Characterization of Dredged Material Stored in New Jersey Confined Disposal Facilities

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Prepared for the New Jersey Department of Transportation Office of Maritime Resources by

HDR | LMS

EXECUTIVE SUMMARY

Typically, projects to dredge New Jersey's State navigation channels, as well as private channels and marinas, are conducted with hydraulic dredges that require a nearby dewatering site. Historically, the materials from these projects were pumped to confined disposal facilities (CDFs) that are located along the shoreline, in wetlands or on man-made islands. Currently, many of the CDFs that were used historically are at or near capacity, and this is the limiting factor for completing dredging projects along many of New Jersey's waterways. The construction of new CDFs is unlikely due to elevated shoreline property values, and environmental regulations restricting construction in wetlands and open waters.

The New Jersey Department of Transportation Office of Maritime Resources (NJDOT / OMR) is investigating the possibility of reclaiming the capacity of existing CDFs by identifying beneficial use applications for the stored dredged materials. This analysis is the first step in the process. The purpose of this current project is to characterize the physical and chemical properties of the material in five existing CDFs. The project was designed to provide sufficient information to allow the NJDEP Office of Dredging and Sediment Technology (NJDEP / ODST) to issue an Acceptable Use Determination for beneficial uses that may be identified for the material.

The five CDFs evaluated for this program are:

- Nummy Island in Stone Harbor
- Middle Thorofare CDF in Cape May
- Site #83 in Ocean City
- Corps Cell D in Cape May
- Waackaack Creek in Keansburg

A sediment characterization plan was designed for each of the CDFs in an effort to determine the physical and chemical characteristics of the material. Following approval from the NJDEP / ODST, the sediment characterization program was implemented.

A total of 98 sediment cores were collected from the five CDFs. A minimum of one sediment sample was prepared for each core. Where stratification of materials was present, an individual sample was prepared for each layer. This resulted in the preparation of 123 samples for physical analyses. Of these samples, 31 were comprised of a minimum of 90% course-grained particles (sand and gravel). Based on the NJDEP guidelines, it was assumed that these samples were not contaminated. This assumption is based on the affinity of contaminants to fine-grained particles (silt and clay). The remaining samples were composited with other samples from the same CDF (with a maximum of three samples per composite). A total of 32 composite samples were sent for chemical analyses.

The results of the analyses indicate that physical properties of the dredged material vary by location. The materials in the Waackaack Creek CDF are comprised mostly of sand, while the Site #83 CDF contains a mixture of clay and silt with only minimal quantities of sand. The Corps Cell D, Nummy Island CDF and Middle Thorofare CDFs contain a mixture of coarse and fine-grained sediments.

The dredged materials in all of the CDFs appear to be relatively clean and suitable for use in residential as well as commercial areas. Only one of the composite samples had contaminants in concentrations that exceeded the New Jersey Residential Direct Contact Soil Cleanup Criteria. These samples were collected from the Corps Cell D in Cape May, NJ. The composite sample had concentrations of five polycyclic aromatic hydrocarbons (PAHs) in levels that exceed the New Jersey Residential Direct Contact Soil Cleanup Criteria and Non-Residential Criteria. Low levels of other organic compounds and metals were detected in the dredged materials, but none in concentrations that would prevent their use in several applications.

The variability of the physical properties of the materials between the individual CDFs indicates that different beneficial uses may be applicable for the materials stored in the different CDFs. Structural applications may be possible for materials in the Waackaack Creek CDF where the sand and gravel content was particularly high (>90%). Embankment or non-structural fill applications may be more suitable for the materials in the other CDFs.

Overall, the dredged material in the evaluated CDFs appears to be relatively clean and could be put to several beneficial use applications. If a beneficial use is identified with specific material requirements, additional testing and/or processing may be required to ensure that the correct specifications for a specific project are achieved. However, other beneficial use applications, such as non-structural fill have few material restrictions and the material could possibly be put to use without further testing.

The limited access to the island CDFs (Nummy Island and Site #83) and CDFs with limited roadway access could be problematic when considering the material for any application. It is not likely that end users of the material will preferentially choose to use these materials over their traditional material sources due to increased transportation costs. While barge transport of the material is possible, the shallow access channels will only allow smaller barges to access the site, and it would require several trips to collect a substantial amount of material. If the end use site is not located on a waterway, an off-loading area would be required and trucks would be needed to haul the material. These factors could make the use of dredged material cost prohibitive for contractors when compared to using virgin materials from a borrow site or another traditional material source.

There are numerous construction projects, landfill closures, and site capping projects in the New York / New Jersey region that are anticipated during the next few years. These projects will require millions of cubic yards of materials. The dredged material stored in many of the CDFs could be appropriate for these applications if it was made readily accessible and less expensive to use when compared to material from a borrow site or another traditional material source.

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CHAPTER 1

INTRODUCTION

New Jersey's marine trade industry and the related sectors of the State's tourist and commercial economy are dependent on adequate water depths for safe navigation in channels and marinas. Obstacles to dredging and dredged material management are hampering the provision of safe channels and marinas with adequate depths, potentially threatening this source of State revenue from maritime commerce, recreation, and related activities. The obstacles include a lack of available dredged material placement options as well as restrictions on the use of dredged materials due to the public's concerns about contamination.

The lack of available placement sites for wet dredged material is the limiting factor for completing dredging projects in many of New Jersey's State Navigation Channels and within private marinas. Many historic placement sites have reached their capacity, and the construction of new placement sites is challenging due to regulatory and economic constraints. Traditionally, placement sites were established along the dredged waterways, in tidal wetlands, or on the shoreline. The practice of establishing placement sites in wetlands has become increasingly difficult due to negative environmental impacts and difficulties obtaining permits from the U.S. Army Corps of Engineers (USACE) and the New Jersey Department of Environmental Protection (NJDEP). Elevated property values within the State's coastal zone prohibit the acquisition of less environmentally sensitive sites to place dredged material on the shoreline.

It is clear that the marine trades industry and the resultant marine trades economy would benefit from the reclamation of dredged material storage capacity in existing placement sites. This would free capacity for future dredging projects. A potential means for this reclamation of capacity is the development of beneficial use options for dredged material that can be embraced by both governmental agencies and the general public. One beneficial use option currently being considered by the New Jersey Department of Transportation Office of Maritime Resources (NJDOT / OMR) would incorporate dredged material into USACE Flood and Hurricane Damage Reduction Projects and NJDOT Transportation Projects in New Jersey.

However, the general lack of information about the properties of the stored dredged materials in existing placement sites presents an obstacle to the development of this and other beneficial use options. The purpose of this project is to characterize the physical and chemical properties of the dredged materials stored in a number of representative placement sites located along New Jersey's shoreline.

1.1 BACKGROUND

Confined Disposal Facilities (CDFs) are located throughout New Jersey's coastal areas and are typically a relatively short distance from the channels and marinas that require periodic dredging. The CDF locations facilitate the traditional use of hydraulic dredges, which remove sediment from the channels and marinas and deposit it directly into the CDFs. Owners and operators of New Jersey CDFs include Federal and State agencies, such as the USACE and the NJDEP Bureau of Coastal Engineering, and private marinas.

Dredging operations generally result in dredged material with very high water content and dredged material is pumped into the CDF as a sediment-water slurry. The CDF allows for the release of the water from the dredged material, while retaining dredged solids within a diked containment area. The CDF is designed to have enough capacity to contain the volume of added dredged material and to allow sufficient retention time for settling of associated dredged solids (sediment). Once solids have settled, the residual clarified water is usually discharged from the CDF back into the source waters. Upon the suspension of an active dredging operation and the discharge of associated water, natural drying forces dewater the material remaining in the CDF. Drying results in the consolidation of the placed material adding additional storage capacity for the next dredging operation. The intermittent demand for dredging operations allows for this consolidation to take place, resulting in an ability to use CDFs over an extended period of time.

Figure 1-1 depicts the typical components of a CDF and is from the USACE Manual Publication Number: EM 1110-2-5027, Engineering and Design - Confined Disposal of Dredged Material, 30 September 1987.

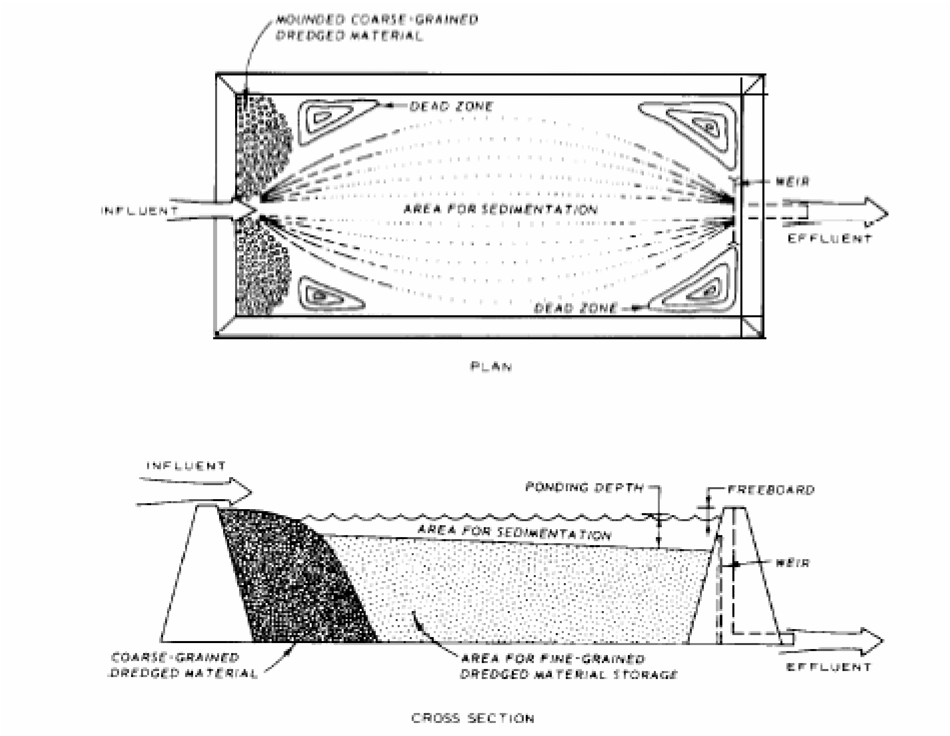
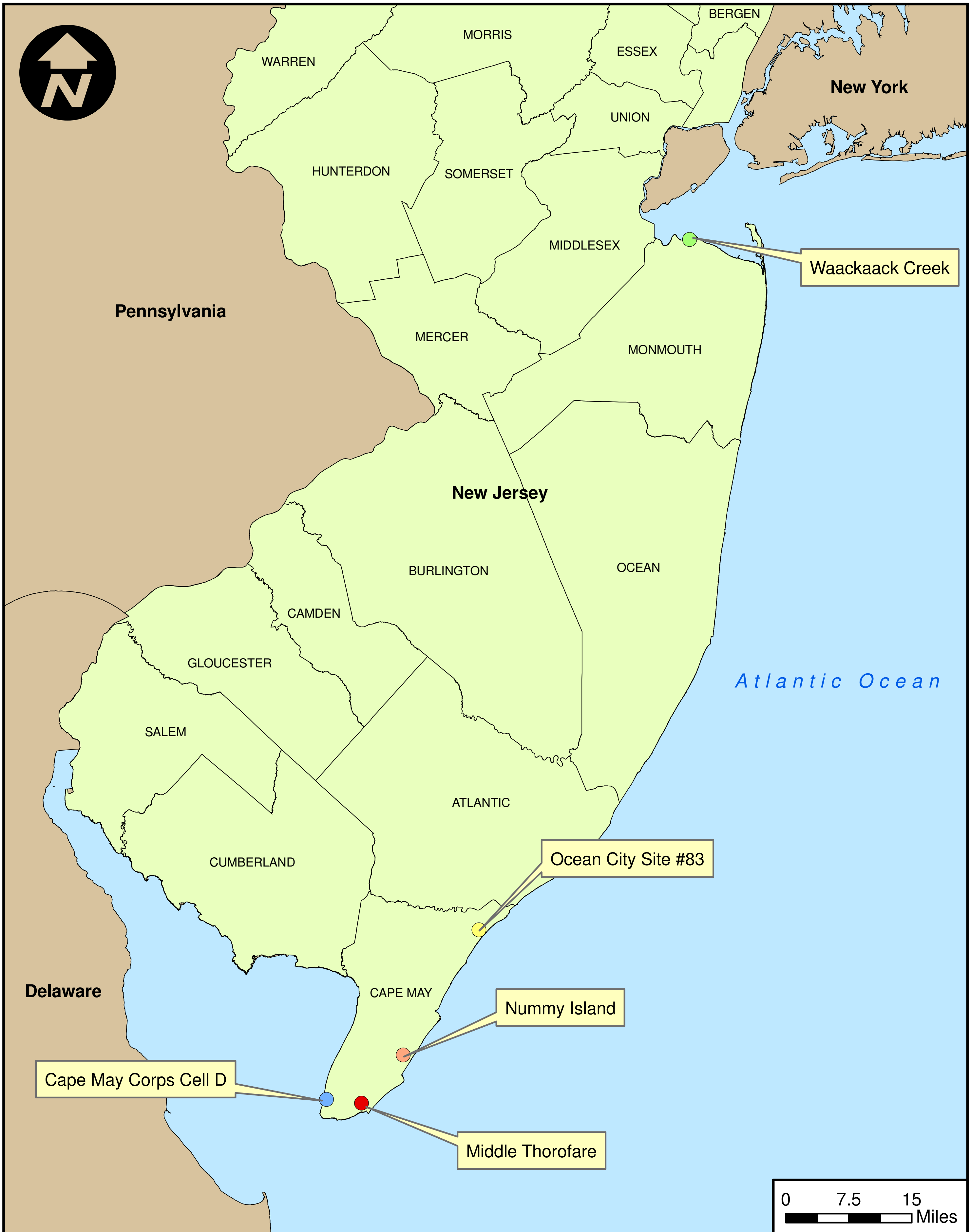


Figure 1-1. Conceptual Drawing of a Typical Confined Disposal Facility

Many of New Jersey's CDFs have been in operation for decades and little information exists about the physical and chemical properties of the material that was placed in them. Characterization of this material is necessary in order to designate beneficial uses and regenerate CDF capacity so that future dredging projects can be accommodated.

For this project, five New Jersey CDFs were selected for sediment characterization. These CDFs include Nummy Island in Stone Harbor, Middle Thorofare in Cape May, Ocean City Site #83, Corps Cell D in Cape May, and Waackaack Creek in Keansburg. The general locations of the selected CDFs are provided in Figure 1-2.



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Locations of the New Jersey Confined Disposal Facilities selected for the characterization program

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CHAPTER 2

CHARACTERIZATION PROGRAM

The NJDEP Office of Dredging and Sediment Technology (NJDEP / ODST) governs the beneficial use of dredged material in New Jersey. For each project, NJDEP / ODST evaluates the physical and chemical properties of the material and determines whether or not the material is suitable for the proposed beneficial use. If the material is suitable, the office issues an Acceptable Use Determination (AUD). The following sections describe the dredged material characterization program that was designed to provide the NJDEP / ODST and NJDOT / OMR sufficient information to determine potential acceptable uses for the material.

2.1 HISTORIC RECORDS SEARCH

A search of potential sources of contamination was conducted for an area of one mile from the approximate center of each CDF. Environmental Data Resources Inc. (EDR) was contacted to compile available Federal, State and Local environmental records. The records included information such as usage of hazardous materials, spills, discharges, brownfields, major facilities and underground storage tanks. Spills and/or discharges to adjacent waterways could affect material in the CDFs through subsequent dredging and placement of affected sediment. The full results of the historic records search are provided as an attachment to this document in a compact disc.

2.2 CDF VOLUME ESTIMATE

Using recent topographic surveys and knowledge of subsequent dredging projects, typical cross-sections of the CDFs were developed. These cross-sections were used to estimate the volume of material currently in the CDF. Based on these data, we estimated the volume of material that could be removed and reused while still allowing enough material to remain for the development of an adequate berm for containment of future dredging projects. A number of site-specific assumptions were used to guide the analyses, and these assumptions are presented with the calculations in Appendix A.

2.3 NUMBER AND LOCATION OF CORES

The number of cores required to characterize the dredged material in each CDF was estimated using guidelines provided in the NJDEP / ODST publication *The Management* *and Regulation of Dredging Activities and Dredged Material in New Jersey's Tidal Waters* (October 1997). To adequately characterize dredged material, the NJDEP / ODST recommends collection of one sample for every 4,000 cy to be dredged in Region 1 (Atlantic coast north of Sandy Hook, NJ) and one sample for every 8,000 cy of material to be dredged in Region 2 (Atlantic coast south of Sandy Hook). With the exception of the Waackaack Creek CDF, located in Region 1, the remaining CDFs considered in this analysis are located in Region 2. For larger CDFs (i.e. Corps Cell D and Ocean City Site # 83) it was assumed that the material could be characterized with fewer samples than recommended in the guidelines.

Using the site plans and volume calculations, a sample location plan was developed to characterize the material that could be removed from the CDFs. For sites where the majority of material is in the containment berms, more cores were collected from the berms than the plateau areas. In addition, two of the sites (Corps Cell D and Waackaack Creek) have more than one cell. The volume contained in each cell was calculated, and the number of cores collected from each cell corresponded to the estimated volume of material present in each cell. In addition, more cores were taken from the area near the weir structure to maximize the likelihood of finding existing contaminated sediments. Fine-grained particles (silt and clay) have a tendency to settle close to the weir structures in CDFs, and hydrophobic contaminants generally have a greater affinity for fine-grained particles.

The final sampling plans were submitted to and approved by the NJDEP / ODST. The sampling plans for all of the CDFs with the volume calculations, site plans and proposed core locations are provided in Appendix A.

2.4 FIELD PROCEDURES

Aqua Survey, Inc. (ASI) collected sediment cores from each CDF. Access to the sites was accomplished by jon boat (Nummy Island), amphibious vehicle (Ocean City Site #83 and Corps Cell D), truck (Waackaack Creek) and on foot (Middle Thorofare). Cores were collected as close as possible to the proposed locations and coordinates of the actual coring locations were recorded using a Trimble DGPS system. At all of the CDFs, sediment cores were collected using a 2-inch split spoon sampler. A tetrapod was placed over the sampling location and a cathead was mounted to the tetropod. This apparatus maneuvered a 140-lb hammer that was used to drive and remove split spoons to the appropriate coring depths. In areas of standing water or moist ground, a slam bar was used to drive in the spoons and a combination of vices and jacks was used to pull them out.

Equipment was decontaminated between each sampling location. Spoons and other equipment that contacted samples were washed with Alconox® and thoroughly rinsed with deionized water.

Samples were kept on ice until analysis.

2.5 SEDIMENT ANALYTICAL PROCEDURES

The sediment cores were delivered to the ASI laboratory for logging and processing. All core samples were photographed, with the exception of those collected from the Nummy Island CDF. Photographs are provided on a compact disc provided with this report.

The physical analysis of the sediment was conducted by ASI and the chemical analysis was performed by American Analytical Laboratories and Environmental Testing Laboratory analytical laboratories. Both laboratories are located in Farmingdale, NY.

- *2.5.1 Physical Analysis*

The sediment cores were visually evaluated for the presence of distinct strata, i.e. layers with distinctly different sediment characteristics. The strata were identified based upon the color, odor, and texture of the sediments. Each stratum greater than two (2) feet in depth within each core was subsampled. If no stratification was evident, the entire core was subsampled. Each subsample was analyzed for percent moisture, total organic carbon (TOC) content and grain size composition (method described by R.L. Folk (1980)). The sediments were classified by grain size as follows:

- Gravel: ≥ 2.00 mm in diameter
- Sand: < 2.00 mm and ≥ 0.0625 mm in diameter
- Silt: < 0.0625 mm and ≥ 0.0039 mm in diameter
- Clay: < 0.039 mm in diameter

Sediment that was greater than or equal to 0.0625 mm (sand and gravel) in diameter was considered course-grained sediment. Sediment that was less than 0.0625 mm (silt and clay) was considered fine-grained sediment. The results of the grain size analyses were used to guide the level of effort for the remaining analytical procedures.

If a strata's grain size composition was determined to be greater than or equal to 90% coarse-grained material (e.g. sand or gravel), no further testing was performed. However, if the grain size composition was less than 90% coarse-grained material, the samples were composited and analyzed for contaminants.

- *2.5.2 Sample Compositing*

Composite samples were prepared for sediments with similar physical properties. For cores with no stratification, the entire core was homogenized and one composite sample was prepared from a maximum of three cores. For cores with distinct strata greater than two feet in depth, the strata were separated. Similar strata from similar depths were composited from a maximum of three cores.

- *2.5.3 Chemical Analysis*

Bulk sediment chemical analysis was performed on each composite sample. Target analytes included semivolatile organic compounds, pesticides, PCBs as Aroclors, and metals as listed in the NJDEP's Soil Cleanup Criteria (PP+40 list) and Appendix A of the NJDEP 1997 Dredging Manual. The samples were analyzed for these compounds due to their potential to accumulate in sediment.

Pesticides, PCBs and metals are well known contaminants due to their potential to accumulate in organisms and/or cause toxicity. Semivolatile organic compounds are a broad class of compounds that have low to moderate vapor pressures and are slightly soluble or insoluble in water. Common semivolatile compounds include phthalates (used in plastics), phenols (used as disinfectants, additives to lubricants, and chemical intermediates), and polycyclic aromatic hydrocarbons (PAHs). PAHs are generally formed from the incomplete combustion of organic matter, such as wood and fossil fuels.

The composite samples were also subjected to the Synthetic Precipitation Leaching Procedure (SPLP) and the leachates were analyzed for the same chemical compounds as the bulk sediment. The purpose of this procedure is to determine whether the chemical contaminants could be mobilized by rainwater.

The results of the chemical analyses were compared against the New Jersey Residential Direct Contact Soil Contact Criteria (NJRDCSCC; last revised 5/12/1999) and the New Jersey Specific Groundwater Quality Criteria (NJSGWQC; last revised 11/07/2005). Bulk sediment results are compared to the NJRDCSCC in order to determine potential placement sites for the material. When dredged material is placed at an upland site, there is potential for human contact with the material. The NJRCSCC are health-based Criteria that reflect concentrations generally considered safe for human contact. Comparison of leachate results to the NJSGWQC are also used to evaluate potential placement sites for dredged material. When dredged material is placed upland, the leachate produced from exposure to rainwater has the potential to migrate to groundwater. The NJSGWQC are health-based criteria for potable water. This means that if a placement site is located over a source of potable water, these criteria are used to determine whether there may be a negative affect to the health of people who drink the water.

The bulk sediment and leachate samples from the Waackaack Creek CDF were tested for dioxin/furan congeners due to a request from the NJDEP / ODST. Dioxins/furans are produced as byproducts of combustion processes, chemical manufacturing and processing, and bleaching. When evaluating the potential for measured concentrations of dioxins/furans to cause adverse biological effects, concentrations of individual congeners are converted to equivalent concentrations of the most toxic congener. These equivalent concentrations are known as Toxicity Equivalents (TEQs).

CHAPTER 3

CHARACTERIZATION OF THE DREDGED MATERIAL IN CONFINED DISPOSAL FACILITIES

The full sediment characterization program was conducted at the five selected New Jersey CDFs: Nummy Island, Middle Thorofare, Ocean City Site #83, Corps Cell D, and Waackaack Creek. Results of the individual characterizations are presented below. A detailed analysis of the sediment data (physical and chemical) is provided in Appendix B.

3.1 NUMMY ISLAND, STONE HARBOR, NJ

The Nummy Island CDF is a 3-acre site located in a salt marsh in the vicinity of Stone Harbor, NJ. The CDF has a 140-foot wide containment berm that is approximately 32 feet above mean sea level (MSL) and the plateau area within the CDF is approximately 20 feet above MSL. This CDF has been used for the placement of dredged material from State and Federal dredging projects from the Intracoastal Waterway, and from dredging projects contracted by the Borough of Stone Harbor.

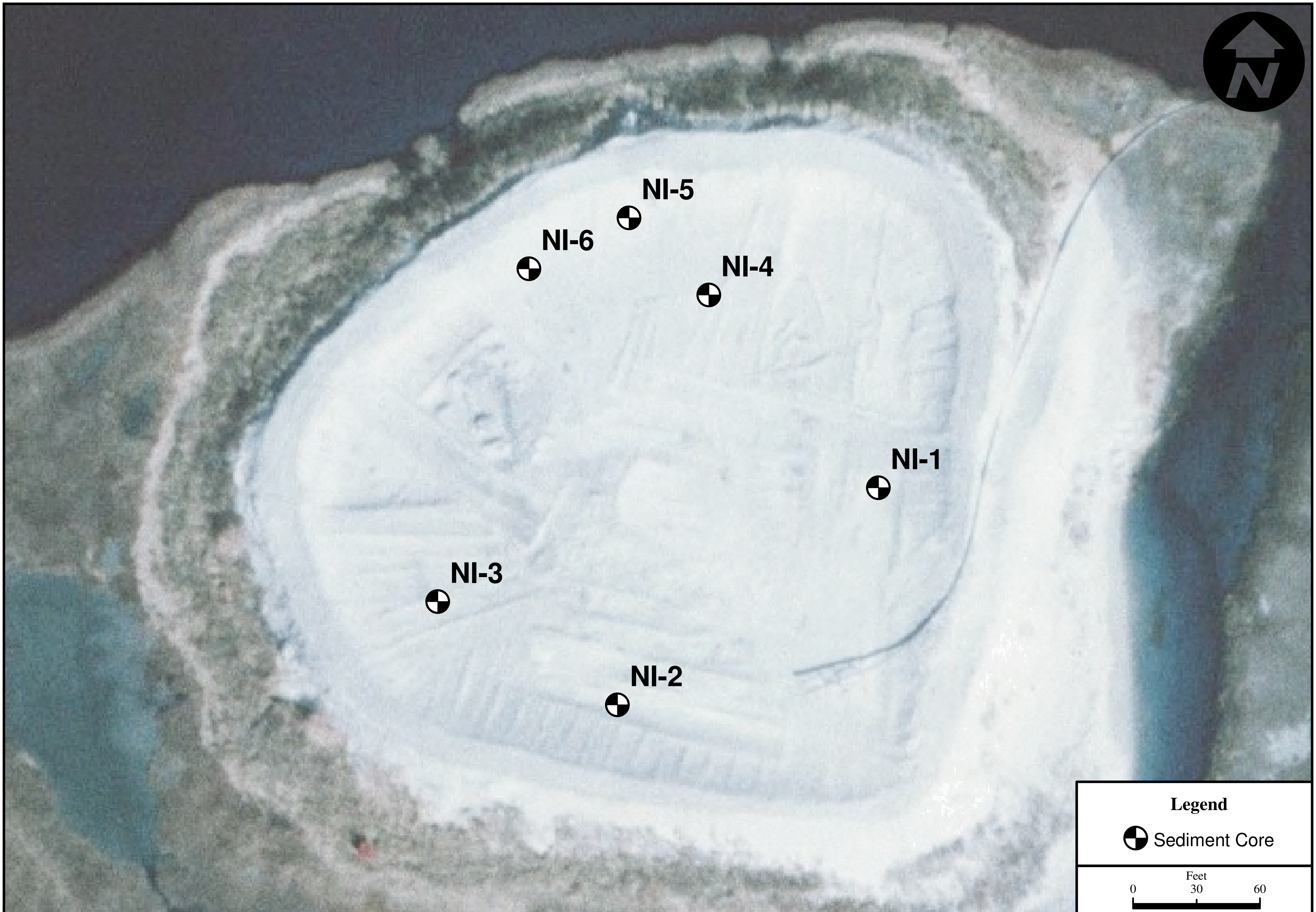
- *3.1.1 File Search Results*

The database search of Federal, State and Local environmental records did not indicate any potential sources of contaminants to sediments in the Nummy Island CDF.

- *3.1.2 Volume Estimates*

The total amount of material reported to be placed in the Nummy Island CDF between 1964 and 2003 was approximately 154,400 cubic yards (cy) (OCC 2005). This volume represents the wet volume of material removed from nearby channels. As the material dries in a CDF it contracts, and we estimated that the CDF contains approximately 90,000 cy of dried dredged material above the 5-foot elevation mark, based on calculations using the most recent survey drawing (Appendix A).

It was estimated that approximately 50,000 cy of material could be removed from the CDF, leaving 40,000 cy to reshape a 20 foot tall containment berm to accommodate future dredging projects. Six cores were collected to characterize the dredged material that could be removed from the CDF. Figure 3-1 depicts the sampling locations at the Nummy Island CDF.



Location of Sediment Cores taken from the Nummy Island CDF in Stone Harbor, NJ

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* *3.1.3 Physical Characteristics*

The Nummy Island CDF contains three distinct layers of dredged material. An eight foot thick top layer of black silt overlies a seven to eight foot deep layer of white sand that overlies a six-to-seven foot deep layer of grey sand.

Figure 3-2 shows grain size composition of the Nummy Island sediment core subsamples. As expected, the top layer (a) of Cores 4, 5, and 6, located near the weir box contained the greatest amount of fine-grained material, with silt and clay comprising 88% to 92% of the material. Cores 1, 2 and 3 were located farther away from the weir and the percent of silt and clay particles in the top layer of these cores ranged from 30% to 72%, with the greatest amount of fine-grained material in Core 3. The sample locations and the percent of coarse material found in each sample are provided in Figure 3-3.

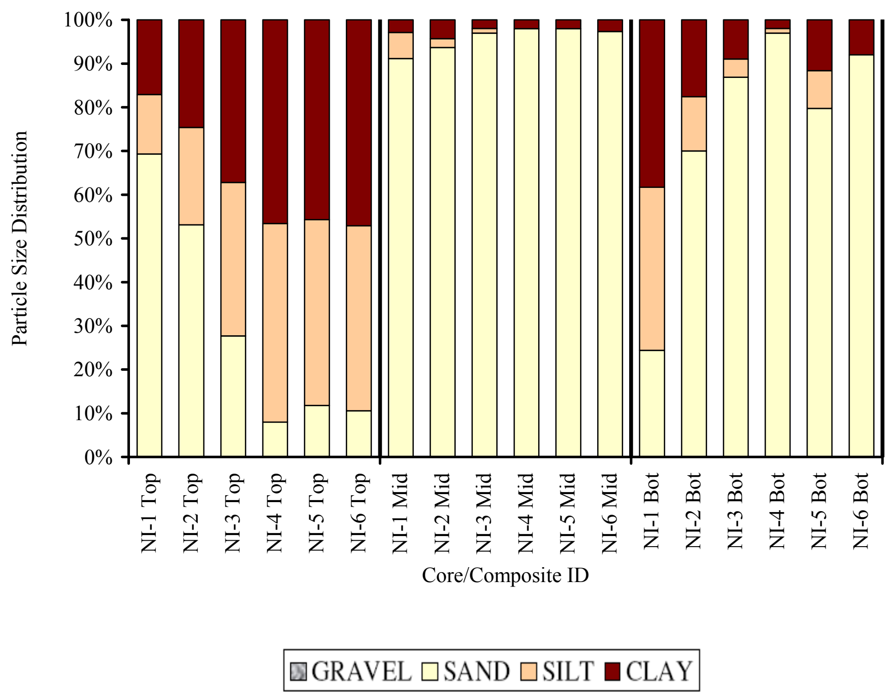
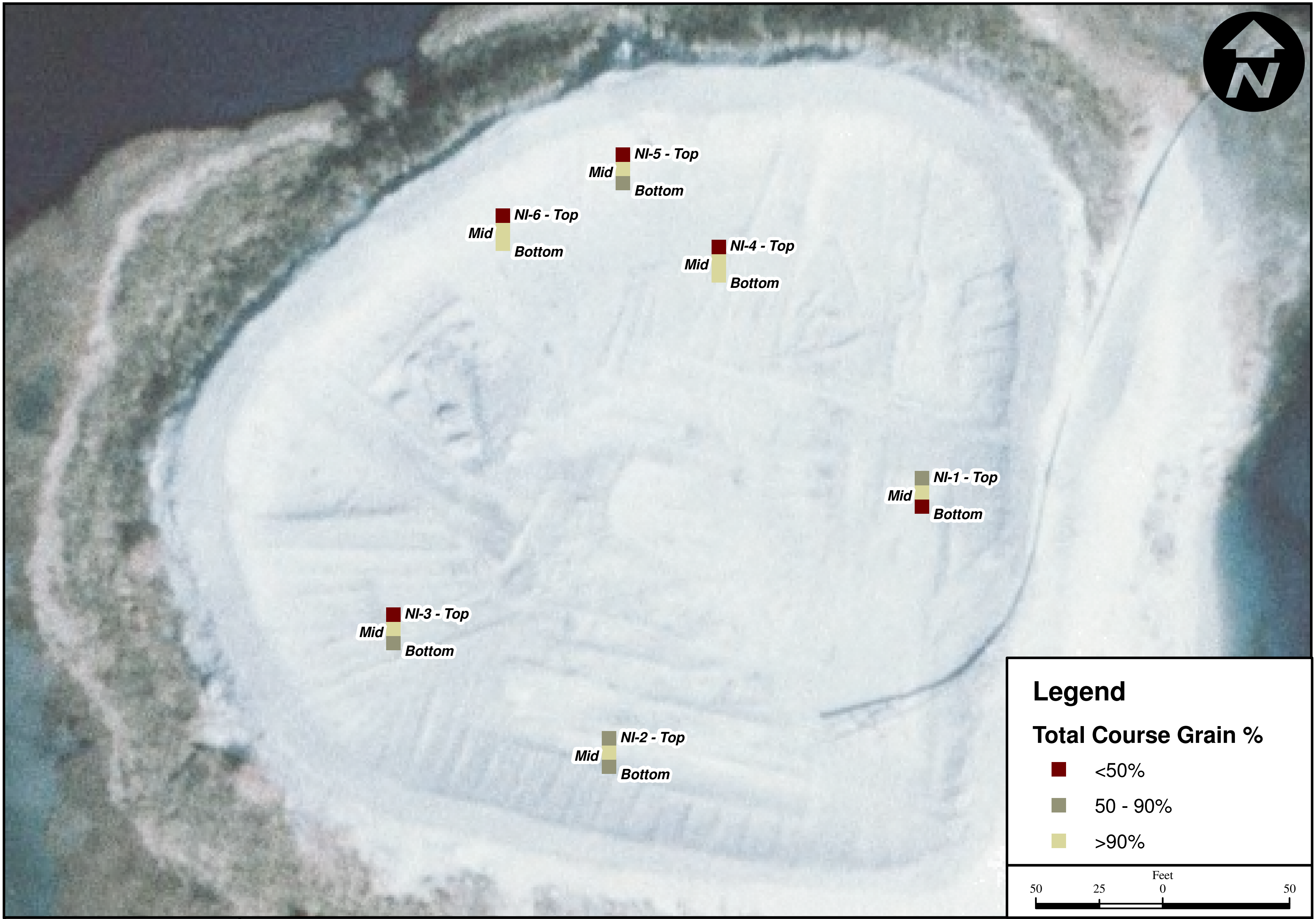


Figure 3-2. Grain size composition of the sediment cores collected from the Nummy Island CDF.

The middle layer (b) of all collected cores had sand content ranging from 91% to 98%. The grain size composition of the bottom layer (c) of the cores varied, but with the exception of Core 1, the subsamples had sand content greater than 50%. The difference



HDR | LMS	Percent Coarse Grained Materials Taken from each Sample in the Nummy Island CDF in Stone Harbor, NJ.	Job No.	Date	Figure No.
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in the grain size composition of the bottom section of Core 1 compared to the other cores is likely due to inclusion of peat moss from the underlying marsh in the subsample.

Both the percent moisture and TOC content were highest in the fine-grained sediments from the top layer of the CDF, and lowest in the sandy sediment. The percent moisture ranged from 5% to 53%, and the TOC content ranged from less than one-tenth of a percent to 5% in the subsamples.

The nine subsamples that contained less than 90% sand and gravel were combined to form three composite samples. Material from the top layers of Cores 4, 5, and 6 formed Composite A – Top (A layer), material from the top layers of Cores 1, 2, and 3 formed Composite B – Top (A layer), and the bottom layers of cores 4, 5, and 6 formed the third sample, Composite A - Bottom (C layer). Physical characteristics of the composite samples were not determined.

- *3.1.4 Chemical Characteristics*

The composite sediment samples were analyzed for pesticides, PCBs, semivolatile compounds and metals. None of the samples had concentrations of analytes above the NJRDCSCC. Generally, all were below the Criteria by an order of magnitude. However, traces of some of the target analytes were detected in the samples. Products of plastic (phthalates) and petroleum (PAHs) were present in low levels. Traces of metals were detected in all three composite samples. For the compounds that were detected, concentrations were generally higher in Composite A-Top (top layer of Cores 4, 5 and 6), followed by Composite B-Top (top layer of Cores 1, 2, and 3) and Composite A-Bottom (bottom layer of Cores 4, 5 and 6).

In the leachate produced from exposure of the composite samples to artificial rainwater, bis(2-Ethyltexyl)phthalate was the only organic compound detected. However, this may be the result of laboratory contamination. Bis(2-Ethyltexyl)phthalate is a very common compound that is produced during plastics manufacture. The compound was present in the sediment samples at very low levels when compared to the NJRDCSCC. And, the compound was also detected in the analytical blank. It is widely recognized as a common laboratory contaminant (USEPA 1970). Metals were detected in the leachate from all three sediment composites. Concentrations of five metals in the leachate samples exceeded the NJSGWQC. The metals that exceeded NJSGWQC and the composites from which the corresponding samples originated include: manganese and selenium in all three composite samples, aluminum in Composites A-Bottom and B-Top, sodium in Composites A-Top and B-Top and iron in Composite A-Bottom.

A detailed discussion of the chemical and physical analyses for the samples collected from the Nummy Island CDF is provided in Appendix B.

3.2 MIDDLE THOROFARE, CAPE MAY, NJ

The Middle Thorofare CDF is located in close proximity to Cape May Harbor and is approximately two acres in area. The CDF is bordered by marsh to the north, Upper Thorofare River to the west, Ocean Drive to south, and Backwater Lagoon to the east. This CDF is privately operated and is road accessible. The containment berm is approximately 20 feet above MSL at the highest point, which is 11 feet above the road elevation and 15 feet above the marsh elevation. The height of the material in the plateau area is estimated to be 15 feet above MSL (6 feet above the road and 10 feet above the marsh).

- ### *3.2.1 File Search Results*

The database search revealed several potential sources of contaminants to the Middle Thorofare CDF. Spills and discharges to the waters in the vicinity of the CDF may result in contamination of the sediments, which may be dredged and placed into the CDF. Reported spills in the Middle Thorofare River include diesel fuel (approximately 50 gallons) and an oil-like substance (between 20 and 70 gallons). Unknown sheens were also reported in the river in July and August of 1996.

Reported spills in Cape May Bay/ Cape May Harbor include approximately five gallons of hydraulic oil and 300 gallons of soybean oil, respectively. A seafood processing facility, located between 1/8-1/4 mile from the CDF, discharges arsenic to receiving waters (water body not specified in the report) and several violations were recorded during the NJDEP Safe Drinking Water inspections conducted in 2000 and 2005. This facility has also been cited for discharging seafood processing waste to receiving waters and has received administrative violations as a small quantity hazardous waste generator. Reports were also filed for Backwater Lagoon, located between 1/4-1/2 mile of the CDF, regarding an oil spill (unknown quantity) in 1996 and an unknown cause of dead bait fish in 1994. Finally, three permitted stormwater discharges were found within ½ mile of the CDF, discharging into Backwater Lagoon, Mill Creek and Cape May Harbor.

