.0	17.2	58
	3	-47.3	-50	0	0.67	0.63	3.18	0.11	16.4	23.7	12.6	14
	4	-50	-52	0	-0.20	1.15	2.51	0.18	8.3	21.7	19.4	2
	5	-52	-54	0	0.19	0.87	2.50	0.18	12.0	19.6	16.4	1
	6	-54	-55.7	0	-0.99	1.98	2.56	0.17	5.8	22.4	34.5	1
		EL -44.5 to -47.3		D=2.8	0.82	0.57	2.28	0.21	5.8	16.0	11.1	45
TI-03-V-48	1	-44.2	-46.4	2.2	1.63	0.32	1.12	0.46	3.9	6.2	2.0	18
	2	-46.4	-48.2	0	1.93	0.26	2.82	0.14	17.3	10.6	5.2	27
	3	-48.2	-50	0	0.36	0.78	2.55	0.17	10.8	17.3	17.0	1
	4	-50	-52	0	-0.01	1.01	2.69	0.15	13.5	24.1	18.5	0
	5	-52	-54	0	0.15	0.90	2.39	0.19	10.3	21.9	14.7	1
	6	-54	-55.2	0	0.41	0.75	2.48	0.18	11.3	19.3	14.9	1
		EL -44.2 to -46.4		D=2.2	1.63	0.32	1.12	0.46	3.9	6.2	2.0	18
TI-03-V-49	1	-43.8	-46.1	2.3	2.22	0.21	0.53	0.69	1.3	0.9	0.1	8
	2	-46.1	-47.7	0	2.68	0.16	1.05	0.48	14.3	1.3	1.4	8
	3	-47.7	-49.3	0	3.52	0.09	1.26	0.42	33.1	0.1	0.0	1
	4	-49.3	-51.5	0	2.63	0.16	0.64	0.64	7.9	0.2	0.0	2
	5	-51.5	-54.1	0	1.50	0.35	1.67	0.31	11.7	5.4	7.6	2
	6	-54.1	-55	0	-0.13	1.09	2.74	0.15	7.6	14.7	23.9	1
		EL -43.8 to -46.1		D=2.3	2.22	0.21	0.53	0.69	1.3	0.9	0.1	8

Table E-11
Borings for Borrow Area S (cont.)

Boring Number	Layer Number	Layer Depth (ft) Top	Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-51	1	-44.1	-46.7	2.6	2.01	0.25	0.67	0.63	1.8	2.8	0.5	16
	2	-46.7	-50	0	3.57	0.08	2.30	0.20	27.2	3.6	3.0	12
	3	-50	-52	0	2.25	0.21	0.70	0.61	13.3	3.0	0.7	2
	4	-52	-54	0	2.28	0.21	0.69	0.62	13.1	1.2	0.2	2
	5	-54	-56	0	1.44	0.37	1.78	0.29	11.7	4.5	10.2	2
	6	-56	-57.6	0	-0.66	1.58	3.46	0.09	7.6	9.7	34.5	1
		EL -44.1 to -46.7		D=2.6	2.01	0.25	0.67	0.63	1.8	2.8	0.5	16
TI-03-V-52	1	-44.2	-46	1.8	1.96	0.26	0.58	0.67	1.4	1.0	0.9	9
	2	-46	-47.7	1.7	2.40	0.19	0.41	0.75	2.1	1.0	1.7	6
		EL -44.2 to -47.7		D=3.5	2.18	0.22	0.56	0.68	1.8	1.0	1.3	8
TI-03-V-53	1	-44.8	-46.3	1.5	2.31	0.20	0.43	0.74	1.2	0.1	0.0	6
	2	-46.3	-47.5	1.2	1.30	0.41	1.98	0.25	11.2	12.4	1.7	32
		EL -44.8 to -47.5		D=2.7	1.98	0.25	0.93	0.52	5.6	5.6	1.7	18

Table E-11
Borings for Borrow Area S

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-46	1	-44.7	-47	2.3	0.17	0.89	2.09	0.23	3.3	15.6	12.7	47
	2	-47	-48	0	2.01	0.25	2.22	0.21	16.7	6.5	0.4	8
	3	-48	-50	0	-0.13	1.10	2.42	0.19	9.2	22.1	18.1	3
	4	-50	-53	0	-1.41	2.66	2.95	0.13	6.1	21.0	39.5	1
		EL -44.7 to -47		D= 2.3	0.17	0.89	2.09	0.23	3.3	15.6	12.7	47
TI-03-V-47	1	-44.5	-45.5	1	1.98	0.25	0.93	0.53	4.0	5.0	0.2	22
	2	-45.5	-47.3	1.8	-0.02	1.01	2.50	0.18	6.8	22.0	17.2	58
	3	-47.3	-50	0	0.67	0.63	3.18	0.11	16.4	23.7	12.6	14
	4	-50	-52	0	-0.20	1.15	2.51	0.18	8.3	21.7	19.4	2
	5	-52	-54	0	0.19	0.87	2.50	0.18	12.0	19.6	16.4	1
	6	-54	-55.7	0	-0.99	1.98	2.56	0.17	5.8	22.4	34.5	1
		EL -44.5 to -47.3		D=2.8	0.82	0.57	2.28	0.21	5.8	16.0	11.1	45
TI-03-V-48	1	-44.2	-46.4	2.2	1.63	0.32	1.12	0.46	3.9	6.2	2.0	18
	2	-46.4	-48.2	0	1.93	0.26	2.82	0.14	17.3	10.6	5.2	27
	3	-48.2	-50	0	0.36	0.78	2.55	0.17	10.8	17.3	17.0	1
	4	-50	-52	0	-0.01	1.01	2.69	0.15	13.5	24.1	18.5	0
	5	-52	-54	0	0.15	0.90	2.39	0.19	10.3	21.9	14.7	1
	6	-54	-55.2	0	0.41	0.75	2.48	0.18	11.3	19.3	14.9	1
		EL -44.2 to -46.4		D=2.2	1.63	0.32	1.12	0.46	3.9	6.2	2.0	18
TI-03-V-49	1	-43.8	-46.1	2.3	2.22	0.21	0.53	0.69	1.3	0.9	0.1	8
	2	-46.1	-47.7	0	2.68	0.16	1.05	0.48	14.3	1.3	1.4	8
	3	-47.7	-49.3	0	3.52	0.09	1.26	0.42	33.1	0.1	0.0	1
	4	-49.3	-51.5	0	2.63	0.16	0.64	0.64	7.9	0.2	0.0	2
	5	-51.5	-54.1	0	1.50	0.35	1.67	0.31	11.7	5.4	7.6	2
	6	-54.1	-55	0	-0.13	1.09	2.74	0.15	7.6	14.7	23.9	1
		EL -43.8 to -46.1		D=2.3	2.22	0.21	0.53	0.69	1.3	0.9	0.1	8

Table E-11
Borings for Borrow Area S (cont.)

