Sediment Sampling and Testing In Support Of Dredged Material Suitability Determination

Final

Menemsha Creek Federal Navigation Project Maintenance Dredging Martha's Vineyard, MA





US Army Corps of Engineers ® New England District

October 2013

SEDIMENT SAMPLING AND TESTING IN SUPPORT OF DREDGED MATERIAL SUITABILITY DETERMINATION

MENEMSHA CREEK FEDERAL NAVIGATION PROJECT MAINTENANCE DREDGING

MARTHA'S VINEYARD, MASSACHUESTTS

OCTOBER, 2013

Prepared by:

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TABLE OF CONTENTS

| 1.0 | INTRODUCTION | 1 |
|-----|------------------------|---|
| 2.0 | Materials and Methods | 1 |
| 2.1 | Sample Collections | 2 |
| 2.2 | Sample Processing | 4 |
| 2.3 | Physical Testing | 4 |
| 3.0 | RESULTS AND DISCUSSION | 4 |
| 3.1 | Grain Size | 5 |

TABLES

| Table 1: Summary of Menemsha Creek Sediment Collection Data | . 2 |
|---|-----|
| Table 4: Summary of Grain Size Results | . 5 |

FIGURES

| Figure 1: Sediment Sample Locations | í | 3 |
|-------------------------------------|---|---|
|-------------------------------------|---|---|

APPENDICES

| APPENDIX A: | SAMPLING AND ANALYSIS PLAN |
|-------------|----------------------------|
| APPENDIX B: | SAMPLING LOGS |
| APPENDIX C: | LABORATORY REPORT |

1.0 INTRODUCTION

Menemsha Creek is a small, tidal inlet located near the western end of Martha's Vineyard, on the south side of Vineyard Sound, approximately 11 miles southwest of Woods Hole. The Creek is situated between the towns of Chilmark to the east and Aquinnah to the west. The waterway is utilized by recreational craft, a small fishing fleet, Coast Guard rescue vessels stationed in the creek, and numerous transient vessels during the summer months. The existing Federal Navigation Project (FNP) consists of an entrance channel that is 10 foot deep (MLW), 80 feet wide, and 700 feet long, extending between two jetties at the northern entrance to Menemsha Creek; an 8 foot deep (MLW) channel that is 80 feet wide and 1.2 miles long, extending south from the jetties to deep water in Menemsha Pond; and an anchorage basin, situated in the northeastern portion of the creek, that is 10 feet deep (MLW) in the northern section and 6 feet deep (MLW) in the southern section.

The New England District (NAE) of the US Army Corps of Engineers (USACE) is currently proposing to dredge approximately 62,000 cy of sandy material from the channels and anchorage of the Menemsha Creek FNP in order to restore the project to its authorized dimensions. It is expected that this material will be hydraulically dredged used to nourish adjacent beaches to the north of the pond.

The purpose of the sampling effort described in this report was to collect sediment cores from 8 locations within the proposed dredge area in order to evaluate suitable disposal options. The sampling effort was conducted in accordance with the sampling and analysis plan (Appendix A) dated April 29, 2013 that was developed by the Marine Analysis Section of the Regulatory Division of NAE, and coordinated with the State of Massachusetts Department of Environmental Protection (MADEP), the Massachusetts Office of Coastal Zone Management (MACZM), the United States Fish and Wildlife Service (USFWS), and the United States Environmental Protection Agency (EPA) Region 1. This report describes the field methods employed, site conditions encountered, and results of physical analysis.

2.0 MATERIALS AND METHODS

Sediment sampling efforts were conducted on August 20, 2013. Work was carried out onboard the R/V Gloria H., a 24 foot pontoon style workboat outfitted with an a-frame and electric winch for sampling through a moon pool located in the center of the vessel. A three point anchor system was used to hold the boat in position while sampling. Positioning was achieved using a WAAS enabled Lowrance HDS-10 sonar/chart plotter with external LGC-4000 GPS receiver antenna, and verified with a Trimble GeoXM Differential Global Positioning System (DGPS), both with an accuracy of 3 meters or less. Depth measurements were made using the HDS-10 unit and 50/200 kHz transducer with lead line verification. Tidal corrections to Mean Lower Low Water (MLLW) were made using data for the Gay Head tide station, accessed in the field through the tides and currents feature of Navionics Mobile software.

2.1 Sample Collections

Sediment samples were collected to project depth (authorized depth plus one foot of overdepth) or refusal from 8 stations (Figure 1) using an SDI VibeCore-D electric vibracorer and 2.75" i.d. polycarbonate tubing. Upon collection the cores were secured in an upright position and allowed to settle before being processed on board the sampling vessel. Sampling equipment was cleaned with a brush and rinsed with site water prior to sampling and between each sample station. The core liners were assumed to be clean asreceived from the supplier but were rinsed in site water prior to use.

Water depths in the vicinity of the sample locations ranged from 1.0 to 9.5 feet MLLW. The sediment cores from all stations consisted of poorly graded medium sand with scattered shell fragments. Station H, located in the 10 foot anchorage, included approximately one foot of medium to fine sand with algal debris at the surface, transitioning into the more characteristic packed medium sand at depth. The vibracorer reached refusal in hard packed sand before reaching the project depth at stations A, B, C, E, and G. Refusal was reached at project depth at station F.