Groundwater can transport contaminants from upland areas to surface waters, which can potentially affect sediment quality in the vicinity of the CDF. Four spills were reported within 1/8-1/4 mile of the CDF. These spills included an unknown quantity of oil from a leaking underground storage tank, approximately 9,000 gallons of oil from a broken pipe, an unspecified amount of unknown petroleum from above-ground storage tank leakage/overfill, and approximately five gallons of hydraulic oil from a broken truck hose.

While these spills and/or discharges represent potential sources of contamination to the Middle Thorofare CDF through dredging of affected sediments, the actual fate of the contaminants after entry into the water is unknown.

- *3.2.2 Volume Estimates*

The Middle Thorofare CDF contains approximately 39,500 cy of dredged material. It was estimated that approximately 35,000 cy of material can be removed from the Middle Thorofare CDF, leaving 4,400 cy to recontour the containment berm. The locations sampled at the Middle Thorofare CDF are shown in Figure 3-4.

- *3.2.3 Physical Characteristics*

Figure 3-5 shows the grain size composition of the Middle Thorofare sediment core subsamples. The three collected cores did not have any sediment stratification and each core was homogenized over the entire length. Core 1 was collected from the plateau area near the weir. The sediment composition in this area was dominated by black silt and clay (80%) with some sand (20%). Core 2 was collected from the plateau in the approximate center of the CDF. This core had greater sand content (60%) and approximately half of the silt and clay of Core 1. Core 3 was collected in the berm area on the north side of the CDF. Sediment composition at this location was primarily brown sand and gravel (95%), with little silt and clay (5%). The sample locations and the percent of coarse material found in each sample are provided in Figure 3-6.

Percent moisture and TOC content of the sediment samples correlated with the amount of silt and clay. Moisture and TOC content was greatest in Core 1 and least in Core 3. Percent moisture in the individual cores ranged from 4.1% to 44.5% and TOC content ranged from 0.29% to 3.1%.

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Location of Sediment Cores taken from the Middle Thorofare CDF in Cape May, NJ

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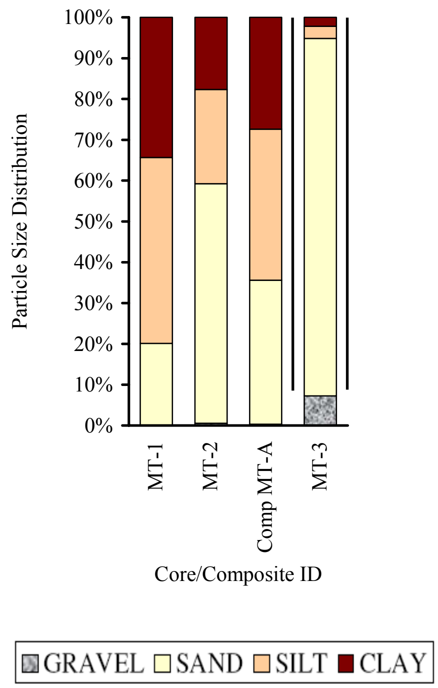

Figure 3-5. Grain size composition of the sediment cores collected from the Middle Thorofare CDF.

The material in Core 3 was comprised of more than 90% sand and gravel, and did not require further testing, based on the NJDEP guidance document (NJDEP 1997). Composite MT-A was comprised of sediment from Cores 1 and 2 and had grain size composition of 36% sand and 64% silt and clay (Figure 3-5). Composite MT-A had similar percent moisture and TOC content to Cores 1 and 2.

- *3.2.4 Chemical Characteristics*

Composite MT-A was analyzed for semivolatile compounds, pesticides, PCBs and metals. None of the analytes had concentrations above the NJRDCSCC. However, traces of organic compounds and metals were detected in the sample. Phthalates, some PAHs and 4,4'-DDE were the only organic compounds detected in the composite sediment sample. Low levels of almost all of the metals for which analyses were conducted were detected in the composite sample.

The leachate produced from exposure of composite MT-A to artificial rainwater did not have detectable concentrations of organic compounds. However, metals were detected in the leachate sample. Concentrations of four metals exceeded the NJSGWQC (last

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Percent Coarse Grained Materials Taken from each Sample in the Middle Thorofare CDF in Keansburg, NJ

Job No.	Date	Figure No.
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revised 11/07/2005). The metals that exceeded the NJSGWQC in the leachate samples include: antimony, arsenic, manganese and sodium.

A detailed discussion of the chemical and physical analyses for the samples collected from the Middle Thorofare CDF is provided in Appendix B.

3.3 OCEAN CITY SITE #83, OCEAN CITY, NJ

The Ocean City Site #83 (32nd Street) CDF has an area of approximately five acres and is one of several CDFs in the Ocean City area. The Site #83 CDF is bordered by Peck Bay to the north and west, Clubhouse Lagoon to the north and tidal marsh to the south. This CDF has a containment berm that is approximately 20 feet above MSL (16 feet above the marsh) at its highest point and the plateau area is approximately 18 feet above MSL (14 feet above the marsh). Like other CDFs in the Ocean City area, Site #83 is near capacity, constraining dredging in both private channels and the Intracoastal Waterway.

- *3.3.1 File Search Results*

The database search of Federal, State and Local environmental records did not indicate any potential sources of contaminants to sediments in the Ocean City Site #83 CDF.

- *3.3.2 Volume Estimates*

The CDF contains approximately 395,000 cy of dredged material. It was estimated that approximately 375,000 cy could be removed from the CDF, leaving approximately 20,000 cy of material to be recontoured to accommodate future dredging projects. The majority of sediment in the Ocean City CDF is contained in the plateau area. Nineteen cores were collected to characterize material in the plateau and five cores were collected to characterize the material in the berm. Sampling locations are depicted in Figure 3-7.

- *3.3.3 Physical Characteristics*

All cores collected from the Ocean City Site #83 CDF were predominantly comprised of black silt and clay. With the exception of Cores 16 and 24, all collected cores were approximately 8 feet in length and no stratification was evident. Cores 16 and 24 were approximately 14 feet in length and were also comprised primarily of black silt and clay with no stratification evident throughout.

HDR | LMS

Location of Sediment Cores taken from the Ocean City Site #83 CDF in Ocean City, NJ

Job No.	Date	Figure No.
0904-007	06/05/06	3-7

The sediment composition was greater than 95% silt and clay in of all of the collected cores except Cores 6, 16, 17 and 19 (Figure 3-8). Silt and clay content ranged from 71% to 92% in these cores. These cores are randomly distributed throughout the CDF, suggesting that there are no large areas with predominantly sandy material. Overall, the CDF appears to be filled with fine-grained material. The sample locations and the percent of coarse material found in each sample are provided in Figure 3-9.

Total organic carbon content was relatively high in all of the collected cores, ranging from 2.61% to 4.76%. Moisture content was between 42% and 57% in all collected cores.

Eight composites were formed from the collected cores (Composites OC-A through OC-H).

- *3.3.4 Chemical Characteristics*

The eight composite sediment samples were analyzed for semivolatile compounds, pesticides, PCBs and metals. For all analytes, measured concentrations did not exceed the NJRDCSCC. However, trace concentrations of Phthalates and PAHs were detected in all of the composite samples, and Phenolic compounds were detected in three composites. A trace concentration of 4,4'-DDT was measured in one composite and trace levels of alpha- and gamma-chlordane were measured in another. No other semivolatiles, pesticides or PCBs were detected in the composite samples. Almost all of the metals for which analyses were conducted were detected in the composite samples.

No semivolatile compounds, pesticides or PCBs were detected in the leachate produced from exposure of the composite sample to artificial rainwater. Metals were detected in all of the leachate samples. Concentrations of six metals exceeded the NJSGWQC in one or more leachate samples. Aluminum and sodium concentrations exceeded the Criteria in all of the leachate samples. Arsenic and Iron concentrations exceeded the Criteria in 7 of the 8 leachate samples. Selenium concentrations exceeded the Criteria in five of the leachate samples and manganese concentrations exceeded the standard in leachate from two of the composite samples.

A detailed discussion of the chemical and physical analyses for the samples collected from the Ocean City Site #83 is provided in Appendix B.

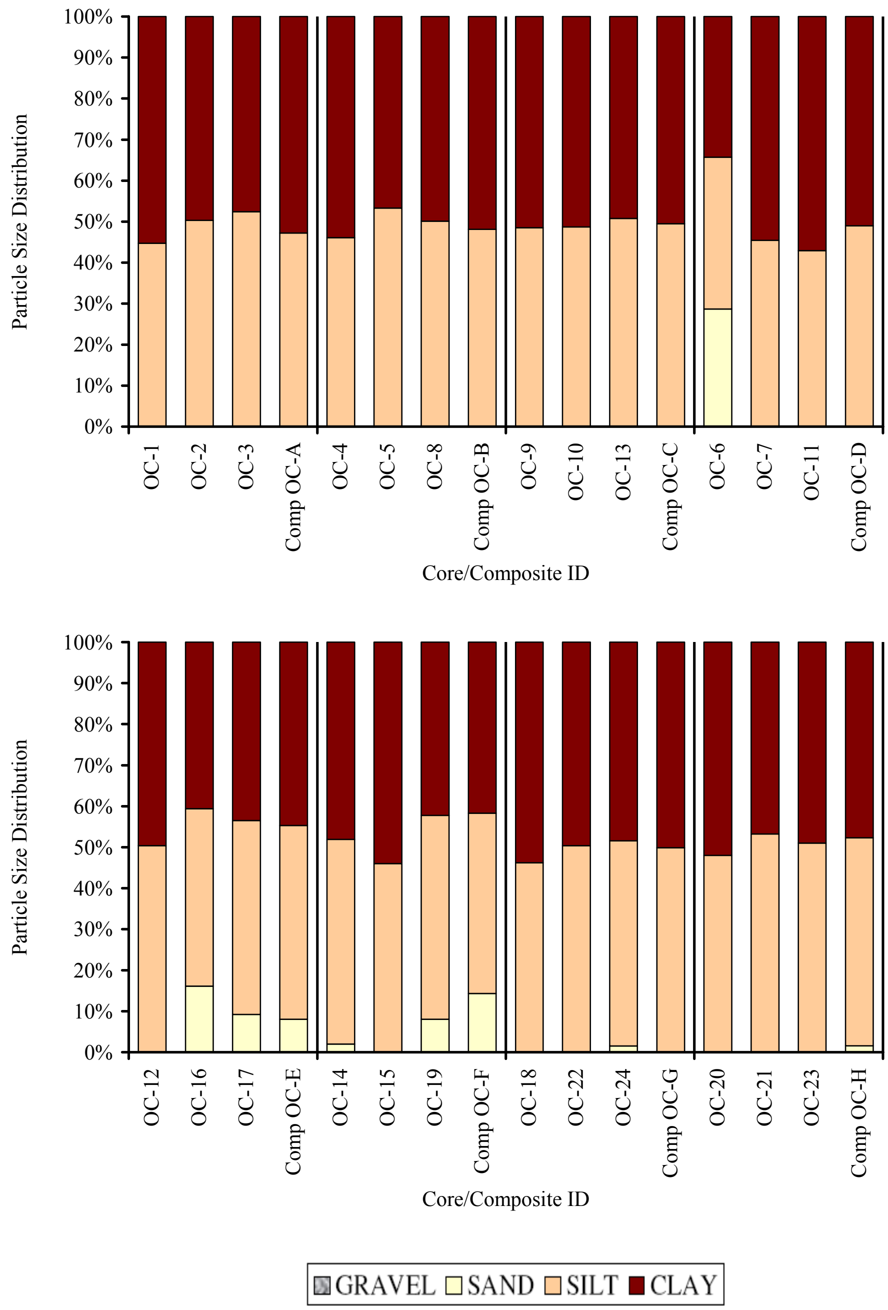
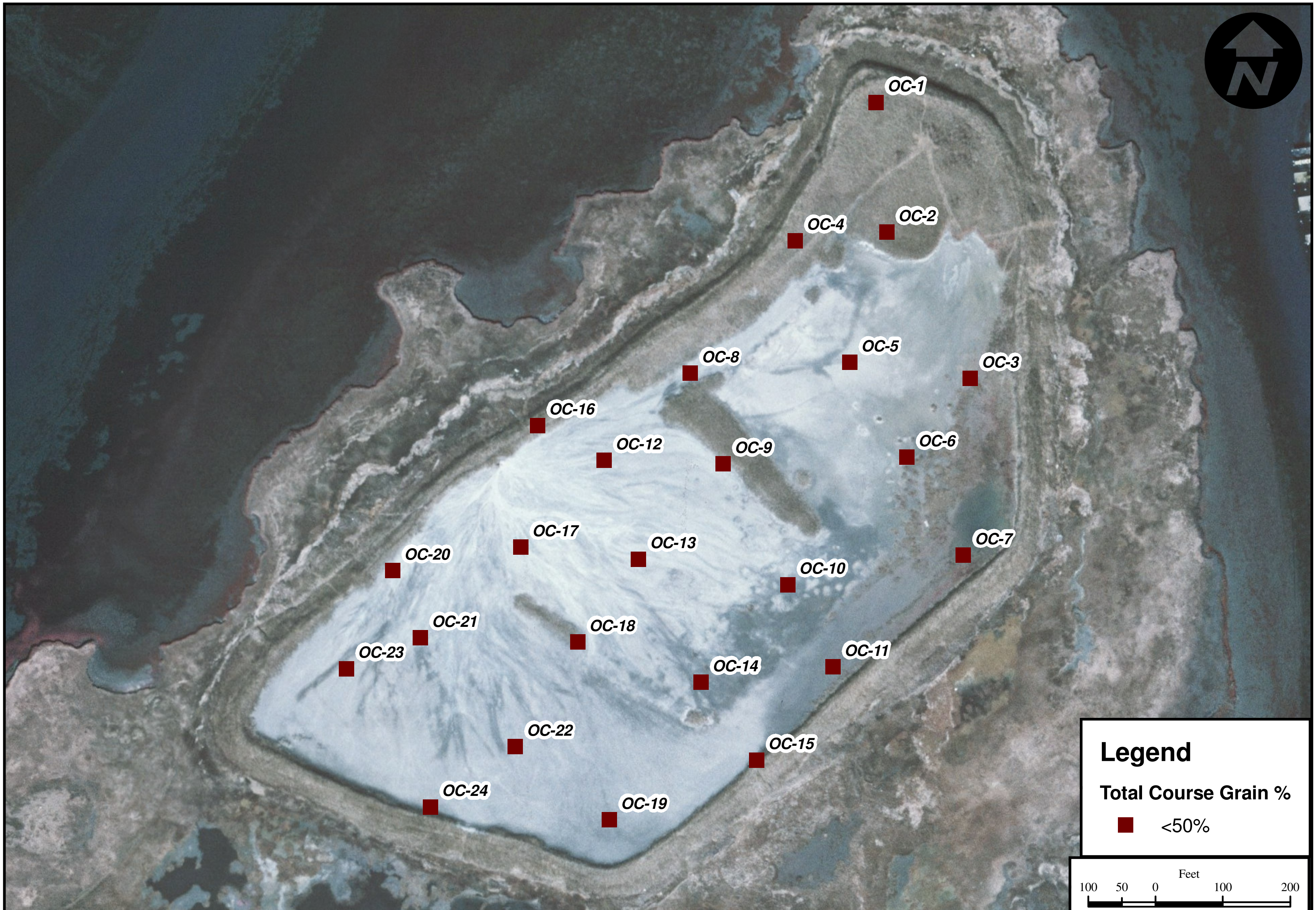


Figure 3-8. Grain size composition of the sediment cores collected from the Ocean City Site #83 CDF



Percent Coarse Grained Materials Taken from each Sample in the Ocean City Site #83 CDF

Job No.	Date	Figure No.
0904-007	06/05/06	3-9

3.4 CORPS CELL D, CAPE MAY, NJ

The Cape May Corps Cell D is a large CDF operated by the U.S. Army Corps of Engineers Philadelphia District. This CDF is located along the Cape May Canal (Intracoastal Waterway), directly opposite of the Cape May Ferry Terminal, and is bordered by upland areas on the remaining three sides. This CDF has two distinct cells, east and west. The western cell has a maximum berm height of approximately 35 feet above MSL (30 feet above ground elevation) and an average plateau height of approximately 29 feet above MSL (24 feet above ground elevation). The eastern cell has a maximum berm height of approximately 29 feet above MSL (24 feet above ground elevation) and an average plateau height of 19 feet above MSL (14 feet above ground elevation).

- ### *3.4.1 File Search Results*

There were no reported spills or releases in the vicinity of the Cape May Corps Cell D that could have affected the concentrations of contaminants in the stored sediment. Two spills were reported in the vicinity of the CDF, including an unknown hazardous material and approximately 15 cans of abandoned paint. However, these spills occurred at the Higbee Beach Complex and were not in or directly adjacent to navigation channels.

- ### *3.4.2 Volume Estimates*

The estimated volume of dredged material in the entire CDF is 969,500 cy, with three-fourths of the material located in the western cell. Approximately 856,000 cy of material could be removed, leaving sufficient material to recontour the berms to accommodate future dredging projects.

A total of 54 sediment cores were collected from the Corps Cell D CDF. Thirty-eight cores were collected from the western cell and 16 cores were collected from the eastern cell. The sampling locations are shown in Figure 3-10.

- ### *3.4.3 Physical Characteristics*

Figure 3-11 shows the grain size composition of the Corps Cell D sediment core subsamples. In general, the CDF has been used to dewater the material from several dredging projects resulting in a CDF containing material that varies in physical characteristics. Overall, these cores did not have distinct stratification, but stratification was evident in some areas, particularly when the samples were located on a berm. The

HDR | LMS

Location of Sediment Cores taken from the Cape May Corps Cell D CDF in Cape May, NJ

Job No.	Date	Figure No.
0904-007	06/05/06	3-10

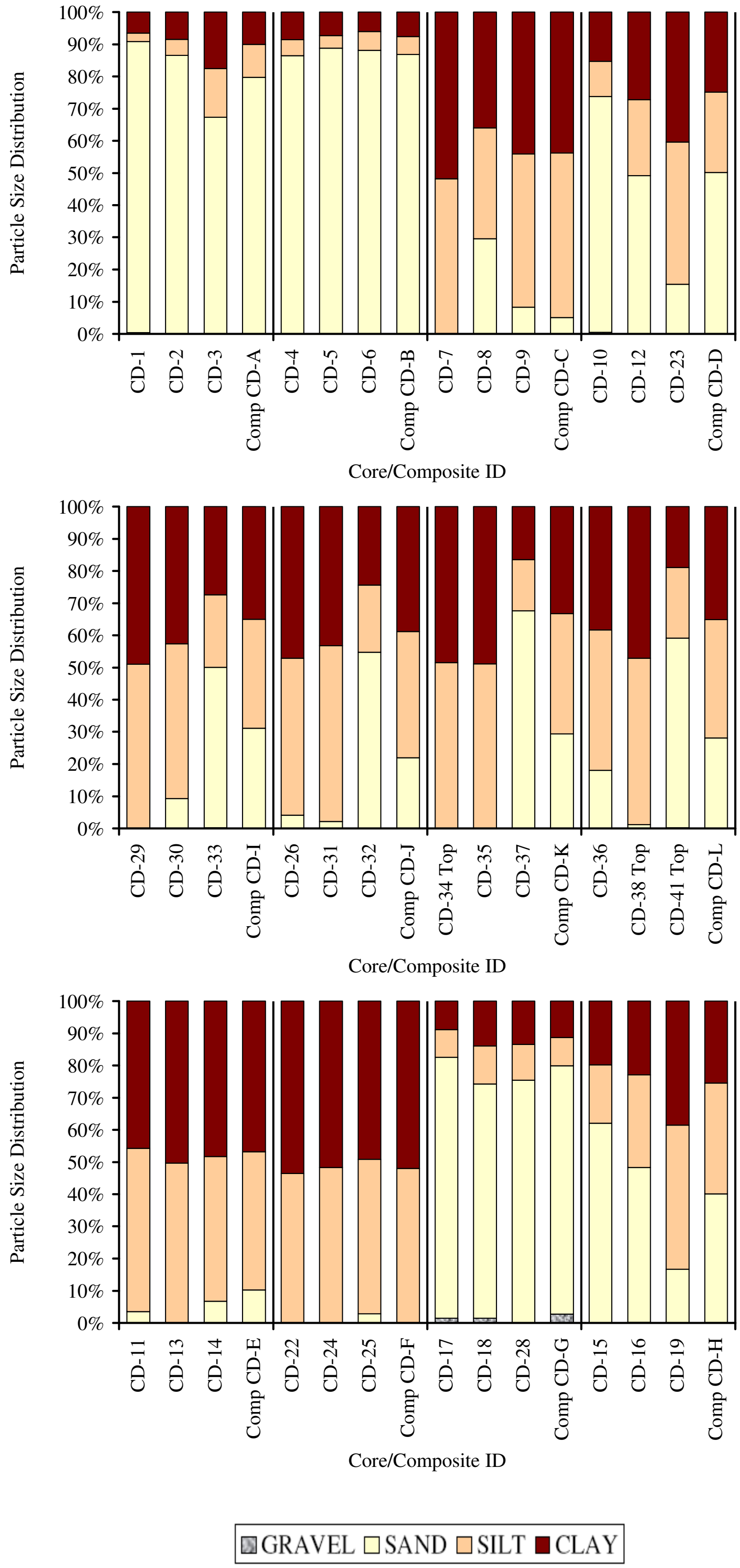


Figure 3-11. Grain size composition of the sediment cores collected from the Corps Cell D CDF.

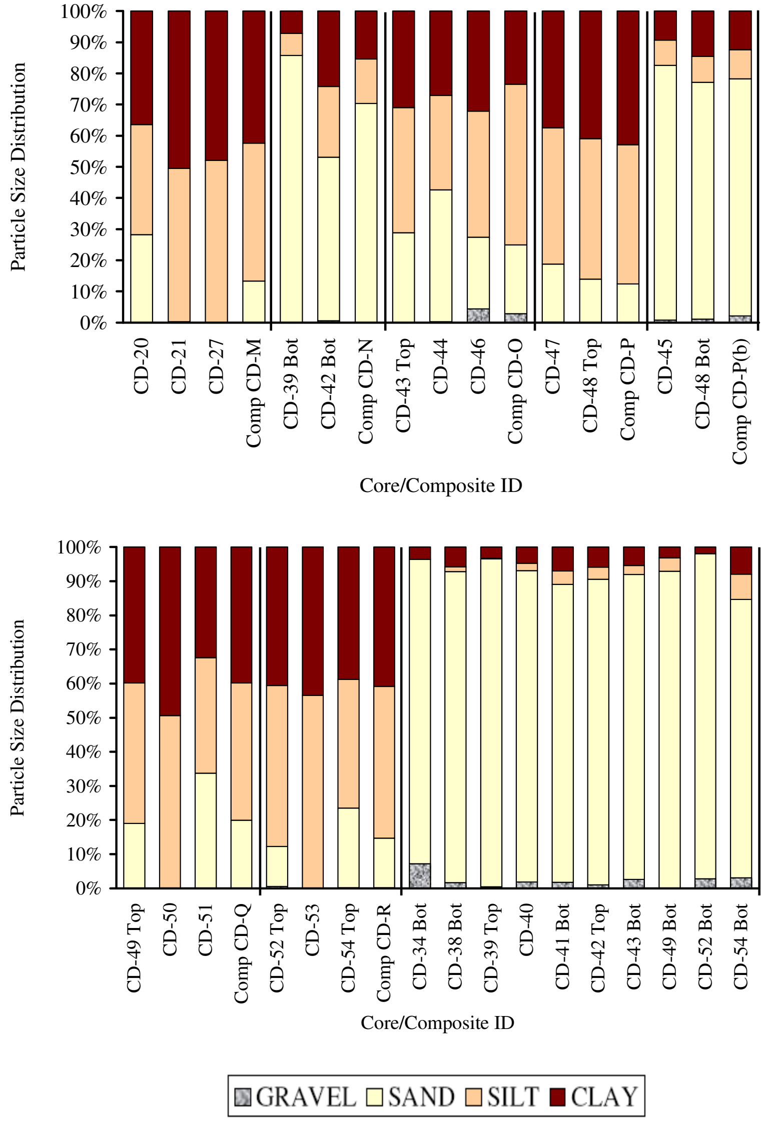


Figure 3-11 Continued. Grain size composition of the sediment cores collected from the Corps Cell D CDF.

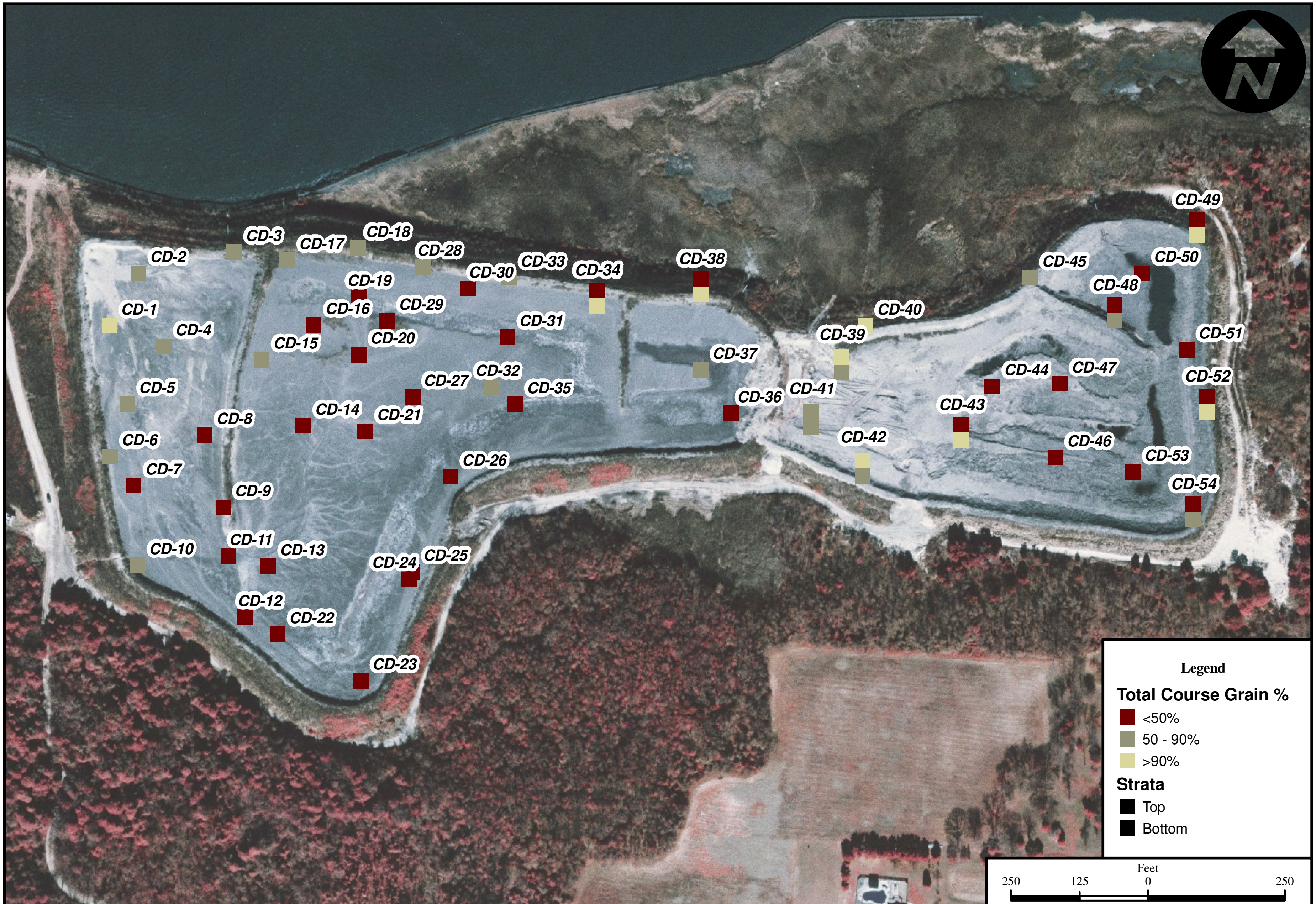
sample locations and the percent of coarse material found in each sample are provided in Figure 3-12.

Sediment cores collected from the far western corner of the CDF were comprised primarily of sand and gravel, with the total amount of coarse-grained material ranging from 67% to 91%. Many of the cores collected from the berm portion of the western cell were also dominated by coarse-grained sediment (74%-83%). The majority of cores collected from the interior of the western cell were dominated by silt and clay. Two of the cores (34 and 38) that were collected from the western cell near the junction of the eastern and western cells were stratified. These cores had an eight to twelve foot deep layer of silt and clay (99-100% fine-grained material) overlying a nine to twelve foot deep layer of sand (93-98% coarse-grained material).

Sixteen cores were collected from the eastern side of the CDF and approximately half of these cores had distinct sediment stratification. Three of the stratified cores were collected from the berm on the eastern edge of the CDF. These cores (49, 52 and 54) had an eight to twelve foot thick layer of silt and clay (77-88% fine-grained material) over an eight to twelve foot thick layer of sand and gravel (85-98% course-grained material). Similar stratification and sediment composition was found in two cores (43 and 48) collected from the interior of the eastern portion of the CDF. Cores collected from the portion of the eastern cell near the junction with the western cell were also stratified. The two cores collected form the northern berm of the eastern cell (Cores 40 and 45) were not stratified and were predominantly comprised of sand (83-93% course-grained material). Cores collected from the eastern interior of the eastern cell were not stratified and were dominated by silt and clay (66-100%).

For both the eastern and western cells, TOC and moisture content correlated with the grain size composition of the sediment samples, samples with a greater percentage of fine-grained material had higher TOC and moisture content. For all collected cores, the percent moisture ranged from 6% to 69% and percent TOC ranged from 0.05% to 5.3%.

A total of 19 composite samples were formed from the 54 cores collected at Corps Cell D (CD-A through CD-R). Thirteen composite samples were formed from cores collected in the western cell. In general, these composites had similar grain size composition and TOC content as their component cores (Figure 3-11). Six composite samples were



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Percent Coarse Grained Materials Taken from each Sample in the Corps Cell D CDF

Job No.	Date	Figure No.
0904-007	06/05/06	3-12

formed from cores collected in the eastern cell. Entire cores or portions of cores with greater than 90% sand and gravel content were not included in the composites.

- *3.4.4 Chemical Characteristics*

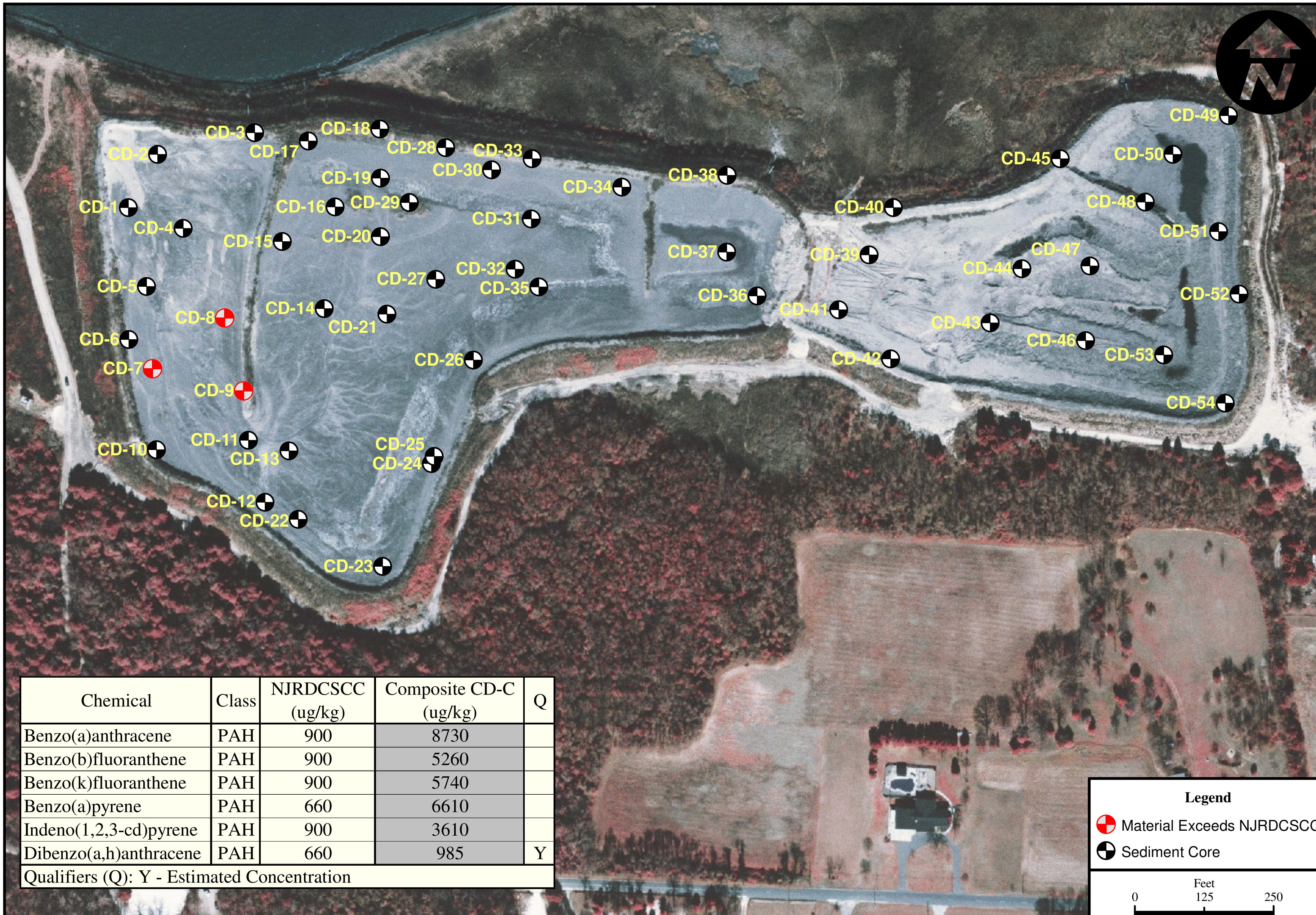
The 19 composite sediment samples and two individual core sections that had less than 90% sand content (bottom sections (b) of Cores 41 and 54) were analyzed for semivolatile compounds, pesticides, PCBs and metals. No pesticides or PCBs were detected in any of the sediment samples. Phthalates and PAHs were detected in all of the composite samples and phenolic compounds were detected in eight of the composite samples.

The semivolatile compounds carbazole and dibenzofuran were detected in two of the composites. Metals were detected in all of the composite samples. With the exception of one composite samples, the concentration of targeted analytes were below the NJRDCSCC.

In one composite from materials in the western portion of the western cell (Cores 7, 8 and 9), concentrations of six PAHs far exceeded the NJRDCSCC (Figure 3-13). Concentrations of five of these PAHs also far exceeded the Non-Residential Direct Contact Soil Cleanup Criteria (NJNRDCSCC; last revised 5/12/99). There would be restrictions placed upon the use of this material. Additional sampling and analytical testing will be required to determine the extent of the contamination. A sampling program should be designed to delineate the aerial extent and depth of the material that exceeds the NJRDCSCC and this material should be removed and sent to a NJDEP approved facility for remediation and/or disposal.

No semivolatile compounds, pesticides or PCBs were detected in any of the leachate samples. Metals were detected in all of the leachate samples. Concentrations of six metals exceeded the NJSGWQC in one or more leachate samples. The criteria for the following metals were exceeded: sodium, arsenic, aluminum, selenium, iron and manganese.

A detailed discussion of the chemical and physical analyses for the samples collected from the Corps Cell D CDF is provided in Appendix B.



Chemical	Class	NJRDCSCC (ug/kg)	Composite CD-C (ug/kg)	Q
Benzo(a)anthracene	PAH	900	8730	
Benzo(b)fluoranthene	PAH	900	5260	
Benzo(k)fluoranthene	PAH	900	5740	
Benzo(a)pyrene	PAH	660	6610	
Indeno(1,2,3-cd)pyrene	PAH	900	3610	
Dibenzo(a,h)anthracene	PAH	660	985	Y
Qualifiers (Q): Y - Estimated Concentration				

HDR | LMS

Location of the composite materials exceeding the New Jersey Residential Direct Contact Soil Cleanup Criteria and the measured chemical concentrations in Corps Cell D, Cape May, NJ

Job No.	Date	Figure No.
0904-007	06/05/06	3-13

3.5 WAACKAACK CREEK, KEANSBURG, NJ

The Waackaack Creek CDF is a small disposal area located in Keansburg, NJ. This CDF is bordered by Raritan Bay, Waackaack Creek, and residential development. There are three disposal areas in the Waackaack Creek CDF. The average height of areas “A” and “B” is 18 feet above MSL (nine feet above the existing vegetation line) and the average height of area “C” is 21 feet above MSL (12 feet above the existing vegetation line). This CDF does not have a containment berm but there is an existing flood control dune. If material was only excavated from the plateau areas of the CDF, the remaining material could be used to maintain the flood control dune and establish a containment berm.

- *3.5.1 File Search Results*

The database search revealed a few potential sources of contaminants to the Waackaack Creek CDF through spills and discharges to adjacent waters. Two releases from underground storage tanks (USTs) were documented at two marinas between 1/8-1/4 miles from the CDF. These reports indicated leakage from a 4,000 gallon gasoline tank in 1991 and an unspecified release from another UST in 2002. Three reported spills of an unspecified amount of unspecified material occurred in the vicinity of the CDF, one in Waackaack Creek (1998) and one in each of the aforementioned marinas, in 1991 and 2004. In addition to the reported spills, both marinas have permitted stormwater discharges.

Two gas stations, located between 1/8-1/4 mile from the Waackaack Creek CDF, had leaking underground gasoline storage tanks. At least one set of tanks contained leaded gasoline. Both gas stations had the tanks removed in 1992. There is the potential for the gasoline to have migrated to Waackaack Creek via groundwater transport, but the ultimate fate of any resulting contaminants is unknown.

- *3.5.2 Volume Estimates*

The estimated volume of dredged material in the Waackaack Creek CDF is 132,000 cy. Approximately 47,000 cy of material could be removed from the Waackaack Creek CDF. The remaining 85,000 cy of material would be contoured to reestablish the flood control dune and establish a containment berm for future dredging projects. Twelve cores were collected from the Waackaack Creek CDF to characterize the material. The locations of the collected cores are shown in Figure 3-14.

HDR | LMS

Location of Sediment Cores taken from the Waackaack Creek CDF in Keansburg, NJ

Job No.	Date	Figure No.
0904-007	06/05/06	3-14

- *3.5.3 Physical Characteristics*

The majority of material stored in the Waackaack Creek CDF is sand with some gravel content. The western portion of the CDF is an approximately 5-foot deep mound of brown sand. The percent sand content in this area ranges from 84% to 98%. The grain size composition of the sediment samples is depicted in Figure 3-15. Grain size analysis showed that the sediment in these cores had a total percent silt and clay less than or equal to 4%, with total percent sand and gravel greater than 96%. Moisture and TOC content were very low in these sediment samples.