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-51	1	-44.1	-46.7	2.6	2.01	0.25	0.67	0.63	1.8	2.8	0.5	16
	2	-46.7	-50	0	3.57	0.08	2.30	0.20	27.2	3.6	3.0	12
	3	-50	-52	0	2.25	0.21	0.70	0.61	13.3	3.0	0.7	2
	4	-52	-54	0	2.28	0.21	0.69	0.62	13.1	1.2	0.2	2
	5	-54	-56	0	1.44	0.37	1.78	0.29	11.7	4.5	10.2	2
	6	-56	-57.6	0	-0.66	1.58	3.46	0.09	7.6	9.7	34.5	1
		EL -44.1 to -46.7		D=2.6	2.01	0.25	0.67	0.63	1.8	2.8	0.5	16
TI-03-V-52	1	-44.2	-46	1.8	1.96	0.26	0.58	0.67	1.4	1.0	0.9	9
	2	-46	-47.7	1.7	2.40	0.19	0.41	0.75	2.1	1.0	1.7	6
		EL -44.2 to -47.7		D=3.5	2.18	0.22	0.56	0.68	1.8	1.0	1.3	8
TI-03-V-53	1	-44.8	-46.3	1.5	2.31	0.20	0.43	0.74	1.2	0.1	0.0	6
	2	-46.3	-47.5	1.2	1.30	0.41	1.98	0.25	11.2	12.4	1.7	32
		EL -44.8 to -47.5		D=2.7	1.98	0.25	0.93	0.52	5.6	5.6	1.7	18

Table E-12
Borings for Borrow Area T

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-14	1	-37.2	-39.5	2.3	2.18	0.22	0.54	0.69	1.4	2.0	0.5	8
	2	-39.5	-40.4	0.9	1.12	0.46	1.50	0.35	1.4	4.0	10.5	24
		EL -37.2 to -40.4		D= 3.2	1.97	0.26	0.74	0.60	1.4	2.6	3.3	13
TI-03-V-17	1	-40.6	-43	2.4	1.97	0.25	0.66	0.63	1.2	1.5	0.6	14
	2	-43	-45	2	2.16	0.22	0.54	0.69	2.6	0.6	0.4	7
	3	-45	-47	2	1.40	0.38	1.46	0.36	2.9	4.6	7.5	25
	4	-47	-49.2	2.2	1.78	0.29	0.82	0.57	2.6	2.5	75.3	21
		EL -40.6 to -49.2		D=8.6	1.91	0.27	0.78	0.58	2.3	2.3	2.9	17
TI-03-V-22	1	-41.6	-42.1	0.5	1.29	0.41	1.73	0.30	4.8	9.6	5.0	9
	2	-42.1	-43.8	1.7	2.38	0.19	0.53	0.69	10.5	0.0	0.0	2
		EL -41.6 to -43.8		D=2.2	2.26	0.21	0.62	0.65	9.2	2.2	1.1	4
TI-03-V-23	1	-41.4	-43	1.6	1.80	0.29	0.65	0.64	1.6	0.5	0.0	10
	2	-43	-45	2	0.14	0.91	2.55	0.17	2.1	12.7	21.5	44
	3	-45	-45.9	0.9	2.51	0.18	0.42	0.75	4.9	0.5	0.3	4
	4	-45.9	-48.2	0	0.16	0.90	3.55	0.09	15.3	12.0	31.1	1
		EL -41.4 to -45.9		D=4.5	1.18	0.44	1.74	0.30	2.5	5.9	9.6	24
TI-03-V-27	1	-42	-43.9	1.9	1.77	0.29	0.69	0.62	1.1	0.8	0.1	19
	2	-43.9	-44.4	0.5	1.79	0.29	0.75	0.60	1.3	2.0	2.2	19
		EL -42.7 to -44.7		D=2.4	1.78	0.29	0.70	0.62	1.2	1.1	0.6	19