Sediment collection data is summarized in Table 1. Sampling logs are presented in Appendix B.

| Station ID | Latitude (NAD 83) | Longitude (NAD 83) | Time (EDT) | Measured Water Depth (FT) | Corrected Water Depth (FT MLLW) | Penetration/ Recovery (FT) | # Attempts |
|---------------|----------------------|-----------------------|---------------|---------------------------------|--|----------------------------------|---------------|
| А | 41.339781 | -70.769874 | 14:40 | 5.0 | 4.5 | 3.6 | 3 |
| В | 41.341209 | -70.769247 | 14:43 | 1.2 | 1.0 | 3.2 | 3 |
| С | 41.343503 | -70.768515 | 13:54 | 5.2 | 5.2 | 2.8 | 3 |
| D | 41.346496 | -70.767971 | 12:53 | 6.4 | 6.7 | 2.5 | 3 |
| Е | 41.347188 | -70.767884 | 12:36 | 3.5 | 3.7 | 3.5 | 3 |
| F | 41.349654 | -70.766859 | 12:00 | 6.9 | 7.0 | 2.0 | 2 |
| G | 41.350648 | -70.766311 | 11:42 | 2.1 | 2.0 | 4.0 | 3 |
| Н | 41.353938 | -70.767588 | 11:21 | 9.8 | 9.5 | 2.0 | 1 |

Table 1: Summary of Guilford Harbor Sediment Collection Data





2.2 Sample Processing

Upon collection the sediment cores from each station were secured in an upright position and allowed to settle. After settling, the cores were measured, and clear excess water was carefully drained from the top of the core tube by drilling a small hole in the liner above the water/sediment interface. Measured cores were placed horizontally into a wooden trough and secured by hand. Each core liner was cut lengthwise using electric shears in two places, approximately 180° apart, and clean stainless steel wire was then used to slice the length of the core into two halves. Immediately after a core was split and exposed to the atmosphere, it was photographed, described, and transferred into a clean stainless steel pan for sampling.

Each split core was photographed before undergoing the description process. All core photos included a stadia rod for scale, and for referencing the depth below surface. A photograph of the complete core was taken, as well as close-ups of discrete layering down core, and sediment strata horizons/transitions of interest.

Cores were examined from the top of the core, downward to the bottom, using a stadia rod to define sediment layer thicknesses and depth below the surface (top of core at sediment–water interface). Each core was classified in accordance with ASTM D 2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), and notes on relative grain sizes, color, odor, strata, and other pertinent observations were recorded in the environmental sampling logs (Appendix B).

The material from each core was transferred into a clean stainless steel pan and homogenized using clean stainless steel spatulas and spoons. Representative portions from each sample were placed into clean zip-loc bags for grain size analysis and archiving. All samples were delivered to the NAE environmental laboratory in Concord, MA at the conclusion of field activities.

2.3 Physical Testing

Grain size analysis was completed by the NAE environmental laboratory. Samples were prepared according to the guidance in ASTM D421-85 (Re-approved 2002), Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants, and analyzed according to ASTM D422-63 (Re-approved 2002), Standard Test Method for Particle-Size Analysis of Soils using sieve nos. 4, 10, 40, 100, 200. There were no deviations from the established laboratory testing protocols.

3.0 RESULTS AND DISCUSSION

This section summarizes results obtained from physical testing of sediments collected from shoaled areas within the Menemsha Creek FNP on Martha's Vineyard, MA, on August 20, 2013. Eight sediment samples were analyzed for grain size distribution. Grain size curves and laboratory data sheets can be found in the analytical report presented as Appendix B.

3.1 Grain Size

All sediments collected from the Menemsha Creek FNP were classified by the laboratory as poorly graded sand. Particle sizes were predominantly medium sand (65.4-91.6%) with some fine sand (8.1 - 33.9%). Sample H, from the anchorage area, included a small fraction of fine grained material (5.7% passing the no. 200 sieve). All samples contained trace amounts of coarse sand to fine gravel, the majority of which was shell fragments. A summary of the results of grain size analysis is presented in Table 2.

| Samula ID | Sample ID %Cobble | %Gravel | | %Sand | | | 0/ Einag |
|-----------|-------------------|---------|------|--------|--------|------|----------|
| Sample ID | | Coarse | Fine | Coarse | Medium | Fine | %rmes |
| А | 0.0 | 0.0 | 0.3 | 2.9 | 73.1 | 23.7 | 0.0 |
| В | 0.0 | 0.0 | 0.0 | 0.0 | 67.7 | 32.3 | 0.0 |
| С | 0.0 | 0.0 | 0.0 | 0.7 | 65.4 | 33.9 | 0.0 |
| D | 0.0 | 0.0 | 1.1 | 4.2 | 77.6 | 17.0 | 0.1 |
| E | 0.0 | 0.0 | 9.5 | 9.6 | 70.8 | 10.0 | 0.1 |
| F | 0.0 | 0.0 | 0.2 | 0.2 | 91.6 | 8.1 | 0.0 |
| G | 0.0 | 0.0 | 0.3 | 1.5 | 89.5 | 8.7 | 0.0 |
| Н | 0.0 | 0.0 | 1.0 | 3.2 | 66.1 | 24.1 | 5.7 |

Table 2: Summary of Grain Size Results

APPENDIX A SAMPLING AND ANALYSIS PLAN

CENAE-R-PT

MEMORANDUM FOR: Craig Martin, Project Manager, CENAE-PP-P-N

SUBJECT: DRAFT Sampling and Analysis Plan for Menemsha Creek Federal Navigation Project, Chilmark and Aquinnah, Massachusetts.