The eastern portion of the CDF is deeper, with depths ranging from 10- to 19-feet of dredged material. Sand content in the eastern portion of the CDF ranges from 82% to 95%. There was no apparent stratification of materials throughout most of the CDF, with the exception of the two easternmost cores (Cores 11 and 12). These cores had two distinct layers; the top layer is about 5-feet and consists of brown sand. The bottom layer is approximately 8- to 10-feet deep and it consists of black silt with sand. There was a one to two foot deep layer of brown sand with peat at the bottom of the core. Grain size analysis showed that the top portions of the cores were comprised primarily of sand (93-97% coarse-grained sediment), with low moisture and TOC. The sediment from the bottom portions of the cores was primarily comprised of silt and clay (39-55% fine-grained material), with moisture content ranging from 30% to 40% and TOC content ranging from 2.7% to 3.1%. The location of the sediment samples with the percent coarse-grained materials is depicted in Figure 3-16.

Composite WK-D was formed from the bottom portions of Cores 11 and 12. Only one composite sample was formed, since all other cores or core sections were comprised of greater than 90% sand. Composite WK-D had silt, clay and sand content intermediate between those measured in the bottom portions of Cores 11 and 12, but had greater gravel content (7% compared to 1-2%) (Figure 3-15). The composite sample also had intermediate percent moisture and TOC content relative to the bottom portions of Cores 11 and 12.

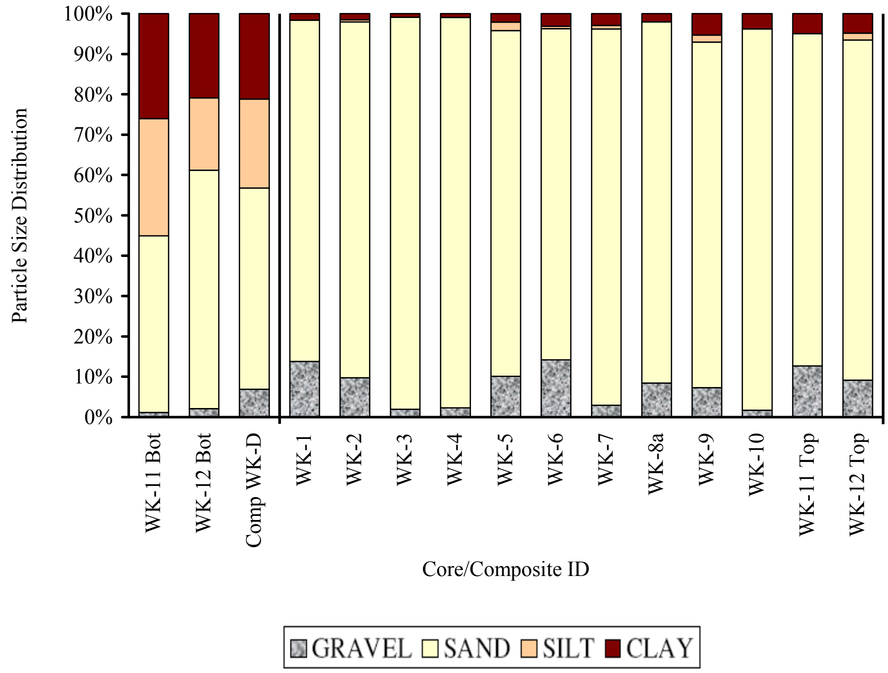


Figure 3-15. Grain size composition of the sediment cores collected from the Waackaack Creek CDF

- *3.5.4 Chemical Characteristics*

Composite WK-D was analyzed for semivolatile compounds, pesticides, PCBs, metals, and dioxin/furan congeners. None of the detected analytes had concentrations above the NJRDCSCC, except for arsenic which was measured at 20.10 mg/kg, slightly exceeding the criterion of 20 mg/kg. The location of the samples that had arsenic concentrations that exceeded the NJRDCSCC are provided in Figure 3-17. However, trace levels of one Phthalate and some PAHs were detected in the sediment sample. No pesticides or PCBs were detected. Almost all of the metals for which analyses were conducted were detected in the composite sample. Dioxin/furan congeners were detected in the composite sample, but the total TEQ value was very low, only 3.1 ng/kg (parts-per-trillion).

No pesticides, PCBs or semivolatile compounds were detected in the leachate produced from exposure of the composite sample to artificial rainwater. However, metals and dioxin/furan congeners were detected in the leachate. Concentrations of four metals (iron, lead, manganese and sodium) in the leachate samples exceeded the NJSGWQC. The total TEQ for dioxin/furan congeners in the leachate sample was 0.012 ng/L which slightly exceeds the NJSGWQC of 0.01 ng/L.

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Percent Coarse Grained Materials Taken from each Sample in the Waackaack Creek CDF in Keansburg, NJ

Job No.	Date	Figure No.
0904-007	06/05/06	3-16

Chemical	Class	NJRDCSCC (mg/kg)	Composite WC-D (mg/kg)
Arsenic	Metal	20	20.1

HDR | LMS

Location of the composite materials exceeding the New Jersey Residential Direct Contact Soil Cleanup Criteria and the measured chemical concentrations at Waackaack Creek CDF in Keansburg, NJ

Job No.	Date	Figure No.
0904-007	06/05/06	3-17

CHAPTER 4

CONCLUSIONS

The purpose of this project is to define the physical and chemical characteristics of the dredged materials stored in a number of representative CDFs along the coast of New Jersey. Prior to the undertaking of this project, the nature of these stored materials has been relatively uncertain. By defining the characteristics of the dredged material in these CDFs, one of the obstacles to the beneficial use of the material may have been removed. The results of this characterization program demonstrate that the physical properties of the material vary substantially by geographic location. Generally, the material in the Waackaack Creek CDF has the highest sand and gravel content, while the Ocean City Site #83 materials have the highest clay and silt content. The Corps Cell D and Middle Thorofare CDFs contain a mixture of materials, with some of the samples containing high percentages of coarse-grained materials and others containing more fine-grained sediments. Because the CDFs contain materials that have been deposited during several dredging projects, the material characteristics also vary by location within the CDF. Distinct strata were observed in cores taken from the Nummy Island, Corps Cell D and Waackaack Creek CDFs. The variability of the physical properties of the materials between the individual CDFs indicates that different beneficial uses may be applicable for the materials stored in the different CDFs.

The sandy materials in the Waackaack Creek CDF may be appropriate for building materials or construction applications that require materials with more than 90% sand content and little organic material. The fine-grained materials with higher organic content in the Ocean City Site #83 may be more suitable for non-structural fill applications with few material restrictions. It is possible that the mixed materials in the Corps Cell D and Middle Thorofare CDFs could be used for compacted fill applications. Processing and/or screening would be required to generate uniform materials out of these CDFs and these materials could be appropriate for use in structural fill applications. Ultimately, the specific requirements of potential projects would need to be examined to determine if CDF materials can be utilized. Depending on the testing requirements of the end-user, further analysis of the CDF materials may be required to determine if the materials meet project specifications.

Contaminant concentrations were relatively low in the sediments contained in the sampled CDFs. With the exception of one composite sample from Corps Cell D, none of the samples analyzed exceeded New Jersey's Residential Direct Contact Soil Cleanup Criteria (NJRDCSCC) for any of the target analytes. PCBs were not detected in sediments from any of the CDFs. Pesticides were only detected at trace levels in composite samples from the Nummy Island, Middle Thorofare and Ocean City Site #83 CDFs. Semivolatile compounds and metals were detected in sediment samples from all of the CDFs. However, concentrations of organic compounds were well below NJRDCSCC in all of the samples except for the one composite sample from the Corps Cell D CDF. This sample had concentrations of PAHs that exceeded the Residential and Non-Residential Criteria. The area of concern in the Corps Cell D CDF (western edge of the western cell) could be delineated with further testing and separated from the rest of the material in the CDF. Concentrations of metals were also below the NJRDCSCC in all of the samples, with the exception of the one composite sample from the Waackaack Creek CDF. This sample had concentrations of arsenic slightly above the Criteria.

With the exception of concentrations of the Phthalate bis(2-ethylhexyl)phthalate, detected concentrations of semivolatile organic compounds, pesticides and PCBs in leachates produced from the sediment samples were below New Jersey's Specific Groundwater Quality Criteria for all of the samples from the CDFs. Since bis(2-ethylhexyl)phthalate is a ubiquitous compound that is widely recognized as a common laboratory contaminant (USEPA 1970), and the compound was only detected in low levels in the sediments, the concentrations should not pose a regulatory concern.

Concentrations of some metals, typically sodium, manganese, iron, selenium, aluminum and arsenic, exceeded the Groundwater Criteria in leachate samples produced from sediment samples from all of the CDFs. It is important to note that the concentrations were measured in leachate samples which are representative of the concentration that may be delivered to the groundwater via runoff/seepage, not necessarily the concentration measured in the receiving groundwater, which is likely to be much less than in the leachate. Minor restrictions on potential placement sites may be issued based on the leachate results, i.e. no placement over sensitive aquifers. Overall, the dredged material in the evaluated CDFs appears to be relatively clean and could potentially be put to several beneficial use applications.

There are numerous construction projects, landfill closures, and site capping projects in the New York / New Jersey region that are anticipated during the next few years. These projects will require millions of cubic yards of materials and the dredged material in many of the CDFs analyzed could be appropriate for these applications if it was made readily accessible.

The limited access to the island CDFs (Nummy Island and Site #83) and CDFs with limited roadway access could be problematic, and due to higher transportation costs, it is not likely that end users of the material will preferentially choose to use these materials over their traditional material sources. While barge transport of the material is possible from a number of the studied sites, shallow access channels will only allow smaller barges to access the site. If the end use site is not located on a waterway, an off-loading area would be required and trucks would be needed to haul the material to its final placement site. These handling requirements and overall transportation logistics could make the use of dredged material cost prohibitive for contractors when compared to using virgin materials from a readily accessible borrow site or another traditional material source. However, if the material was re-located to a centralized area with both navigational and roadway transportation options, it would reduce the transportation and handling costs for prospective users and may become an attractive product.

In conclusion, the results of this analysis remove one of the obstacles from the potential beneficial use of dredged materials stored in these CDFs. Basic information on the material composition is provided and potential end users can determine if the material in the CDFs may meet the needs of their projects. Also, the analysis has demonstrated that the material is largely free from contaminants and can be applied to projects without significant concerns.

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Appendix A

Sampling and Compositing Plan

BACKGROUND

HDR│LMS and Aqua Survey Inc. are planning to characterize the dredged materials stored in several Confined Disposal Facilities (CDF's) throughout New Jersey for the New Jersey Department of Transportation Office of Maritime Resources (NJDOT/OMR). This project will be carried out under the I Boat New Jersey program. The purpose of the project is to characterize the physical and chemical properties of the materials sufficiently to obtain an Acceptable Use Determination (AUD) from your office for their beneficial use. The purpose of this report is to describe our proposed sampling plans for the CDF's and the methods that we used to determine the number of samples, sampling locations, and analytical requirements. We hope to obtain a guidance letter from your office prior to the sampling events.

We plan to sample the following five CDF's:

1. Nummy Island in the Town of Stone Harbor, NJ
2. Middle Thorofare in Cape May, NJ
3. Site 83 in Ocean City, NJ
4. Corps Site D in Cape May, NJ
5. Waackaack Creek in Keansburg, NJ

METHODOLOGY

1. CDF Volume Estimate

HDR│LMS calculated the volume of dredged material stored in the CDFs using the most recent topographic surveys for the sites and knowledge of subsequent dredging projects. Using the topographic contours on the site plan as a guide, typical cross-sections of the CDFs were developed and used to calculate the volume of material currently in the CDF. Based on that data, we estimated the volume of material that could be proposed for removal and reuse while still retaining an adequate berm for containment of future dredging projects. A number of site-specific assumptions were used to guide the analyses, and these assumptions are presented below.

- 1.1 Nummy Island

HDR│LMS calculated the volume of dredged material stored in the Nummy Island CDF using the "proposed elevations" on the topographic survey prepared by Hyland Design Group, Inc. We estimate that a volume of 50,000 cubic yards could be removed from the

CDF while still retaining an adequate berm for containment of future dredging projects. Therefore, the sampling plan was developed to characterize approximately 50,000 cy of the material. It is anticipated that the remaining 40,600 cy will remain in the CDF and be recontoured to accommodate future dredging projects.

Detailed calculations are provided in Attachment 1.

- 1.2 Middle Thorofare

The volume estimate of dredged material stored in the Middle Thorofare CDF was calculated using elevation estimates based on the topographic survey map prepared by Gibson Associates, P.A in 1998. Based on a 2004 site visit, it appeared that the survey drawings did not reflect recent dredging projects. We estimated a berm height of 20’ and a plateau height of 15’ (NGVD). The volume of the material in the plateau section of the CDF was calculated as the surface area multiplied by the depth of excavation. We assumed that the plateau section would be excavated to a depth of 4’. A cross-section of the berm was developed to determine potential excavation volumes (above the road elevation of 9’).

In summary, it is estimated that the CDF contains about 39,500 cy of material, of which we intend to remove approximately 35,000 cy. This will allow the berm to be recontoured to an elevation of 15’ NGVD, approximately 6’ above the roadway.

Detailed calculations are provided in Attachment 1.

- 1.3 Ocean City Site 83

HDR│LMS estimated the volume of dredged material contained in Site 83 using the existing conditions from the most recent topographic survey obtained from the Department of Public Works Engineering & Construction division of the City of Ocean City. The volume of the material in the plateau section of the CDF was calculated as the surface area multiplied by the depth of excavation. We assumed that the depth of the CDF following excavation (4’) would be slightly higher in elevation than the depth of the existing marshes (3.9’). A cross-section of the berm was developed to determine potential excavation volumes.

In summary, it is estimated that the CDF currently contains approximately 395,000 cy of material, of which we propose to remove about 375,000 cy. Approximately 20,000 cy of material will be recontoured to accommodate future dredging projects.

Detailed calculations are provided in Attachment 1.

- 1.4 Corps Cell D

Volume estimates for the Corps Cell D CDF in Cape May, NJ were based on the most recent topographic survey drawings that were prepared by the U.S. Army Corps of Engineers Philadelphia District. The volume of the material in the plateau section of the CDF was calculated as the surface area multiplied by the depth of excavation. The surface area for the plateau section of the CDF was estimated using the digital copy of the drawing and AutoCad. It was estimated that the CDF could be excavated to 5' before encountering virgin materials. Because there are two distinct cells in the CDF, the volume of the western side of the CDF was calculated separately from that of the eastern side. Cross sections of the eastern and western berm areas were developed to estimate the volume of dredged material in the berms, and potential removal volumes.

It is estimated that the CDF contains 969,500 cy of dredged material; three-fourths of this material is located in the western cell. Approximately 856,000 cy of material could be removed while leaving sufficient material to recontour the berms to accommodate future dredging projects.

Detailed calculations are provided in Attachment 1.

- 1.5 Waackaack Creek

HDR│LMS calculated the volume of dredged material stored in the Waackaack Creek CDF using elevation estimates based on the topographic survey map prepared by State of New Jersey, Department of Environmental Protection, Division of Engineering and Construction, Bureau of Coastal Engineering (NJDEP BCE). The drawings indicate that there is no existing containment berm on the CDF. There is however an earthen flood control dune that would remain in place following excavation.

It is estimated that the CDF contains about 132,000 cy of material, of which we estimate 47,000 cy will be removed. The remaining 85,000 cy of material will be contoured to reestablish the flood control dune and to establish a containment berm for future dredging projects.

Detailed calculations are provided in Attachment 1.

2. Number and Location of Cores

Table 1 below shows the proposed excavation volumes for each CDF, the number of cores required to characterize the material as described in *The Management and Regulation of Dredging Activities and Dredged Material in New Jersey's Tidal Waters* (October 1997).

Table 1 – Number of sediment cores recommended for the five CDFs, based on NJDEP guidance manual

CDF	**Excavation Volume (cy)**	**# Cores based on Guidelines**	
Nummy Island	50,000	1/8000 cy	6
Corps Cell D	856,000	1/8000 cy	107
Middle Thorofare	35,000	1/8000 cy	4
Ocean City Site 83	375,000	1/8000 cy	47
Waackaack Creek	47,000	1/4000 cy	12

HDR│LMS developed a sample location plan that would characterize the material that would be removed from the CDFs. The sampling locations were selected using the site plans and volume calculations. Sample locations were selected to characterize the material proposed for removal, based on location within the CDFs. For sites where the majority of material is contained in the containment berms, more cores will be taken from the berms than the plateau areas. Two of the sites (Corps Cell D and Waackaack Creek) have more than one cell. The volume contained in each cell was calculated, and the number of cores to be taken from each cell will correspond to the estimated volume. Table 2 below provides the basis for selecting the location of cores within the CDFs. The site plans for all of the CDFs with the proposed core locations are provided in Attachment 2.

As we discussed, fine-grained particles have a tendency to settle close to the weir structures in CDFs. For this reason, additional sediment cores will be taken near the weir structure.

Please note that conditions in the field may slightly alter the location of the borings. Equipment and safety concerns may require that the cores be taken from alternate regions in the CDFs. However, the field crew will select alternate core locations with the same elevation and general location of the proposed sampling locations. The final sampling locations (NJ State plane coordinates and NGVD 1988 elevation datum) will be provided to your office following the surveys. Each core will be assigned a separate number, and each composit sample will be assigned a letter.

Table 2. Proposed sampling locations and number of cores taken from the five CDFs.

CDF Location	**Section**	**% of Total Material**	**# Cores Based on Guidelines**	**# Cores Proposed**
Nummy Island – Stone Harbor	Berm	91%	5	5
	Plateau	9%	1	1
	Total # Cores		*6*	6
Corps Cell D – Cape May	Plateau East	18%	18	10
	Plateau West	55%	58	29
	Berm East	11%	12	6
	Berm West	19%	20	9
	Total # Cores		*107*	54
Middle Thorofare – Cape May	Plateau	64%	3	2
	Berm	36%	1	1
	Total # Cores		*4*	3
Ocean City Site #83	Plateau	81%	36	19
	Berm	19%	9	5
	Total # Cores		*47*	24
Waackaack Creek – Keansburg	Plateau – Areas A&B	58%	16	7
	Plateau – Area C	42%	12	5
	Total # Cores		*12*	12

3. Sediment Analytical Procedures

The physical and chemical characteristics of the dredged material will be determined in an analytical laboratory. The sediment cores will be delivered whole to the Aqua Survey, Inc. laboratory for analysis. The following sections describe the testing and composting protocols that are proposed for the materials stored in the CDFs.

- 3.1 Grain Size Analysis

The sediment cores will be evaluated for the presence of distinct strata where the sediment characteristics are distinctly different than other layers within the core. Photographs of the cores will be provided to your office with the results of the analytical tests. The determination of the presence of strata will performed by Aqua Survey, Inc. and will be based upon the color, odor, and texture of the sediments. For each stratum greater than two (2) feet in depth within each core, grain size analysis will be performed in the Aqua Survey, Inc. laboratory on one sample using the methods described by R.L. Folk (1980). The results of the grain size analyses will be used to guide the level of effort for the remaining analytical procedures.

If a sample's grain size is determined to be 90% or greater sand content, no further testing will be performed. It is anticipated that the majority of the samples will require further characterization.

- 3.2 Sample Compositing

Composite samples will be prepared for sediments with similar physical properties. For cores where there is no stratification, one composite sample will be prepared from a maximum of three (3) cores. For cores where distinct strata greater than 2 feet in depth exist, composite samples will be prepared for each stratum from a maximum of three (3) cores with similar physical properties.

- 3.3 Chemical Parameters

The bulk sediment chemistry analysis on the composite samples will include the target analytes found in the NJDEP's Soil Cleanup Criteria (PP+40 list) and those found in Attachment 1 of New Jersey's 1997 Dredging Manual. Composite samples will be analyzed for the following parameters:

i. Total Organic Carbon
ii. Percent Moisture

iii. Bulk Sediment Chemistry for metals, semi-volatiles, pesticides, and PCBs (total and aroclors)
iv. Synthetic Precipitation Leaching Procedure for metals, semi-volatiles, pesticides and PCBs (total and aroclors)
v. Dioxin analysis (for the Waackaack Creek CDF only)

4. Reporting

The results of the laboratory analysis and field efforts will be submitted to your office. The following information will be provided in the report: location of the cores (NJ State plane coordinates, NGVD 1988 elevations); photographs of individual cores; composit descriptions and justification; and the results of the laboratory analysis.

Attachment 1

Volume Calculations

Nummy Island in the Town of Stone Harbor, NJ

ONE BLUE HILL PLAZA
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PEARL RIVER, NEW YORK 10965
845-735-8300
SUBJECT SAMPLING PLAN + SITE 103
VOLUME ESTIMATES - NUMMY ISLAND COF

I. ESTIMATE EXISTING VOLUME OF MATERIAL WITHIN COF.

STEP 1 - ESTIMATE VOLUME OF BERM BASED ON A TYPICAL SECTION - SINCE BERM IS CIRCULAR, DIVIDE INTO REPRESENTATIVE SECTIONS AND MEASURE TOTAL LENGTH ALONG CENTROID

STEP 2 - ESTIMATE VOLUME OF CENTRAL PLATEAU BY MEASUREMENT OF SURFACE AREA X DEPTH

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CHKD. BY ______ DATE ______ JOB NO 0904-007

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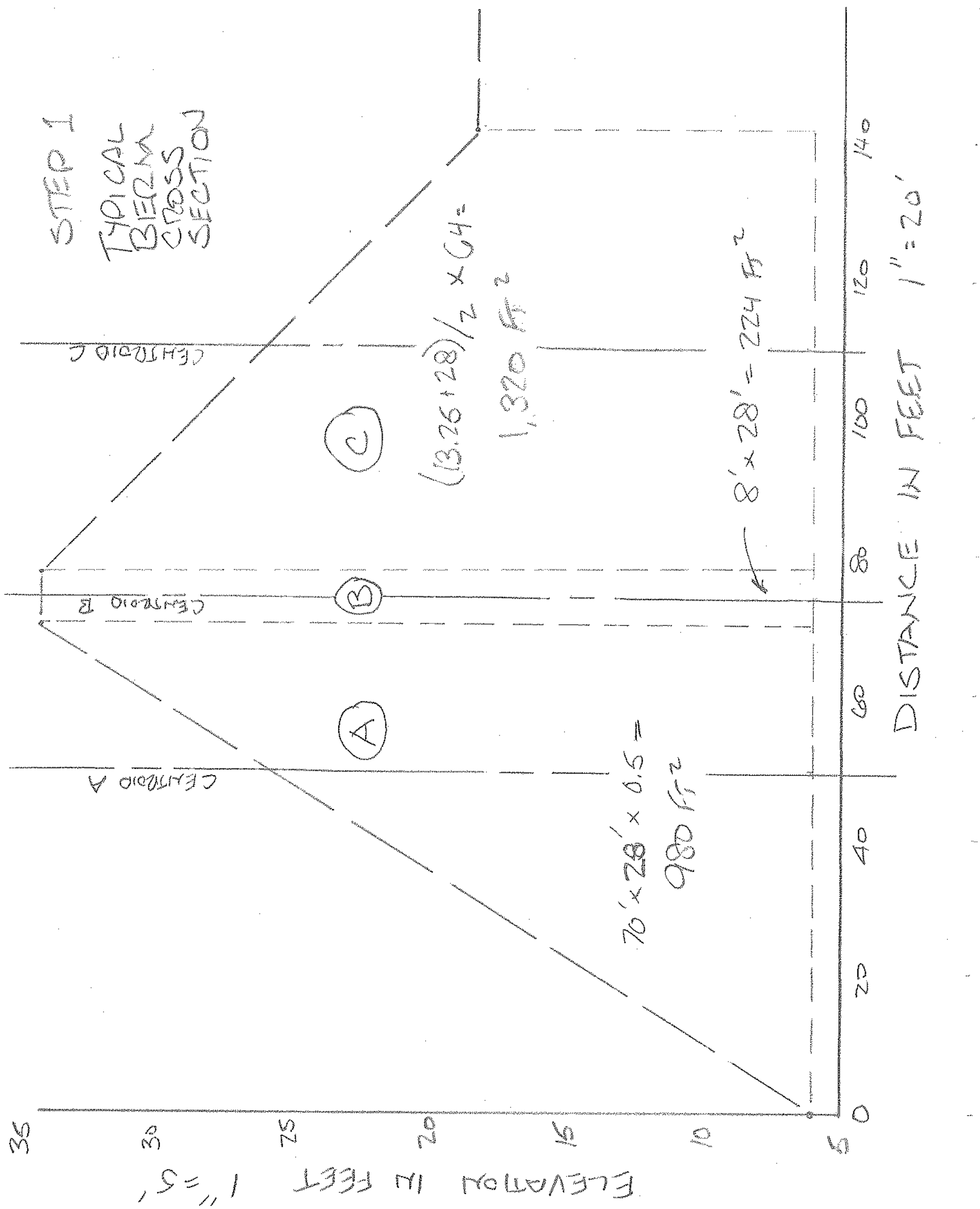
SUBJECT SAMPLING PLAN + SITE 103
VOLUME ESTIMATES – ANNSVILLE ISLAND CDF



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PEARL RIVER, NEW YORK 10965
845-735-8300

SUBJECT: SAMPLING PLAN + SITE 103
VOLUME ESTIMATE - NUMMY ISLAND CDF

(1) VOLUME OF BERM ABOVE EL. 5

DISTANCE ALONG CENTROID A = 1,120 FEET
" " " B = 940 FEET
" " " C = 700 FEET

(AS MEASURED IN PLAN VIEW)

VOLUME SECTION A = 980 FT^2 × 1,120 FT = 1,097,600 FT^3
VOLUME SECTION B = 224 FT^2 × 940 FT = 210,560 FT^3
VOLUME SECTION C = 1,320 FT^2 × 700 FT = 924,000 FT^3

TOTAL 2,232,160 FT^3
82,700 CYDS

(2) VOLUME OF INTERIOR PLATEAU

APPROX. TRAPEZOIDAL AREA

$$\frac{(80 + 150)}{2} \times 140 = 16,100 \text{ FT}^2$$

DEPTH = 18.75 - 5 = 13.75

VOLUME = 16,100 FT^2 × 13.25 = 213,325 FT^3
7,900 CYDS

(3) TOTAL VOLUME IN CDF

82,700 + 7,900 = 90,600 CYDS

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SUBJECT SAMPLING PLAN + VOLUME ESTIMATES - NUMMY ISLAND SITE 103

II ESTIMATE AMOUNT OF MATERIAL TO BE REMOVED

ASSUME:

- INTERIOR PLATEAU TO BE LOWERED TO ELEVATION 5
- ASSUME OUTSIDE BERM TO BE LOWERED TO ELEVATION 20, 15 FEET ABOVE INTERIOR PLATEAU

AREA OF BERM TO REMAIN = 900 FT^2
(SEE PAGE 5)

APPROX LENGTH OF BERM TO REMAIN MEASURED ON PLAN VIEW = 1,200 F

VOLUME OF BERM TO REMAIN

900 FT^2 x 1,200 FT = 1,080,000 FT^3

40,000 CYDS

VOLUME TO BE REMOVED

EXISTING VOLUME 90,600 CYDS (Pg 3)

VOLUME TO REMAIN 40,000 CYDS

SAY 50,000 CYDS

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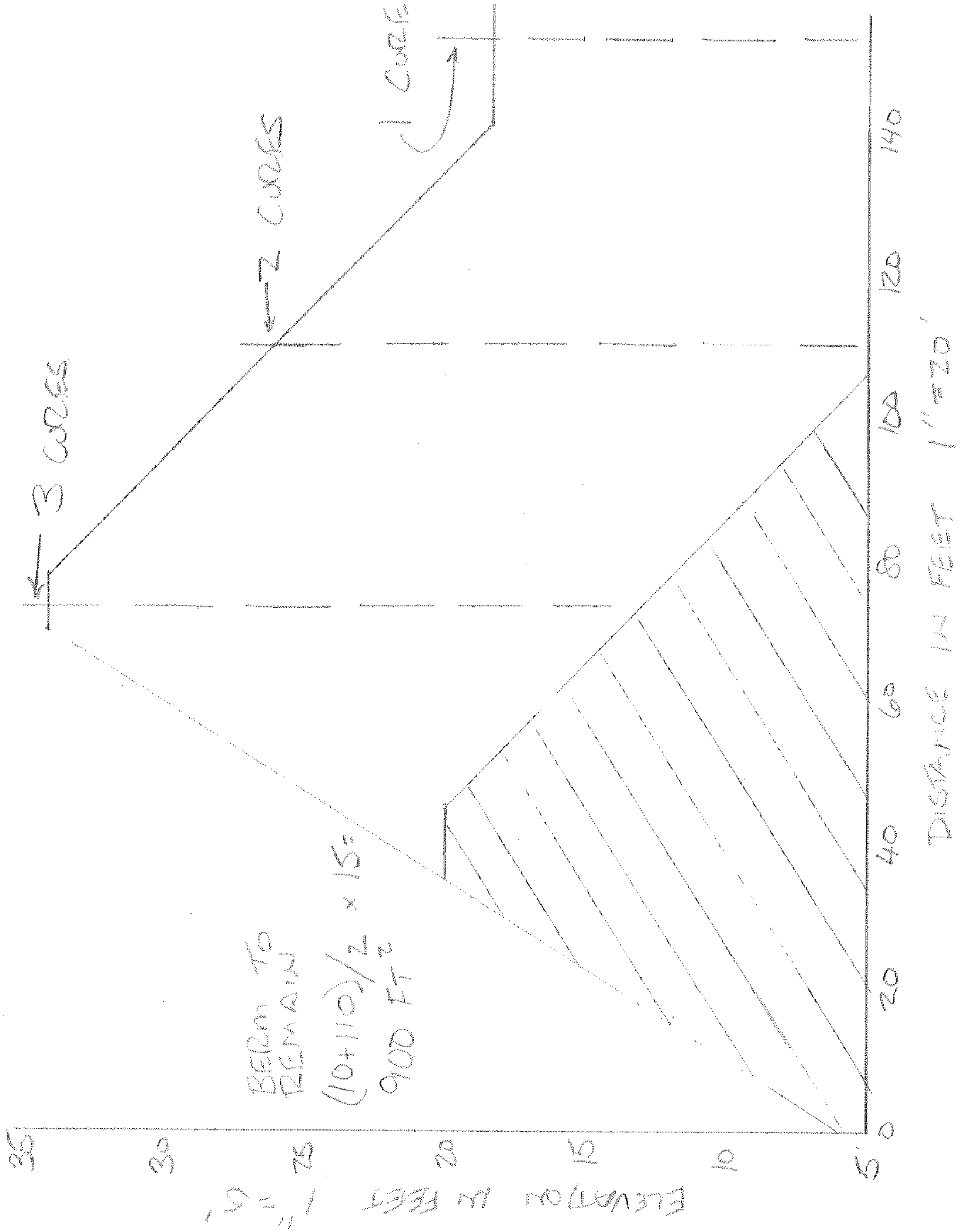
JOB NO 0904-007

SUBJECT SAMPLING PLAN SITE 103
VOLUME ESTIMATES - NUNNY ISLAND



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THE NJDEP MANUAL ON "THE MANAGEMENT OF DREDGING ACTIVITIES AND DREDGED MATERIAL IN NEW JERSEY TIDAL WATERS" REQUIRES PRE-DREDGING SAMPLING OF MATERIALS TO BE DREDGED. WITHIN REGION 2 - 1 CORE / 8,000 CYDS IS RECOMMENDED. BASED ON THIS SAMPLING RATE, WE RECOMMEND THAT 50,000 CYDS / 8,000 CYDS = 6 CORES BE TAKEN TO REPRESENT THE MATERIAL PROPOSED FOR REMOVAL FROM NUMMY ISLAND.

PROPOSED CORE LOCATIONS:

MAJORITY OF MATERIAL TO BE REMOVED IS WITHIN BERM. THEREFORE, SAMPLING IS PROPOSED AS FOLLOWS

- 3 CORES FROM BERM PLATEAU TO 20 FT DEPTH
- 2 CORES IN INTERIOR SIDESLOPE OF BERM TO 20 FT DEPTH
- 1 CORE IN INTERIOR PLATEAU

(SEE PG 5 + PLAN SHEET)

Middle Thorofare in Cape May, NJ

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CHKD. BY NGM DATE 12/12/05 JOB NO.

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POST OFFICE BOX 1509
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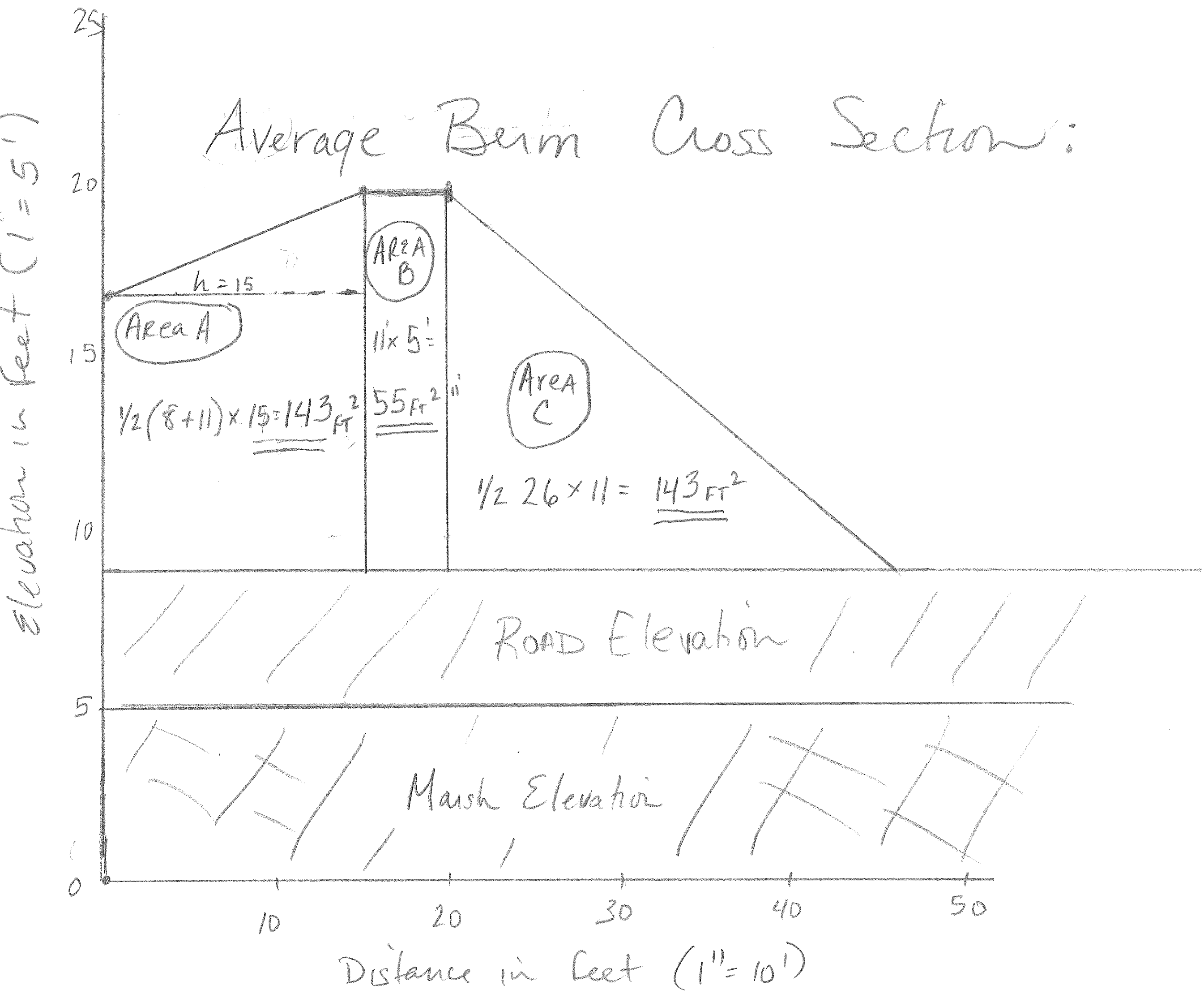
SUBJECT Middle Thorofare CDF
Volume Estimate For Berm



Area of Berm = 143 + 55 + 143 = 341 FT²
x Length of Perimeter (1,135 FT) =

Volume of Berm = 387,035 FT³

TOTAL Volume of CDF = Plateau - 681,868 FT³ 64%
Berm - 387,035 FT³ 36%

1,068,903 FT³

= 39,561 cy

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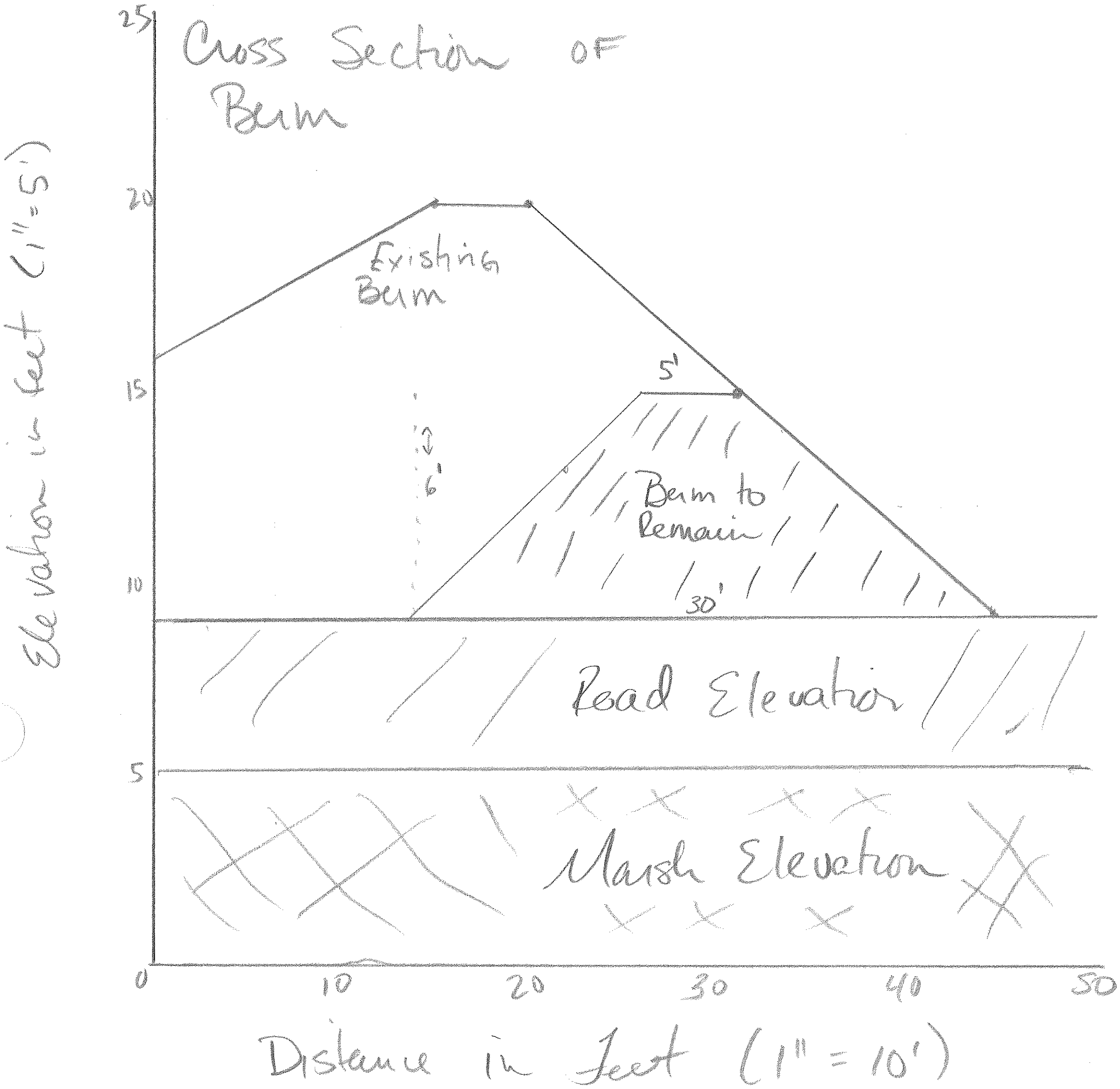
SUBJECT Middle Thorofare CDF - Volume Estimate



Area of Berm to Remain = (5' + 30')/2 × 6' = 105 FT^2

Volume of Remaining Berm = 105 FT^2 × 1,135 FT = 119,175 FT^3

Volume to be excavated = 1,068,903 FT^3
− 119,175 FT^3

= 949,728 FT^3

= 35,175 cy

@ 8000 cy/core → 4 cores

Site 83 in Ocean City, NJ

BY JLC DATE 10/10/05

CHKD. BY NGW DATE 10/18/05

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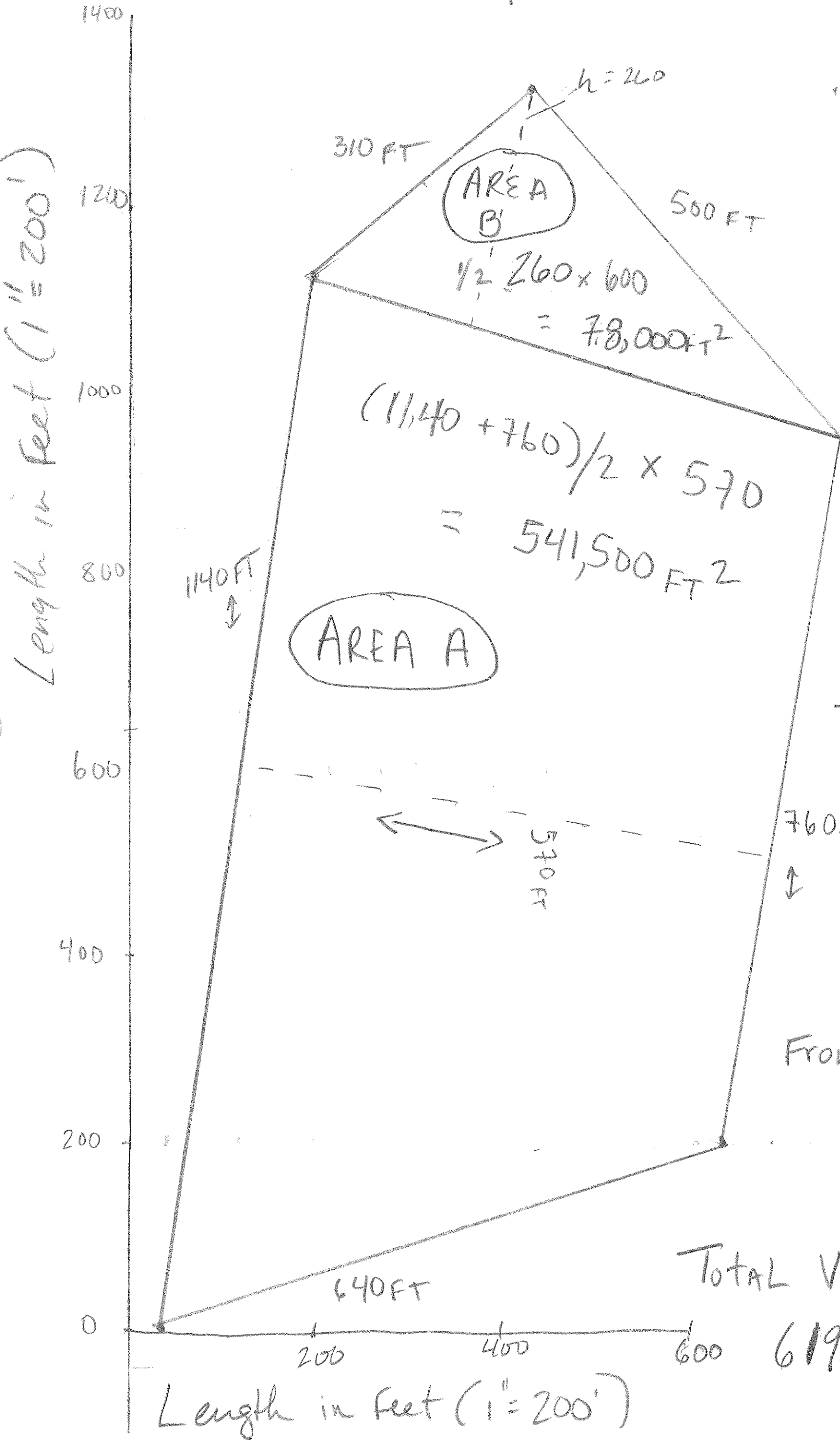
JOB NO. 904-007

SUBJECT Ocean City Site 83 CDF Volume Calculation

PLAN VIEW OF CDF Plateau

↑ North



Area A + Area B = Area

78,000 + 541,500 = 619,500 FT

From Plan - Marsh el = 3.9' MLW

- Post Pump Avg el = 18.'