Table E-13
Borings for Borrow Area A

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-124	1	-38.5	-40.5	2	1.72	0.30	1.59	0.33	9.0	8.5	2.1	22
	2	-40.5	-42.5	0	2.37	0.19	0.54	0.69	18.2	3.2	1.0	11
	3	-42.5	-45	0	2.79	0.14	0.42	0.75	5.6	0.1	0.0	3
	4	-45	-48	0	2.84	0.14	0.58	0.67	12.7	0.0	0.0	1
	5	-48	-51	0	2.73	0.15	0.67	0.63	13.9	0.0	0.0	1
	6	-51	-53.5	0	2.61	0.16	0.47	0.72	11.2	0.0	0.0	1
		EL -38.5 to -40.5		D= 2	1.72	0.30	1.59	0.33	9.0	8.5	2.1	22
TI-03-V-125	1	-38.9	-40.9	2	2.31	0.20	0.98	0.51	8.4	4.5	2.6	17
	2	-40.9	-43	0	2.71	0.15	0.58	0.67	11.3	2.8	0.3	9
	3	-43	-46	0	2.94	0.13	0.42	0.75	11.8	0.1	0.0	1
	4	-46	-48	0	2.93	0.13	0.44	0.74	11.7	0.0	0.0	1
	5	-48	-50.5	0	2.95	0.13	0.55	0.68	13.2	0.0	0.0	1
	6	-50.5	-51	0	2.88	0.14	0.67	0.63	13.4	0.0	0.0	1
		EL -38.9 to -40.9		D=2	2.31	0.20	0.98	0.51	8.4	4.5	2.6	17
TI-03-V-126	1	-38.7	-41	2.3	1.00	0.50	2.20	0.22	8.7	14.9	6.5	43
	2	-41	-43.5	2.5	2.77	0.15	0.38	0.77	6.0	0.5	0.1	3
	3	-43.5	-45.5	0	3.06	0.12	0.64	0.64	16.4	1.1	0.0	2
	4	-45.5	-47.5	0	2.75	0.15	0.57	0.67	12.7	0.4	0.0	2
	5	-47.5	-49.2	0	3.28	0.10	1.32	0.40	21.7	1.2	0.7	1
	6	-49.2	-49.7	0	2.81	0.14	0.61	0.66	14.2	0.2	0.1	2
		EL -38.7 to -43.5		D=4.8	1.76	0.30	1.79	0.29	7.3	7.4	3.2	22
TI-03-V-127	1	-39.8	-42.3	2.5	1.41	0.38	1.91	0.27	3.8	6.6	8.5	28
	2	-42.3	-44	1.7	2.86	0.14	0.36	0.78	6.9	0.1	0.0	1
	3	-44	-44.7	0.7	2.90	0.13	0.36	0.78	6.2	0.2	0.0	1
		EL -39.8 to -44.7		D=4.9	2.19	0.22	1.11	0.46	5.2	3.4	4.3	15

Table E-13
Borings for Borrow Area A (cont.)

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-129	1	-40.9	-42.5	1.6	1.48	0.36	1.25	0.42	1.2	5.5	0.9	24
	2	-42.5	-43.4	0.9	2.41	0.19	0.54	0.69	1.8	2.1	0.3	9
	3	-43.4	-44.3	0.9	ND	ND	ND	ND	37.3	1.8	0.0	7
	4	-44.3	-47.6	3.3	1.59	0.33	1.16	0.45	7.4	2.7	0.5	6
	5	-47.6	-49.2	1.6	ND	ND	ND	ND	70.7	0.1	0.0	1
		EL -40.9 to -43.4		D=2.5	1.84	0.28	1.09	0.47	1.4	4.2	0.7	19
TI-03-V-130	1	-42.6	-45.1	2.5	2.62	0.16	0.51	0.70	8.0	2.3	0.1	7
	2	-45.1	-47	1.9	2.82	0.14	0.32	0.80	4.9	0.2	0.0	2
	3	-47	-49	2	2.82	0.14	0.29	0.82	3.6	0.1	0.0	1
	4	-49	-50.9	1.9	2.65	0.16	0.44	0.74	3.8	0.0	0.0	1
		EL -42.6 to -50.9		D=8.3	2.71	0.15	0.42	0.75	5.3	0.7	0.0	3
TI-03-V-182	1	-44.7	-46	1.3	2.30	0.20	0.63	0.65	2.5	1.8	0.5	7
	2	-46	-47	1	1.88	0.27	1.26	0.42	2.2	6.4	2.1	11
	3	-47	-49	2	2.90	0.13	0.44	0.74	11.2	0.1	0.0	1
	4	-49	-52.3	3.3	2.93	0.13	0.42	0.75	12.2	0.1	0.0	0
		EL -44.7 to -49		D=4.3	2.55	0.17	0.49	0.71	6.5	2.1	0.6	5
TI-03-V-187	1	-42.5	-44.5	2	2.40	0.19	0.65	0.64	2.9	3.5	1.3	11
	2	-44.5	-46.5	2	2.81	0.14	0.55	0.68	9.1	1.9	0.3	7
	3	-46.5	-49	2.5	2.92	0.13	0.40	0.76	8.9	0.1	0.0	1
	4	-49	-52	3	2.92	0.13	0.42	0.75	9.4	0.0	0.0	1
	5	-52	-54	2	2.81	0.14	0.56	0.68	10.6	0.0	0.0	1
	6	-54	-55.5	1.5	3.37	0.10	1.27	0.41	20.4	0.0	0.0	1
		EL -42.5 to -46.5		D=4	2.63	0.16	0.56	0.68	6.0	2.7	0.8	9

Table E-13
Borings for Borrow Area A (cont.)

Boring Number	Layer Number	Layer Depth (ft) Top	Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-188	1	-44.2	-47.8	3.6	1.74	0.30	1.51	0.35	3.2	5.2	6.2	19
	2	-47.8	-50	2.2	2.97	0.13	0.46	0.73	12.2	0.2	0.0	2
	3	-50	-52	2	3.07	0.12	0.52	0.70	11.6	0.0	0.0	0
	4	-52	-54.2	2.2	2.93	0.13	0.48	0.72	12.0	0.1	0.0	1
		EL -44.2 to -52		D=7.8	2.69	0.15	0.65	0.64	7.9	2.5	2.9	9
TI-03-V-189	1	-45.5	-47.5	2	2.36	0.20	0.60	0.66	2.9	1.8	0.9	8
	2	-47.5	-51	3.5	2.06	0.24	1.16	0.45	7.6	5.6	3.8	16
	3	-51	-54.8	3.8	2.81	0.14	0.60	0.66	11.6	1.8	1.1	8
	4	-54.8	-57	2.2	2.91	0.13	0.46	0.73	10.5	1.5	0.7	5
	5	-57	-59	2	3.04	0.12	0.55	0.68	12.1	0.1	0.0	3
	6	-59	-59.5	0.5	2.92	0.13	0.47	0.72	11.8	0.1	0.0	2
		EL -45.5 to -54.8		D=9.3	2.46	0.18	0.77	0.59	8.2	3.3	2.1	11
TI-03-V-197	1	-45.5	-47	1.5	2.23	0.21	0.64	0.64	1.6	2.1	3.2	8
	2	-47	-49.5	2.5	2.88	0.14	0.43	0.74	10.1	0.5	0.6	3
	3	-49.5	-52	2.5	3.35	0.10	0.77	0.59	26.7	0.2	0.1	1
	4	-52	-52.9	0.9	ND	ND	ND	ND	73.5	0.0	0.0	0
	5	-52.9	-55	2.1	3.61	0.08	1.03	0.49	40.5	0.0	0.0	1
	6	-55	-56.7	1.7	3.71	0.08	1.18	0.44	42.0	0.1	0.0	1
	7	-56.7	-57.5	0.8	ND	ND	ND	ND	72.4	0.1	0.0	0
		EL -45.5 to -49.5		D=4	2.61	0.16	0.51	0.70	6.9	1.1	1.6	5
TI-03-V-202	1	-46.3	-48	1.7	2.24	0.21	0.75	0.59	1.8	3.5	1.5	9
	2	-48	-50	2	2.70	0.15	0.79	0.58	12.6	2.8	0.7	9
	3	-50	-52	2	2.99	0.13	1.09	0.47	18.3	2.4	0.6	10
	4	-52	-53.9	1.9	2.92	0.13	0.69	0.62	15.3	2.3	0.8	9
		EL -46.3 to -50		D=3.7	2.44	0.18	0.77	0.59	7.6	3.2	1.1	9