1. In response to your request of 6 March 2013, I have developed a sampling plan for the above project. The CENAE is proposing to dredge an total area of approximately **10 acres** in the **Menemsha Creek**. The channel will be dredged to a project depth of **-8' MLLW** and an anchorage to the project depth of **-10' MLLW**, plus 1' overdredge. A total of approximately **62,000 cu. yds**. of material will be hydraulically removed and disposed of **on East Beach**, **Chilmark; West Beach, Aquinnah; or upland to rebuild the dunes on the southern side of the creek mouth**. This area was last dredged in 1973. At prior dredging efforts, the sediments were found to be predominantly sand.

 Please note that the "Regional Implementation Manual for the Evaluation of Dredged Material Proposed for Disposal in New England Waters" (RIM) is now final and took effect on May 6, 2004. The RIM, as well as requirements for electronic submission of data, may be downloaded from the website <u>http://www.nae.usace.army.mil/Regulatory/Dredging/RegionalImple</u> <u>mentationManual.pdf</u>.

3. There are no known spills or outfalls in the vicinity of the project, according to the information collected by Craig Martin.

4. **Eight** cores should be taken from the area to be dredged according to the attached plan. Core samples should be taken to the proposed dredge depth. The cores should be inspected in the field for stratification. If the cores show significant stratification, in the opinion of the sampling crew, subsamples should be made of each layer. All sediments being held for testing should be stored in accordance with the requirements of Table 8-2 in <u>Evaluation of Dredged Material Proposed for Ocean Disposal, Testing Manual</u>, 1991.

5. Each core or core layer should be individually analyzed for sediment grain size and the results reported to me with a copy of the boring log. The grain size analysis should use the Wet Sieve method and use sieve sizes #4, 10, 40, and 200.

6. If you, the applicant or the testing laboratory have any questions, feel free to call me at 978-318-8660.

PHILLIP NIMESKERN Project Manager Marine Analysis Section

CENAE-R-PT

SUBJECT: DRAFT Sampling and Analysis Plan for Menemsha Creek Federal Navigation Project, Chilmark and Aquinnah, Massachusetts





APPENDIX B SAMPLING LOGS

| PROJECT: Menemsha Creek | DATE: <u>8/20/2013</u> | | |
|---|--------------------------------|--|--|
| SAMPLING PERSONNEL: RBL, TAR, LAO | | | |
| SEA STATE: Calm | WEATHER CODE: Sunny | | |
| LOCATION METHOD: DGPS | | | |
| | | | |
| SAMPLE ID: A | SAMPLER TYPE: Vibracore | | |
| TIME: 14:40 | | | |
| SOUNDING: 5.0' | CORRECTED DEPTH:0.5=4.5' | | |
| COORDINATES: N <u>41.339781</u> | E70.769874 | | |
| PENETRATION: <u>3.6</u> ' RECOVERY: | 3.6' NO. OF ATTEMPTS: <u>3</u> | | |
| MATERIAL DESCRIPTION: Medium sand with scattered shell fragments (SP) | | | |
| | | | |

| CORE PHOTO: | NOTES: |
|-------------|--|
| | Core taken to refusal. Hard packed sand. 0-3.6': SP – Light gray, poorly graded, medium sand with scattered shell fragments |

| PROJECT: Menemsha Creek | DATE: <u>8/20/2013</u> | | | | |
|--|--------------------------|--|--|--|--|
| SAMPLING PERSONNEL: RBL, TAR, LAO | | | | | |
| SEA STATE: Calm | WEATHER CODE: Sunny | | | | |
| LOCATION METHOD: DGPS | | | | | |
| | | | | | |
| SAMPLE ID: B | SAMPLER TYPE: Vibracore | | | | |
| TIME: 14:13 | TIME: 14:13 | | | | |
| SOUNDING: <u>1.2</u> ' | CORRECTED DEPTH:0.2=1.0' | | | | |
| COORDINATES: N <u>41.341209</u> | Е70.769247 | | | | |
| PENETRATION: <u>3.2</u> ' RECOVERY: | 3.2' NO. OF ATTEMPTS: 3 | | | | |
| MATERIAL DESCRIPTION: Medium Sand (SP) | | | | | |

| CORE PHOTO: | NOTES: |
|-------------|--|
| | Core taken to refusal. Hard packed sand. Channel markers appear to have been moved due to shoaling. The shoal is a sand spit extending from the beach on the western side of the channel. 0-3.2': SP – Poorly graded medium sand, transitioning from tan (0-0.9') to light gray (0.9-3.2') |