Excavation Depth = 18 - 4 = 14 F

Total Volume of Plateau =

619,500 FT² × 14.0 FT =

8,673,000 FT³

Perimeter = 3,350 FT

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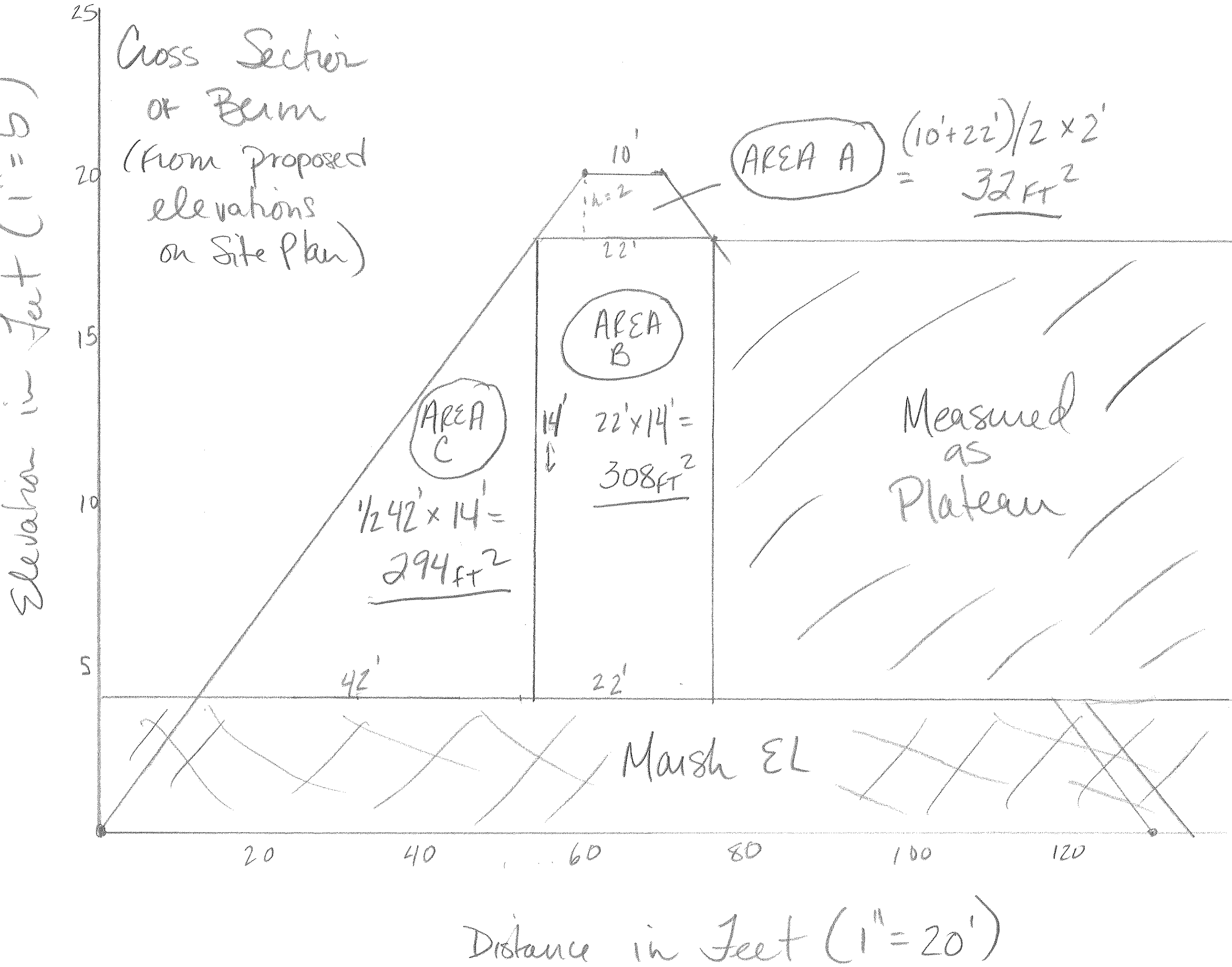
SUBJECT Ocean City Site 83 CDF Volume Estimate



Area of Berm = 634 FT²

x Perimeter of Plateau (3,350 FT)

= Volume of Berm = 2,123,900 FT³

Total CDF Volume =	Plateau -	9,292,500 FT³	81%
	Berm -	2,123,900 FT³	19%
Total =		11,416,400 FT³	

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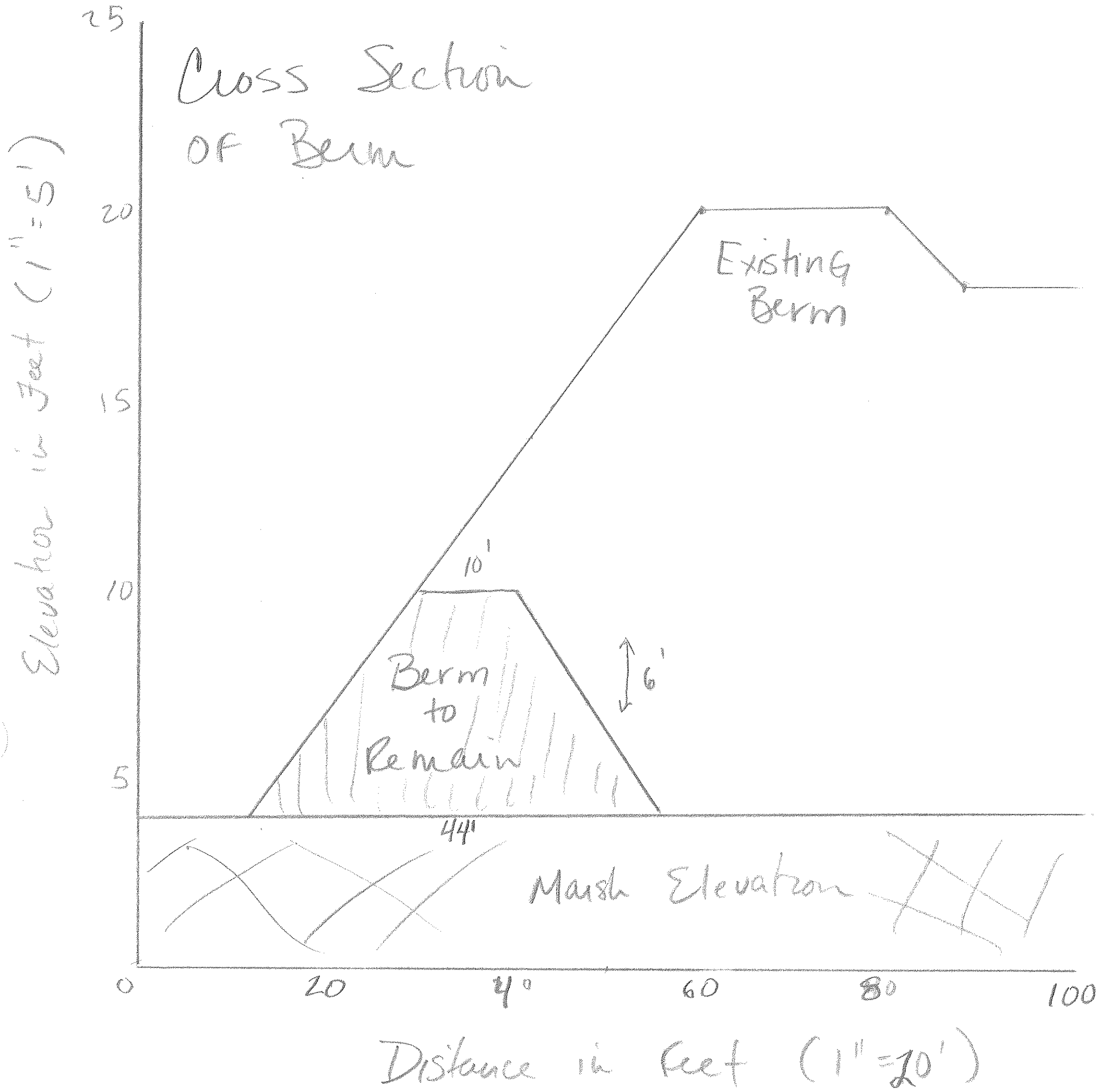
SUBJECT Ocean City Site 83 CDF - Volume Estimate



Area of Berm to Remain = (10' + 44')/2 × 6' = 162 FT^2

Volume of Remaining Berm = 162 FT^2 × 3,350 FT = 542,700 FT

Volume to be excavated = 10,662,450 FT^3 − 542,700 FT^3

= 10,119,750 FT^3

= 374,806 cy

@ 8,000 cy / Core → 47 cores

Corps Site D in Cape May, NJ

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SUBJECT Corps Site D - Cape May, NJ Volume Estimate

① Area of Plateau - From AutoCad

Western SIDE - 596,098 FT^2
EASTERN SIDE - 275,722 FT^2

A Western Side - Avg El. ≈ 29. FT
Assume CDF will be Excavated to 5' → Excavation Depth = 24. FT

Volume of Western SIDE ≈ 14,306,352 FT^3
Perimeter of Western Plateau = 3,498 FT (From AutoCad)

B. EASTERN SIDE - Avg El. ≈ 19. FT
Excavation Depth ≈ 14 FT

Volume of Eastern SIDE ≈ 3,860,108 FT^3

TOTAL Volume of Plateau ≈ 18,166,460 FT^3

Perimeter of Eastern Plateau = 2,245 FT (From AutoCad)

* Note Berm Separating Western & Eastern Cells Not included in Volume Estimate

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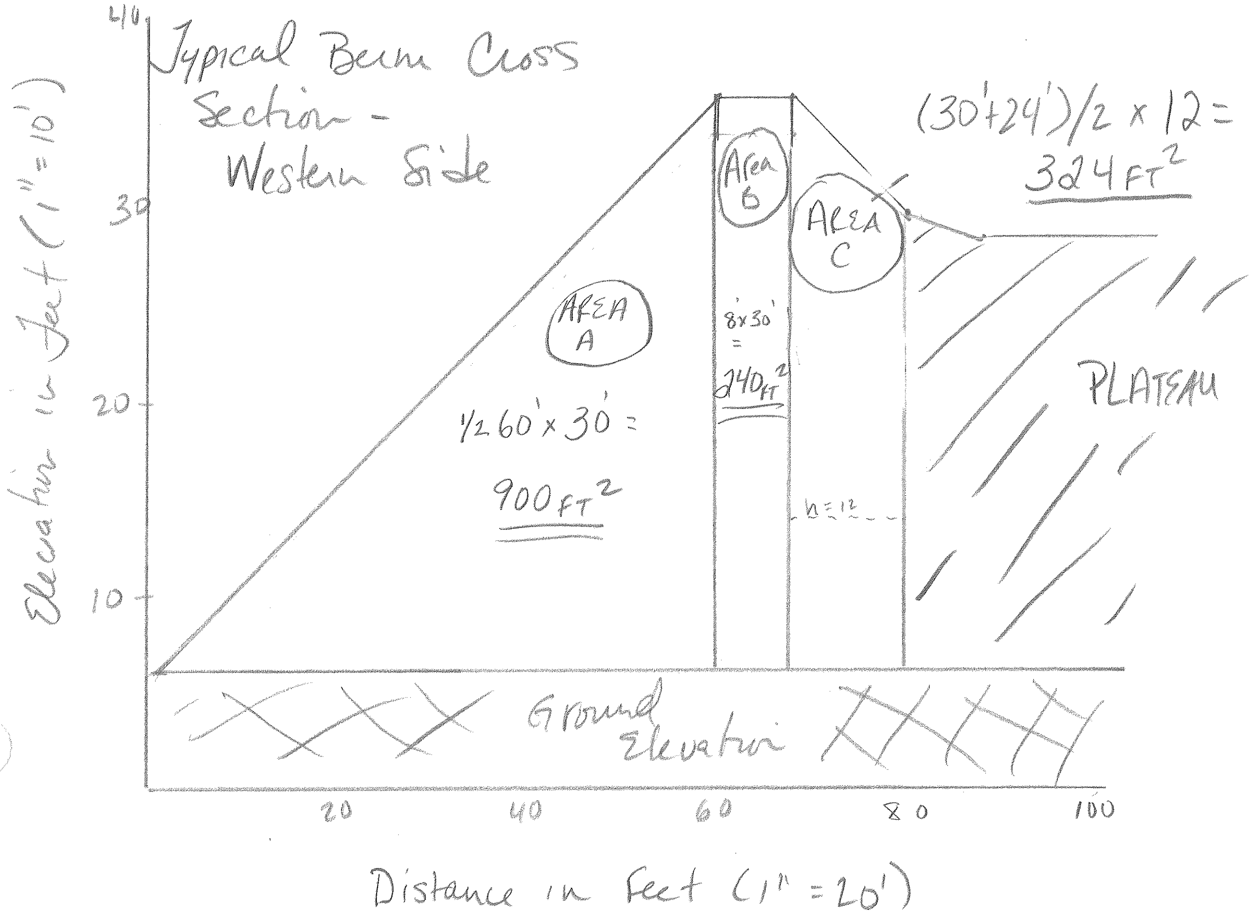
SUBJECT Corps Site D, Cape May NJ - Volume Calculations



Total Area Western Berm = 1,464 ft²

× Perimeter of Western Plateau (3,498 ft) =

5,121,072 ft³

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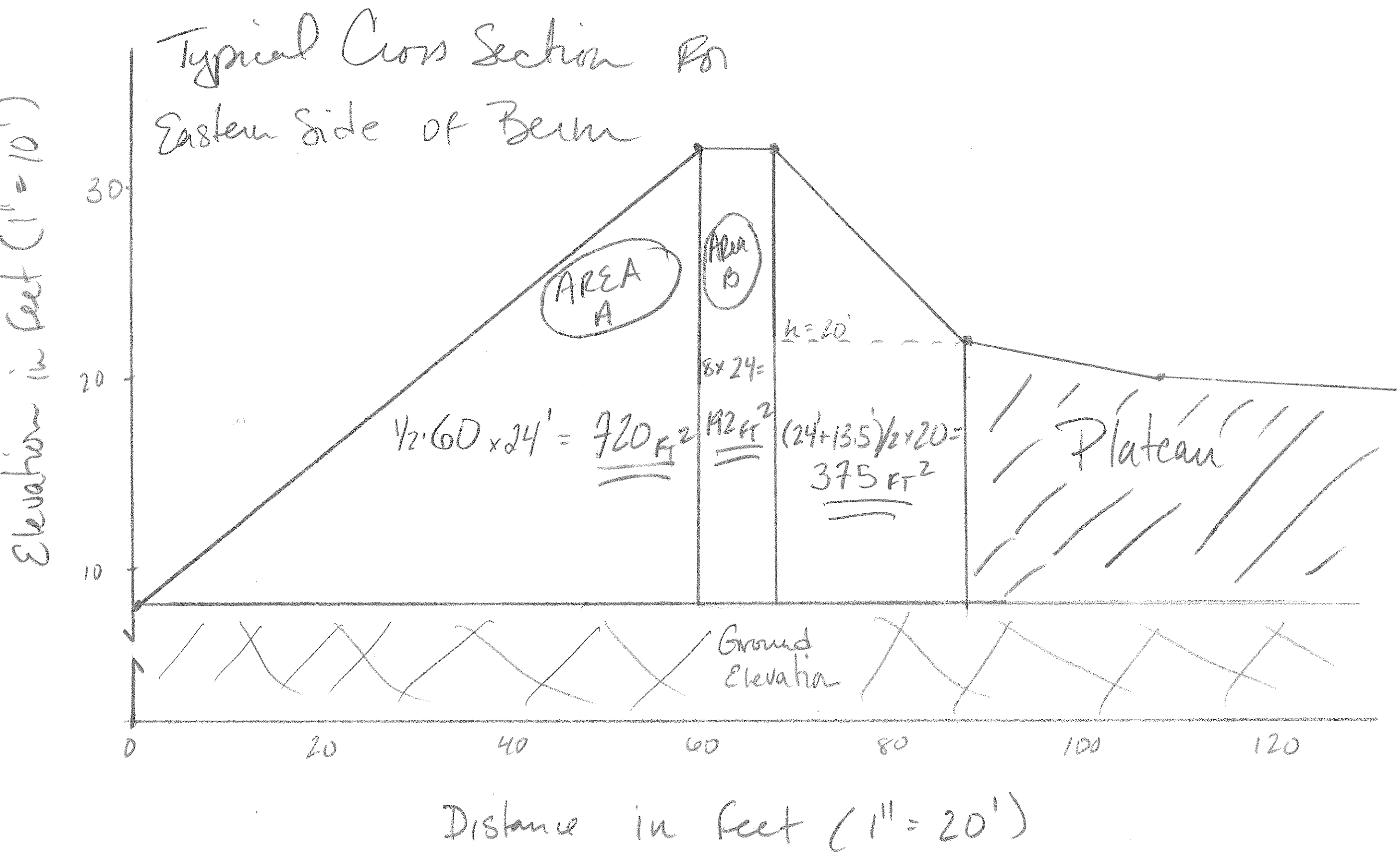
SUBJECT Corps Site D - Volume Calculation



TOTAL AREA - Eastern Portion of Berm = 1,287 FT^2

x Perimeter of E. Portion of Plateau (2,245 FT) =

Total Volume of E. Portion of Berm ≈ 2,889,315 FT^3

Total CDF Volume

i	Plateau - EAST	3,860,108 FT^3	15% of Total
ii	Plateau - West	14,306,352 FT^3	55% of Total
iii	Berm - East	2,889,315 FT^3	11% of Total
iV	Berm - West	5,121,072 FT^3	19% of Total

26,176,847 FT^3

= 969,513 cy

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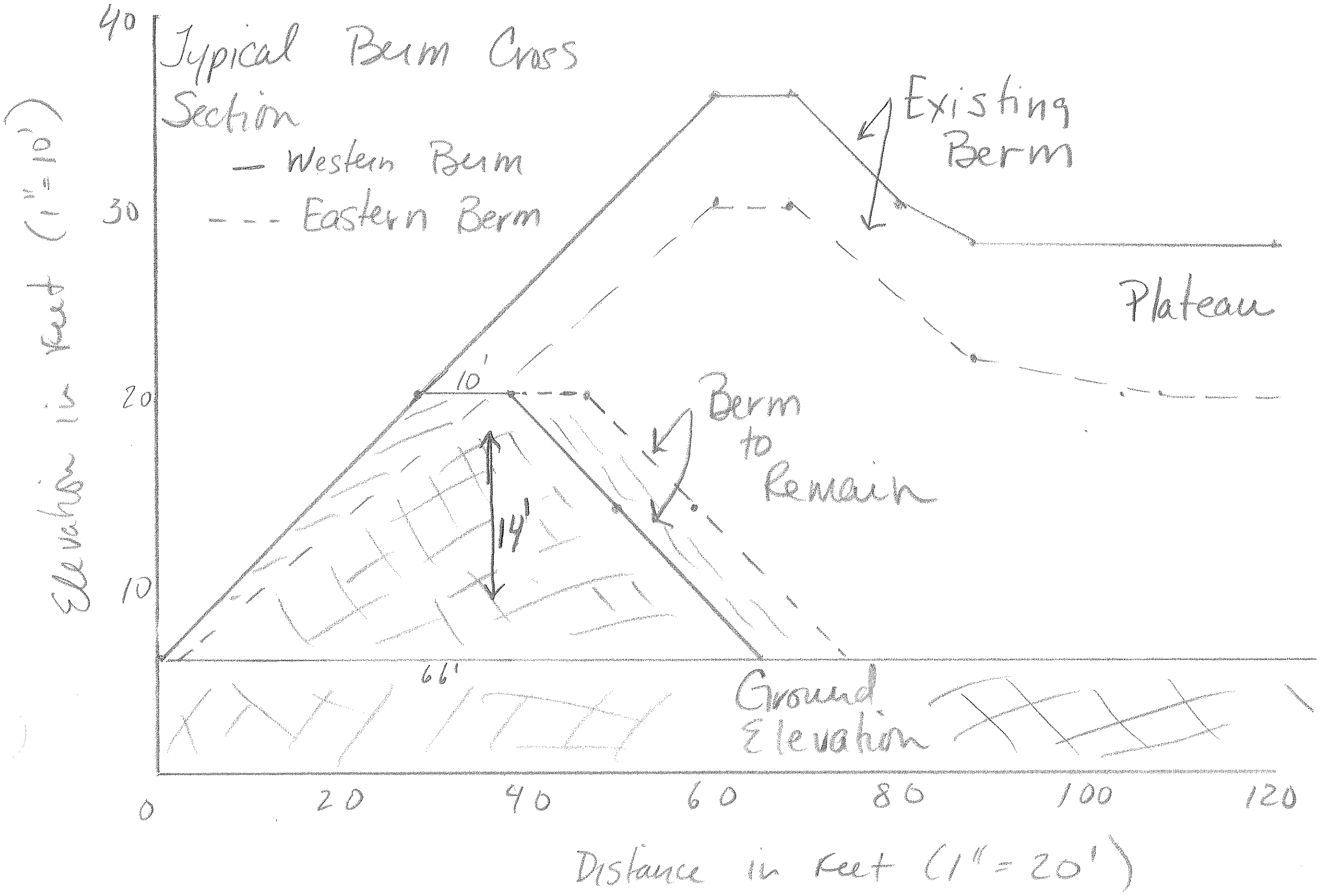
SHEET NO. 4 OF 4

CHKD. BY ______ DATE ______

JOB NO. 904087

SUBJECT Corps Site D - Volume Calculations



- Area of Remaining Berm = (66' + 10')/2 × 14' = 532 ft^2

- Volume of Remaining Berm =

1. Western Berm - 532 ft^2 × 3,498 ft = 1,860,936 ft^3

2. Eastern Berm - 532 ft^2 × 2,245 ft = 1,194,340 ft^3

Total Berm Volume = 3,055,276 ft^3

Total CDF Volume = 26,176,847 ft^3

− Vol. of Remaining Berm = 3,055,276 ft^3

= Total Vol. to Excavate = 23,121,571 ft^3

= 856,354 cy

1 core/8,000 = 107 cores

Waackaack Creek in Keansburg, NJ

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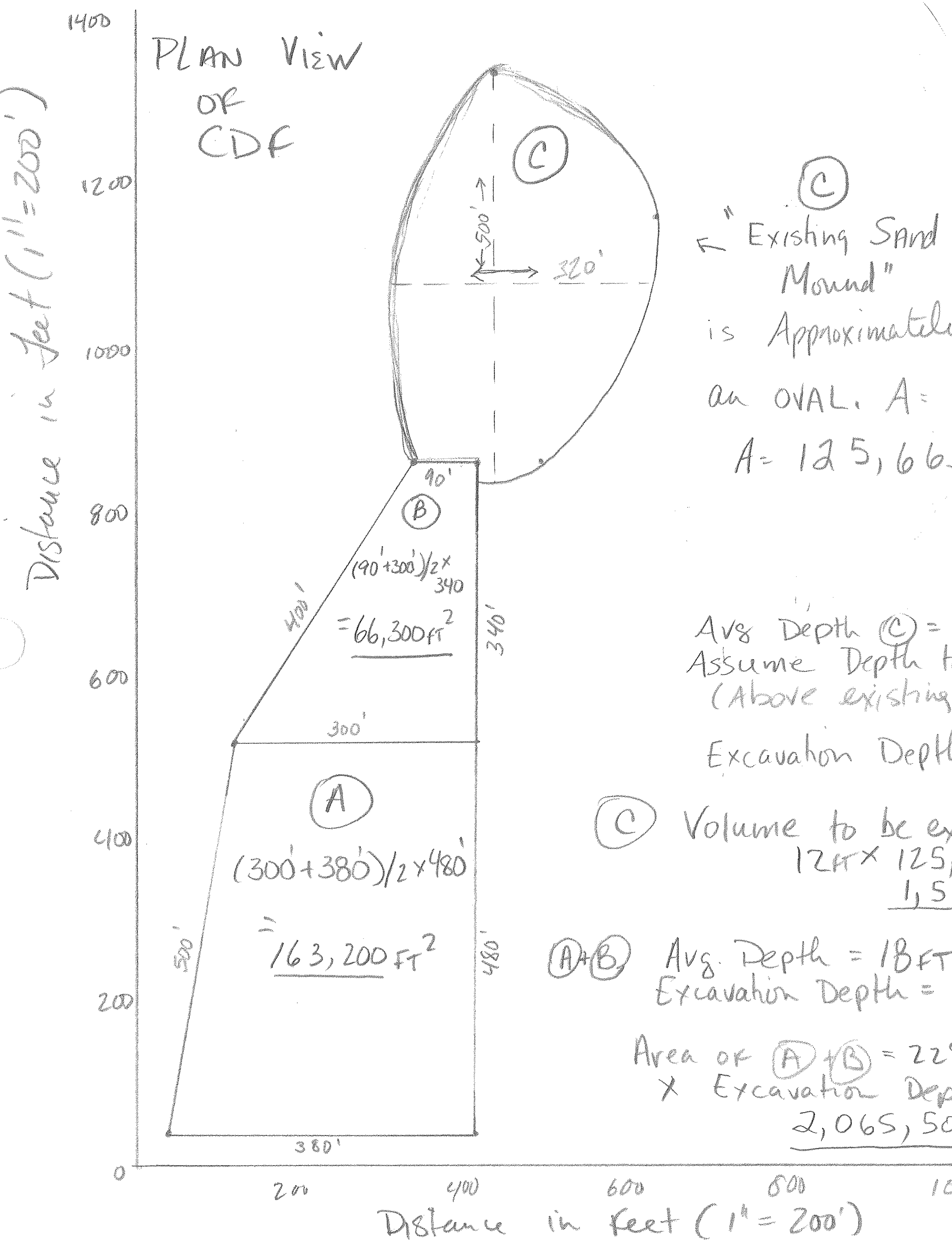
SUBJECT Waackaack Creek - CDF Volume Estimate



North

Ⓒ "Existing Sand Mound" is Approximately the shape of an OVAL. $A = \pi(320'/2)(500'/2)$

$A = 125,663\ FT^2$

Avg Depth Ⓒ = 21 FT
Assume Depth to Excavation of 9 Feet (Above existing Veg. Line)

Excavation Depth = 21' - 9' = 12'

Ⓒ Volume to be excavated = $12\ FT \times 125,663\ FT^2$ = 1,507,956 FT^3

Ⓐ+Ⓑ Avg. Depth = 18 FT
Excavation Depth = 18' - 9' = 9 FT

Area of Ⓐ+Ⓑ = 229,500 FT^2
× Excavation Depth (9') = 2,065,500 FT^3

Total Volume to be excavated = 3,573,456 FT^3 - Vol of Berm

* Containment & Flood Control Earthen Berms will remain.
See next pages for Vol. Estimates

BY JCC DATE 10/13/05

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CHKD. BY WGM DATE 10/18/05

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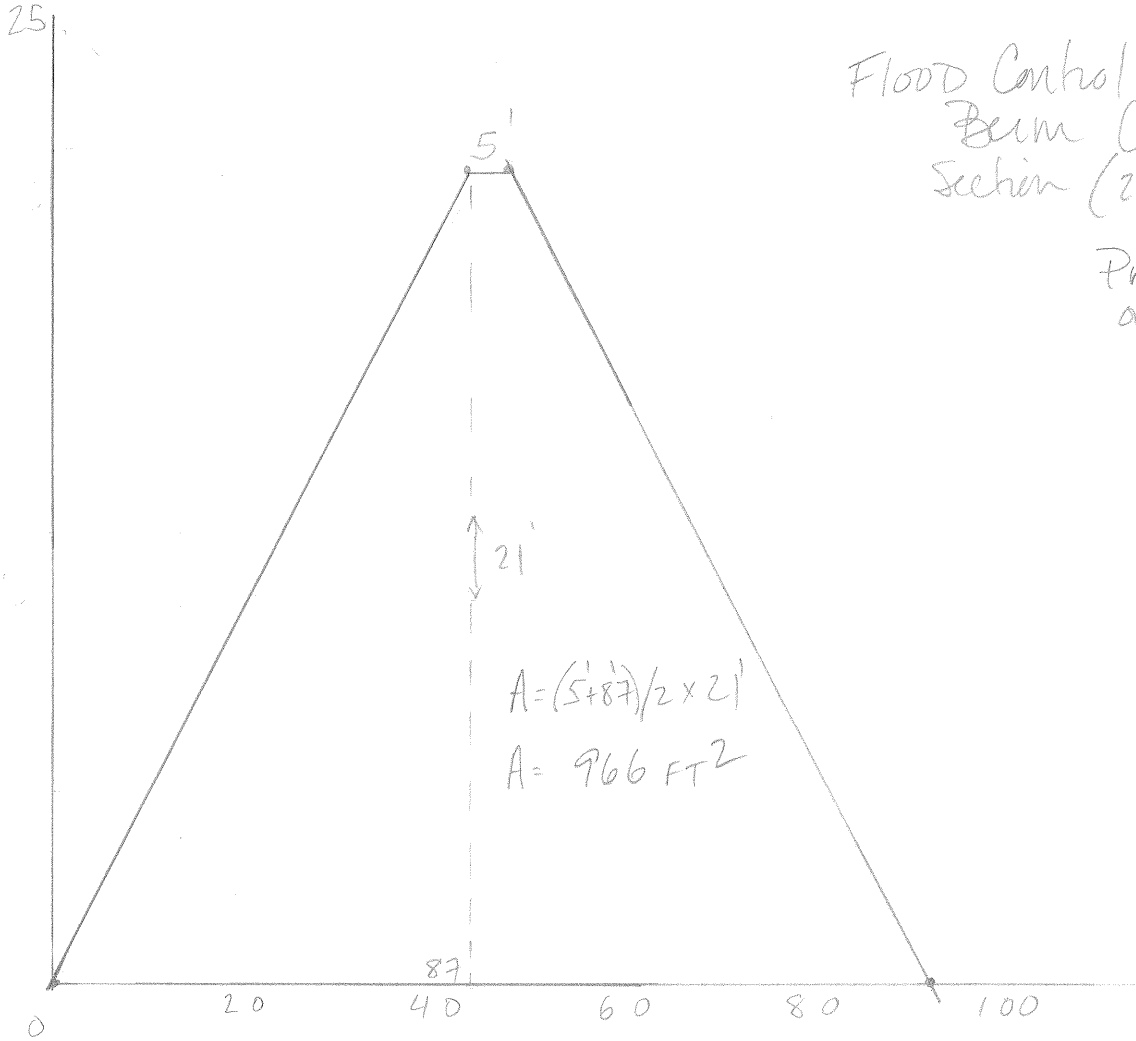
SUBJECT Wackaack Creek Volume Estimates

Flood Control Earthen Berm Cross Section (2:1 slope assumed for Proposed Condition on site plan



Length of Berm = 555 FT

Area of Berm Cross-Section = $966\ FT^2$

Volume of Berm to Remain =

Flood Control Berm – $\underline{536{,}130\ FT^3}$

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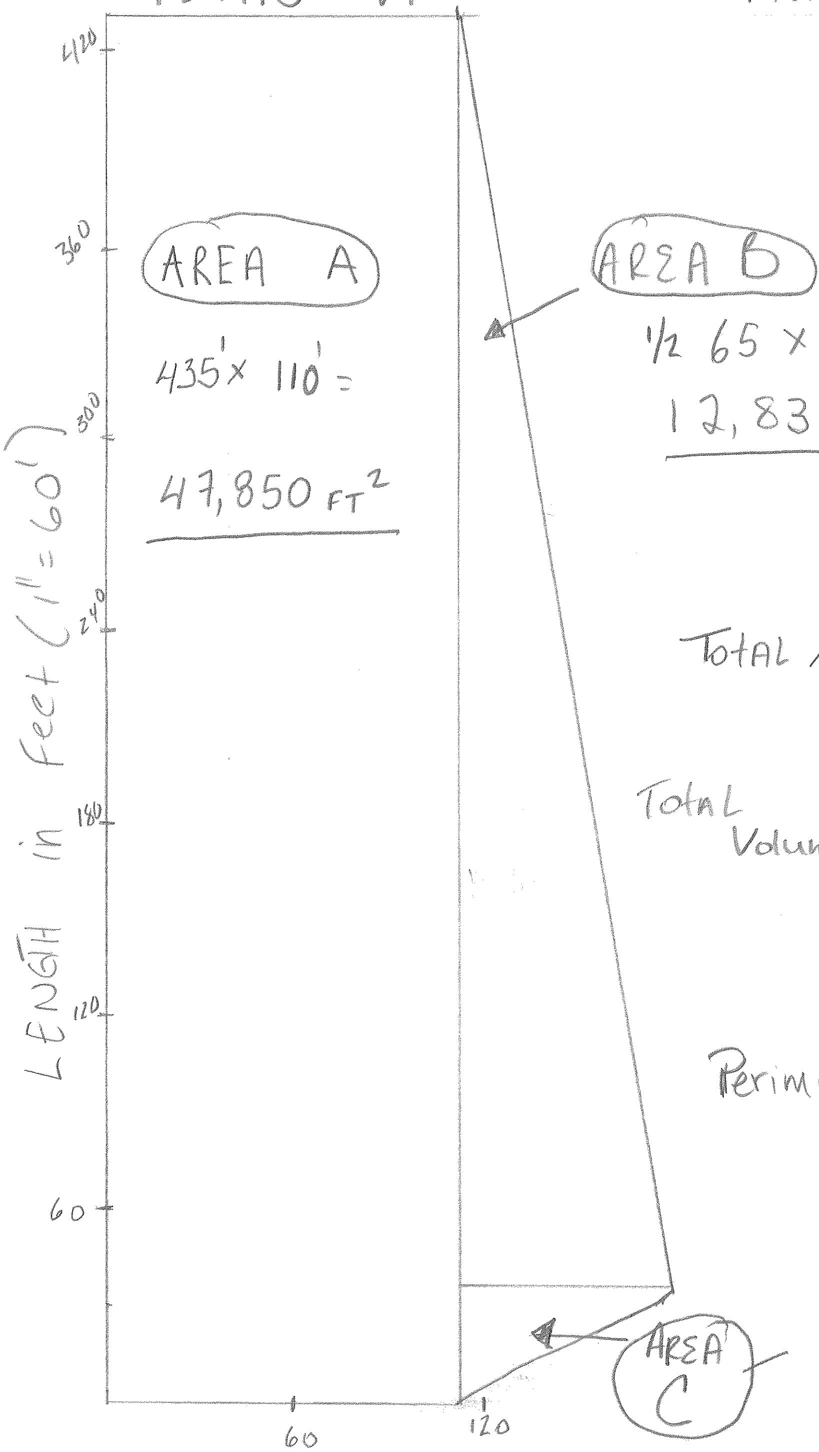
SUBJECT Volume Estimate - For Plateau Area on Middle Thorotare CDF