Table E-13
Borings for Borrow Area A (cont.)

Boring Number	Layer Number	Layer Depth (ft) Top	Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-203	1	-43.4	-45.5	2.1	0.93	0.52	2.03	0.25	2.3	9.9	9.4	25
	2	-45.5	-46.6	1.1	2.28	0.21	0.64	0.64	1.8	2.1	3.1	10
		EL -43.4 to -46.6		D=3.2	1.34	0.39	1.78	0.29	2.1	7.2	7.2	20
TI-03-V-208	1	-49	-51	2	2.61	0.16	0.42	0.75	4.6	1.4	0.4	6
	2	-51	-52.2	1.2	2.88	0.14	0.41	0.75	9.6	0.8	0.1	3
		EL -49 to -52.2		D=3.2	2.70	0.15	0.44	0.74	6.5	1.2	0.3	5
TI-03-V-216	1	-48.2	-49	0.8	1.15	0.45	2.12	0.23	1.9	10.4	9.3	23
	2	-49	-50.3	1.3	1.75	0.30	1.94	0.26	12.3	7.9	4.6	18
		EL -48.2 to -50.3		D=2.1	1.45	0.36	1.95	0.26	8.3	8.9	6.4	20

Table E-14
Borings for Borrow Area B

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-132	1	-42.2	-43.8	1.6	0.58	0.67	2.04	0.24	1.5	12.3	9.4	44
	2	-43.8	-46	2.2	2.64	0.16	0.44	0.74	5.3	0.9	0.1	5
	3	-46	-47.6	1.6	2.86	0.14	0.37	0.77	6.7	0.1	0.0	2
	EL -42.2 to -47.6			D= 5.4	2.09	0.23	1.16	0.45	4.6	4.0	2.8	16

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-205	1	-43.2	-45.2	2	2.39	0.19	0.56	0.68	2.2	0.9	0.1	6
	2	-45.2	-47.2	0	ND	ND	ND	ND	64.2	0.0	0.0	0
	3	-47.2	-50	0	3.73	0.08	1.02	0.49	36.3	0.1	0.0	1
	4	-50	-53	0	3.74	0.08	1.09	0.47	37.8	0.0	0.0	1
	5	-53	-55.2	0	3.32	0.10	0.84	0.56	21.5	0.0	0.0	1
	EL -43.2 to -45.2			D=2	2.39	0.19	0.56	0.68	2.2	0.9	0.1	6

Table E-15
Borings for Borrow Area C

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-174	1	-45.5	-47.8	2.3	2.43	0.18	0.53	0.69	2.4	2.5	2.1	9
	2	-47.8	-49.5	0	ND	ND	ND	ND	68.4	0.1	0.0	3
	3	-49.5	-50.5	0	ND	ND	ND	ND	80.8	0.6	0.4	3
	4	-50.5	-51.3	0	3.53	0.09	1.27	0.41	24.4	1.0	0.3	2
		EL -45.5 to -47.8		D= 2.3	2.43	0.18	0.53	0.69	2.4	2.5	2.1	9
TI-03-V-178	1	-46.3	-48.5	2.2	2.58	0.17	0.53	0.69	7.0	0.9	4.9	9
	2	-48.5	-50.5	0	2.95	0.13	0.43	0.74	9.5	0.2	0.3	2
	3	-50.5	-52	0	2.52	0.17	0.81	0.57	8.5	1.8	5.2	11
	4	-52	-54.5	0	2.59	0.17	0.49	0.71	7.2	0.0	0.0	2
	5	-54.5	-57	0	2.50	0.18	0.44	0.74	3.6	0.1	0.0	3
	6	-57	-60	0	2.06	0.24	0.87	0.55	3.6	0.8	0.1	9
	7	-60	-62.5	0	2.01	0.25	0.87	0.55	2.1	0.4	0.0	2
	8	-62.5	-63.3	0	2.69	0.15	0.31	0.81	3.0	0.0	0.0	1
		EL -46.3 to -48.5		D=2.2	2.58	0.17	0.53	0.69	7.0	0.9	4.9	9
TI-03-V-185	1	-46.5	-48.5	2	2.38	0.19	0.53	0.69	1.2	1.4	0.5	5
	2	-48.5	-51	2.5	2.73	0.15	0.63	0.65	11.7	1.2	1.2	8
	3	-51	-53	0	3.12	0.11	0.68	0.62	15.1	0.8	0.5	8
	4	-53	-55	0	ND	ND	ND	ND	49.9	0.3	0.2	1
	5	-55	-58	0	ND	ND	ND	ND	82.3	0.0	0.0	0
	6	-58	-61	3	ND	ND	ND	ND	84.5	0.0	0.0	0
	7	-61	-64.3	0	3.32	0.10	0.81	0.57	22.0	0.1	0.0	1
	8	-64.3	-64.8	0	3.06	0.12	0.72	0.61	14.9	0.0	0.0	1
		EL -46.5 to -51		D=4.5	2.54	0.17	0.49	0.71	7.0	1.3	0.9	7

Table E-15
Borings for Borrow Area C (cont.)