| PROJECT: Menemsha Creek | DATE: <u>8/20/2013</u> | | |
|---|--------------------------|--|--|
| SAMPLING PERSONNEL: RBL, TAR, LOA | | | |
| SEA STATE: Calm | WEATHER CODE: Sunny | | |
| LOCATION METHOD: DGPS | | | |
| | | | |
| SAMPLE ID: C | SAMPLER TYPE: Vibracore | | |
| TIME: <u>13:54</u> | | | |
| SOUNDING: <u>5.2</u> ' | CORRECTED DEPTH:0.0=5.2' | | |
| COORDINATES: N <u>41.343503</u> | Е70.768515 | | |
| PENETRATION: 2.8' RECOVERY: | 2.8' NO. OF ATTEMPTS: 3 | | |
| MATERIAL DESCRIPTION: Medium sand with scattered shell fragments (SP) | | | |

| CORE PHOTO: | NOTES: |
|---|--|
| 26 5 4 70 2 - 29 8 7 45 45 4 70 4 7 6 4 7 6 4 7 6 4 7 6 4 7 6 4 7 6 4 7 6 4 7 6 4 7 6 4 7 6 4 7 6 4 7 6 4 7 6 4 7 6 4 7 6 4 7 6 4 7 6 6 7 6 6 7 6 6 7 6 6 7 6 6 7 6 6 7 6 6 7 6 6 7 6 6 7 6 6 7 6 6 7 6 6 7 6 6 7 6 6 7 6 6 7 6 6 7 6 6 7 6 6 7 6 6 7 | Core taken to refusal. Hard packed sand. 0-2.8': SP – Poorly graded medium sand with scattered shell fragments, transitioning from tan (0-1.2') to light gray (1.2-2.8') |

| PROJECT: Menemsha Creek | DATE: <u>8/20/2013</u> |
|--|------------------------------|
| SAMPLING PERSONNEL: RBL, TAR, LAO | |
| SEA STATE: Calm | WEATHER CODE: Sunny |
| LOCATION METHOD: DGPS | |
| | |
| SAMPLE ID: D | SAMPLER TYPE: Vibracore |
| TIME: 12:53 | |
| SOUNDING: <u>6.4</u> ' | CORRECTED DEPTH: $+0.3=6.7$ |
| COORDINATES: N <u>41.346496</u> | Е70.767971 |
| PENETRATION: 2.5' RECOVERY: | 2.5' NO. OF ATTEMPTS: 2 |
| MATERIAL DESCRIPTION: Medium sand with sca | attered shell fragments (SP) |

| CORE PHOTO: | NOTES: |
|-------------|---|
| | Core taken to refusal. Hard packed sand. 0-2.5': SP – Light gray, poorly graded, medium sand with scattered shell fragments |

| PROJECT: Menemsha Creek | DATE: <u>8/20/2013</u> |
|--|---|
| SAMPLING PERSONNEL: RBL, TAR, LAO | |
| SEA STATE: Calm | WEATHER CODE: Sunny |
| LOCATION METHOD: DGPS | |
| | |
| SAMPLE ID: E | SAMPLER TYPE: Vibracore |
| TIME: 12:36 | |
| SOUNDING: <u>3.5</u> ' | CORRECTED DEPTH: +0.2=3.7' |
| COORDINATES: N <u>41.347188</u> | Е70.767884 |
| PENETRATION: <u>3.5</u> ' RECOVERY: | 3.5' NO. OF ATTEMPTS: 3 |
| MATERIAL DESCRIPTION: Medium sand with sca | attered gravel and shell fragments (SP) |

| CORE PHOTO: | NOTES: |
|-------------|--|
| | Core taken to refusal. Hard packed sand. 0-3.5': SP – Light gray, poorly graded, medium sand with scattered fine gravel and shell fragments |

| PROJECT: Menemsha Creek | DATE: <u>8/20/2013</u> |
|---|-----------------------------|
| SAMPLING PERSONNEL: RBL, TAR, LAO | |
| SEA STATE: Calm | WEATHER CODE: Sunny |
| LOCATION METHOD: DGPS | |
| | |
| SAMPLE ID: F | SAMPLER TYPE: Vibracore |
| TIME: 12:00 | |
| SOUNDING: 6.9' | CORRECTED DEPTH: +0.1=7.0' |
| COORDINATES: N 41.349654 | E70.766859 |
| PENETRATION: 2.0' RECOVERY: | 2.0' NO. OF ATTEMPTS: 2 |
| MATERIAL DESCRIPTION: Medium sand with scat | ttered shell fragments (SP) |
| | |

| CORE PHOTO: | NOTES: | | | | | |
|-------------|---|--|--|--|--|--|
| | Hard packed sand. 0-2.0': SP – Tan, poorly graded, medium sand with scattered shell fragments | | | | | |

| PROJECT: Menemsha Creek | DATE: <u>8/20/2013</u> |
|--|--------------------------------|
| SAMPLING PERSONNEL: RBL, TAR, LAO | |
| SEA STATE: Calm | WEATHER CODE: Sunny |
| LOCATION METHOD: DGPS | |
| | |
| SAMPLE ID: G | SAMPLER TYPE: Vibracore |
| TIME: 11:42 | |
| SOUNDING: 2.1' | _ CORRECTED DEPTH:0.1= 2.0' |
| COORDINATES: N <u>41.350648</u> | E70.766311 |
| PENETRATION: 4.0' RECOVERY: | 4.0' NO. OF ATTEMPTS: <u>3</u> |
| MATERIAL DESCRIPTION: Medium sand with sca | ttered shell fragments (SP) |