PLAN VIEW of CDF Plateau

North



AREA A: 435' x 110' = 47,850 FT²

AREA B: 1/2 65 x 395 = 12,838 FT²

AREA C: 1/2 40 x 65 = 1,300 FT²

Total Area = (47,850' + 12,838 + 1,300) = 61,988 FT²

Total Volume = 61,988 FT² x 11' = 681,868 FT³

Perimeter = 1,135 FT

Total Volume = (Area A + Area B + Area C) x Excavation Depth (11')
= 681,868 FT²

BY JC DATE 10/18/05 **LAWLER, MATUSKY & SKELLY ENGINEERS LLP** SHEET NO. 3 OF 3

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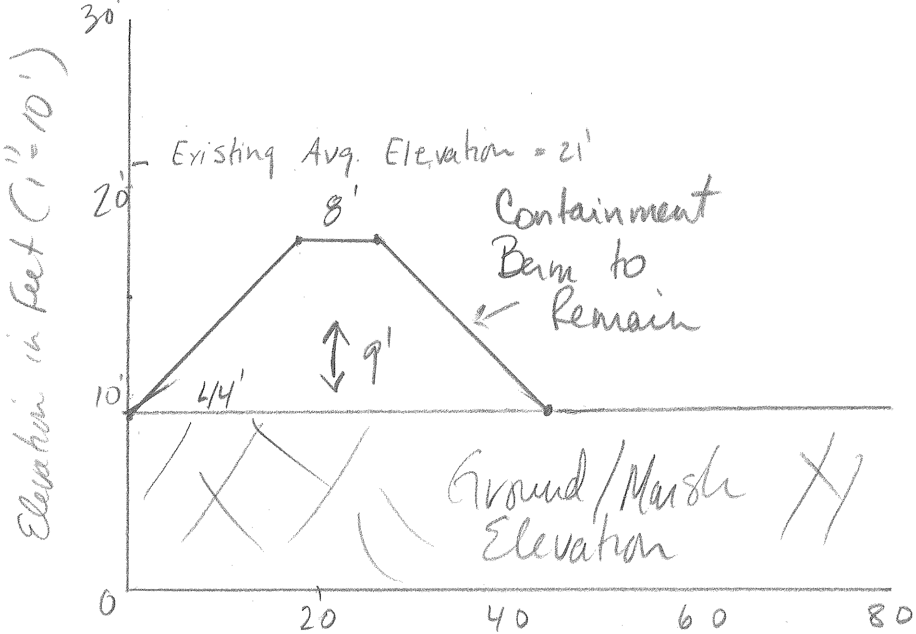
SUBJECT Waackaack Creek - Volume Estimate



Area of Containment Berm

$= (8+44)/2 \times 9 = 234 \text{ FT}^2$

Circumference of Area (C) Page 1 $= \dfrac{500\text{FT} + 320\text{FT}}{2} \times \pi$

$= 5{,}152 \text{ FT}$

Perimeter of Area (B) page 1 = (400' + 300' + 340') = 1,040 FT

Perimeter of Area (C) page 1 = (500' + 480' + 380') = 1,360 FT

Perimeter of CDF = 7,552 FT

× Area of Containment Berm = 1,767,168 FT^3

+ Volume of Flood Control Berm = + 536,130 FT^3

= Material to remain 2,303,298 FT^3

Total Volume Excavated = 3,573,456 FT^3 (from pg 1)

− 2,303,298 FT^3

= 1,270,158 FT^3 = 47,042 cy

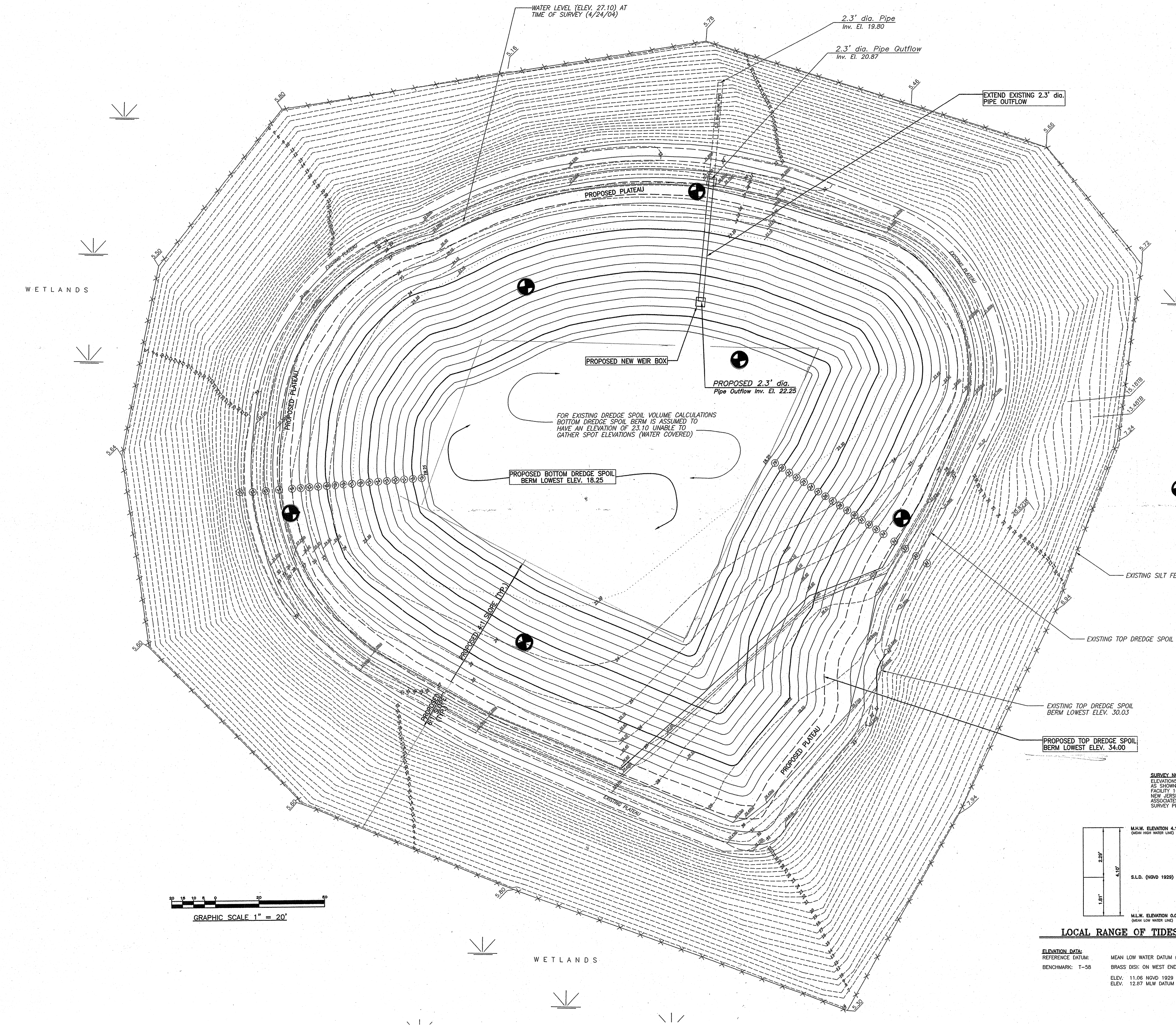
@ 4,000 / Core = 12 Cores

Attachment 2

Sample Locations

Nummy Island in the Town of Stone Harbor, NJ

Nummy Island
Stone Harbor, NJ



PROPOSED SAMPLING LOCATION

CONTAINED DISPOSAL FACILITY SITE 103:
EXISTING AVAILABLE CAPACITIES

TO ELEV. 30.03:	14,530.2 C.Y.	(392,315.9 C.F.)
TO ELEV. 29.03:	11,864.9 C.Y.	(320,352.7 C.F.)
TO ELEV. 28.03:	9,345.0 C.Y.	(252,313.9 C.F.)

CONTAINED DISPOSAL FACILITY SITE 103:
PROPOSED AVAILABLE CAPACITIES

TO ELEV. 34.00:	21,340.4 C.Y.	(576,191.9 C.F.)
TO ELEV. 33.00:	19,136.8 C.Y.	(516,694.8 C.F.)
TO ELEV. 32.00:	17,065.9 C.Y.	(460,779.9 C.F.)

SURVEY NOTE:
ELEVATIONS AND CONDITIONS OUTSIDE OF TOP DREDGE SPOIL BERM LINE AS SHOWN HEREON ARE AS SHOWN ON PLAN "CONTAINED DISPOSAL FACILITY 103, LOT 1, BLOCK 320, MIDDLE TOWNSHIP, CAPE MAY COUNTY, NEW JERSEY", DRAWING No. H-5670, PREPARED BY MICHAEL W. HYLAND ASSOCIATES, P.A., DATED AUGUST 12, 2002, (NOTED ON PLAN AS FIELD SURVEY PERFORMED ON JULY 31, 2002).

M.H.W. ELEVATION 4.10 (MEAN HIGH WATER LINE)
2.29'
4.10'
S.L.D. (NGVD 1929) 1.81
1.81'
M.L.W. ELEVATION 0.00 (MEAN LOW WATER LINE)

LOCAL RANGE OF TIDES
NOT TO SCALE

ELEVATION DATA:
REFERENCE DATUM: MEAN LOW WATER DATUM (LOCAL)
BENCHMARK: T-58 BRASS DISK ON WEST END OF GREAT CHANNEL BRIDGE
ELEV. 11.06 NGVD 1929
ELEV. 12.87 MLW DATUM LOCAL

ELEVATION DATA LEGEND:
EXISTING CONTOUR
PROPOSED CONTOUR
WATER LINE (ELEV. 7.10)
EXISTING ELEVATION
BOTTOM OF BERM
TOP OF BERM
WEIR PLANKS
WATER LEVEL (7.10)

Initially Issued: May 28, 2004
No. REVISION BY DATE

HYLAND DESIGN GROUP, Inc.
101 East Eighth Street, Ocean City, New Jersey 08226
Phone: (609) 399-4477 Fax: (609) 398-7366
www.hylandDesignGroup.com
Bd. of Engineers and Surveyors Certificate of Authorization No. 24GA28088700
ENGINEERS ○ ARCHITECTS ○ SURVEYORS ○ PLANNERS ○ ENVIRONMENTAL CONSULTANTS

Michael W. Hyland
N.J.P.E. & L.S. No. 20509
N.J.R.A. No. 09025

MODIFICATIONS TO CONTAINED DISPOSAL FACILITY 103

TAX LOT 1 TAX BLOCK 320
MIDDLE TOWNSHIP, CAPE MAY COUNTY, NEW JERSEY

C.D.F. PROPOSED MODIFICATIONS

PROJECT No.	4361
DRAWN BY	RSS
CHECKED BY	MWH
Field Book / page	889, 62-65
DRAWING SET No.	H-6136
SHEET	2
OF 2 SHEETS	

Middle Thorofare in Cape May, NJ

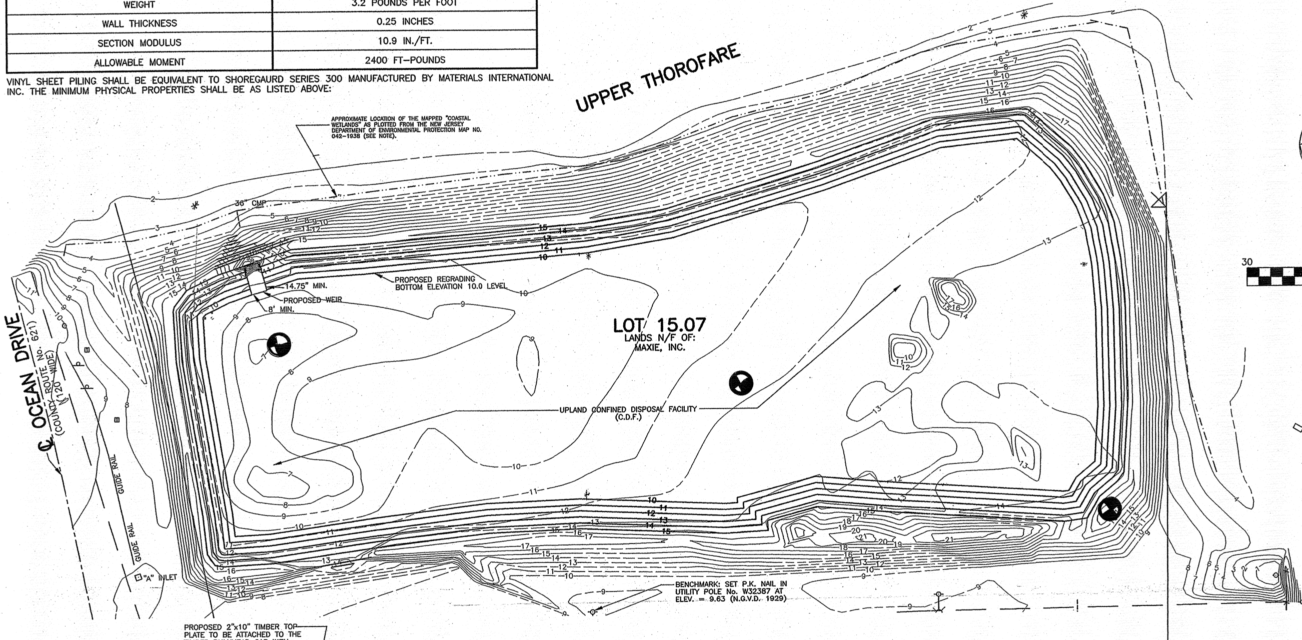
GENERAL NOTES:

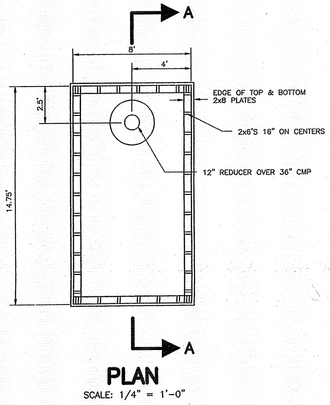
1. DREDGE SPOILS TO BE HYDRAULICALLY DREDGED FROM HINCH MARINA ON LOTS 15.04 & 15.05 BLOCK 793, AND DEPOSITED ON EXISTING SPOILS SITE LOCATED ON LOT 15.07 BLOCK 793, LOWER TOWNSHIP, CAPE MAY COUNTY, NEW JERSEY.
2. THE APPLICANT SHALL PROVIDE WRITTEN AUTHORIZATION FROM THE OWNER OF LOT 15.07 BLOCK 793 TO UTILIZE THE PROPOSED DISPOSAL SITE, DREDGE AND INSTALL BULKHEAD AND ANCHORAGE SYSTEM ON A PORTION OF LOT 15.07.
3. ALL DISCHARGE LINES SHALL BE LOCATED AS NOT TO INTERFERE WITH VESSEL ACCESS TO EXISTING DOCKING AND/OR LAUNCHING FACILITIES OR NAVIGATION, AND SHALL BE PROPERLY MARKED.
4. PRIOR TO COMMENCEMENT OF PROPOSED DREDGING OPERATIONS, THE APPLICANT SHALL OBTAIN CERTIFICATION FROM THE CAPE-ATLANTIC SOIL CONSERVATION DISTRICT FOR SOIL EROSION AND SEDIMENT CONTROL PROCEEDURES, AND SHALL ALSO CONTACT THE N.J.D.E.P. BUREAU OF COASTAL AND LAND USE ENFORCEMENT TO FIELD VERIFY THE INTEGRETY OF THE SPOILS DIKE.
5. DREGING DATES TO BE ESTABLISHED BY THE N.J.D.E.P.
6. ALL CONSTRUCTION EQUIPMENT WORKING ON THE WETLANDS SURFACE SHALL BE SUPPORTED ON MATS, AND ANY WETLANDS DISTURBED DURING CONSTRUCTION SHALL BE RESTORED TO ITS PRE-CONSTRUCTION CONDITION.
7. LIMITS OF EXISTING SPOILS AREA WERE LOCATED IN THE FIELD ON APRIL 30,1998 BY GIBSON ASSOCIATES, P.A.
8. CAPACITY OF EXISTING SPOILS AREA REGRADED IS 13124+/- CUBIC YARDS (CALCULATED USING THE REGRADED BOTTOM ELEVATION OF 10.0 AND THE BERM ELEVATION OF 15.0) THE VOLUME OF PROPOSED SPOILS IS 7836+/- CUBIC YARDS.
9. CONTRACTOR SHALL CHECK AND VERIFY ALL DIMENSIONS AND CONDITIONS AT THE SPOILS SITE PRIOR TO PROCEEDING WITH WORK. ANY DISCREPANCIES SHALL BE REPORTED TO THE ENGINEER AND RESOLVED BEFOR PROCEEDING WITH WORK IN QUESTION.
10. ALL TIMBER/LUMBER SHALL BE C.C.A. PRESSURE TREATED IN ACCORDANCE WITH A.W.P.A. C-1 STANDARDS (2.5# MINIMUM TREATMENT OR EQUIVALENT).
11. ALL CUTS AND HOLES MADE IN THE RIGID VINYL SHEET PILES SHALL BE FILLED WITH A WATERPROOF SEALER.
12. ALL CONSTRUCTION SHALL BE IN ACCORDANCE WITH APPLICABLE CODES AND ORDINANCES, AND IN GOOD CONSTRUCTION PRACTICE.
13. ANY CHANGES, MODIFICATIONS AND/OR SUBSTITUTION OF MATERIALS TO THE BULKHEAD DESIGN AND/OR ANCHORAGE SYSTEM IS SUBJECT TO REVIEW AND APPROVAL BY THE DESIGN ENGINEER.
14. ALL UPLAND DISTURBED AREAS TO BE PERMANENTLY STABILIZED IN ACCORDANCE WITH THE STANDARDS FOR SOIL EROSION AND SEDIMENT CONTROL IN NEW JERSEY.
15. ALL HARDWARE SHALL BE HOT DIPPED GALVANIZIED.

BULKHEAD SPECIFICATION:

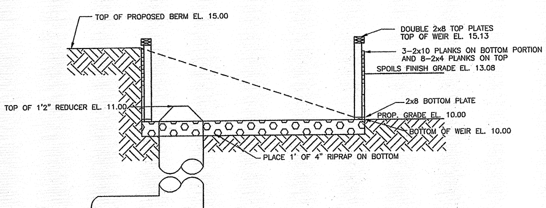
PHYSICAL PROPERTY	MINIMUM SPECIFICATION
MATERIAL	RECYCLED VINYL WITH WEATHERABLE VIRGIN CAPSTOCK
DEPTH OF SECTION	7 INCHES
WEIGHT	3.2 POUNDS PER FOOT
WALL THICKNESS	0.25 INCHES
SECTION MODULUS	10.9 IN./FT.
ALLOWABLE MOMENT	2400 FT-POUNDS

VINYL SHEET PILING SHALL BE EQUIVALENT TO SHOREGAURD SERIES 300 MANUFACTURED BY MATERIALS INTERNATIONAL INC. THE MINIMUM PHYSICAL PROPERTIES SHALL BE AS LISTED ABOVE:

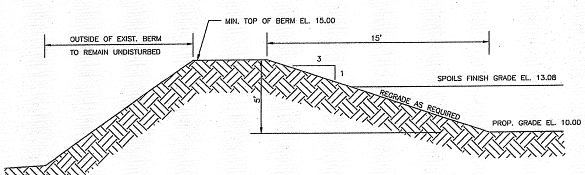




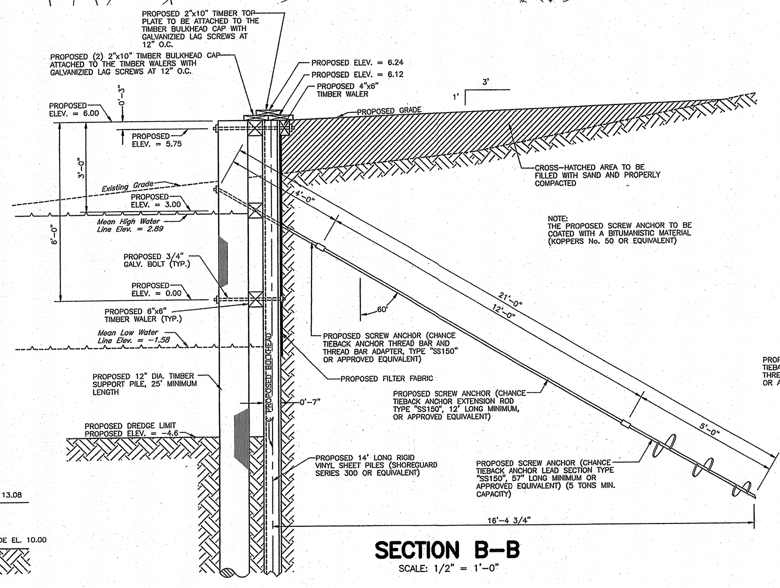
PLAN
SCALE: 1/4" = 1'-0"



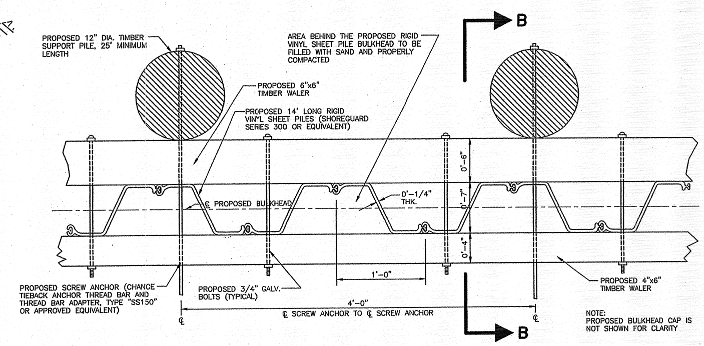
SECTION A–A
OVERFLOW WEIR DETAIL
SCALE: 1/4" = 1'-0"



SPOILS DIKE SECTION
NOT TO SCALE



SECTION B–B
SCALE: 1/2" = 1'-0"



RIGID VINYL SHEET PILE BULKHEAD DETAIL
SCALE: 1-1/2" = 1'-0"

ISSUED FOR PERMIT APPLICATION

DATE	REVISIONS
03/22/99	GENERAL REVISIONS PER N.J.D.E.P. LETTER DATED FEBRUARY 16, 1999

PREPARED BY:
Walter E. Surran Jr.
WALTER E. SURRAN, JR
PROFESSIONAL ENGINEER
N.J.P.E. LICENSE NO. 31859

DRAWN: WES | CHECKED: MJG

GIBSON ASSOCIATES, P.A.
CONSULTING ENGINEERS AND SURVEYORS
4211 LANDIS AVENUE
SEA ISLE CITY, NEW JERSEY 08243-1921
(609) 263-3178

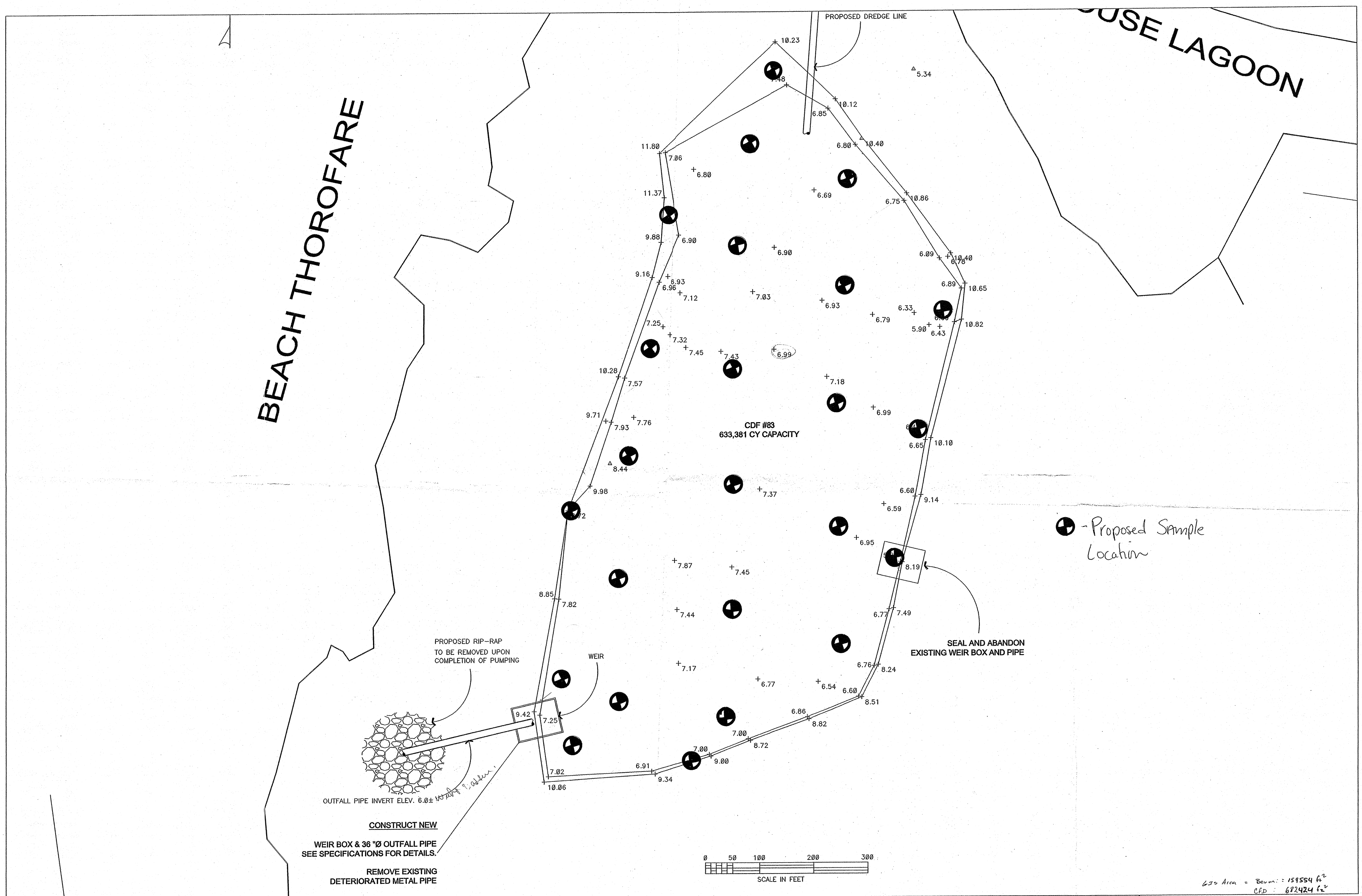
UPLAND CONFINED DISPOSAL FACILITY (C.D.F.)
for
HINCH MARINA, INC.
LOT 15.07, BLOCK 793
LOWER TOWNSHIP
CAPE MAY COUNTY, NEW JERSEY

DATE: 01-07-98 | SCALE: 1"=30' | SHEET 3 OF 3 | DWG. NO.: 2382-2

SHEET3.DWG F-1429

Site 83 in Ocean City, NJ

Ocean City



32nd Street Site (Site #83) - Ocean City, NJ

Corps Site D in Cape May, NJ

Horizontal reference — NAD 83, New Jersey State Plane, Zone 2900, U.S. Foot.

Vertical reference — NAVD 88

Elevations are expressed in Feet and Tenths and refer to NAVD 88.

5' Contour Interval is shown thus:

1' Contour Ineterval is shown thus:

The information depicted on this map represents the results of surveys made on the dates indicated and can only be considered as indicating the general conditions existing at that time.

- Proposed Sample Locations

Scale in Feet

100 0 100 200 300

US Army Corps of Engineers Philadelphia District

Mark	Description	Date	Appr.

Mark	Description	Date	Appr.

U.S. ARMY ENGINEER DISTRICT, PHILADELPHIA CORPS OF ENGINEERS PHILADELPHIA, PENNSYLVANIA	Designed by:		Date: / Rev.
	Dwn by:	Ckd by:	IFB DACW61–
TRACED BY M.Wallowicz / PLOTTED BY M.Wallowicz / DRAWING NO.	Reviewed by:		Drawing code:
SURVEYED BY C.Cipriani / DATE SURVEYED Apr/May 2002 / APPROVED	Submitted by: Chief, Arch. Branch		File name: Plot date: May/22/2002 Plot scale: 1in to 100 ft

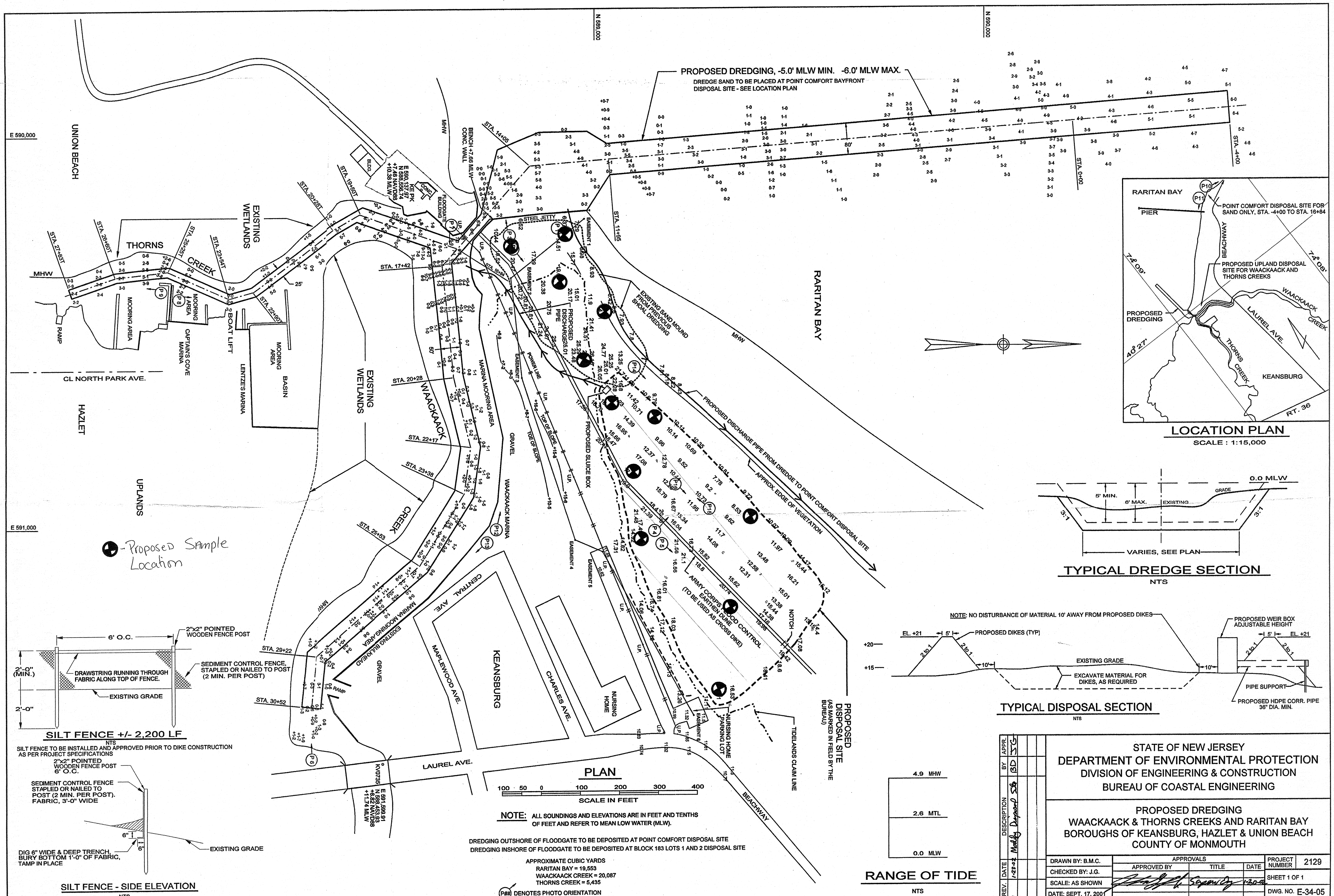
DISPOSAL AREA – VICINITY OF HIGBEE BEACH CAPE MAY COUNTY, NEW JERSEY

TOPOGRAPHIC SURVEYS

Sheet reference number:

Sheet 1 of 1

Waackaack Creek in Keansburg, NJ



PROPOSED DREDGING, -5.0' MLW MIN. -6.0' MLW MAX.
DREDGE SAND TO BE PLACED AT POINT COMFORT BAYFRONT DISPOSAL SITE - SEE LOCATION PLAN
UNION BEACH
HAZLET
UPLANDS
THORNS CREEK
WAACKAACK CREEK
EXISTING WETLANDS
RARITAN BAY
KEANSBURG
MOORING AREA
CAPTAIN'S COVE MARINA
BOAT LIFT
LENTZE'S MARINA
BASIN
CL NORTH PARK AVE.
WAACKAACK MARINA
MARINA MOORING AREA
EXISTING BULKHEAD
GRAVEL
CENTRAL AVE.
MAPLEWOOD AVE.
CHARLES AVE.
LAUREL AVE.
BEACHWAY
NURSING HOME
NURSING HOME PARKING LOT
FLOODGATE BUILDING
STEEL JETTY
PROPOSED DISCHARGE PIPE
PROPOSED SLUICE BOX
POWER LINE
TOP OF SLOPE
EXISTING SAND MOUND FROM PREVIOUS SHOAL DREDGING
PROPOSED DISCHARGE PIPE FROM DREDGE TO POINT COMFORT DISPOSAL SITE
APPROX. EDGE OF VEGETATION
ARMY CORPS FLOOD CONTROL EARTHEN DUNE (TO BE USED AS CROSS DIKE)
NOTCH
TIDELANDS CLAIM LINE
PROPOSED DISPOSAL SITE (AS MARKED IN FIELD BY THE BUREAU)
-Proposed Sample Location
LOCATION PLAN
SCALE : 1:15,000
RARITAN BAY
PIER
POINT COMFORT DISPOSAL SITE FOR SAND ONLY, STA. -4+00 TO STA. 16+84
PROPOSED UPLAND DISPOSAL SITE FOR WAACKAACK AND THORNS CREEKS
PROPOSED DREDGING
KEANSBURG
RT. 36
TYPICAL DREDGE SECTION
NTS
0.0 MLW
5' MIN.
6' MAX.
EXISTING GRADE
VARIES, SEE PLAN
3:1
NOTE: NO DISTURBANCE OF MATERIAL 10' AWAY FROM PROPOSED DIKES
PROPOSED DIKES (TYP)
EXISTING GRADE
EXCAVATE MATERIAL FOR DIKES, AS REQUIRED
PROPOSED WEIR BOX ADJUSTABLE HEIGHT
PIPE SUPPORT
PROPOSED HDPE CORR. PIPE 36" DIA. MIN.
TYPICAL DISPOSAL SECTION
NTS
SILT FENCE +/- 2,200 LF
NTS
SILT FENCE TO BE INSTALLED AND APPROVED PRIOR TO DIKE CONSTRUCTION AS PER PROJECT SPECIFICATIONS
2"x2" POINTED WOODEN FENCE POST
DRAWSTRING RUNNING THROUGH FABRIC ALONG TOP OF FENCE.
SEDIMENT CONTROL FENCE, STAPLED OR NAILED TO POST (2 MIN. PER POST)
EXISTING GRADE
6' O.C.
SEDIMENT CONTROL FENCE STAPLED OR NAILED TO POST (2 MIN. PER POST). FABRIC, 3'-0" WIDE
DIG 6" WIDE & DEEP TRENCH, BURY BOTTOM 1'-0" OF FABRIC, TAMP IN PLACE
SILT FENCE - SIDE ELEVATION
NTS
PLAN
SCALE IN FEET
NOTE: ALL SOUNDINGS AND ELEVATIONS ARE IN FEET AND TENTHS OF FEET AND REFER TO MEAN LOW WATER (MLW).
DREDGING OUTSHORE OF FLOODGATE TO BE DEPOSITED AT POINT COMFORT DISPOSAL SITE
DREDGING INSHORE OF FLOODGATE TO BE DEPOSITED AT BLOCK 183 LOTS 1 AND 2 DISPOSAL SITE
APPROXIMATE CUBIC YARDS
RARITAN BAY = 19,553
WAACKAACK CREEK = 20,087
THORNS CREEK = 5,435
P## DENOTES PHOTO ORIENTATION
4.9 MHW
2.6 MTL
0.0 MLW
RANGE OF TIDE
NTS
STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF ENGINEERING & CONSTRUCTION
BUREAU OF COASTAL ENGINEERING
PROPOSED DREDGING
WAACKAACK & THORNS CREEKS AND RARITAN BAY
BOROUGHS OF KEANSBURG, HAZLET & UNION BEACH
COUNTY OF MONMOUTH
REV. DATE DESCRIPTION BY APPR.
1 1-23-02 Modify Disposal Site BD JG
DRAWN BY: B.M.C.
CHECKED BY: J.G.
SCALE: AS SHOWN
DATE: SEPT. 17, 2001
APPROVALS
APPROVED BY TITLE DATE
PROJECT NUMBER 2129
SHEET 1 OF 1
DWG. NO. E-34-05

Curran, Jennifer L.

From: Suzanne Dietrick [Suzanne.Dietrick@dep.state.nj.us]
Sent: Thursday, December 22, 2005 1:20 PM
To: Dave Risilia; Curran, Jennifer L.
Cc: dolce@aquasurvey.com; GENEVIEVE.BOEHM@dot.state.nj.us; Mueller, Werner G.
Subject: Re: Proposed composits for remaining CDFs

The proposed sampling/compositing scheme looks fine.

>>> "Curran, Jennifer L." <Jennifer.Curran@hdrinc.com> 12/21/05 2:51 PM
>>>
Dave/Suzanne,
Attached is our proposed compositing schemes for the remaining 4 CDFs to be sampled under the I Boat NJ CDF Sampling Program. The document provides a description of the proposed composites and site plans that show their locations. At this point we are assuming that the cores to be composited will contain similar material. We propose to combine the material from each distinct strata of the cores. If we find that the material within the strata or the cores is different, we will not
combine the samples.

Aqua Survey is currently sampling Waackaack Creek.

Please let us know if you approve of the plan.
Thanks,
Jennifer Curran
<<Compositing Proposal.pdf>>

Appendix B
Detailed Analytical Results

APPENDIX B – DETAILED ANALYTICAL RESULTS

The following sections provide a detailed analysis of the results of the sampling program carried out under the project entitled "Characterization of Dredged Material Stored in New Jersey Confined Disposal Facilities" for the New Jersey Department of Transportation Office of Maritime Resources' I Boat NJ program. Five CDFs were evaluated as a part of this analysis: Nummy Island in Stone Harbor, Middle Thorofare in Cape May, Site #83 in Ocean City, Corps Cell D in Cape May, and Waackaack Creek in Keansburg. The sampling plan for the CDFs and the methodology for the chemical and physical analyses for the sediments are provided in Appendix A of this report.