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-186	1	-47.7	-49.5	1.8	2.42	0.19	0.49	0.71	2.6	1.5	1.1	7
	2	-49.5	-51	1.5	2.48	0.18	0.43	0.74	4.5	0.9	4.0	7
	3	-51	-53.9	2.9	2.73	0.15	0.51	0.70	7.9	0.2	0.0	2
	4	-53.9	-56	2.1	ND	ND	ND	ND	54.1	0.2	0.0	2
	5	-56	-57	1	ND	ND	ND	ND	65.6	0.1	0.0	0
	6	-57	-60	3	3.28	0.10	0.84	0.56	21.8	0.2	0.1	2
	7	-60	-63	3	2.93	0.13	0.45	0.73	10.8	0.1	0.0	2
	8	-63	-65.5	2.5	3.18	0.11	0.76	0.59	16.8	0.1	0.0	1
		EL -47.7 to -51		D=3.3	2.46	0.18	0.44	0.73	3.4	1.2	2.4	7
TI-03-V-192	1	-47	-49	2	2.10	0.23	0.69	0.62	1.5	1.2	0.1	7
	2	-49	-50	1	ND	ND	ND	ND	35.1	1.2	0.0	1
		EL -47 to -49		D=2	2.10	0.23	0.69	0.62	1.5	1.2	0.1	7
TI-03-V-198	1	-46.5	-48.5	2	1.35	0.39	1.75	0.30	1.5	5.3	9.8	20
	2	-48.5	-49.5	1	2.33	0.20	0.56	0.68	2.3	1.7	1.5	7
	3	-49.5	-50.5	1	3.29	0.10	1.05	0.48	23.9	0.1	0.0	1
	4	-50.5	-52.5	2	2.43	0.18	0.60	0.66	6.1	0.0	0.0	0
	5	-52.5	-54.5	2	3.05	0.12	0.48	0.72	7.8	0.0	0.0	0
		EL -46.5 to -49.5		D=3	1.84	0.28	1.14	0.45	1.7	4.1	7.1	16
TI-03-V-199	1	-46.6	-48.8	2.2	2.14	0.23	0.70	0.62	1.4	0.7	0.5	7
	2	-48.8	-51.1	2.3	3.11	0.12	0.68	0.63	14.2	0.1	0.0	2
	3	-51.1	-51.6	0.5	2.97	0.13	0.73	0.60	13.8	0.1	0.0	2
		EL -46.6 to -48.8		D=2.2	2.14	0.23	0.70	0.62	1.4	0.7	0.5	7

Table E-16
Borings for Borrow Area D

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-223	1	-43.5	-45	1.5	2.12	0.23	0.63	0.65	0.9	1.3	1.1	8
	2	-45	-46.5	1.5	1.85	0.28	0.90	0.54	1.3	4.4	4.5	16
	3	-46.5	-47.2	0	3.00	0.13	1.15	0.45	19.4	3.3	1.1	8
		EL -43.5 to -46.5		D= 3	2.00	0.25	0.75	0.59	1.1	2.9	2.8	12
TI-03-V-224	1	-46.4	-48.4	2	2.23	0.21	0.54	0.69	1.5	2.1	1.4	7
	2	-48.4	-50.5	0	3.63	0.08	1.46	0.36	32.5	0.5	0.0	2
	3	-50.5	-52.6	0	3.38	0.10	0.86	0.55	28.0	0.2	0.0	1
		EL -46.4 to -48.4		D=2	2.23	0.21	0.54	0.69	1.5	2.1	1.4	7
TI-03-V-228	1	-46.9	-47.9	1	2.10	0.23	0.68	0.63	1.6	2.0	0.5	6
	2	-47.9	-50.6	2.7	1.29	0.41	2.08	0.24	7.4	12.8	5.2	18
	3	-50.6	-52.5	1.9	2.93	0.13	0.44	0.73	11.3	0.9	0.1	3
	4	-52.5	-53.6	1.1	2.92	0.13	0.46	0.73	11.0	2.2	1.7	5
		EL -46.9 to -53.6		D=6.7	2.16	0.22	1.23	0.43	8.2	6.1	2.5	10

Table E-17
Borings for Borrow Area E

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-240	1	-50	-52	2	1.78	0.29	0.74	0.60	1.0	1.7	3.5	9
	2	-52	-52.8	0.8	2.56	0.17	0.42	0.75	5.7	0.6	0.2	3
		EL -50 to -52.8		D= 2.8	2.00	0.25	0.82	0.57	2.3	1.4	2.5	7
TI-03-V-241	1	-49	-51.2	2.2	2.01	0.25	0.50	0.71	0.8	0.5	0.5	4
	2	-51.2	-53	1.8	2.55	0.17	0.45	0.73	7.6	0.7	0.1	3
	3	-53	-54	0	3.87	0.07	1.27	0.42	42.6	0.1	0.0	1
	4	-54	-56.1	0	3.62	0.08	1.39	0.38	36.0	0.1	0.0	1
		EL -49 to -53		D=4	2.25	0.21	0.61	0.66	3.9	0.6	0.3	4

Table E-18
Borings for Borrow Area F

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-245	1	-47.2	-48.5	1.3	0.50	0.71	1.47	0.36	1.8	9.6	6.6	18
	2	-48.5	-49.7	1.2	1.55	0.34	1.37	0.39	1.4	4.5	8.0	18
		EL -47.2 to -49.7		D= 2.5	0.96	0.51	1.64	0.32	1.6	7.2	7.3	18