| CORE PHOTO: | NOTES: |
|-------------|---|
| | Core taken to refusal. Hard packed sand. 0.0-4.0': SP – Tan, poorly graded, medium sand with scattered shell fragments |

| PROJECT: Menemsha Creek | DATE: <u>8/20/2013</u> |
|---|---------------------------|
| SAMPLING PERSONNEL: RBL, TAR, LAO | |
| SEA STATE: Calm | WEATHER CODE: Sunny |
| LOCATION METHOD: DGPS | |
| | |
| SAMPLE ID: H | SAMPLER TYPE: Vibracore |
| TIME: 11:21 | |
| SOUNDING: 9.8' | CORRECTED DEPTH:0.26=9.5' |
| COORDINATES: N <u>41.353938</u> | Е70.767588 |
| PENETRATION: 2.0' RECOVERY: | 2.0' NO. OF ATTEMPTS: 1 |
| MATERIAL DESCRIPTION: Silt with fine sand (ML |) |

| CORE PHOTO: | NOTES: |
|--|--|
| 40 8 2 20 20 20 20 20 20 20 20 20 20 20 20 2 | 0-0.9': SP – Dark gray, poorly graded, medium to fine sand with organic debris. H ₂ S odor. 0.9-2.0': SP – Gray and tan, poorly graded medium sand. Hard packed. |

APPENDIX C LABORATORY REPORT



NAE ENVIRONMENTAL LABORATORY Project Name: Menemsha Creek Project Location: Marthas Vineyard, MA
 Date Collected:
 08/20/13

 Date Recieved:
 08/26/13

 Date Analyzed:
 09/20/13

Preparation Method: ASTM D421-85 (reapproved 2002)

Analysis Method: ASTM D 422-63 (reapproved 2002) - Sieve Nos. 4, 10, 40, 100, 200

Lab SOP: Particle Size Analysis of Sediments - Without Hydrometer (October 2011)

Received By: RBL

Analyzed By: CGB

Checked By: RBL

Discussion: 8 samples from the Menemsha Creek FNP were received by the lab upon completion of field activities. There were no deviations from the established laboratory testing protocols during preparation or analysis.

QA/QC Narrative: Not requested

| Summary | of Results: | | | | | | |
|---------------------|-------------|---------|------|--------|--------|------|----------|
| Commin ID 0/ Cohile | | %Gravel | | %Sand | | | 0/ Einee |
| Sample ID | | Coarse | Fine | Coarse | Medium | Fine | 70Filles |
| A | 0.0 | 0.0 | 0.3 | 2.9 | 73.1 | 23.7 | 0.0 |
| В | 0.0 | 0.0 | 0.0 | 0.0 | 67.7 | 32.3 | 0.0 |
| С | 0.0 | 0.0 | 0.0 | 0.7 | 65.4 | 33.9 | 0.0 |
| D | 0.0 | 0.0 | 1.1 | 4.2 | 77.6 | 17.0 | 0.1 |
| E | 0.0 | 0.0 | 9.5 | 9.6 | 70.8 | 10.0 | 0.1 |
| F | 0.0 | 0.0 | 0.2 | 0.2 | 91.6 | 8.1 | 0.0 |
| G | 0.0 | 0.0 | 0.3 | 1.5 | 89.5 | 8.7 | 0.0 |
| Н | 0.0 | 0.0 | 1.0 | 3.2 | 66.1 | 24.1 | 5.7 |



Project Name: Menemsha Creek Project Location: Marthas Vineyard, MA Sample ID: Menemsha-A

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



| %Cobblo | %Gi | ravel | %Sand | | | %Fines | |
|-----------|--------|--------|--------|--------|--------|--------|------|
| ->0CODDIe | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.3 | 2.9 | 73.1 | 23.7 | 0.0 | |
| | | | | | | | |
| D10 | D15 | D30 | D50 | D60 | D85 | Cc | Cu |
| 0.2655 | 0 3236 | 0 5602 | 0 9913 | 1 2068 | 1 7457 | 3 50 | 4 55 |

| Origina | Sample We | eight (g) | 540.3 | Post | Wash Weig | ht (g) | |
|---------|--------------------|---------------------|----------------------|---------------------------|---------------------|-----------------------------|------------------|
| Sieve | Sieve Size (mm) | Sieve Weight (g) | Shaken Weight (g) | Weight Retained (g) | Percent Retained | Cum. Percent Retained | Percent Finer |
| 3" | 76.200 | - | - | 0.0 | 0.0 | 0.0 | 100.0 |
| 3/4" | 19.000 | 1 | - | 0.0 | 0.0 | 0.0 | 100.0 |
| #4 | 4.750 | 489.3 | 491.1 | 1.8 | 0.3 | 0.3 | 99.7 |
| #10 | 2.000 | 470.4 | 485.9 | 15.5 | 2.9 | 3.2 | 96.8 |
| #40 | 0.425 | 354.6 | 749.4 | 394.8 | 73.1 | 76.3 | 23.7 |
| #100 | 0.150 | 325.6 | 453.5 | 127.9 | 23.7 | 99.9 | 0.1 |
| #200 | 0.075 | 316.6 | 316.9 | 0.3 | 0.1 | 100.0 | 0.0 |
| Pan | 0.000 | 458.1 | 458.1 | 0.0 | 0.0 | 100.0 | 0.0 |

Sample Notes: SP - Grey, medium to fine sand with shell fragments.