The results of the physical and chemical analyses are organized in this Appendix as follows:

- Section B.1 Nummy Island
- Section B.2 Middle Thorofare
- Section B.3 Site #83
- Section B.4 Corps Cell D
- Section B.5 Waackaack Creek
- Section B.6 Summary

B.1 NUMMY ISLAND, STONE HARBOR, NJ

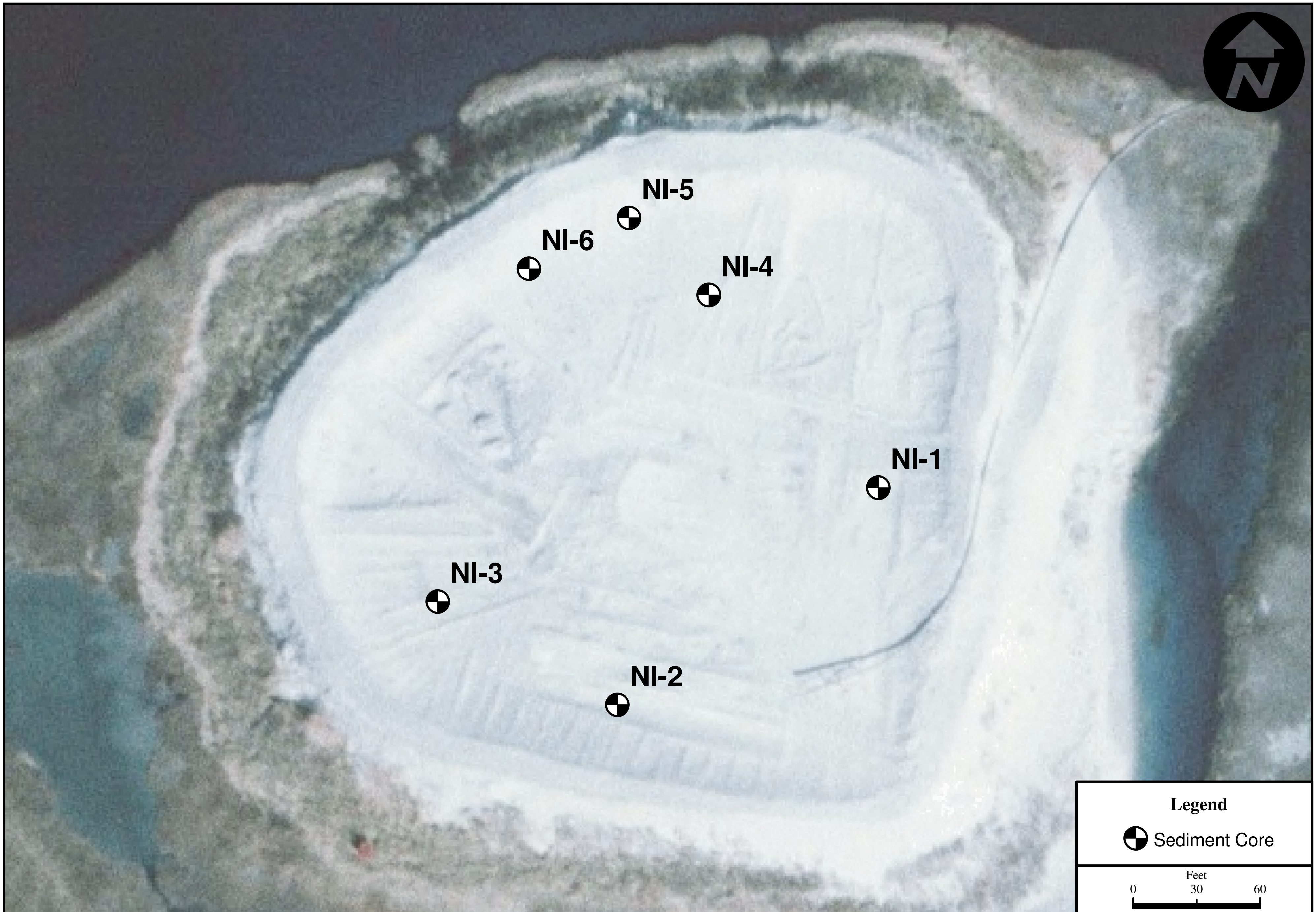
Nummy Island is located in the Borough of Stone Harbor, New Jersey. It is a man-made Island that has been used as a confined disposal facility (CDF) for containing and dewatering material dredged from nearby waterways and marinas. Approximately 90,000 cy of dredged material are currently stored in the CDF. It is estimated that approximately 50,000 cubic yards (cy) of dredged material could be removed from the CDF, leaving 40,000 cy of material to reshape the berm to allow for containment of future dredging projects.

A sampling program was designed to characterize the 50,000 cy of material that could be removed from the CDF. Six sediment cores were collected from the CDF by Aqua Survey, Inc. (ASI) in 2005, and the location of these cores is depicted on Figure B-1. One sample was prepared from each distinct strata of material from each core. The dredged material in the cores was stratified into three distinct layers, and therefore 18 samples were prepared for physical analysis. Physical properties of the sediments were analyzed in the ASI laboratory. These properties included grain size composition, total organic carbon and percent moisture.

- *B.1.1 Physical Characteristics*

The Nummy Island CDF contains three distinct layers of dredged material. An eight foot thick top layer of black silt overlies a seven to eight foot deep layer of fine white sand which overlies a six to seven foot deep layer of fine grey sand.

Table B-1 shows grain size composition of the Nummy Island sediment core subsamples. The top layer (a) of Cores 4, 5, and 6, located near the weir box, contained the greatest amount of fine-grained material. The percent of silt and clay particles in the top layer of these cores ranged from 88% to 92%. Cores 1, 2 and 3 were located on the opposite side of the CDF and the percent of silt and clay particles in the top layer of these cores ranged from 30% to 72%, with the greatest amount of fine-grained material in Core 3.



Legend

Sediment Core

Feet
0 30 60

HDR | LMS

Location of Sediment Cores taken from the Nummy Island CDF in Stone Harbor, NJ

Job No.	Date	Figure No.
0904-007	06/05/06	B-1

The middle layer (b) of all collected cores had sand content ranging from 91% to 98%. The grain size composition of the bottom layer (c) of the cores varied, but with the exception of Core 1, the subsamples had sand content greater than 50%. The difference in the grain size composition of the bottom section of Core 1 compared to the other cores is likely due to inclusion of peat moss from the underlying marsh in the subsample.

Both the percent moisture and TOC content were highest in the fine-grained sediments from the top layer of the CDF, and lowest in the sandy sediment. The percent moisture ranged from 5% to 53%, and the TOC content ranged from less than one-tenth of a percent to 5% in the subsamples.

The nine subsamples that contained less than 90% sand and gravel were combined to form three composite samples. Material from the top layers of Cores 4, 5, and 6 formed Composite A – Top (A layer), material from the top layers of Cores 1, 2, and 3 formed Composite B – Top (A layer), and the bottom layers of cores 4, 5, and 6 formed the third sample, Composite A - Bottom (C layer). Physical characteristics of the composite samples were not determined.

Table B-1. Physical properties of the sediment cores collected from the Nummy Island CDF.

Core/ Comp ID	ASI #	Moisture (%)	TOC (ppm)	TOC (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	% Fine Materials	% Coarse Materials
NI-1 Top	20050969a	25.4	8,809	0.9	17.1	13.6	69.3	0.0	30.7	69.3
NI-2 Top	20050946a	30.9	15,017	1.5	24.6	22.3	53.1	0.0	46.9	53.1
NI-3 Top	20050947a	38.3	31,476	3.2	37.2	35.1	27.7	0.0	72.3	27.7
NI-4 Top	20050948a	51.7	35,013	3.5	46.6	45.4	8.0	0.0	92.0	8.0
NI-5 Top	20050949a	47.4	35,539	3.6	45.7	42.5	11.8	0.0	88.2	11.8
NI-6 Top	20050950a	53.2	36,928	3.7	47.1	42.3	10.6	0.0	89.4	10.6
NI-1 Mid	20050969b	13.6	931	0.1	2.9	5.9	91.2	0.0	8.8	91.2
NI-2 Mid	20050946b	9.6	1,038	0.1	4.3	2.0	93.7	0.0	6.3	93.7
NI-3 Mid	20050947b	9.1	1,172	0.1	2.0	1.1	97.0	0.0	3.0	97.0
NI-4 Mid	20050948b	5.6	889	0.1	2.0	0.0	98.0	0.0	2.0	98.0
NI-5 Mid	20050949b	5.8	815	0.1	2.0	0.0	98.0	0.0	2.0	98.0
NI-6 Mid	20050950b	8.7	2,998	0.3	2.7	0.0	97.6	0.0	2.7	97.6
NI-1 Bot*	20050969c	42.3	49,730	5.0	38.3	37.3	24.4	0.0	75.6	24.4

Table B-1 (Cont'd). Physical properties of the sediment cores collected from the Nummy Island CDF.

Core/ Comp ID	ASI #	Moisture (%)	TOC (ppm)	TOC (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	% Fine Materials	% Coarse Materials
NI-2 Bot	20050946c	28.2	10,881	1.1	17.6	12.4	70.0	0.0	30.0	70.0
NI-3 Bot	20050947c	21.7	4,797	0.5	8.9	4.2	86.9	0.0	13.1	86.9
NI-4 Bot	20050948c	22.6	16,235	1.6	2.0	1.1	97.0	0.0	3.0	97.0
NI-5 Bot	20050949c	19.5	2,480	0.3	11.6	8.7	79.7	0.0	20.3	79.7
NI-6 Bot	20050950c	21.0	5,075	0.5	8.0	0.0	92.0	0.0	8.0	92.0

* NI-1Bot was peat moss from the underlying marsh.

- *B.1.2 Chemical Characteristics*

The composite sediment samples were analyzed for pesticides, PCBs, semivolatile compounds and metals. Of the organic compounds, only 4'4'-DDE, 4'4'-DDD, phthalates and some PAHs were detected in the composite samples (Table B-2). Metals were detected in all three composite samples. For the compounds that were detected, concentrations were generally higher in Composite A-Top (top layer of Cores 4, 5 and 6), followed by Composite B-Top (top layer of Cores 1, 2, and 3) and Composite A-Bottom (bottom layer of Cores 4, 5 and 6). However, none of the detected compounds had concentrations above the NJRDCSCC. Generally, all were below the Criteria by an order of magnitude.

Table B-2. Compounds detected in sediment samples from the Nummy Island CDF.

	NJ RDCSCC	**Comp A-Top (A-layer)**		**Comp A-Bottom (C-layer)**		**Comp B-Top (A-layer)**	
		Cores 4,5,6 (Top)		**Cores 4,5,6 (Bottom)**		**Cores 1,2,3 (Top)**	
	Soil	**Unamended Sediment**		**Unamended Sediment**		**Unamended Sediment**	
Organics	**ug/kg**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**
Di-n-butylphthalate	5700000	190.0	J	110.0	J	130.0	J
Fluoranthene (PAH)	2300000	390.0			ND	290.0	
Pyrene (PAH)	1700000	410.0			ND	300.0	
Butylbenzylphthalate	1100000	140.0	J		ND		ND
Benzo(a)anthracene (PAH)	900	160.0	J		ND	100.0	J
Chrysene (PAH)	9000	250.0			ND	160.0	J
bis(2-Ethylhexyl)phthalate	49000	360.0		77.00	J	120.0	J

Table B-2 (Cont'd). Compounds detected in sediment samples from the Nummy Island CDF.

Organics	ug/kg	ug/kg	Q	ug/kg	Q	ug/kg	Q
Benzo(b)fluoranthene (PAH)	900	230.0	J		ND	130.0	J
Benzo(k)fluoranthene (PAH)	900	72.00	J		ND	53.0	J
Benzo(a)pyrene (PAH)	660	160.0	J		ND	85.0	J
Indeno(1,2,3-cd)pyrene (PAH)	900	130.0	J		ND	59.0	J
4,4'-DDE	2000	12.00		1.700		9.7	
4,4'-DDD	3000	11.00		1.700		11.0	
Metals	**mg/kg**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**
Aluminum	NA	15200		2740		9160	
Arsenic	20	7.98		1.89		4.79	
Barium	700	39.40		9.66		23.40	
Cadmium	39	0.40			ND		ND
Calcium	NA	4360		2360		2720	
Chromium	NA	50.60		11.90		31.80	
Cobalt	NA	18.00		4.83		10.50	
Copper	600	26.60		4.42		16.20	
Lead	400	34.90		5.74		20.50	
Magnesium	NA	8480		1560		4680	
Manganese	NA	254.00		63.50		145.00	
Mercury	14	0.35		0.044		0.19	
Nickel	250	21.00		5.46		12.80	
Potassium	NA	2530		777		1490	
Silver	110	0.52	J		ND		ND
Sodium	NA	8230		891		1310	
Vanadium	370	47.50		11.30		27.90	
Zinc	1500	105.00		24.40		58.80	

Qualifiers (Q):
NA - No criteria
ND - Not detected at the method detection limit (MDL)
J - Estimated concentration, below calibration range and above MDL

In the leachate produced from exposure of the composite samples to artificial rainwater, bis(2-Ethyltexyl)phthalate was the only organic compound detected (Table B-3). This compound was also detected in the analytical blank, and it's presence in the sample may be due to cross-contamination. This compound was found in very low concentrations in the sediments, and Phthalates are widely recognized as ubiquitous compounds that are often found as laboratory contaminants (USEPA 1970). Metals were detected in the leachate from all three sediment composites (Table B-3). Concentrations of five metals in the leachate samples exceeded the NJSGWQC. The metals that exceeded the Criteria in the leachate samples and the composites from which the samples originated include:

manganese and selenium in all three composite samples, aluminum in Composites A-Bottom and B-Top, sodium in Composites A-Top and B-Top and iron in Composite A-Bottom.

Table B-3. Compounds detected in leachate from Nummy Island CDF sediment samples

	NJSGWQC	Comp A-Top (A-layer)		Comp A-Bottom (C-layer)		Comp B-Top (A-layer)	
		Cores 4,5,6 (Top layer)		Cores 4,5,6 (Bottom layer)		Cores 1,2,3 (Top layer)	
	Groundwater	Leachate		Leachate		Leachate	
Organics	**ug/L**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**
bis(2-Ethylhexyl)phthalate	3		ND	7.800	B	7.800	B
Metals	**ug/L**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**
Cobalt	NA		ND	0.01	J		ND
Copper	1.3	0.01	J	0.01	J	0.03	
Iron	0.3	0.07		7.98		0.18	
Magnesium	NA	27		15		22	
Manganese	0.05	0.06		0.29		0.18	
Nickel	0.1		ND	0.02	J	0.004	J
Potassium	NA	20		8		15	
Selenium	0.04	0.174		0.116		0.090	
Sodium	50	71		39		56	
Vanadium	NA		ND	0.005	J		ND
Zinc	2	0.03		0.3		0.15	

Qualifiers (Q):
NA - No criteria
ND - Not detected at the method detection limit (MDL)
B - Compound also detected in the batch blank
J - Estimated concentration, below calibration range and above MDL
A highlighted value indicates that the concentration was above Groundwater Criteria

Some of the method detection limits for semivolatile compounds, pesticides and metals exceeded the NJSGWQC and whether actual concentrations in the samples exceeded the Criteria is unknown (Table B-4). The method detection limits for these compounds were all equal to or below those required by NJDEP for dredging projects (NJDEP 1997).

Table B-4. Compounds with method detection limits exceeding the NJSGWQC in the analysis of leachate samples from the Nummy Island CDF.

	NJSGWQC	NJ Required MDL	Comp A-Top (A-layer)		Comp A-Bottom (C-layer)		Comp B-Top (A-layer)	
			Cores 4,5,6 (Top)		Cores 4,5,6 (Bottom)		Cores 1,2,3 (Top)	
	Groundwater	Leachate	Leachate		Leachate		Leachate	
Organics	**ug/L**	**ug/L**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**
bis(2-Chloroethyl)ether	7	10	10	ND	10	ND	10	ND
Hexachloroethane	7	10	10	ND	10	ND	10	ND
Nitrobenzene	6	10	10	ND	10	ND	10	ND
1,2,4-Trichlorobenzene	9	10	10	ND	10	ND	10	ND
Hexachloro-1,3-butadiene	1	10	10	ND	10	ND	10	ND
Hexachlorobenzene	0.02	10	10	ND	10	ND	10	ND
Pentachlorophenol	0.3	50	10	ND	10	ND	10	ND
Benzo(a)anthracene	0.1	10	10	ND	10	ND	10	ND
Chrysene	5	10	10	ND	10	ND	10	ND
bis(2-Ethylhexyl)phthalate	3	10	10	ND	7.8	B	7.80	B
Benzo(b)fluoranthene	0.2	10	10	ND	10	ND	10	ND
Benzo(k)fluoranthene	0.5	10	10	ND	10	ND	10	ND
Benzo(a)pyrene	0.1	10	10	ND	10	ND	10	ND
Indeno(1,2,3-cd)pyrene	0.2	10	10	ND	10	ND	10	ND
Dibenzo(a,h))anthracene	0.3	10	10	ND	10	ND	10	ND
alpha-BHC	0.02	0.05	0.05	ND	0.05	ND	0.05	ND
beta-BHC	0.04	0.05	0.05	ND	0.05	ND	0.05	ND
gamma-BHC (Lindane)	0.03	0.05	0.05	ND	0.05	ND	0.05	ND
Aldrin	0.04	0.05	0.05	ND	0.05	ND	0.05	ND
Dieldrin	0.03	0.10	0.05	ND	0.05	ND	0.05	ND
Metals	**mg/L**	**mg/L**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**
Antimony	0.006	0.06	0.025	ND	0.025	ND	0.025	ND
Arsenic	0.003	0.01	0.010	ND	0.010	ND	0.010	ND
Beryllium	0.001	0.005	0.005	ND	0.005	ND	0.005	ND
Cadmium	0.004	0.005	0.005	ND	0.005	ND	0.005	ND
Thallium	0.002	0.01	0.010	ND	0.010	ND	0.010	ND

Qualifiers (Q):
ND - Not detected at the listed method detection limit (MDL)
B - Compound also detected in the batch blank

B.2 MIDDLE THOROFARE, CAPE MAY, NJ

The Middle Thorofare CDF is a shoreline CDF located in Cape May, NJ. The CDF contains approximately 39,500 cy of dredged material, and it was estimated that approximately 35,000 cy of material can be removed, which would leave a sufficient volume of material to reshape the berm to facilitate future dredging projects.

ASI collected three sediment cores from the Middle Thorofare CDF (Figure B-2). The three collected cores did not have any sediment stratification and each core was homogenized over the entire length. Three samples were prepared for physical and chemical analyses. The following sections describe the physical and chemical properties of the material in the sediment samples.

- *B.2.1 Physical Characteristics*

Table B-4 shows the grain size composition of the Middle Thorofare sediment core subsamples. Core 1 was collected from near the weir structure. The sediment composition in this area was dominated by black silt and clay (80%) with some sand (20%). Core 2 was collected from the approximate center of the CDF. This core had greater sand content (60%) and approximately half of the silt and clay of Core 1. Core 3 was collected in the berm area on the north side of the CDF. Sediment composition at this location was primarily brown sand and gravel (95%), with little silt and clay (5%).

Percent moisture and TOC content of the sediment samples was correlated with the amount of silt and clay. Moisture and TOC content was greatest in Core 1 and least in Core 3. Percent moisture in the individual cores ranged from 4.1% to 44.5% and TOC content ranged from 0.29% to 3.1%.

Composite MT-A was comprised of sediment from Cores 1 and 2 and had grain size composition of 36% sand and 64% silt and clay (Table B-5). Composite MT-A had similar percent moisture and TOC content to Cores 1 and 2.

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Location of Sediment Cores taken from the Middle Thorofare CDF in Cape May, NJ

Job No.	Date	Figure No.
0904-007	06/05/06	B-2

Table B-5. Physical properties of the sediment cores collected from the Middle Thorofare CDF.

Core/ Comp ID	ASI #	Moisture (%)	TOC (ppm)	TOC (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	% Fine Material	% Coarse Material
MT-1	20060009	44.5	30,508	3.1	34.3	45.5	20.1	0.0	79.8	20.1
MT-2	20060010	32.3	14,654	1.5	17.7	23.1	58.7	0.6	40.8	59.3
Comp MT-A	20060015	41.9	28,263	2.8	27.4	37.0	35.3	0.3	64.4	35.6
MT-3	20060003	4.1	2,918	0.3	2.2	3.0	87.6	7.2	5.2	94.8

- *B.2.2 Chemical Characteristics*

Composite MT-A was analyzed for semivolatile compounds, pesticides, PCBs and metals. Phthalates, some PAHs and 4,4'-DDE were the only organic compounds detected in the composite sediment sample (Table B-6). Almost all of the metals for which analyses were conducted were detected in the composite sample (Table B-6). None of the detected compounds had concentrations above the NJRDCSCC.

Table B-6. Compounds detected in the Middle Thorofare CDF composite sediment sample

	NJ RDCSCC	**Composite MT-A**	
		Cores 1 and 2	
	Soil	**Unamended Sediment**	
Organics	**ug/kg**	**ug/kg**	**Q**
Diethylphthalate +	10,000,000	260.0	
Di-n-butylphthalate +	5700000	130.0	J
Fluoranthene (PAH)+	2300000	680.0	
Pyrene (PAH)+	1700000	600.0	
Benzo(a)anthracene (PAH)+	900	170.0	J
Chrysene (PAH)+	9000	200.0	J
bis(2-Ethylhexyl)phthalate +	49000	290.0	
Benzo(b)fluoranthene +	900	160.0	J
4,4'-DDE	2000	8.40	J
Metals	**mg/kg**	**mg/kg**	**Q**
Aluminum	NA	7910	
Arsenic	20	7.8	

Table B-6 (Cont'd). Compounds detected in the Middle Thorofare CDF composite sediment sample

	NJ RDCSCC	Composite MT-A	
		Cores 1 and 2	
	Soil	Unamended Sediment	
Organics	ug/kg	ug/kg	Q
Barium	700	27.3	
Cadmium	39	0.5	
Calcium	NA	3880	
Chromium	NA	28	
Cobalt	NA	9	
Copper	600	29.1	
Iron	NA	15700	
Lead	400	20	
Magnesium	NA	4130	
Manganese	NA	165	
Mercury	14	0.2	
Nickel	250	13.2	
Potassium	NA	3160	
Sodium	NA	4490	
Vanadium	370	26.9	
Zinc	1500	136	

Qualifiers (Q):
(+) All sediment semivolatile analysis outside method holding limit
NA - No criteria
J - Estimated concentration, below calibration range and above MDL

The leachate produced from exposure of composite MT-A to artificial rainwater did not have detectable concentrations of organic compounds. However, metals were detected in the leachate sample (Table B-7). Concentrations of four metals exceeded the NJSGWQC (last revised 11/07/2005). The metals that exceeded the NJSGWQC in the leachate samples include: antimony, arsenic, manganese and sodium.

Table B-7. Compounds detected in the leachate from the Middle Thorofare CDF sediment sample

	NJSGWQC	Composite MT-A Cores 1 and 2	
	Groundwater	Leachate	
Metals	mg/L	mg/L	Q
Aluminum	0.2	0.026	
Antimony	0.006	0.029	
Arsenic	0.003	0.02	
Barium	2	0.12	
Calcium	NA	45	
Iron	0.3	0.16	
Lead	0.005	0.003	
Magnesium	NA	27	
Manganese	0.05	0.198	
Potassium	NA	29	
Sodium	0.1	120.0	
Zinc	2	0.02	J

NA - No standard
J - Estimated concentration, below calibration range and above MDL
A shaded value indicates that the concentration exceeded groundwater criteria

The detection limits for some semivolatile compounds, pesticides and metals were above the revised Criteria (Table B-8) Although the compounds were not detected in the leachate sample, it is unknown if the actual concentrations exceeded the Criteria. The method detection limits for these compounds were equal to or below those required by NJDEP (1997) for dredging projects.

Table B-8. Compounds with method detection limits greater than the NJSGWQC in the analysis of the Middle Thorofare CDF leachate sample

	NJSGWQC	NJ Required MDL	Composite MT-A Cores 1 and 2	
	Groundwater	Leachate	Leachate	
Organics	ug/L	ug/L	ug/L	Q
Hexachloro-1,3-butadiene	1	10	5.00	ND
Hexachlorobenzene	0.02	10	5.00	ND

Table B-8 (Cont'd). Compounds with method detection limits greater than the NJSGWQC in the analysis of the Middle Thorofare CDF leachate sample

Organics (cont'd)	ug/L	ug/L	ug/L	Q
Pentachlorophenol	0.3	50	5.00	ND
Benzo(a)anthracene	0.1	10	5.00	ND
bis(2-Ethylhexyl)phthalate	3	10	5.00	ND
Benzo(b)fluoranthene	0.2	10	5.00	ND
Benzo(k)fluoranthene	0.5	10	5.00	ND
Benzo(a)pyrene	0.1	10	5.00	ND
Indeno(1,2,3-cd)pyrene	0.2	10	5.00	ND
Dibenzo(a,h))anthracene	0.3	10	5.00	ND
alpha-BHC	0.02	0.05	0.05	ND
beta-BHC	0.04	0.05	0.05	ND
gamma-BHC (Lindane)	0.03	0.05	0.05	ND
Aldrin	0.04	0.05	0.05	ND
Dieldrin	0.03	0.1	0.05	ND
Metals	**mg/L**	**mg/L**	**mg/L**	**Q**
Beryllium	0.001	0.005	0.005	ND
Cadmium	0.004	0.005	0.005	ND
Thallium	0.002	0.01	0.010	ND
Qualifiers (Q): ND - Not detected at the listed method detection limit (MDL)				

B.3. SITE #83, OCEAN CITY, NJ

The Ocean City Site #83 is an island CDF surrounded by marshland that is located adjacent to 32nd Street in Ocean City, NJ. The CDF contains approximately 395,000 cy of dredged material. It was estimated that approximately 375,000 cy could be removed from the CDF, leaving approximately 20,000 cy of material to be recontoured to accommodate future dredging projects.

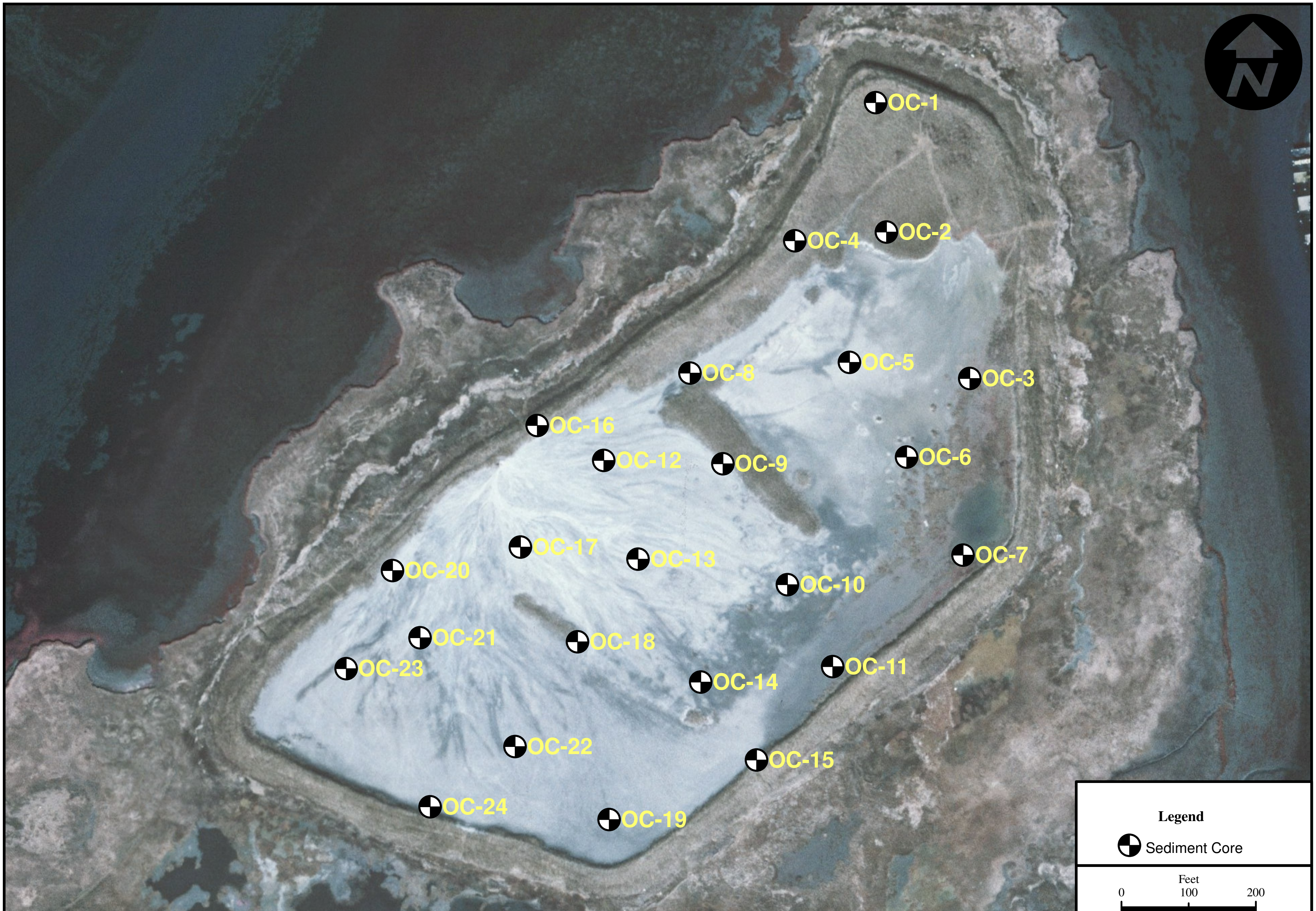
ASI collected 24 sediment cores from the Site #83 CDF (Figure B-3). No stratification of the material was apparent, so 24 samples were prepared for physical and chemical analyses. The results of these analyses are described below.

- *B.3.1 Physical Characteristics*

All cores collected from the Ocean City Site #83 CDF were predominantly comprised of black silt and clay. With the exception of Cores 16 and 24, all collected cores were approximately 8 feet in length and no stratification was evident. Cores 16 and 24 were approximately 14 feet in length and were also comprised primarily of black silt and clay with no stratification evident throughout.

The sediment composition was greater than 95% silt and clay in of all of the collected cores except Cores 6, 16, 17 and 19. Silt and clay content ranged from 71% to 92% in these cores. These cores are randomly distributed throughout the CDF, suggesting that there are no large areas with predominantly sandy material.

Eight composites were formed from the collected cores (Composites A-H; Table B-9). All of the composites had similar characteristics to the individual component cores except for composite OC-D. This composite had 100% silt and clay, but included Core 6, which had 28.7% sand content.



HDR LMS	Location of Sediment Cores taken from the Ocean City Site #83 CDF in Ocean City, NJ	Job No.	Date	Figure No.
		0904-007	06/05/06	B-3

Table B-9. Composites formed from the sediment cores collected from the Ocean City Site #83 CDF

Cores	Composite	Cores	Composite
1, 2, 3	OC-A	12, 16, 17	OC-E
4, 5, 8	OC-B	14, 15, 19	OC-F
9, 11, 13	OC-C	18, 22, 24	OC-G
6, 7, 11	OC-D	20, 21, 23	OC-H

Overall, the CDF appears to be filled with fine-grained material. Total organic carbon content was relatively high in all of the collected cores, ranging from 2.61% to 4.76%. Moisture content was between 42% and 57% in all collected cores. The physical properties of the materials in the composite samples are presented in Table B-10.

Table B-10. Physical properties of the sediment cores collected from the Ocean City Site #83 CDF

Core/ Comp ID	ASI #	Moisture (%)	TOC (ppm)	TOC (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	% Fine Materials	% Coarse Materials
OC-1	20060254	54.6	47,625	4.8	55.3	44.7	0.0	0.0	100.0	0.0
OC-2	20060238	56.0	41,761	4.2	49.7	50.3	0.0	0.0	100.0	0.0
OC-3	20060237	51.4	40,987	4.1	47.6	52.4	0.0	0.0	100.0	0.0
Comp OC-A	20060255	54.3	43,057	4.3	52.8	47.2	0.0	0.0	100.0	0.0
OC-4	20060253	49.8	40,374	4.0	53.9	46.1	0.0	0.0	100.0	0.0
OC-5	20060239	54.1	43,483	4.4	46.7	53.3	0.0	0.0	100.0	0.0
OC-8	20060199	57.5	36,305	3.6	49.9	50.1	0.0	0.0	100.0	0.0
Comp OC-B	20060256	54.5	37,993	3.8	51.9	48.1	0.0	0.0	100.0	0.0
OC-9	20060215	51.8	36,586	3.7	51.5	48.5	0.0	0.0	100.0	0.0
OC-10	20060217	53.6	39,407	3.9	51.3	48.7	0.0	0.0	100.0	0.0
OC-13	20060214	54.8	37,760	3.8	49.2	50.8	0.0	0.0	100.0	0.0
Comp OC-C	20060257	53.4	36,718	3.7	50.5	49.5	0.0	0.0	100.0	0.0
OC-6	20060240	45.0	27,752	2.8	34.3	37.0	28.7	0.0	71.3	28.7
OC-7	20060241	54.1	38,514	3.9	54.6	45.4	0.0	0.0	100.0	0.0
OC-11	20060218	51.8	41,904	4.2	57.1	42.9	0.0	0.0	100.0	0.0

Table B-10 (Cont'd). Physical properties of the sediment cores collected from the Ocean City Site #83 CDF

Core/ Comp ID	ASI #	Moisture (%)	TOC (ppm)	TOC (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	% Fine Materials	% Coarse Materials
Comp OC-D	20060258	49.9	36,226	3.6	51.0	49.0	0.0	0.0	100.0	0.0
OC-12	20060194	55.7	38,440	3.8	49.6	50.4	0.0	0.0	100.0	0.0
OC-16	20060251	39.8	28,713	2.9	40.6	43.3	16.1	0.0	83.9	12.0
OC-17	20060195	49.3	29,443	2.9	43.5	47.3	9.2	0.0	90.8	9.2
Comp OC-E	20060259	47.7	31,724	3.2	44.7	47.2	8.0	0.0	91.9	8.0
OC-14	20060236	49.2	34,377	3.4	48.1	49.9	2.0	0.0	98.0	2.0
OC-15	20060252	46.6	43,939	4.4	54.0	46.0	0.0	0.0	100.0	0.0
OC-19	20060219	48.0	26,067	2.6	42.2	49.7	8.0	0.0	91.9	8.0
Comp OC-F	20060260	46.9	31,932	3.2	41.7	44.0	14.3	0.0	85.7	14.3
OC-18	20060213	53.7	40,137	4.0	53.8	46.2	0.0	0.0	100.0	0.0
OC-22	20060212	55.5	38,831	3.9	49.6	50.4	0.0	0.0	100.0	0.0
OC-24	20060216	41.8	38,400	3.8	48.5	50.0	1.5	0.0	98.5	1.5
Comp OC-G	20060261	49.6	38,426	3.8	50.1	49.9	0.0	0.0	100.0	0.0
OC-20	20060196	52.0	40,247	4.0	52.0	48.0	0.0	0.0	100.0	0.0
OC-21	20060197	56.6	40,748	4.1	46.8	53.2	0.0	0.0	100.0	0.0
OC-23	20060198	56.0	36,938	3.7	49.0	51.0	0.0	0.0	100.0	0.0
Comp OC-H	20060262	51.3	35,909	3.6	47.7	50.7	1.6	0.0	98.4	1.6

- *B.3.2 Chemical Characteristics*

The eight composite sediment samples were analyzed for semivolatile compounds, pesticides, PCBs and metals. Phthalates and PAHs were detected in all of the composite samples. Phenolic compounds were detected in composites OC-A, OC-B and OC-C (Table B-11). A trace concentration of 4,4'-DDT was measured in composite OC-B and trace levels of alpha- and gamma-chlordane were measured in composite OC-D (Table B-11). No other semivolatiles, pesticides or PCBs were detected in the composite samples. Almost all of the metals for which analyses were conducted were detected in the composite samples (Table B-11). For all compounds, measured concentrations did not exceed the NJRDCSCC.

Table B-11. Compounds detected in the composite sediment samples from Ocean City Site #83 CDF

	NJ RDCSCC	Comp OC-A Cores 1,2,3		Comp OC-B Cores 4,5,8		Comp OC-C Cores 9,10,13		Comp OC-D Cores 6,7,11		Comp OC-E Cores 12,16,17		Comp OC-F Cores 14,15,19		Comp OC-G Cores 18,22,24		Comp OC-H Cores 20,21,23	
	Soil	Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment	
Organics	**ug/kg**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**
4-Methylphenol	2800000	66.40	Y	52.00	Y	156.00	Y		ND		ND		ND		ND		ND
Naphthalene	230000	30.90	J		ND	26.50	J		ND		ND	21.10	J	21.80	J		ND
4-Nitrophenol	NA	234.0	J		ND		ND		ND		ND		ND		ND		ND
Diethylphthalate	10,000,000	31.80	Y		ND		ND		ND	24.70	Y		ND	28.70	Y	32.40	J
Phenanthrene (PAH)	NA	34.40	Y		ND	42.90	Y	24.70	J	22.00	J	43.20	Y	30.00	Y	34.10	J
Anthracene (PAH)	10000000		ND		ND	26.30	Y		ND		ND	21.30	J	22.40	J		ND
Di-n-butylphthalate	5700000	25.40	J	33.20	J		ND	23.10	J		ND	23.00	J		ND	22.70	J
Fluoranthene (PAH)	2300000	190.0	Y	101.0	Y	229.0	Y	123.0	Y	123.0	Y	184.0	Y	202.0	Y	84.0	Y
Pyrene (PAH)	1700000	152.0	Y	90.80	Y	200.0	Y	137.0	Y	105.0	Y	173.0	Y	208.0	Y	66.7	Y
Benzo(a)anthracene (PAH)	900	50.40	Y	35.20	Y	68.60	Y	50.60	Y	34.90	Y	56.90	Y	62.60	Y	29.90	Y
Chrysene (PAH)	9000	80.90	Y	54.70	Y	118.0	Y	78.30	Y	59.30	Y	75.00	Y	92.10	Y	32.20	J
bis(2-Ethylhexyl)phthalate	49000	144.0	BY	105.0	BY	112.0	BY	119.0	BY	104.0	BY	137.0	BY	139.0	BY	138.0	BY
Benzo(b)fluoranthene (PAH)	900	42.30	Y		ND	57.10	Y	44.70	Y	27.60	Y	46.40	Y	50.70	Y		ND
Benzo(k)fluoranthene (PAH)	900	41.20	J		ND	60.00	Y	42.10	J	27.20	J	42.40	J	49.10	Y		ND
Benzo(a)pyrene (PAH)	660	36.50	Y		ND	45.20	Y	36.00	Y		ND	36.60	Y	38.20	Y	21.30	J
Indeno(1,2,3-cd)pyrene (PAH)	900		ND		ND	25.50	Y		ND		ND		ND	20.50	Y		ND
Benzo(ghi)perylene (PAH)	NA		ND		ND	26.30	Y		ND		ND		ND		ND		ND
4,4'-DDT	2000		ND	1.930			ND		ND		ND		ND		ND		ND
alpha-Chlordane	NA		ND		ND		ND	4.290			ND		ND		ND		ND
gamma-Chlordane	NA		ND		ND		ND	3.440			ND		ND		ND		ND
Metals	**mg/kg**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**
Aluminum	NA	14600		14300		12400		12600		12000		11600		12200		16300	
Antimony	14	0.98		1.17		1.36		1.3		0.94		0.68		0.6		1.36	
Arsenic	20	13.900		12.900		10.800		12.000		10.00		10.1		10.3		15.4	
Barium	700	46.700		46.10		39.500		40.50		38.10		36.4		37.6		51.5	
Cadmium	39		ND		ND		ND	0.051			ND		ND		ND		ND
Calcium	NA	6070		5880		4460		5130		4140		4030		3760		5600	
Chromium	NA	62.600		61.30		52.200		53.40		49.40		47.9		48.9		67.4	
Cobalt	NA	10.8		10.900		9.28		9.780		9.04		9		8.9		12.2	
Copper	600	38.800		38.500		34.200		33.400		30.500		29		31		39.7	
Iron	NA	29900		29700		25500		26100		24700		24900		24600		34300	
Lead	400	50.900		48.300		41.600		45.20		35.1		38.4		36.1		49.7	
Magnesium	NA	8280		8070		6970		7120		6610		6430		6530		9100	
Manganese	NA	338.00		328.0		256.00		319.0		228.0		234		244		323	
Mercury	14	0.75		0.680		0.67		0.67		0.52		0.52		0.56		0.54	
Nickel	250	25.800		25.800		22.200		23.500		21		21		20.9		28.3	
Potassium	NA	5120.0		4950		4470.0		4430		4230.0		4100		4320		6130	
Silver	110		ND		ND	0.51			ND		ND		ND		ND		ND
Sodium	NA	7900		6810.0		7550.0		7240		7930		7790		7390		13500	
Vanadium	370	54.500		52.400		45.800		47.50		43.200		42.9		43.5		60.8	
Zinc	1500	140.00		141.00		122.00		131.00		110.00		111		110		145	
Cyanide, total	1100		ND		ND		ND		ND		ND		ND	0.45	Y		ND

Qualifiers (Q):
NA - No critiera
Y - Estimated concentration, below calibration range and above MDL
B - Compound also detected in the batch blank
J - Estimated concentration, below MDL
ND - Not detected at the method detection limit (MDL)

No pesticides or PCBs were detected in the leachate produced from exposure of the composite sample to artificial rainwater. The semivolatile organic compounds naphthalene, 4-chloro-3-methylphenol, and di-n-butylphthalate were detected in a few of the leachate samples (Table B-12). The compounds diethylphthalate and bis(2-ethylhexyl)phthalate were detected in all of the leachate samples. The concentration of bis(2-ethylhexyl)phthalate in leachate from composite OC-H exceeded the NJSGWQC. However, this compound was also detected in the analytical blank at a level of 1.02 ppb (or 1.02 μg/L) which suggests that its presence in the sample may be due to laboratory contamination. Phthalates are widely recognized as common laboratory contaminants (EPA 1970). The USEPA provides the guidance that when a semivolatile organic compound is detected in the analytical blank, detections in samples at less than ten times the level of the concentrations in the analytical blank should be treated as non-detects (USEPA 2001). The highest concentration of bis(2-ethylhexyl)phthalate found in the composites was 3.07 μg/L, which is less than the 10.2 μg/L required to indicate that the sample has detectable concentrations of this Phthalate.