Boring Number	Layer Number	Layer Depth (ft) Top	Layer Depth (ft) Bottom	Layer Thickness (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-369	1	-48	-49	1	1.73	0.30	1.25	0.42	7.3	3.6	0.3	2
	2	-49	-51	2	0.82	0.56	2.34	0.20	4.7	8.4	14.1	3
	3	-51	-53	2	-0.08	1.06	2.64	0.16	6.2	13.4	20.6	1
		EL -48 to -51		D=3	1.20	0.44	1.90	0.27	5.6	6.8	9.5	2

Table E-19
Composite Characteristics for Borrow Area G

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-254	5.0	2.09	0.23	0.90	0.54	7.6	3.5	3.8	5
TI-03-V-256	2.0	2.09	0.23	0.62	0.65	1.1	0.8	2.0	7
TI-03-V-257	3.0	2.04	0.24	0.97	0.51	3.9	2.9	7.2	14
TI-03-V-258	2.8	0.89	0.54	2.48	0.18	2.8	6.9	15.7	28
TI-03-V-275	5.5	2.58	0.17	0.43	0.74	6.3	0.4	1.2	4

Borrow Area G Composite Data

Mean	**2.0**
Mean (mm)	**0.24**
Std Dev (phi)	**1.0**
Std Dev (mm)	**0.51**
% Silt	**5.2**
% Granular	**2.7**
% Gravel	**5.2**
% Shell	**10**

Table E-20
Composite Characteristics for Borrow Area H

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-260	2.2	2.07	0.24	0.87	0.55	3.6	2.2	4.5	11
TI-03-V-273	4.8	2.27	0.21	0.55	0.68	2.1	1.3	0.9	5

Borrow Area H Composite Data

Mean	**2.21**
Mean (mm)	**0.22**
Std Dev (phi)	**0.65**
Std Dev (mm)	**0.64**
% Silt	**2.6**
% Granular	**1.6**
% Gravel	**2.0**
% Shell	**7**

Table E-21
Composite Characteristics for Borrow Area J

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-98	2.8	2.13	0.23	0.73	0.60	5.2	1.3	0.5	11
TI-03-V-99	8.3	2.45	0.18	0.44	0.74	9.5	1.4	0.2	6
TI-03-V-102	3.0	1.86	0.27	1.05	0.48	2.3	4.5	1.3	16
TI-03-V-103	2.6	2.29	0.20	0.58	0.67	2.8	1.6	0.2	10
TI-03-V-270A	2.0	2.00	0.25	0.81	0.57	1.5	3.0	1.1	9
TI-03-V-281	3.4	2.02	0.25	0.72	0.61	1.2	2.5	1.0	10
TI-03-V-283	3.2	1.87	0.27	0.88	0.54	2.1	3.7	1.8	9
TI-03-V-286	4.0	1.85	0.28	1.15	0.45	2.6	1.8	3.3	14

Borrow Area J Composite Data

Mean	**2.12**
Mean (mm)	**0.23**
Std Dev (phi)	**0.75**
Std Dev (mm)	**0.60**
% Silt	**4.5**
% Granular	**2.3**
% Gravel	**1.1**
% Shell	**10**

Table E-22
Composite Characteristics for Borrow Area L

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-91	3.5	1.61	0.33	1.69	0.31	7.1	4.4	9.6	19
TI-03-V-93	2.3	2.15	0.23	0.83	0.56	8.5	3.8	0.8	15
TI-03-V-95	13.8	2.50	0.18	0.42	0.75	8.4	0.9	0.2	6
TI-03-V-341	4.3	2.12	0.23	0.88	0.54	6.3	2.5	0.7	6
TI-03-V-342	2.0	1.89	0.27	1.04	0.49	3.8	5.6	2.8	15
TI-03-V-343	5.0	2.37	0.19	0.50	0.71	3.3	1.0	0.4	3
TI-03-V-344	2.3	0.81	0.57	2.23	0.21	1.6	7.0	13.8	22
TI-03-V-345	3.0	1.65	0.32	1.01	0.50	1.8	2.8	2.1	15
TI-03-V-346	3.0	1.93	0.26	1.09	0.47	7.6	3.4	4.9	13
TI-03-V-351	2.8	1.31	0.40	2.13	0.23	7.3	7.4	10.5	16

Borrow Area L Composite Data

Mean	**2.05**
Mean (mm)	**0.24**
Std Dev (phi)	**0.94**
Std Dev (mm)	**0.52**
% Silt	**6.3**
% Granular	**2.8**
% Gravel	**3.1**
% Shell	**10**

Table E-23
Composite Characteristics for Borrow Area N

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-63	3.0	2.08	0.24	0.63	0.65	1.2	2.2	4.9	14
TI-03-V-65	5.5	2.37	0.19	0.43	0.74	1.5	0.5	0.6	7
TI-03-V-68	6.0	1.71	0.31	1.20	0.44	4.6	3.4	2.7	3
TI-03-V-69	3.7	1.31	0.40	1.71	0.31	1.1	5.7	8.8	24
TI-03-V-70	5.0	1.33	0.40	1.46	0.36	6.3	4.4	8.4	14
TI-03-V-72	2.8	0.54	0.69	1.64	0.32	1.1	6.9	10.9	19
TI-03-V-74	5.5	2.20	0.22	0.67	0.63	3.3	3.4	3.5	10
TI-03-V-77	2.3	2.23	0.21	0.57	0.67	1.4	1.5	0.9	7
TI-03-V-78	4.0	2.38	0.19	0.65	0.64	4.8	3.5	4.1	9
TI-03-V-79	2.3	2.03	0.24	0.60	0.66	1.6	0.5	0.1	8
TI-03-V-86	14.8	1.88	0.27	0.91	0.53	3.4	3.6	3.0	8
TI-03-V-87	5.8	1.88	0.27	1.09	0.47	5.8	2.4	7.7	5

Borrow Area N Composite Data

Mean	**1.86**
Mean (mm)	**0.28**
Std Dev (phi)	**0.96**
Std Dev (mm)	**0.51**
% Silt	**3.6**
% Granular	**3.2**
% Gravel	**4.8**
% Shell	**9**