Project Name: Menemsha Creek Project Location: Marthas Vineyard, MA Sample ID: Menemsha-B

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



| %Cobble | %Gravel | | %Sand | | | %Fines | |
|---------|---------|--------|--------|--------|--------|--------|------|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.0 | 67.7 | 32.3 | 0.0 | |
| 5 | | | | | | | |
| D10 | D15 | D30 | D50 | D60 | D85 | Cc | Cu |
| 0 2349 | 0 2775 | 0 4054 | 0.8368 | 1 0695 | 1 6513 | 3 23 | 4 55 |

| Origina | Sample We | eight (g) | 548.2 | Post | Wash Weig | ht (g) | |
|---------|--------------------|---------------------|----------------------|---------------------------|---------------------|-----------------------------|------------------|
| Sieve | Sieve Size (mm) | Sieve Weight (g) | Shaken Weight (g) | Weight Retained (g) | Percent Retained | Cum. Percent Retained | Percent Finer |
| 3" | 76.200 | - | - | 0.0 | 0.0 | 0.0 | 100.0 |
| 3/4" | 19.000 | 1 | - | 0.0 | 0.0 | 0.0 | 100.0 |
| #4 | 4.750 | 494.0 | 494.0 | 0.0 | 0.0 | 0.0 | 100.0 |
| #10 | 2.000 | 468.3 | 468.4 | 0.1 | 0.0 | 0.0 | 100.0 |
| #40 | 0.425 | 353.0 | 724.0 | 371.0 | 67.7 | 67.7 | 32.3 |
| #100 | 0.150 | 328.9 | 505.8 | 176.9 | 32.3 | 100.0 | 0.0 |
| #200 | 0.075 | 313.6 | 313.8 | 0.2 | 0.0 | 100.0 | 0.0 |
| Pan | 0.000 | 458.9 | 458.9 | 0.0 | 0.0 | 100.0 | 0.0 |

Sample Notes: SP - Tan, medium to fine sand.



Project Name: Menemsha Creek Project Location: Marthas Vineyard, MA Sample ID: Menemsha-C

Date: 09/20/13





| %Cobble | %Gravel | | %Sand | | | %Fines | |
|---------|---------|------|--------|------------|------|--------|------|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.0 | 0.7 | 65.4 | 33.9 | 0.0 | |
| | | | | | | | |
| D40 | D46 | 000 | DC0 | D00 | | • | 0 |

| D10 | D15 | D30 | D50 | D60 | D85 | Cc | Cu |
|--------|--------|--------|--------|--------|--------|------|------|
| 0.2311 | 0.2716 | 0.3932 | 0.8126 | 1.0536 | 1.6561 | 3.23 | 4.56 |
| | | | | | | | |

| Original | Sample W | eight (g) | 520.1 | Post | Wash Weig | ht (g) | |
|----------|--------------------|---------------------|----------------------|---------------------------|---------------------|-----------------------------|------------------|
| Sieve | Sieve Size (mm) | Sieve Weight (g) | Shaken Weight (g) | Weight Retained (g) | Percent Retained | Cum. Percent Retained | Percent Finer |
| 3" | 76.200 | 1 | - | 0.0 | 0.0 | 0.0 | 100.0 |
| 3/4" | 19.000 | 1 | - | 0.0 | 0.0 | 0.0 | 100.0 |
| #4 | 4.750 | 489.3 | 489.5 | 0.2 | 0.0 | 0.0 | 100.0 |
| #10 | 2.000 | 470.5 | 474.1 | 3.6 | 0.7 | 0.7 | 99.3 |
| #40 | 0.425 | 354.8 | 694.7 | 339.9 | 65.4 | 66.1 | 33.9 |
| #100 | 0.150 | 325.6 | 502.0 | 176.4 | 33.9 | 100.0 | 0.0 |
| #200 | 0.075 | 316.7 | 316.7 | 0.0 | 0.0 | 100.0 | 0.0 |
| Pan | 0.000 | 458.0 | 458.0 | 0.0 | 0.0 | 100.0 | 0.0 |

Sample Notes: SP - Tan/grey, medium to fine sand.