Metals were detected in all of the leachate samples (Table B-12). Concentrations of six metals exceeded the NJSGWQC in one or more leachate samples. Aluminum and sodium concentrations exceeded the Criteria in all of the leachate samples. Arsenic concentrations exceeded the Criteria in all leachate samples except for leachate produced from composite CD-F. Iron concentrations exceeded the Criteria in all leachate samples except for that produced from composite OC-E. Selenium concentrations exceeded the Criteria in five of the leachate samples (from composites OC-C, OC-D, OC-E, OC-G, and OC-H) and manganese concentrations exceeded the standard in leachate from two of the composite samples (OC-E and OC-G).

For some semivolatile compounds, method detection limits exceeded the NJSGWQC (Table B-13). Although these compounds were not detected in the leachate samples, it is unknown whether actual concentrations in the samples exceeded the NJSGWQC. However, all of the method detection limits were equal to or below those required by the NJDEP for dredging projects (NJDEP 1997).

Table B-12. Compounds detected in the leachate from the Ocean City Site #83 CDF sediment samples

	NJSGWQC	Comp OC-A		Comp OC-B		Comp OC-C		Comp OC-D		Comp OC-E		Comp OC-F		Comp OC-G		Comp OC-H	
		Cores 1,2,3		Cores 4,5,8		Cores 9,10,13		Cores 6,7,11		Cores 12,16,17		Cores 14,15,19		Cores 18,22,24		Cores 20,21,23	
	Groundwater	Leachate		Leachate		Leachate		Leachate		Leachate		Leachate		Leachate		Leachate	
Organics	**ug/L**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**
Naphthalene	300		ND		ND		ND	0.680	J		ND		ND		ND	0.640	J
4-Chloro-3-methylphenol	NA		ND		ND		ND		ND		ND		ND		ND	1.880	J
2-Methylnaphthalene	NA		ND		ND		ND		ND		ND		ND	0.740	J		ND
Diethylphthalate	6,000	3.370	BY	4.000	BY	2.260	BY	3.230	BY	2.970	BY	1.800	JB	2.200	BY	2.610	BY
Di-n-butylphthalate	900	0.570	J		ND		ND		ND		ND		ND		ND		ND
bis(2-Ethylhexyl)phthalate	3	1.610	JB	1.720	JB	0.910	JB	1.260	JB	0.990	JB	0.630	JB	0.920	JB	3.070	JB
Metals	**mg/L**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**
Aluminum	0.2	0.63		1.43		1.22		0.88		0.73		1.15		0.93		0.82	
Arsenic	0.003	0.0064		0.0069		0.0044		0.0063		0.0057			ND	0.0058		0.0059	
Barium	2	0.17		0.31		0.33		0.24		0.19		0.3		0.25		0.29	
Beryllium	0.001	0.0004		0.0003		0.0004		0.0004		0.0005		0.0003		0.0004		0.0004	
Cadmium	0.004		ND		ND		ND		ND	0.0003			ND		ND		ND
Calcium	NA	10.9		11.1		12.2		11.2		20		12.7		19.4		11.9	
Chromium	0.07	0.0027		0.0035		0.0034		0.0024		0.0025		0.0027		0.0031		0.0024	
Cobalt	NA	0.0006			ND		ND		ND	0.0004	ND		ND		ND		ND
Iron	0.3	0.4		0.87		0.65		0.48		0.26		0.53		0.36		0.37	
Lead	0.005	0.0027		0.0035		0.0023		0.0035		0.0034		0.0034		0.004		0.0024	
Magnesium	NA	13.5		11.3		14.5		12.7		20.2		14.3		22.1		16.8	
Manganese	0.05	0.027		0.022		0.017		0.021		0.14		0.015		0.093		0.02	
Mercury	0.002	0.000064		0.000048		0.000052		0.000052		0.000035		0.000046		0.000027		0.000028	
Nickel	0.1	0.0024		0.0021		0.0019		0.002		0.0018		0.0016		0.0019		0.0012	
Potassium	NA	13.2		12		16		12.5		12.5		14.4		15.6		17.1	
Selenium	0.04	0.04		0.037		0.045		0.041		0.061		0.038		0.068		0.046	
Sodium	50	143		118		174		139		163		169		186		214	
Vanadium	NA	0.012		0.013		0.01		0.013		0.0037		0.0071		0.005		0.0067	
Zinc	2	0.036		0.054		0.078		0.045		0.11		0.056		0.1		0.061	

Qualifiers (Q):
NA - No critiera
ND - Not detected at the method detection limit (MDL)
Y - Estimated concentration, below calibration range and above MDL
B - Compound also detected in the batch blank
J - Estimated concentration, below MDL
A shaded value indicates that the concentration exceeds the groundwater criteria

Table B-13. Compounds with method detection limits greater than the NJSGWQC in the analysis of the Ocean City Site #83 CDF leachate samples

	NJ SGWQC	NJ Req'd MDL	Comp OC-A		Comp OC-B		Comp OC-C		Comp OC-D	
			Cores 1,2,3		Cores 4,5,8		Cores 9,10,13		Cores 6,7,11	
	Ground-water	Leachate	Leachate		Leachate		Leachate		Leachate	
Organics	**ug/L**	**ug/L**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**
Hexachloro-1,3-butadiene	1	10	1.34	ND	1.34	ND	1.34	ND	1.34	ND
Hexachlorobenzene	0.02	10	1.48	ND	1.48	ND	1.48	ND	1.48	ND
Benzo(a)anthracene	0.1	10	1.88	ND	1.88	ND	1.88	ND	1.88	ND
Benzo(b)fluoranthene	0.2	10	1.98	ND	1.98	ND	1.98	ND	1.98	ND
Benzo(k)fluoranthene	0.5	10	1.88	ND	1.88	ND	1.88	ND	1.88	ND
Benzo(a)pyrene	0.1	10	1.92	ND	1.92	ND	1.92	ND	1.92	ND
Indeno(1,2,3-cd)pyrene	0.2	10	2	ND	2	ND	2	ND	2	ND
Dibenzo(a,h)anthracene	0.3	10	1.82	ND	1.82	ND	1.82	ND	1.82	ND
Qualifiers (Q): ND - Not detected at the listed method detection limit										

	NJ SGWQC	NJ Req'd MDL	Comp OC-E		Comp OC-F		Comp OC-G		Comp OC-H	
			Cores 12,16,17		Cores 14,15,19		Cores 18,22,24		Cores 20,21,23	
	Ground-water	Leachate	Leachate		Leachate		Leachate		Leachate	
Organics	**ug/L**	**ug/L**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**
Hexachloro-1,3-butadiene	1	10	1.34	ND	1.34	ND	1.34	ND	1.34	ND
Hexachlorobenzene	0.02	10	1.48	ND	1.48	ND	1.48	ND	1.48	ND
Benzo(a)anthracene	0.1	10	1.88	ND	1.88	ND	1.88	ND	1.88	ND
Benzo(b)fluoranthene	0.2	10	1.98	ND	1.98	ND	1.98	ND	1.98	ND
Benzo(k)fluoranthene	0.5	10	1.88	ND	1.88	ND	1.88	ND	1.88	ND
Benzo(a)pyrene	0.1	10	1.92	ND	1.92	ND	1.92	ND	1.92	ND
Indeno(1,2,3-cd)pyrene	0.2	10	2	ND	2	ND	2	ND	2	ND
Dibenzo(a,h)anthracene	0.3	10	1.82	ND	1.82	ND	1.82	ND	1.82	ND
Qualifiers (Q): ND - Not detected at the listed method detection limit										

B.4. CORPS CELL D, CAPE MAY, NJ

Corps Cell D is a large CDF in Cape May, NJ that is managed by the U.S. Army Corps of Engineers Philadelphia District. The CDF contains two cells divided by a berm. The estimated volume of dredged material in the entire CDF is 969,500 cy, with three-fourths of the material located in the western cell. Approximately 856,000 cy of material could be removed, leaving sufficient material to recontour the berms and accommodate future dredging projects.

ASI collected 54 sediment cores from the CDF (Figure B-4). Stratification of material was apparent in 10 of these cores where there were layers of both fine and coarse grained materials. A total of 64 samples were prepared for physical and chemical analyses. The following sections describe the results of the analyses.

- *B.4.1 Physical Characteristics*

Table B-14 shows the grain size composition of the Corps Cell D sediment core subsamples. Thirty-eight cores were collected from the western side of the CDF. In general, these cores did not have distinct stratification, but stratification was evident in cores collected near the junction of the eastern and western cells. Sediment cores collected from the far western corner of the CDF (Cores 1-6) were comprised primarily of sand and gravel, with the total amount of coarse-grained material ranging from 67% to 91%. Cores 17, 18, 28 and 10 were also dominated by coarse-grained sediment (74%-83%). These cores were all collected from the berm portion of the western cell. The majority of cores collected from the interior of the western cell were dominated by silt and clay. Total percent silt and clay ranged from 70% to 100% in Cores 7-9, 11, 13, 14, 19-27, 29-31, 35 and 36. A few collected cores contained a mixture of silt and clay in approximately 50/50 proportion. These cores were randomly dispersed throughout the western cell (Cores 12, 15, 16, 32 and 33). Cores 34 and 38 were collected from the western cell near the junction of the eastern and western cells. These cores were stratified, with an eight to twelve foot deep layer of silt and clay (top layer (a), 99-100% fine-grained material) overlying a nine to twelve foot deep layer of sand (bottom layer (b), 93-98% coarse-grained material). Core 37 was collected from an area intermediate to Cores 34 and 38 and was a mixture of sand, silt and clay throughout its length (17 feet).

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Location of Sediment Cores taken from the Cape May Corps Cell D CDF in Cape May, NJ

Job No.	Date	Figure No.
0904-007	06/05/06	B-4

Sixteen cores were collected from the eastern side of the CDF and approximately half of these cores had distinct sediment stratification. Three of the stratified cores were collected from the berm on the eastern edge of the CDF. These cores (49, 52 and 54) had an eight to twelve foot thick layer of predominantly fine-grained material (top layer (a), 77-88% silt and clay) over an eight to twelve foot thick layer of predominantly coarse-grained material (bottom layer (b), 85-98% sand and gravel). Similar stratification and sediment composition was found in Cores 43 and 48, collected from the interior of the eastern portion of the CDF. Cores collected from the portion of the eastern cell near the junction with the western cell were also stratified. Core 41 had a 12 foot layer of a 50/50 silt and sand mix (top layer (a)) over four feet of sand (bottom layer (b), 89% coarse-grained material). Core 42 had the opposite stratification with a 16 foot layer of fine brown sand (top layer (a), 91% sand content) over 4 feet of 50/50 silt and sand mixture (bottom layer (b)). Core 39 was comprised of predominantly sand, but the top four feet of the core was 97% sand while the bottom 13 feet had some silt and clay (14% fine-grained material). The two cores collected form the northern berm of the eastern cell (Cores 40 and 45) were not stratified and were predominantly comprised of sand (83-93% sand and gravel). Cores collected from the eastern interior of the eastern cell (Cores 46, 47, 50, 51 and 53) were not stratified and were dominated by silt and clay (66-100%). Core 44 was collected from the center of the eastern cell and was comprised of 57% silt and clay and 43% sand and gravel.

For both the eastern and western cells, TOC and moisture content were correlated with the grain size composition of the sediment samples, samples with a greater percentage of fine-grained material had higher TOC and moisture content. For all collected cores, the percent moisture ranged from 6% to 69% and percent TOC ranged from 0.05% to 5.3%.

Table B-14. Grain size composition of the sediment cores collected from the Corps Cell D CDF

Core/ CompID	ASI #	Moisture (%)	TOC (ppm)	TOC (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	% Coarse Material	% Fine Material
CD-1	20060013	19.8	5,149	0.5	6.5	2.6	90.5	0.4	90.9	93.1
CD-2	20060017	21.6	6,395	0.6	8.5	4.9	86.6	0.0	86.6	91.5
CD-3	20060018	39.0	17,284	1.7	17.5	15.2	67.3	0.0	67.3	82.5
Comp CD-A	20060191	23.5	9,873	1.0	10.0	10.3	79.7	0.0	79.7	20.3
CD-4	20060014	26.2	8,945	0.9	8.6	5.0	86.5	0.0	86.5	91.5
CD-5	20060012	22.1	8,076	0.8	7.4	3.8	88.8	0.0	88.8	92.6
CD-6	20060011	19.5	8,363	0.8	6.1	5.9	88.1	0.0	88.1	94.0

Table B-14 (Cont'd). Grain size composition of the sediment cores collected from the Corps Cell D CDF

Core/ CompID	ASI #	Moisture (%)	TOC (ppm)	TOC (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	% Coarse Material	% Fine Material
Comp CD-B	20060016	21.4	10,344	1.0	7.6	5.6	86.8	0.0	86.8	13.2
CD-7	20060155	66.3	48,547	4.9	51.8	48.2	0.0	0.0	0.0	48.2
CD-8	20060045	46.6	29,302	2.9	36.0	34.4	29.6	0.0	29.6	64.0
CD-9	20060168	68.8	42,139	4.2	44.0	47.6	8.3	0.0	8.3	55.9
Comp CD-C	20060176	69.7	39,473	4.0	43.8	51.0	5.1	0.0	5.1	94.8
CD-10	20060052	26.1	13,209	1.3	15.3	10.9	73.4	0.4	73.8	84.3
CD-12	20060053	37.5	23,953	2.4	27.2	23.7	49.2	0.0	49.2	72.9
CD-23	20060057	47.2	44,517	4.5	40.4	44.2	15.4	0.0	15.4	59.6
Comp CD-D	20060068	36.5	26,301	2.6	24.8	25.0	50.1	0.0	50.1	49.8
CD-11	20060149	65.4	39,497	4.0	45.7	50.8	3.5	0.0	3.5	54.3
CD-13	20060171	69.4	39,742	4.0	50.3	49.7	0.0	0.0	0.0	49.7
CD-14	20060106	57.3	45,371	4.5	48.3	45.0	6.8	0.0	6.8	51.8
Comp CD-E	20060177	63.9	44,691	4.5	46.8	42.8	10.3	0.0	10.3	89.6
CD-22	20060170	67.1	44,283	4.4	53.5	46.5	0.0	0.0	0.0	46.5
CD-24	20060169	68.7	45,825	4.6	51.7	48.3	0.0	0.0	0.0	48.3
CD-25	20060058	50.8	45,919	4.6	49.2	48.0	2.9	0.0	2.9	50.9
Comp CD-F	20060178	64.0	45,846	4.6	52.0	48.0	0.0	0.0	0.0	100.0
CD-17	20060020	22.6	7,795	0.8	8.9	8.6	81.1	1.5	82.6	89.7
CD-18	20060037	25.0	11,316	1.1	13.9	11.9	72.8	1.4	74.2	84.7
CD-28	20060038	26.0	13,968	1.4	13.4	11.2	75.4	0.0	75.4	86.6
Comp CD-G	20060050	24.5	11,147	1.1	11.3	8.8	77.2	2.8	80.0	20.1
CD-15	20060044	35.3	15,332	1.5	19.8	18.2	62.0	0.0	62.0	80.2
CD-16	20060019	46.7	18,349	1.8	22.9	28.8	48.1	0.3	48.4	76.9
CD-19	20060040	56.8	47,451	4.8	38.5	44.8	16.7	0.0	16.7	61.5
Comp CD-H	20060051	45.6	20,861	2.1	25.4	34.5	40.0	0.1	40.1	59.9
CD-29	20060130	64.5	49,408	4.9	49.0	50.9	0.0	0.1	0.1	50.9
CD-30	20060129	61.7	39,228	3.9	42.6	48.2	9.3	0.0	9.3	57.5
CD-33	20060039	30.9	33,426	3.3	27.4	22.5	49.9	0.2	50.1	72.4
Comp CD-I	20060165	50.4	32,374	3.2	35.0	33.9	31.1	0.0	31.1	68.9

Table B-14 (Cont'd). Grain size composition of the sediment cores collected from the Corps Cell D CDF

Core/ CompID	ASI #	Moisture (%)	TOC (ppm)	TOC (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	% Coarse Material	% Fine Material
CD-26	20060059	50.1	45,076	4.5	47.1	48.7	4.2	0.0	4.2	52.9
CD-31	20060150	66.2	41,975	4.2	43.2	54.7	2.1	0.0	2.1	56.8
CD-32	20060060	35.5	18,138	1.8	24.4	20.9	54.7	0.0	54.7	75.6
Comp CD-J	20060166	51.0	37,814	3.8	38.8	39.3	21.9	0.0	21.9	78.1
CD-34 Top	20060064a	49.4	52,717	5.3	48.5	51.5	0.0	0.0	0.0	51.5
CD-35	20060063	55.5	51,989	5.2	48.9	51.1	0.0	0.0	0.0	51.1
CD-37	20060066	33.8	16,241	1.6	16.5	15.9	67.6	0.0	67.6	83.5
Comp CD-K	20060077	45.2	36,438	3.6	33.3	37.3	29.4	0.0	29.4	70.6
CD-36	20060067	50.6	43,476	4.4	38.3	43.7	18.0	0.0	18.0	61.7
CD-38 Top	20060065a	44.2	47,771	4.8	47.1	51.8	1.2	0.0	1.2	53.0
CD-41 Top	20060070a	32.3	18,519	1.9	18.9	22.0	58.9	0.2	59.1	80.9
Comp CD-L	20060078	41.5	33	3.3	35.1	36.8	28.1	0.0	28.1	71.9
CD-20	20060043	50.8	45,076	4.5	36.4	35.4	28.2	0.0	28.2	63.6
CD-21	20060107	56.9	50,113	5.0	50.5	49.1	0.0	0.3	0.3	49.1
CD-27	20060131	65.3	49,536	5.0	47.9	52.1	0.0	0.0	0.0	52.1
Comp CD-M	20060167	57.5	44,673	4.5	42.4	44.3	13.3	0.0	13.3	86.7
CD-39 Bot	20060072b	21.2	5,135	0.5	7.2	7.0	85.8	0.0	85.8	92.8
CD-42 Bot	20060071b	32.7	18,279	1.8	24.2	22.7	52.4	0.6	53.0	75.1
Comp CD-N	20060079	27.3	15,861	1.6	15.4	14.2	70.4	0.0	70.4	84.6
CD-43 Top	20060074a	41.4	35,135	3.5	31.0	40.2	28.8	0.0	28.8	69.0
CD-44	20060081	42.8	29	2.9	27.1	30.3	42.3	0.3	42.6	72.6
CD-46	20060075	46.3	39,303	3.9	32.1	40.5	23.0	4.4	27.4	63.5
Comp CD-O	20060111	43.5	35,827	3.6	23.5	51.6	22.1	2.9	25.0	75.1
CD-47	20060080	47.7	45,076	4.5	37.5	43.8	18.5	0.2	18.7	62.3
CD-48 Top	20060097a	45.7	45,435	4.5	41.0	45.0	14.0	0.0	14.0	59.0

Table B-14 (Cont'd). Grain size composition of the sediment cores collected from the Corps Cell D CDF

Core/ CompID	ASI #	Moisture (%)	TOC (ppm)	TOC (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	% Coarse Material	% Fine Material
Comp CD-P	20060112	47.4	43,852	4.4	43.0	44.7	12.4	0.0	12.4	57.1
CD-45	20060096	16.9	12,095	1.2	9.3	8.1	81.7	0.8	82.5	89.8
CD-48 Bot	20060097b	16.1	14,248	1.4	14.5	8.4	76.0	1.1	77.1	84.4
Comp CD-P(b)	20060267	15.1	14,996	1.5	12.4	9.3	76.2	2.1	78.3	85.5
CD-49 Top	20060095a	41.8	42,625	4.3	39.8	41.2	19.0	0.0	19.0	60.2
CD-50	20060082	49.8	46,187	4.6	49.4	50.6	0.0	0.0	0.0	50.6
CD-51	20060098	40.2	26,659	2.7	32.4	33.9	33.7	0.0	33.7	67.6
Comp CD-Q	20060113	42.6	45,881	4.6	39.8	40.3	19.9	0.0	19.9	80.1
CD-52 Top	20060094a	39.8	40,238	4.0	40.6	47.1	11.7	0.6	12.3	58.8
CD-53	20060076	55.9	45,366	4.5	43.5	56.5	0.0	0.0	0.0	56.5
CD-54 Top	20060093a	41.1	37,634	3.8	38.8	37.8	23.3	0.2	23.5	61.1
Comp CD-R	20060114	46.7	43,254	4.3	40.8	44.5	14.5	0.2	14.7	85.3
CD-34 Bot	20060064b	17.2	1,099	0.1	3.6	0.0	90.2	7.3	97.5	90.2
CD-38 Bot	20060065b	21.2	3,454	0.4	5.8	1.4	91.2	1.7	92.9	92.6
CD-39 Top	20060072a	8.8	1,245	0.1	3.2	0.2	96.2	0.4	96.6	96.4
CD-40	20060073	7.6	2,400	0.2	4.7	2.1	91.3	1.8	93.1	6.9
CD-41 Bot	20060070b	18.3	5,788	0.6	7.0	3.9	87.3	1.8	89.1	91.2
CD-42 Top	20060071a	10.9	2,505	0.3	5.9	3.6	89.6	1.0	90.6	93.2
CD-43 Bot	20060074b	15.5	4,266	0.4	5.4	2.6	89.4	2.6	92.0	92.0
CD-49 Bot	20060095b	14.3	1,995	0.2	3.2	3.9	92.9	0.0	92.9	96.8
CD-52 Bot	20060094b	6.0	502	0.1	1.9	0.0	95.2	2.8	98.0	95.2
CD-54 Bot	20060093b	11.1	11,065	1.1	7.9	7.5	81.6	3.0	84.6	89.1

A total of 19 composite samples were formed from the 54 cores collected at Corps Cell D (Table B-15). Thirteen composite samples were formed from cores collected in the western cell. In general, these composites had similar grain size composition and TOC content to their component cores (Table B-14). However, Composites CD-D, CD-H, CD-I, CD-J, and CD-K were comprised of cores with different grain size composition. Therefore, these composites have sediment characteristics that represent the average between the three cores. Six composite samples were formed from cores collected in the eastern cell. One composite sample, CD-N, included two cores with different grain size composition and the characteristics of the composite are an average of the two component cores. Entire cores or portions of cores with greater than 90% sand and gravel content were not included in the composites and these samples are shown in Table 3-16. Most of these cores were collected in the eastern cell of the Corps Cell D CDF.

Table B-15. Composites (Comp) of the sediment cores collected from the Corps Cell D CDF

Western Cell				Eastern Cell			
Cores	Comp	Cores	Comp	Cores	Comp	Cores	Comp
1, 2, 3	CD-A	29, 30, 33	CD-I	43a, 44, 46	CD-O	41b	--
4, 5, 6	CD-B	26, 31, 32	CD-J	47, 48a	CD-P(a)	42a	--
7, 8, 9	CD-C	34a, 35, 37	CD-K	45, 48b	CD-P(b)	43b	--
10, 12, 23	CD-D	36, 38a, 41a	CD-L	49a, 50, 51	CD-Q	49b	--
11, 13, 14	CD-E	20, 21, 27	CD-M	52a, 53, 54a	CD-R	52b	--
22, 24, 25	CD-F	39b, 42b	CD-N	39a	--	54b	--
17, 18, 28	CD-G	34b	--	40	--		
15, 16, 19	CD-H	38b	--				

- *3.4.4 Chemical Characteristics*

The 19 composite sediment samples and two individual core sections that had less than 90% sand content (bottom sections (b) of Cores 41 and 54) were analyzed for semivolatile compounds, pesticides, PCBs and metals. No pesticides or PCBs were detected in any of the sediment samples. Phthalates and PAHs were detected in all of the composite samples and phenolic compounds were detected in eight of the composite samples (Table B-16).

The semivolatile compounds carbazole and dibenzofuran were only detected in composites CD-C and CD-N. Metals were detected in all of the composite samples (Table B-16). For all composite samples, with the exception of composite CD-C, measured concentrations of all compounds did not exceed the NJRDCSCC. In composite

CD-C, concentrations of six PAHs exceeded the NJRDCSCC. These PAHs include: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, and dibenzo(a,h)anthracene. Concentrations of all of these PAHs except indeno(1,2,3-cd)pyrene also exceeded the Non-Residential Direct Contact Soil Cleanup Criteria (NJNRDCSCC; last revised 5/12/99). These Non-Residential Criteria increase to 4,000 ug/kg for benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene and are the same as the NJRDCSCC for benzo(a)pyrene and dibenzo(a,h)anthracene. Composite CD-C was comprised of Cores 7, 8 and 9, located on the western edge of the western cell of the Corps Cell D CDF (Figure B-5).

Table B-16. Compounds detected in the composite sediment samples from Corps Cell D CDF

	NJRDCSCC	Comp CD-O		Comp CD-P (a)		Comp CD-Q		Comp CD-R		Comp CD-I		Comp CD-J		Comp CD-M	
		Cores 43a ,44, 46		Cores 47 and 48a		Cores 49a, 50, 51		Cores 52a, 53, 54a		Cores 29, 30, 33		Cores 26, 31, 32		Cores 20, 21, 27	
	Soil	Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment	
Organics	**ug/kg**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**
Phenol	10,000,000	48.30	Y		ND		ND		ND	66.10	Y	103.0	Y	191.0	Y
4-Methylphenol	2800000	50.60	Y		ND		ND	94.00	Y	73.60	Y	56.10	Y	152.0	Y
Acenaphthene (PAH)	3400000		ND		ND	27.90	Y		ND		ND		ND		ND
Diethylphthalate	10,000,000	723.0	B	750.0	B	563.0	B	741.0	B	932.0	B	729.0	B	935.0	B
Pentachlorophenol	6000	162.0	Y		ND		ND		ND		ND		ND		ND
Phenanthrene (PAH)	NA	39.20	Y	37.40	Y	42.10	Y	36.20	Y		ND		ND	37.10	Y
Anthracene (PAH)	10000000	26.50	Y		ND	25.40	Y		ND		ND		ND		ND
Di-n-butylphthalate	5700000		ND	109.00	Y		ND		ND		ND		ND		ND
Fluoranthene (PAH)	2300000	291.0	Y	129.0	Y	132.0	Y	147.0	Y	50.90	Y	70.30	Y	85.80	Y
Pyrene (PAH)	1700000	227.0	Y	104.0	Y	96.40	Y	106.0	Y	41.10	Y	56.30	Y	68.80	Y
Benzo(a)anthracene (PAH)	900	129.0	Y	50.20	Y	73.40	Y	40.20	Y	22.30	Y	29.90	Y	26.90	Y
Chrysene (PAH)	9000	174.0	Y	55.10	Y	73.20	Y	50.30	Y	31.70	Y	33.80	Y	35.40	Y
bis(2-Ethylhexyl)phthalate	49000	183.0	BY	206.0	BY	142.0	BY	160.0	BY	226.0	BY	180.0	BY	225.0	BY
Benzo(b)fluoranthene (PAH)	900	98.50	Y	34.90	Y	54.30	Y	32.20	Y		ND	25.50	Y		ND
Benzo(k)fluoranthene (PAH)	900	105.0	Y	34.00	Y	52.40	Y		ND		ND		ND		ND
Benzo(a)pyrene (PAH)	660	80.10	Y		ND	33.50	Y	27.40	Y		ND	24.80	Y		ND
Indeno(1,2,3-cd)pyrene (PAH)	900	38.00	Y		ND	21.50	Y		ND		ND		ND		ND
Benzo(g,h,i)perylene (PAH)	NA	32.70	Y		ND	18.10	Y		ND		ND		ND		ND
Metals	**mg/kg**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**
Aluminum	NA	8280		10400		10200		10800		8950		10100		11100	
Antimony	14	0.670		0.750		1.210		0.820		0.600		0.820		0.920	
Arsenic	20	10.40		12.10		10.50		11.20		9.81		11.60		12.60	
Barium	700	24.60		29.20		28.50		29.70		26.60		29.10		32.00	
Cadmium	39	0.130		0.120		0.076			ND		ND	0.091		0.120	
Calcium	NA	3350		3390		3020		3130		5190		3840		4440	
Chromium	NA	30.40		38.50		37.80		40.10		32.30		36.30		40.40	
Cobalt	NA	6.440		8.080		7.870		8.040		6.900		7.800		8.580	
Copper	600	14.40		18.20		17.30		18.30		14.40		16.80		18.90	
Iron	NA	17900		21400		20400		22000		18900		21300		23200	
Lead	400	21.60		28.90		27.40		28.00		21.60		25.40		28.00	
Magnesium	NA	4490		5230		4970		5200		5270		5630		6520	
Manganese	NA	423.0		486.0		498.0		507.0		490.0		442.0		536.0	
Mercury	14	0.240		0.310		0.330		0.320		0.250		0.210		0.300	
Nickel	250	13.90		17.10		16.90		17.10		14.70		16.60		18.30	
Potassium	NA	2690		3480		3350		3550		3120		3550		4010	
Sodium	NA	7850		7910		6800		7840		11100		12700		15200	
Vanadium	370	32.70		41.40		39.70		43.50		34.10		39.20		43.70	
Zinc	1500	83.60		109.0		102.0		99.90		87.20		99.90		116.0	
Cyanide, total	1100	0.370			ND		ND	0.400	Y	0.510	Y		ND	0.680	Y
% Moisture	NA	NA		NA		NA		NA		NA		NA		NA	
%Solids	NA	58.20		55.50		59.50		55.60		46.80		49.00		40.80	

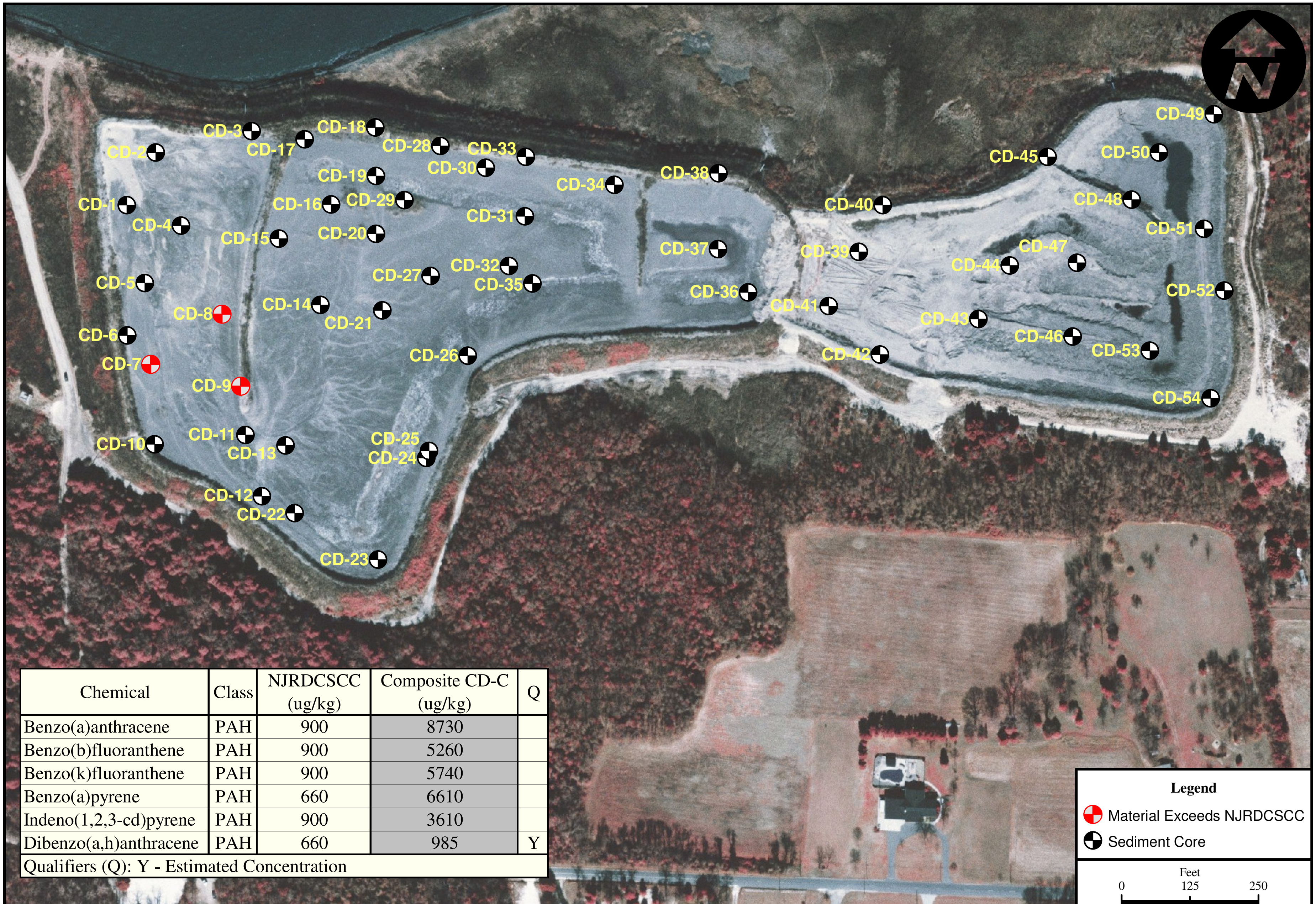
Qualifiers (Q):
NA - No critiera
ND - Not detected at the method detection limit (MDL)
B - Compound also detected in the batch blank
Y - Estimated concentration, below calibration range and above MDL
J - Estimated concentration, below MDL
A shaded value indicates that the concentration exceeds the soil criteria

	NJRDCSCC	Comp CD-K Cores 34a, 35, 37		Comp CD-L Cores 36, 38a, 41a		Comp CD-N Cores 39b and 42b		Site 54 Core 54 - Bottom		Comp CD-E Cores 11, 13, 14		Comp CD-F Cores 22, 24, 25		Comp CD-A2 Cores 1, 2, 3	
	Soil	Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment	
Organics	**ug/kg**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**
4-Methylphenol	2800000		ND	32.70	Y		ND		ND		ND		ND		ND
Naphthalene (PAH)	230000		ND		ND	30.40	Y		ND		ND		ND		ND
Acenaphthene (PAH)	3400000		ND		ND	106.0	Y		ND		ND		ND		ND
Dibenzofuran	NA		ND		ND	20.20	Y		ND		ND		ND		ND
Diethylphthalate	10,000,000	608.0	B	786.0	B	28.30	BY	18.70	BY	51.60	BY	89.70	BY	24.10	BY
Fluorene	2300000		ND		ND	28.90	Y		ND		ND		ND		ND
Phenanthrene (PAH)	NA	40.50	Y	44.10	Y	57.50	Y		ND	34.60	Y		ND	18.60	Y
Anthracene (PAH)	10000000	20.60	Y	20.30	Y	49.30	Y		ND		ND		ND		ND
Carbazole	NA		ND		ND	18.70	Y		ND		ND		ND		ND
Di-n-butylphthalate	5700000		ND		ND	41.90	Y		ND		ND		ND		ND
Fluoranthene (PAH)	2300000	92.90	Y	137.0	Y	758.0		34.50	Y	64.40	Y	38.70	Y	51.10	Y
Pyrene (PAH)	1700000	74.90	Y	107.0	Y	580.0		24.60	Y	57.20	Y	29.80	Y	44.30	Y
Benzo(a)anthracene (PAH)	900	38.90	Y	52.70	Y	152.0	Y	12.20	Y	27.20	Y		ND	25.20	Y
Chrysene (PAH)	9000	48.80	Y	62.20	Y	270.0	Y	14.40	Y		ND		ND	33.30	Y
bis(2-Ethylhexyl)phthalate	49000	233.0	BY	373.0	BY	85.00	BY	62.00	BY	199.0	BY	140.0	BY	76.30	BY
Benzo(b)fluoranthene (PAH)	900		ND	41.70	Y	121.0	Y		ND		ND		ND	15.70	Y
Benzo(k)fluoranthene (PAH)	900	26.60	Y	46.80	Y	172.0	Y		ND		ND		ND		ND
Benzo(a)pyrene (PAH)	660	26.10	Y	41.50	Y	80.10	Y		ND		ND		ND		ND
Indeno(1,2,3-cd)pyrene (PAH)	900		ND	19.60	Y	34.00	Y		ND		ND		ND		ND
Benzo(g,h,i)perylene (PAH)	NA		ND		ND	33.00	Y		ND		ND		ND		ND
	mg/kg	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**
Aluminum	NA	8830		9040		3580		1820		12200		14200		3030	
Antimony	14	0.600		0.680		0.330		0.420		0.880		1.040		0.340	
Arsenic	20	11.20		10.90		3.890		1.760		11.60		15.30		3.390	
Barium	700	26.70		25.20		9.950		4.510		35.00		41.00		8.680	
Cadmium	39	0.065			ND		ND		ND		ND		ND		ND
Calcium	NA	3600		3260		1880		236.0		5150		5320		2140	
Chromium	NA	33.20		34.10		13.00		16.00		43.30		51.20		11.40	
Cobalt	NA	6.970		7.040		2.890		1.850		9.350		10.90		2.450	
Copper	600	16.90		16.30		5.890		2.330		19.50		23.10		4.750	
Iron	NA	18600		19000		7810		4020		25400		29700		6460	
Lead	400	24.40		24.20		10.50		4.720		28.40		34.50		8.340	
Magnesium	NA	4590		4670		1810		640.0		7200		7990		1440	
Manganese	NA	414.0		434.0		238.0		132.0		558.0		663.0		198.0	
Mercury	14	0.310		0.250		0.081		0.026		0.260		0.350		0.071	
Nickel	250	14.80		15.00		6.000		7.600		20.00		23.20		5.170	
Potassium	NA	2960		3040		973.0		371.0		4450		5090		789.0	
Sodium	NA	7590		6440		1980		804.0		16800		16600		1990	
Vanadium	370	36.00		36.30		13.20		5.900		46.40		55.00		11.20	
Zinc	1500	89.40		90.00		39.10		20.20		115.0		134.0		30.80	
% Moisture	NA	NA		NA		NA		NA		NA		NA		NA	
%Solids	NA	58.40		59.30		76.80		91.30		38.60		35.10		75.90	