Table E-24
Composite Characteristics for Borrow Area O

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-83B	5.1	0.33	0.80	2.99	0.13	8.2	8.9	24.6	46
TI-03-V-85	4.5	2.07	0.24	0.74	0.60	4.8	2.4	3.5	8
TI-03-V-322	3.1	2.51	0.18	0.44	0.74	7.1	0.3	0.4	3
TI-03-V-323	12.4	2.46	0.18	0.46	0.73	7.5	1.1	0.7	5
TI-03-V-324	7.0	1.85	0.28	1.22	0.43	5.4	2.7	10.3	9
TI-03-V-325	2.0	2.31	0.20	0.59	0.66	4.5	2.7	1.9	9
TI-03-V-326	12.7	2.54	0.17	0.43	0.74	5.3	0.2	0.1	1
TI-03-V-327	4.0	2.22	0.22	0.76	0.59	5.9	3.4	3.2	11

Borrow Area O Composite Data

Mean	**2.12**
Mean (mm)	**0.23**
Std Dev (phi)	**0.86**
Std Dev (mm)	**0.55**
% Silt	**6.2**
% Granular	**2.0**
% Gravel	**4.7**
% Shell	**9**

Table E-25
Composite Characteristics for Borrow Area P

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-317	4.5	1.52	0.35	1.75	0.30	6.4	3.5	11.2	11
TI-03-V-318	2.0	1.99	0.25	0.72	0.61	1.4	1.4	0.6	8
TI-03-V-320	10.5	2.23	0.21	0.66	0.63	5.9	2.0	5.9	5

Borrow Area P Composite Data

Mean	**2.01**
Mean (mm)	**0.25**
Std Dev (phi)	**0.96**
Std Dev (mm)	**0.52**
% Silt	**5.5**
% Granular	**2.4**
% Gravel	**6.6**
% Shell	**7**

Table E-26
Composite Characteristics for Borrow Area Q

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-161	4.2	2.23	0.21	0.61	0.65	4.1	1.6	2.6	8
TI-03-V-162	6.0	2.35	0.20	0.70	0.62	7.2	2.9	2.1	10

Borrow Area Q Composite Data

Mean	**2.30**
Mean (mm)	**0.20**
Std Dev (phi)	**0.66**
Std Dev (mm)	**0.63**
% Silt	**5.9**
% Granular	**2.4**
% Gravel	**2.3**
% Shell	**10**

Table E-27
Composite Characteristics for Borrow Area S

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-46	2.3	0.17	0.89	2.09	0.23	3.3	15.6	12.7	47
TI-03-V-47	2.8	0.82	0.57	2.28	0.21	5.8	16.0	11.1	45
TI-03-V-48	2.2	1.63	0.32	1.12	0.46	3.9	6.2	2.0	18
TI-03-V-49	2.3	2.34	0.20	0.30	0.81	1.3	0.9	0.1	8
TI-03-V-51	2.6	2.01	0.25	0.67	0.63	1.8	2.8	0.5	16
TI-03-V-52	3.5	2.18	0.22	0.56	0.68	1.8	1.0	1.3	8
TI-03-V-53	2.7	1.98	0.25	0.93	0.52	5.6	5.6	1.7	18

Borrow Area S Composite Data

Mean	**1.62**
Mean (mm)	**0.32**
Std Dev (phi)	**1.12**
Std Dev (mm)	**0.46**
% Silt	**3.3**
% Granular	**6.6**
% Gravel	**4.1**
% Shell	**21**

Table E-28
Composite Characteristics for Borrow Area T

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-14	3.2	1.97	0.26	0.74	0.60	1.4	2.6	3.3	13
TI-03-V-17	8.6	1.91	0.27	0.78	0.58	2.3	2.3	2.9	17
TI-03-V-22	2.2	2.26	0.21	0.62	0.65	9.2	2.2	1.1	4
TI-03-V-23	4.5	1.18	0.44	1.74	0.30	2.5	5.9	9.6	24
TI-03-V-27	2.4	1.78	0.29	0.70	0.62	1.2	1.1	0.6	19

Borrow Area T Composite Data

Mean	**1.78**
Mean (mm)	**0.29**
Std Dev (phi)	**0.95**
Std Dev (mm)	**0.52**
% Silt	**2.8**
% Granular	**3.0**
% Gravel	**3.9**
% Shell	**16.5**

Table E-29
Composite Characteristics for Borrow Area A

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-124	2.0	1.72	0.30	1.59	0.33	9.0	8.5	2.1	22
TI-03-V-125	2.0	2.31	0.20	0.98	0.51	8.4	4.5	2.6	17
TI-03-V-126	4.8	1.76	0.30	1.79	0.29	7.3	7.4	3.2	22
TI-03-V-127	4.9	2.19	0.22	1.11	0.46	5.2	3.4	4.3	15
TI-03-V-129	2.5	1.84	0.28	1.09	0.47	1.4	4.2	0.7	19
TI-03-V-130	8.3	2.71	0.15	0.42	0.75	5.3	0.7	0.0	3
TI-03-V-182	4.3	2.55	0.17	0.49	0.71	6.5	2.1	0.6	5
TI-03-V-187	4.0	2.63	0.16	0.56	0.68	6.0	2.7	0.8	9
TI-03-V-188	7.8	2.69	0.15	0.65	0.64	7.9	2.5	2.9	9
TI-03-V-189	9.3	2.46	0.18	0.77	0.59	8.2	3.3	2.1	11
TI-03-V-197	4.0	2.61	0.16	0.51	0.70	6.9	1.1	1.6	5
TI-03-V-202	3.7	2.44	0.18	0.77	0.59	7.6	3.2	1.1	9
TI-03-V-203	3.2	1.34	0.39	1.78	0.29	2.1	7.2	7.2	20
TI-03-V-208	3.2	2.70	0.15	0.44	0.74	6.5	1.2	0.3	5
TI-03-V-216	2.1	1.45	0.36	1.95	0.26	8.3	8.9	6.4	20

Borrow Area A Composite Data

Mean	2.36
Mean (mm)	0.20
Std Dev (phi)	0.88
Std Dev (mm)	0.54
% Silt	6.6
% Granular	3.4
% Gravel	2.2
% Shell	11