Project Name: Menemsha Creek Project Location: Marthas Vineyard, MA Sample ID: Menemsha-D

Date: 09/20/13

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



| %Cobble | %Gravel | | | %Sand | | | %Fines | |
|---------|---------|------|--------|--------|------|------|--------|--|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay | |
| 0.0 | 0.0 | 1.1 | 4.2 | 77.6 | 17.0 | 0.1 | | |
| | | | | | | | | |

| D10 | D15 | D30 | D50 | D60 | D85 | Cc | Cu |
|--------|--------|--------|--------|--------|--------|------|------|
| 0.3086 | 0.3901 | 0.6861 | 1.0922 | 1.2953 | 1.8029 | 3.43 | 4.20 |
| | | | | | | | |

| Original | Sample We | eight (g) | 332.5 | Post | Wash Weig | ht (g) | |
|----------|--------------------|---------------------|----------------------|---------------------------|---------------------|-----------------------------|------------------|
| Sieve | Sieve Size (mm) | Sieve Weight (g) | Shaken Weight (g) | Weight Retained (g) | Percent Retained | Cum. Percent Retained | Percent Finer |
| 3" | 76.200 | - | - | 0.0 | 0.0 | 0.0 | 100.0 |
| 3/4" | 19.000 | - | - | 0.0 | 0.0 | 0.0 | 100.0 |
| #4 | 4.750 | 489.3 | 493.1 | 3.8 | 1.1 | 1.1 | 98.9 |
| #10 | 2.000 | 470.5 | 484.3 | 13.8 | 4.2 | 5.3 | 94.7 |
| #40 | 0.425 | 354.7 | 612.6 | 257.9 | 77.6 | 82.9 | 17.1 |
| #100 | 0.150 | 325.6 | 381.7 | 56.1 | 16.9 | 99.7 | 0.3 |
| #200 | 0.075 | 316.7 | 317.2 | 0.5 | 0.2 | 99.9 | 0.1 |
| Pan | 0.000 | 458.0 | 458.4 | 0.4 | 0.1 | 100.0 | 0.0 |

Sample Notes: SP - Tan/grey, medium to fine sand.



Project Name: Menemsha Creek Project Location: Marthas Vineyard, MA Sample ID: Menemsha-E

Date: 09/20/13





| %Cobble | %Gravel | | %Sand | | | %Fines | | |
|---------|---------|------|--------|--------|------|--------|------|--|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay | |
| 0.0 | 0.0 | 9.5 | 9.6 | 70.8 | 10.0 | 0.1 | | |
| | | | | | | | | |
| D10 | D15 | D30 | D50 | D60 | D85 | Co | Cu | |

1.5335

3.1563

2.68

3.64

1.3112

| start from the start | 5-30-40 55 100-400 00 | t for the shear Art | | 0.0017 97 | | | |
|----------------------|-----------------------|---------------------|----------------------|---------------------------|----------------------|-----------------------------|------------------|
| Origina | l Sample We | eight (g) | 457.5 | Post | Post Wash Weight (g) | | |
| Sieve | Sieve Size (mm) | Sieve Weight (g) | Shaken Weight (g) | Weight Retained (g) | Percent Retained | Cum. Percent Retained | Percent Finer |
| 3" | 76.200 | - | - | 0.0 | 0.0 | 0.0 | 100.0 |
| 3/4" | 19.000 | 1 | - | 0.0 | 0.0 | 0.0 | 100.0 |
| #4 | 4.750 | 493.9 | 537.2 | 43.3 | 9.5 | 9.5 | 90.5 |
| #10 | 2.000 | 468.2 | 511.9 | 43.7 | 9.6 | 19.0 | 81.0 |
| #40 | 0.425 | 353.1 | 677.2 | 324.1 | 70.8 | 89.9 | 10.1 |
| #100 | 0.150 | 328.9 | 374.0 | 45.1 | 9.9 | 99.7 | 0.3 |
| #200 | 0.075 | 313.7 | 314.4 | 0.7 | 0.2 | 99.9 | 0.1 |
| Pan | 0.000 | 459.0 | 459.6 | 0.6 | 0.1 | 100.0 | 0.0 |

Sample Notes: SP - Grey, medium sand.

0.4210

0.5330

0.8665



Project Name: Menemsha Creek Project Location: Marthas Vineyard, MA Sample ID: Menemsha-F

Date: 09/20/13





| %Cobble | %Gravel | | %Sand | | | %Fines | |
|-------------|---------|------|--------|------------|------|--------|------|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 0.2 | 0.2 | 91.6 | 8.1 | 0.0 | |
| | | | | | | | |
| D 40 | D46 | 000 | D.C.O. | D00 | 005 | - | 0 |

| D10 | D15 | D30 | D50 | D60 | D85 | Cc | Cu |
|--------|--------|--------|--------|--------|--------|------|------|
| 0.4581 | 0.5441 | 0.8021 | 1.1462 | 1.3182 | 1.7483 | 2.66 | 2.88 |
| | | | | | | | |

| Original Sample Weight (g) | | 430.8 | Post | Post Wash Weight (g) | | | |
|----------------------------|--------------------|---------------------|----------------------|---------------------------|---------------------|-----------------------------|------------------|
| Sieve | Sieve Size (mm) | Sieve Weight (g) | Shaken Weight (g) | Weight Retained (g) | Percent Retained | Cum. Percent Retained | Percent Finer |
| 3" | 76.200 | 1 | - | 0.0 | 0.0 | 0.0 | 100.0 |
| 3/4" | 19.000 | - | - | 0.0 | 0.0 | 0.0 | 100.0 |
| #4 | 4.750 | 489.3 | 490.2 | 0.9 | 0.2 | 0.2 | 99.8 |
| #10 | 2.000 | 470.5 | 471.2 | 0.7 | 0.2 | 0.4 | 99.6 |
| #40 | 0.425 | 354.7 | 749.1 | 394.4 | 91.6 | 91.9 | 8.1 |
| #100 | 0.150 | 325.6 | 360.2 | 34.6 | 8.0 | 100.0 | 0.0 |
| #200 | 0.075 | 316.7 | 316.8 | 0.1 | 0.0 | 100.0 | 0.0 |
| Pan | 0.000 | 458.0 | 458.1 | 0.1 | 0.0 | 100.0 | 0.0 |

Sample Notes: SP - Tan, medium sand with shel fragments.