Qualifiers (Q):
NA - No critiera
ND - Not detected at the method detection limit (MDL)
B - Compound also detected in the batch blank
Y - Estimated concentration, below calibration range and above MDL
J - Estimated concentration, below MDL
A shaded value indicates that the concentration exceeds the soil criteria

	NJRDCSCC	Comp CD-P (b) Cores 45 and 48b		Comp CD-C Cores 7, 8, 9		Comp CD-B Cores 4, 5, 6		Comp CD-G Cores 17, 18, 28		Comp CD-H Cores 15, 16, 19		Comp CD-D Cores 10, 12, 23		Site 41 (12-16') Core 41 - Bottom	
	Soil	Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment		Unamended Sediment	
Organics	**ug/kg**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**	**ug/kg**	**Q**
Phenol	10,000,000		ND		ND	99.30	Y		ND		ND		ND		ND
4-Methylphenol	2800000		ND		ND	147.0	Y		ND	126.0	Y		ND		ND
Naphthalene (PAH)	230000		ND	1120	Y		ND		ND		ND		ND		ND
2-Methylnaphthalene	NA		ND	798.0	Y		ND		ND		ND		ND		ND
Acenaphthylene (PAH)	NA		ND	483.0	Y		ND		ND		ND		ND		ND
Acenaphthene (PAH)	3400000		ND	2730	Y		ND		ND		ND		ND		ND
Dibenzofuran	NA		ND	2610	Y		ND		ND		ND		ND		ND
Diethylphthalate	10,000,000	568.0	B		ND	135.0	BY	1380	B	1620	BY	1690	B	294.0	BY
Fluorene (PAH)	2300000		ND	2940	Y		ND		ND	24.00	ND		ND		ND
Phenanthrene (PAH)	NA		ND	29900			ND	20.30	Y	53.80	Y	32.30	Y	25.30	Y
Anthracene (PAH)	10000000		ND	7250			ND		ND		ND		ND	14.20	Y
Carbazole	NA		ND	3680			ND		ND		ND		ND		ND
Di-n-butylphthalate	5700000		ND		ND		ND	42.40	Y	105.0	Y	66.20	Y		ND
Fluoranthene (PAH)	2300000	36.30	Y	21300		30.40	Y	45.50	Y	106.0	Y	82.20	Y	71.00	Y
Pyrene (PAH)	1700000	24.60	Y	18200		26.50	Y	46.50	Y	79.70	Y	63.80	Y	52.30	Y
Benzo(a)anthracene (PAH)	900	16.10	Y	8730			ND	15.00	Y	40.30	Y	30.30	Y	36.60	Y
Chrysene (PAH)	9000	21.70	Y	8380		15.10	Y		ND	59.80	Y	45.40	Y	48.60	Y
bis(2-Ethylhexyl)phthalate	49000	135.0	BY	207.0	BY	66.90	BY	284.0	BY	411.0	BY	349.0	BY	130.0	BY
Benzo(b)fluoranthene (PAH)	900		ND	5260			ND		ND		ND	21.70	Y		ND
Benzo(k)fluoranthene (PAH)	900		ND	5740			ND		ND	27.50	Y		ND	26.10	Y
Benzo(a)pyrene (PAH)	660		ND	6610			ND		ND	25.50	Y	18.10	Y	15.20	Y
Indeno(1,2,3-cd)pyrene (PAH)	900		ND	3610			ND		ND		ND		ND		ND
Dibenzo(a,h)anthracene (PAH)	660		ND	985.0	Y		ND		ND		ND		ND		ND
Benzo(g,h,i)perylene (PAH)	NA		ND	2960	Y		ND		ND		ND		ND		ND
Metals	**mg/kg**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**	**mg/kg**	**Q**
Aluminum	NA	3110		11700		2900		3370		7490		6410		2240	
Antimony	14	0.220		0.760		0.310		0.370		0.640		0.860		0.250	
Arsenic	20	2.850		13.20		2.710		3.450		8.400		7.020		2.670	
Barium	700	8.080		33.70		8.860		10.30		21.10		19.00		5.640	
Beryllium	1		ND		ND		ND		ND		ND		ND	0.036	
Cadmium	39		ND	0.110			ND		ND		ND	0.055		0.089	
Calcium	NA	862.0		5130		1850		3270		4460		4190		1140	
Chromium	NA	12.00		41.80		11.60		13.00		27.10		24.00		6.880	
Cobalt	NA	2.380		9.080		2.320		2.760		5.860		5.030		1.760	
Copper	600	5.170		18.50		4.350		5.590		12.70		11.50		3.300	
Iron	NA	5970		24800		6120		7120		16100		13300		4610	
Lead	400	8.910		28.00		7.770		9.210		20.00		17.70		5.780	
Magnesium	NA	1280		6520		1540		1700		4710		3340		1030	
Manganese	NA	111.0		620.0		149.0		188.0		427.0		305.0		99.20	
Mercury	14	0.071		0.280		0.048		0.069		0.210		0.180		0.040	
Nickel	250	5.460		19.10		5.350		5.780		12.40		10.70		3.490	
Potassium	NA	808.0		4020		786.0		961.0		2480		2050		528.0	
Sodium	NA	959.0		11800		2620		2480		9390		4980		1880	
Vanadium	370	11.90		44.30		10.50		13.20		28.90		24.90		7.280	
Zinc	1500	29.50		118.0		28.50		33.80		75.20		68.70		23.40	

Qualifiers (Q):
NA - No critiera
ND - Not detected at the method detection limit (MDL)
B - Compound also detected in the batch blank
Y - Estimated concentration, below calibration range and above MDL
J - Estimated concentration, below MDL
A shaded value indicates that the concentration exceeds the soil criteria



Chemical	Class	NJRDCSCC (ug/kg)	Composite CD-C (ug/kg)	Q
Benzo(a)anthracene	PAH	900	8730	
Benzo(b)fluoranthene	PAH	900	5260	
Benzo(k)fluoranthene	PAH	900	5740	
Benzo(a)pyrene	PAH	660	6610	
Indeno(1,2,3-cd)pyrene	PAH	900	3610	
Dibenzo(a,h)anthracene	PAH	660	985	Y

Qualifiers (Q): Y - Estimated Concentration

HDR | LMS

Location of the composite materials exceeding the New Jersey Residential Direct Contact Soil Cleanup Criteria and the measured chemical concentrations in Corps Cell D, Cape May, NJ

Job No.	Date	Figure No.
0904-007	06/05/06	B-5

The semivolatile compounds diethylphthalate, 2-methylnapthalene, and napthalane were detected in the leachate produced from some of the composite samples, but concentrations did not exceed the NJSGWQC (Table B-17). The compound bis(2-ethylhexyl)phthalate was detected in the leachate produced from all of the composite samples and concentrations exceeded the NJSGWQC in the leachate produced from three samples, CD-P(a), CD-R and CD-M. However, bis(2-ethylhexyl)phthalate was also detected in the analytical blank at a level of 1.10 ppb (1.10 μg/L) and its presence in the samples may be due to laboratory contamination. Based on the USEPA guidelines for treatment of results where the analytical blank is contaminated with semivolatile compounds, concentrations of less than 11 μg/L should be considered non-detects (USEPA 2001). The highest concentration of bis(2-ethylhexyl)phthalate in the Corps Cell D composite samples was 6.94, and thus should be considered a non-detect. No pesticides or PCBs were detected in any of the leachate samples. Metals were detected in all of the leachate samples (Table B-17). Concentrations of six metals exceeded the NJSGWQC in one or more leachate samples. The Criteria for the following metals were exceeded: sodium (19 leachate samples), arsenic (15 leachate samples), aluminum (12 leachate samples), selenium (11 leachate samples), iron (6 leachate samples), and manganese (6 leachate samples).

For some semivolatile compounds, method detection limits exceeded the NJSGWQC (Table B-18). Although these compounds were not detected in the leachate samples, it is unknown whether actual concentrations in the samples exceeded the Criteria. However, all of the method detection limits were equal to or below those required by the NJDEP for dredging projects (NJDEP 1997).

Table B-17. Compounds detected in the leachate from the Corps Cell D CDF sediment samples

	NJSGWQC	Comp CD-O		Comp CD-P (a)		Comp CD-Q		Comp CD-R		Comp CD-I		Comp CD-J		Comp CD-M	
		Cores 43a ,44, 46		Cores 47 and 48a		Cores 49a, 50, 51		Cores 52a, 53, 54a		Cores 29, 30, 33		Cores 26, 31, 32		Cores 20, 21, 27	
	Groundwater	Leachate		Leachate		Leachate		Leachate		Leachate		Leachate		Leachate	
Organics	**ug/L**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**
Naphthalene	300	12.00			ND		ND		ND		ND		ND		ND
2-Methylnaphthalene	NA	7.200	Y		ND		ND		ND		ND		ND	2.200	Y
Diethylphthalate	6,000	0.970	JB	0.670	JB	0.500	JB	28.00	BY	0.650	JB	0.530	JB	0.520	JB
bis(2-Ethylhexyl)phthalate	3	2.100	JB	2.700	JB	1.900	JB	6.900	BY	3.000	JB	2.600	JB	3.500	JB
Metals	**mg/L**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**
Aluminum	0.2	0.490		0.600		0.480		0.290		0.044		0.014		0.160	
Antimony	0.006	0.003			ND	0.003		0.003		0.004		0.002		0.002	
Arsenic	0.003	0.008		0.006			ND	0.004		0.005		0.006			ND
Barium	2	0.270		0.210		0.200		0.160		0.069		0.067		0.140	
Beryllium	0.001	0.0005		0.0005		0.0004		0.0005		0.0006		0.0006		0.0005	
Calcium	NA	9.160		13.60		16.40		24.60		14.20		10.50		8.920	
Chromium	0.07	0.002		0.002		0.002		0.002		0.002			ND	0.002	
Copper	1.3		ND		ND		ND	0.003			ND		ND		ND
Iron	0.3	0.360		0.400		0.350		0.180		0.024			ND	0.110	
Lead	0.005	0.003		0.003		0.004		0.005			ND	0.002			ND
Magnesium	NA	11.40		14.70		16.20		21.20		19.90		18.00		20.20	
Manganese	0.05	0.005		0.009		0.072		0.023		0.055		0.078		0.120	
Mercury	0.002	0.00003		0.00006		0.00004			ND		ND	0.00003		0.00004	
Nickel	0.1	0.003		0.002		0.003		0.003		0.002		0.002		0.002	
Potassium	NA	15.20		18.30		17.20		17.20		17.80		18.00		20.40	
Selenium	0.04	0.037		0.041		0.046		0.060		0.062		0.048		0.051	
Sodium	50	192.0		197.0		183.0		198.0		246.0		249.0		291.0	
Vanadium	NA	0.007		0.006		0.004		0.002		0.005		0.005		0.006	
Zinc	2	0.052		0.056		0.066		0.069		0.022		0.016		0.019	

Qualifiers (Q):
NA - No critiera
ND - Not detected at the method detection limit (MDL)
B - Compound also detected in the batch blank
Y - Laboratory defined
J - Estimated concentration, below calibration range and above MDL
A shaded value indicates that the concentration exceeded applicable criteria

Table B-17 (Cont'd). Compounds detected in the leachate from the Corps Cell D CDF sediment samples

	NJSGWQC	Comp CD-P (b)		Comp CD-C		Comp CD-B		Comp CD-G		Comp CD-H		Comp CD-D		Site 41 (12-16')	
		Cores 45 and 48b		Cores 7, 8, 9		Cores 4, 5, 6		Cores 17, 18, 28		Cores 15, 16, 19		Cores 10, 12, 23		Core 41 - Bottom	
	Groundwater	Leachate		Leachate		Leachate		Leachate		Leachate		Leachate		Leachate	
Organics	**ug/L**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**
Naphthalene	300		ND		ND		ND		ND	16.00		6.650	Y		ND
2-Methylnaphthalene	NA		ND		ND	3.700	Y		ND	7.800	Y	3.100	Y	2.670	Y
Diethylphthalate	6,000	0.890	JB	0.410	JB	0.440	JB		ND	0.500	JB	2.360	BY	8.300	BY
bis(2-Ethylhexyl)phthalate	3	4.300	BY	1.500	JB	1.800	JB	2.000	JB	3.200	JB	2.090	JB	1.730	JB
Metals	**mg/L**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**
Aluminum	0.2	1.640		0.310		0.320		0.310		0.017		0.380		0.230	
Arsenic	0.003		ND	0.005		0.008			ND	0.008		0.005		0.008	
Barium	2	0.190		0.170		0.180		0.150		0.120		0.210		0.097	
Beryllium	0.001		ND	0.001		0.0004		0.0003		0.0006		0.0004		0.0003	
Cadmium	0.004		ND		ND		ND		ND	0.0003			ND		ND
Calcium	NA	10.50		7.900		12.10		14.50		11.10		7.200		13.40	
Chromium	0.07	0.006		0.002			ND		ND	0.002			ND		ND
Cobalt	NA	0.0005			ND		ND		ND		ND		ND		ND
Iron	0.3	1.650		0.240		0.230		0.250			ND	0.310		0.160	
Lead	0.005	0.005		0.002		0.002		0.002			ND	0.003			ND
Magnesium	NA	7.060		13.70		8.720		7.940		20.00		8.930		8.570	
Manganese	0.05	0.079		0.076		0.004		0.004		0.031		0.005		0.002	
Mercury	0.002	0.00006			ND	0.00003		0.00003		0.00003		0.00004		0.00003	
Nickel	0.1	0.006		0.002		0.002		0.002		0.002		0.002		0.001	
Potassium	NA	6.720		16.20		6.710		6.980		17.50		13.10		6.030	
Selenium	0.04	0.012		0.041		0.027		0.032		0.059		0.029		0.030	
Sodium	50	42.20		213.0		94.30		77.40		246.0		152.0		73.80	
Vanadium	NA	0.005		0.007		0.007		0.004		0.007		0.007		0.003	
Zinc	2	0.058		0.031		0.035		0.040		0.019		0.030		0.029	

Qualifiers (Q):
NA - No critiera
ND - Not detected at the method detection limit (MDL)
B - Compound also detected in the batch blank
Y - Laboratory defined
J - Estimated concentration, below calibration range and above MDL
A shaded value indicates that the concentration exceeded applicable criteria

Table B-17 (Cont'd). Compounds detected in the leachate from the Corps Cell D CDF sediment samples

	NJSGWQC	Comp CD-K		Comp CD-L		Comp CD-N		Site 54		Comp CD-E		Comp CD-F		Comp CD-A2	
		Cores 34a, 35, 37		Cores 36, 38a, 41a		Cores 39b and 42b		Core 54 - Bottom		Cores 11, 13, 14		Cores 22, 24, 25		Cores 1, 2, 3	
	Groundwater	Leachate		Leachate		Leachate		Leachate		Leachate		Leachate		Leachate	
Organics	**ug/L**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**
Naphthalene	300	1.700	Y		ND		ND		ND		ND		ND		ND
2-Methylnaphthalene	NA	4.410	Y		ND		ND		ND		ND		ND		ND
Diethylphthalate	6,000	1.030	JB	7.940	BY	1.100	JB	0.940	JB	0.900	JB	0.750	JB	2.140	BY
bis(2-Ethylhexyl)phthalate	3	0.570	JB	1.460	JB	0.630	JB	0.690	JB	1.000	JB	0.540	JB	0.860	JB
Metals	**mg/L**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**	**mg/L**	**Q**
Aluminum	0.2	0.017		0.160		0.300		0.110		0.091		0.039		1.450	
Antimony	0.006		ND		ND		ND		ND	0.003			ND		ND
Arsenic	0.003	0.008		0.007		0.004			ND	0.010		0.004		0.005	
Barium	2	0.100		0.120		0.110		0.075		0.110		0.160		0.240	
Beryllium	0.001	0.0005		0.0004			ND		ND	0.0007		0.0006			ND
Cadmium	0.004		ND		ND		ND		ND	0.0003			ND		ND
Calcium	NA	7.320		13.50		5.820		2.130		9.940		8.600		16.60	
Chromium	0.07		ND		ND		ND		ND	0.002		0.002		0.003	
Iron	0.3		ND	0.110		0.240		0.093		0.055		0.026		1.240	
Lead	0.005		ND	0.002		0.002			ND	0.002		0.002		0.005	
Magnesium	NA	11.10		13.00		5.860		3.340		20.10		17.40		7.940	
Manganese	0.05		ND	0.002		0.005		0.003		0.011		0.040		0.015	
Mercury	0.002	0.00006		0.00004		0.00004		0.00002		0.00003		0.00004		0.00004	
Nickel	0.1	0.002		0.002		0.001		0.001		0.002		0.003		0.002	
Potassium	NA	15.50		15.20		7.670		2.980		19.90		19.80		6.790	
Selenium	0.04	0.029		0.048		0.023		0.006		0.060		0.049		0.016	
Sodium	50	189.0		161.0		72.90		36.20		284.0		267.0		71.10	
Vanadium	NA	0.005		0.005		0.006			ND	0.006		0.006		0.005	
Zinc	2	0.024		0.031		0.021		0.026		0.025		0.026		0.056	

Qualifiers (Q):
NA - No critiera
ND - Not detected at the method detection limit (MDL)
B - Compound also detected in the batch blank
Y - Laboratory defined
J - Estimated concentration, below calibration range and above MDL
A shaded value indicates that the concentration exceeded applicable criteria

Table B-18. Compounds with method detection limits greater than the NJSGWQC in the analysis of the Corps Cell D CDF leachate samples

		NJ Required	Comp CD-O		Comp CD-P (a)		Comp CD-Q		Comp CD-R		Comp CD-I		Comp CD-J		Comp CD-M	
	NJSGWQC	MDL	Cores 43a ,44, 46		Cores 47 and 48a		Cores 49a, 50, 51		Cores 52a, 53, 54a		Cores 29, 30, 33		Cores 26, 31, 32		Cores 20, 21, 27	
	Groundwater	Leachate	Leachate		Leachate		Leachate		Leachate		Leachate		Leachate		Leachate	
Organics	**ug/L**	**ug/L**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**
Hexachloro-1,3-butadiene	1	10	1.300	ND	1.300	ND	1.300	ND	1.300	ND	1.300	ND	1.300	ND	1.300	ND
Hexachlorobenzene	0.02	10	1.500	ND	1.500	ND	1.500	ND	1.500	ND	1.500	ND	1.500	ND	1.500	ND
Benzo(a)anthracene	0.1	10	1.900	ND	1.900	ND	1.900	ND	1.900	ND	1.900	ND	1.900	ND	1.900	ND
Benzo(b)fluoranthene	0.2	10	2.000	ND	2.000	ND	2.000	ND	2.000	ND	2.000	ND	2.000	ND	2.000	ND
Benzo(k)fluoranthene	0.5	10	1.900	ND	1.900	ND	1.900	ND	1.900	ND	1.900	ND	1.900	ND	1.900	ND
Benzo(a)pyrene	0.1	10	1.900	ND	1.900	ND	1.900	ND	1.900	ND	1.900	ND	1.900	ND	1.900	ND
Indeno(1,2,3-cd)pyrene	0.2	10	2.000	ND	2.000	ND	2.000	ND	2.000	ND	2.000	ND	2.000	ND	2.000	ND
Dibenzo(a,h)anthracene	0.3	10	1.800	ND	1.800	ND	1.800	ND	1.800	ND	1.800	ND	1.800	ND	1.800	ND

Qualifiers (Q):
ND - Not detected at the listed method detection limit (MDL)

		NJ Required	Comp CD-P (b)		Comp CD-C		Comp CD-B		Comp CD-G		Comp CD-H		Comp CD-D		Site 41 (12-16')	
	NJSGWQC	MDL	Cores 45 and 48b		Cores 7, 8, 9		Cores 4, 5, 6		Cores 17, 18, 28		Cores 15, 16, 19		Cores 10, 12, 23		Core 41 - Bottom	
	Groundwater	Leachate	Leachate		Leachate		Leachate		Leachate		Leachate		Leachate		Leachate	
Organics	**ug/L**	**ug/L**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**
Hexachloro-1,3-butadiene	1	10	1.300	ND	1.300	ND	1.300	ND	1.300	ND	1.300	ND	0.660	ND	0.660	ND
Hexachlorobenzene	0.02	10	1.500	ND	1.500	ND	1.500	ND	1.500	ND	1.500	ND	1.500	ND	1.500	ND
Benzo(a)anthracene	0.1	10	1.900	ND	1.900	ND	1.900	ND	1.900	ND	1.900	ND	1.840	ND	1.840	ND
Benzo(b)fluoranthene	0.2	10	2.000	ND	2.000	ND	2.000	ND	2.000	ND	2.000	ND	1.700	ND	1.700	ND
Benzo(k)fluoranthene	0.5	10	1.900	ND	1.900	ND	1.900	ND	1.900	ND	1.900	ND	2.300	ND	2.300	ND
Benzo(a)pyrene	0.1	10	1.900	ND	1.900	ND	1.900	ND	1.900	ND	1.900	ND	1.740	ND	1.740	ND
Indeno(1,2,3-cd)pyrene	0.2	10	2.000	ND	2.000	ND	2.000	ND	2.000	ND	2.000	ND	1.780	ND	1.780	ND
Dibenzo(a,h)anthracene	0.3	10	1.800	ND	1.800	ND	1.800	ND	1.800	ND	1.800	ND	1.700	ND	1.700	ND

Qualifiers (Q):
ND - Not detected at the listed method detection limit (MDL)

		NJ Required	Comp CD-K		Comp CD-L		Comp CD-N		Site 54		Comp CD-E		Comp CD-F		Comp CD-A2	
	NJSGWQC	MDL	Cores 34a, 35, 37		Cores 36, 38a, 41a		Cores 39b and 42b		Core 54 - Bottom		Cores 11, 13, 14		Cores 22, 24, 25		Cores 1, 2, 3	
	Groundwater	Leachate	Leachate		Leachate		Leachate		Leachate		Leachate		Leachate		Leachate	
Organics	**ug/L**	**ug/L**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**	**ug/L**	**Q**
Hexachloro-1,3-butadiene	1	10	0.660	ND	0.660	ND	0.660	ND	0.660	ND	3.200	ND	0.660	ND	0.660	ND
Hexachlorobenzene	0.02	10	1.500	ND	1.500	ND	1.500	ND	1.500	ND	3.760	ND	1.500	ND	1.500	ND
Benzo(a)anthracene	0.1	10	1.840	ND	1.840	ND	1.840	ND	1.840	ND	3.800	ND	1.840	ND	1.840	ND
Benzo(b)fluoranthene	0.2	10	1.700	ND	1.700	ND	1.700	ND	1.700	ND	3.560	ND	1.700	ND	1.700	ND
Benzo(k)fluoranthene	0.5	10	2.300	ND	2.300	ND	2.300	ND	2.300	ND	4.640	ND	2.300	ND	2.300	ND
Benzo(a)pyrene	0.1	10	1.740	ND	1.740	ND	1.740	ND	1.740	ND	3.920	ND	1.740	ND	1.740	ND
Indeno(1,2,3-cd)pyrene	0.2	10	1.780	ND	1.780	ND	1.780	ND	1.780	ND	3.680	ND	1.780	ND	1.780	ND
Dibenzo(a,h)anthracene	0.3	10	1.700	ND	1.700	ND	1.700	ND	1.700	ND	3.720	ND	1.700	ND	1.700	ND

Qualifiers (Q):
ND - Not detected at the listed method detection limit (MDL)

WAACKAACK CREEK CDF, KEANSBURG, NJ

The Waackaack Creek CDF is a shoreline CDF located in Keansburg, NJ. The site has a flood control berm that appears to have been constructed with dredged material. The estimated volume of dredged material in the Waackaack Creek CDF is 132,000 cy. Approximately 47,000 cy of material could be removed from the Waackaack Creek CDF. The remaining 85,000 cy of material would be contoured to reestablish the flood control dune and establish a containment berm for future dredging projects.

ASI collected 12 sediment cores from the Waackaack Creek CDF (Figure B-6). Stratification was found in the materials from two of the cores in the eastern portion of the CDF where sand is overlying finer grained materials. Fourteen samples were prepared from the sediment cores for physical and chemical analyses. The results of the analyses are provided below.

- *B.5.1 Physical Characteristics*

Cores 1 through 5 and core 8a were collected from plateau area C, Cores 6 and 7 were collected from plateau area B, and Cores 9 through 12 were collected from plateau area A. Table B-19 shows the grain size composition of the Waackaack Creek sediment core subsamples. The material in all sampled portions of areas C and B was comprised of brown sand. The brown sand was present throughout the length of the cores, there was no stratification in sediment type. Grain size analysis showed that the sediment in these cores had a total percent silt and clay less than or equal to 4%, with total percent sand and gravel greater than 96%. Moisture and TOC content were very low in these sediment samples. In the western portion of Area A (Cores 9 and 10), the cores were also comprised of mostly brown sand. Total percent sand and gravel was between 93% and 96% and percent moisture and TOC of the sediment were similar to what was measured in cores from areas C and B. In the eastern portion of area A (Cores 11 and 12), a layer of brown sand was present to a depth of five feet, followed by a six to 10 foot deep layer of black silt with fine sand, with a one to two foot deep layer of brown sand with peat at the bottom of the core. These cores were split into top and bottom portions for analysis. Grain size analysis showed that the top portions of the cores were comprised primarily of sand (93-97% coarse-grained sediment), with low moisture and TOC. The sediment from the bottom portions of the cores was primarily comprised of silt and clay (39-55% fine-grained material), with moisture content ranging from 30% to 40% and TOC content ranging from 2.7% to 3.1%.

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Location of Sediment Cores taken from the Waackaack Creek CDF in Keansburg, NJ

Job No.	Date	Figure No.
0904-007	06/05/06	B-6

Table B-19. Physical properties of the sediment cores collected from the Waackaack Creek CDF

Core/ Comp ID	ASI #	Moisture (%)	TOC (ppm)	TOC (%)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	% Coarse Material	% Fine Material
WK-11 Bot	20051286b	40.2	30,956	3.1	26.0	29.1	43.8	1.2	45.0	55.1
WK-12 Bot	20051284b	30.1	27,358	2.7	20.9	17.9	59.0	2.1	61.1	38.8
Comp WK-D	20060005	34.3	28,966	2.9	21.2	22.0	49.9	6.9	56.8	43.2
WK-1	20051310	5.8	1,421	0.1	1.6	0.0	84.6	13.8	98.4	1.6
WK-2	20051309	4.2	597	0.1	1.5	0.5	88.2	9.7	97.9	2.1
WK-3	20051311	5.6	622	0.1	0.9	0.0	98.3	2.0	100.3	0.9
WK-4	20051312	4.3	493	0.1	1.0	0.0	97.6	2.3	99.9	1.0
WK-5	20051313	5.6	748	0.1	2.1	2.1	85.7	10.1	95.8	4.2
WK-6	20051308	5.3	574	0.1	3.2	0.6	82.1	14.2	96.3	3.7
WK-7	20051307	5.4	524	0.1	2.9	0.9	93.3	2.9	96.2	3.8
WK-8a	20051314	6.0	788	0.1	2.1	0.0	89.8	8.5	98.3	2.1
WK-9	20051306	6.4	478	0.1	5.3	1.8	85.6	7.3	92.9	7.1
WK-10	20051285	7.1	703	0.1	3.9	0.0	95.1	1.7	96.8	3.9
WK-11 Top	20051286a	11.9	1,006	0.1	5.0	0.0	83.2	12.8	96.0	5.0
WK-12 Top	20051284a	7.0	1,350	0.1	4.8	1.7	84.3	9.2	93.5	6.5

Composite WK-D was formed from the bottom portions of Cores 11 and 12. Only one composite sample was formed, since all other cores or core sections were comprised of greater than 90% sand. Composite WK-D had silt, clay and sand content intermediate between those measured in the bottom portions of Cores 11 and 12, but had greater gravel content (7% compared to 1-2%) (Table B-19). The composite sample also had intermediate percent moisture and TOC content relative to the bottom portions of Cores 11 and 12.

- *B.5.2 Chemical Characteristics*

Composite WK-D was analyzed for semivolatile compounds, pesticides, PCBs, metals, and dioxin/furan congeners. Of the organic compounds, only hexachloro-1,3-butadiene, pthalates and some PAHs were detected in the sediment sample (Table B-20) and no pesticides or PCBs were detected. Almost all of the metals for which analyses were conducted were detected in the composite sample (Table B-20). None of the detected compounds had concentrations above the NJRDCSCC, except for arsenic which was measured at 20.10 mg/kg, slightly exceeding the criterion of 20 mg/kg. Composite WK-D was comprised of the bottom portions of Cores WK-11 and WK-12 located on the eastern edge of the Waackaack Creek D CDF (Figure B-7). Dioxin/furan congeners were detected in the composite sample, but the total TEQ value was very low, only 3.1 ng/kg (parts-per-trillion) (Table B-21).

Table B-20. Compounds detected in the composite sediment sample from Waackaack Creek CDF

	NJ RDCSCC	Composite WK-D	
		Cores 11 and 12 - Bottom	
	Soil	Unamended Sediment	
Organics	**ug/kg**	**ug/kg**	**Q**
Hexachloro-1,3-butadiene	NA	200.0	
Diethylphthalate	10,000,000	110.0	J
Phenanthrene (PAH)	NA	120.0	J
Di-n-butylphthalate	5700000	170.0	J
Fluoranthene (PAH)	2300000	460.0	
Pyrene (PAH)	1700000	480.0	
Butylbenzylphthalate	1100000	200.0	
Benzo(a)anthracene (PAH)	900	180.0	J
Chrysene (PAH)	9000	230.0	
bis(2-Ethylhexyl)phthalate	49000	1400	
Benzo(b)fluoranthene (PAH)	900	330.0	
Benzo(k)fluoranthene (PAH)	900	100.0	J
Benzo(a)pyrene (PAH)	660	220.0	
Indeno(1,2,3-cd)pyrene (PAH)	900	160.0	J
Metals	**mg/kg**	**mg/kg**	**Q**
Aluminum	NA	5800	
Arsenic	20	20.10	
Barium	700	23.90	
Cadmium	39	0.751	
Calcium	NA	2470	
Chromium	NA	33.80	
Cobalt	NA	13.00	
Copper	600	55.80	
Iron	NA	23900	
Lead	400	51.40	
Magnesium	NA	2200	
Manganese	NA	164.0	
Mercury	14	0.553	
Nickel	250	13.60	

Table B-20. (Cont'd). Compounds detected in the composite sediment sample from Waackaack Creek CDF

Potassium	NA	2400	
Silver	110	0.809	
Sodium	NA	2330	
Vanadium	370	36.20	
Zinc	1500	132.0	
Qualifiers (Q): NA - No standard J - Estimated concentration, below calibration range and above MDL			

Table B-21. Dioxin/Furan congeners detected in the composite sediment sample from Waackaack Creek CDF and their calculated toxicity equivalents (TEQs)

		Composite WK-D Cores 11 and 12 - Bottom Unamended Sediment		
Dioxin/Furan Congeners	**I-TEF**	**ng/kg**	**Q**	**TEQ**
2,3,7,8-TCDD	1	0.501	A	0.501
1,2,3,7,8-PeCDD	0.5	0.526	A	0.263
1,2,3,4,7,8-HxCDD	0.1	0.503	AI	0.050
1,2,3,6,7,8-HxCDD	0.1	2.650	A	0.265
1,2,3,7,8,9-HxCDD	0.1	1.360	A	0.136
1,2,3,4,6,7,8-HpCDD	0.01	26.60		0.266
OCDD	0.001	574.0		0.574
2,3,7,8-TCDF	0.1	1.460		0.146
1,2,3,7,8-PeCDF	0.05	0.573	A	0.029
2,3,4,7,8-PeCDF	0.5	0.915	A	0.458
1,2,3,4,7,8-HxCDF	0.1	0.997	A	0.100
1,2,3,6,7,8-HxCDF	0.1	0.748	A	0.075
2,3,4,6,7,8-HxCDF	0.1	0.783	A	0.078
1,2,3,7,8,9-HxCDF	0.1	0.623	ND	0.062
1,2,3,4,6,7,8-HpCDF	0.01	6.460		0.065
1,2,3,4,7,8,9-HpCDF	0.01	0.434	A	0.004
OCDF	0.001	13.60		0.014
Sum TEQ (pptr)				**3.085**
Qualifiers (Q): ND - Not detected at the listed method detection limit (MDL) A - Amount detected is less than the lower calibration limit I - Indicates the presence of a qualitative interference that could cause a false positive or overestimation of the affected analytes				

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Location of the composite materials exceeding the New Jersey Residential Direct Contact Soil Cleanup Criteria and the measured chemical concentrations at Waackaack Creek CDF in Keansburg, NJ

Job No.	Date	Figure No.
0904-007	06/05/06	B-7

No pesticides, PCBs or semivolatile compounds were detected in the leachate produced from exposure of the composite sample to artificial rainwater. However, metals and dioxin/furan congeners were detected in the leachate (Tables B-22 and B-23). Concentrations of four metals in the leachate samples exceeded the NJSGWQC (last revised 11/07/2005). The metals that exceeded the Criteria the leachate sample include: iron, lead, manganese and sodium. The total TEQ for dioxin/furan congeners in the leachate sample was 0.012 ng/L which slightly exceeds the NJSGWQC for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (0.01 ng/L).

Table B-22. Compounds detected in the leachate from the Waackaack Creek CDF sediment sample

	NJSGWQC	Composite WK-D Cores 11 and 12 Bottom	
	Groundwater	Leachate	
Metals	**mg/L**	**mg/L**	**Q**
Aluminum	0.2	0.124	
Barium	2	0.070	
Calcium	NA	33.50	
Cobalt	NA	0.021	
Iron	0.3	47.50	
Lead	0.005	0.007	
Magnesium	NA	20.50	
Manganese	0.05	0.974	
Nickel	0.1	0.008	J
Potassium	NA	17.10	
Sodium	50	74.90	
Zinc	2	0.045	

Qualifiers (Q):
NA - No standard
J - Estimated concentration, below calibration range and above MDL
A shaded value indicates that the concentration was above applicable criteria

Table B-23. Dioxin/furan congeners detected in the leachate from the Waackaack Creek CDF sediment sample and their calculated toxicity equivalents (TEQs)

Dioxin/Furan Congeners	I-TEF	Composite WK-D Cores 11 and 12 - Bottom Leachate		
		ng/L	Q	TEQ
2,3,7,8-TCDD	1	0.00235	A	0.00235
1,2,3,7,8-PeCDD	0.5	0.00588	A	0.00294
1,2,3,4,7,8-HxCDD	0.1	0.00424	A	0.000424
1,2,3,6,7,8-HxCDD	0.1	0.00432	AI	0.000432
1,2,3,7,8,9-HxCDD	0.1	0.00514	AI	0.000514
1,2,3,4,6,7,8-HpCDD	0.01	0.00461	A	0.0000461
OCDD	0.001	0.04660	A	0.0000466
2,3,7,8-TCDF	0.1	0.00681	A	0.000681
1,2,3,7,8-PeCDF	0.05	0.00656	A	0.000328
2,3,4,7,8-PeCDF	0.5	0.00484	A	0.00242
1,2,3,4,7,8-HxCDF	0.1	0.00475	A	0.000475
1,2,3,6,7,8-HxCDF	0.1	0.00467	A	0.000467
2,3,4,6,7,8-HxCDF	0.1	0.00364	A	0.000364
1,2,3,7,8,9-HxCDF	0.1	0.00374	A	0.000374
1,2,3,4,6,7,8-HpCDF	0.01	0.00436	A	0.0000436
1,2,3,4,7,8,9-HpCDF	0.01	0.00407	ND	0.0000407
OCDF	0.001	0.00683	A	0.00000683
Sum TEQ (pptr)				**0.012**

Qualifiers (Q):
ND - Not detected at the listed method detection limit (MDL)
A - Amount detected is less than the lower calibration limit
I - Indicates the presence of a qualitative interference that could cause a false positive or overestimation of the affected analytes

Some of the method detection limits for the semivolatile compounds, pesticides and metals exceeded the revised NJSGWQC (Table B-24). Although these compounds were not detected in the leachate samples, it is unknown whether actual concentrations in the samples exceeded the Groundwater Standards. All of the detection limits met the NJDEP requirements for dredging projects (NJDEP 1997).

Table B-24. Compounds with method detection limits greater than the NJSGWQC in the analysis of the Waackaack Creek CDF leachate samples

	NJSGWQC	NJ Req'd MDL	Composite WK-D	
			Cores 11 and 12 Bottom	
	Groundwater	Leachate	Leachate	
Organics	**ug/L**	**ug/L**	**ug/L**	**Q**
Hexachloro-1,3-butadiene	1	10	5.600	ND
Hexachlorobenzene	0.02	10	5.600	ND
Pentachlorophenol	0.3	50	5.600	ND
Benzo(a)anthracene	0.1	10	5.600	ND
bis(2-Ethylhexyl)phthalate	3	10	5.600	ND
Benzo(b)fluoranthene	0.2	10	5.600	ND
Benzo(k)fluoranthene	0.5	10	5.600	ND
Benzo(a)pyrene	0.1	10	5.600	ND
Indeno(1,2,3-cd)pyrene	0.2	10	5.600	ND
Dibenzo(a,h))anthracene	0.3	10	5.600	ND
alpha-BHC	0.02	0.05	0.050	ND
beta-BHC	0.04	0.05	0.050	ND
gamma-BHC (Lindane)	0.03	0.05	0.050	ND
Aldrin	0.04	0.05	0.050	ND
Dieldrin	0.03	0.10	0.050	ND
Metals	**mg/L**	**mg/L**	**mg/L**	**Q**
Antimony	0.006	0.06	0.025	ND
Arsenic	0.003	0.01	0.010	ND
Beryllium	0.001	0.005	0.005	ND
Cadmium	0.004	0.005	0.005	ND
Thallium	0.002	0.01	0.010	ND
Qualifiers (Q): ND - Not detected at the listed method detection limit (MDL)				

B.6 CONCLUSIONS

The physical properties of the dredged materials stored in the five CDFs evaluated during this analysis vary by geographic region, and by location within the CDF. While the Waackaack Creek CDF contains mostly sand, the materials in the Site #83 CDF have virtually no sand. The Corps Cell D and Nummy Island CDFs contain pockets of fine grained materials and pockets of coarse materials. This is likely the result of the reuse of the CDFs for separate dredging projects that excavated different types of material.

The materials in all of the CDFs appear to be relatively clean and free of contaminants at concentrations of concern. With the exception of one sample from the Corps Cell D CDF, none of the materials exceeded the NJDEP's Direct Contact Residential Soil Cleanup Criteria. The leachates produced with the SPLP procedures had concentrations of some metals that may result in slight restrictions for their use in areas where there is a drinking water aquifer.