Table E-30
Composite Characteristics for Borrow Area B

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-132	5.4	2.09	0.23	1.16	0.45	4.6	4.0	2.8	16
TI-03-V-205	2.0	2.39	0.19	0.56	0.68	2.2	0.9	0.1	6

Borrow Area B Composite Data

Mean	**2.17**
Mean (mm)	**0.22**
Std Dev (phi)	**0.99**
Std Dev (mm)	**0.50**
% Silt	**4.0**
% Granular	**1.7**
% Gravel	**0.8**
% Shell	**13**

Table E-31
Composite Characteristics for Borrow Area C

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-174	2.3	2.43	0.18	0.53	0.69	2.4	2.5	2.1	9
TI-03-V-178	2.2	2.58	0.17	0.53	0.69	7.0	0.9	4.9	9
TI-03-V-185	4.5	2.54	0.17	0.49	0.71	7.0	1.3	0.9	7
TI-03-V-186	3.3	2.46	0.18	0.44	0.73	3.4	1.2	2.4	7
TI-03-V-192	2.0	2.10	0.23	0.69	0.62	1.5	1.2	0.1	7
TI-03-V-198	3.0	1.84	0.28	1.14	0.45	1.7	4.1	7.1	16
TI-03-V-199	2.2	2.14	0.23	0.70	0.62	1.4	0.7	0.5	7

Borrow Area C Composite Data

Mean	**2.32**
Mean (mm)	**0.20**
Std Dev (phi)	**0.63**
Std Dev (mm)	**0.64**
% Silt	**3.9**
% Granular	**1.7**
% Gravel	**2.6**
% Shell	**9**

Table E-32
Composite Characteristics for Borrow Area D

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-223	3.0	2.00	0.25	0.75	0.59	1.1	2.9	2.8	12
TI-03-V-224	2.0	2.23	0.21	0.54	0.69	1.4	2.1	0.6	7
TI-03-V-228	6.7	2.16	0.22	1.23	0.43	8.2	6.1	2.5	10

Borrow Area D Composite Data

Mean	**2.13**
Mean (mm)	**0.23**
Std Dev (phi)	**0.99**
Std Dev (mm)	**0.50**
% Silt	**5.2**
% Granular	**4.6**
% Gravel	**2.2**
% Shell	**10**

Table E-33
Composite Characteristics for Borrow Area E

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-240	2.8	2.00	0.25	0.82	0.57	2.3	1.4	2.5	7
TI-03-V-241	4.0	2.25	0.21	0.61	0.66	3.9	0.6	0.3	4

Borrow Area E Composite Data

Mean	**2.15**
Mean (mm)	**0.23**
Std Dev (phi)	**0.69**
Std Dev (mm)	**0.62**
% Silt	**3.2**
% Granular	**0.9**
% Gravel	**1.2**
% Shell	**5**

Table E-34
Composite Characteristics for Borrow Area F

Boring Number	Depth (ft)	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
TI-03-V-245	2.5	0.96	0.51	1.64	0.32	1.6	7.2	7.3	18
TI-03-V-369	3.0	1.20	0.44	1.90	0.27	5.6	6.8	9.5	2

Borrow Area E Composite Data

Mean	**1.09**
Mean (mm)	**0.47**
Std Dev (phi)	**1.78**
Std Dev (mm)	**0.29**
% Silt	**3.8**
% Granular	**7.0**
% Gravel	**8.5**
% Shell	**10**

Table E-35
Compatibility of Native and Borrow Sand

Native Beach	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell
Surf City/North Topsail Beach	2.15	0.23	0.71	0.61	1.2	1.1	0.5	9

Borrow Site	Mean (phi)	Mean (mm)	Std Dev (phi)	Std Dev (mm)	% Silt (0.062 mm)	% Granular (2 - 4.76 mm)	% Gravel (4.76 mm)	% Shell	Overfill Ratio	Silt Correction Factor	Final Overfill Ratios Corrected for Silt Content
A ^	2.36	0.20	0.88	0.54	6.6	3.4	2.2	11	1.29	1.07	1.38
B ^	2.17	0.22	0.99	0.50	4.0	1.7	0.8	13	1.18	1.04	1.23
C ^	2.32	0.20	0.63	0.64	3.9	1.7	2.6	9	1.50	1.04	1.56
D ^	2.13	0.23	0.99	0.50	5.2	4.6	2.2	10	1.15	1.06	1.21
E ^	2.15	0.23	0.69	0.62	3.2	0.9	1.2	5	1.02	1.03	1.15
F ^	1.09	0.47	1.78	0.23	3.8	7.0	8.5	10	1.14	1.04	1.19
G	2.05	0.24	0.98	0.51	5.2	2.7	5.2	10	1.11	1.05	1.17
H	2.21	0.22	0.65	0.64	2.6	1.6	2.0	7	1.16	1.03	1.19
J	2.12	0.23	0.75	0.60	4.5	2.3	1.1	10	1.01	1.05	1.15
L	2.05	0.24	0.94	0.52	6.3	2.8	3.1	10	1.09	1.07	1.16
N	1.86	0.28	0.96	0.51	3.6	3.2	4.8	9	1.05	1.04	1.15
O	2.12	0.23	0.86	0.55	6.2	2.0	4.7	9	1.08	1.07	1.15
P	2.01	0.25	0.96	0.52	5.5	2.4	6.6	7	1.09	1.06	1.15
Q	2.30	0.20	0.66	0.63	5.9	2.4	2.3	10	1.37	1.06	1.46
S	1.62	0.32	1.12	0.46	3.3	6.6	4.1	21	1.06	1.03	1.15
T	1.78	0.29	0.95	0.52	2.8	3.0	3.9	17	1.03	1.03	1.15

^ These borrow areas have been identified for the Topsail Beach Federal project. The excess material not used for these projects is planned to be available for the Surf City/North Topsail Beach Federal project. This amount is approximately 9.68 million cubic yards.