Project Name: Menemsha Creek Project Location: Marthas Vineyard, MA Sample ID: Menemsha-G

Date: 09/20/13

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



| %Gravel | | | %Sand | %Fines | | |
|---------|-----------------------|-----------------------------------|----------------------------------|---|--|---|
| Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.3 | 1.5 | 89.5 | 8.7 | 0.0 | |
| 0.0 | 0.0 | 1.0 | 00.0 | 0.1 | | |
| | %Gr: Coarse 0.0 | %Gravel Coarse Fine 0.0 0.3 | %GravelCoarseFineCoarse0.00.31.5 | %Gravel%SandCoarseFineCoarseMedium0.00.31.589.5 | %Gravel%SandCoarseFineCoarseMediumFine0.00.31.589.58.7 | %Gravel%Sand%FCoarseFineCoarseMediumFineSilt0.00.31.589.58.70 |

| D10 | D15 | D30 | D50 | D60 | D85 | Cc | Cu |
|--------|--------|--------|--------|--------|--------|------|------|
| 0.4471 | 0.5350 | 0.7990 | 1.1509 | 1.3269 | 1.7668 | 2.69 | 2.97 |
| | 9 | | | | | | |

| Original Sample Weight (g) | | 343.0 | Post | Post Wash Weight (g) | | | |
|----------------------------|--------------------|---------------------|----------------------|---------------------------|---------------------|-----------------------------|------------------|
| Sieve | Sieve Size (mm) | Sieve Weight (g) | Shaken Weight (g) | Weight Retained (g) | Percent Retained | Cum. Percent Retained | Percent Finer |
| 3" | 76.200 | - | - | 0.0 | 0.0 | 0.0 | 100.0 |
| 3/4" | 19.000 | 1 | . | 0.0 | 0.0 | 0.0 | 100.0 |
| #4 | 4.750 | 494.0 | 495.0 | 1.0 | 0.3 | 0.3 | 99.7 |
| #10 | 2.000 | 468.2 | 473.2 | 5.0 | 1.5 | 1.7 | 98.3 |
| #40 | 0.425 | 353.1 | 660.1 | 307.0 | 89.5 | 91.3 | 8.7 |
| #100 | 0.150 | 328.8 | 358.7 | 29.9 | 8.7 | 100.0 | 0.0 |
| #200 | 0.075 | 313.6 | 313.7 | 0.1 | 0.0 | 100.0 | 0.0 |
| Pan | 0.000 | 459.0 | 459.0 | 0.0 | 0.0 | 100.0 | 0.0 |

Sample Notes: SP - Tan, medium sand with shel fragments.



Project Name: Menemsha Creek Project Location: Marthas Vineyard, MA Sample ID: Menemsha-H

Date: 09/20/13

Particle Size Analysis - ASTM D 422-63 (reapproved 2002)



| %Cobble | %Gravel | | %Sand | | | %Fines | |
|---------|---------|------|--------|--------|------|--------|------|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 0.0 | 1.0 | 3.2 | 66.1 | 24.1 | 5.7 | |
| | | | | | | | |

| D10 | D15 | D30 | D50 | D60 | D85 | Cc | Cu |
|--------|--------|--------|--------|--------|--------|------|------|
| 0.1582 | 0.2256 | 0.4300 | 0.9066 | 1.1449 | 1.7406 | 4.75 | 7.24 |
| | | | | | | | |

| Original Sample Weight (g) | | 345.1 | Post | Post Wash Weight (g) | | | |
|----------------------------|--------------------|---------------------|----------------------|---------------------------|---------------------|-----------------------------|------------------|
| Sieve | Sieve Size (mm) | Sieve Weight (g) | Shaken Weight (g) | Weight Retained (g) | Percent Retained | Cum. Percent Retained | Percent Finer |
| 3" | 76.200 | - | - | 0.0 | 0.0 | 0.0 | 100.0 |
| 3/4" | 19.000 | - | - | 0.0 | 0.0 | 0.0 | 100.0 |
| #4 | 4.750 | 489.3 | 492.6 | 3.3 | 1.0 | 1.0 | 99.0 |
| #10 | 2.000 | 470.4 | 481.3 | 10.9 | 3.2 | 4.1 | 95.9 |
| #40 | 0.425 | 354.8 | 582.9 | 228.1 | 66.1 | 70.2 | 29.8 |
| #100 | 0.150 | 325.6 | 396.0 | 70.4 | 20.4 | 90.6 | 9.4 |
| #200 | 0.075 | 316.6 | 329.2 | 12.6 | 3.7 | 94.3 | 5.7 |
| Pan | 0.000 | 458.0 | 477.8 | 19.8 | 5.7 | 100.0 | 0.0 |

Sample Notes: SP - Grey, medium to fine sand.