BRUSH NECK COVE
AQUATIC ECOSYSTEM RESTORATION
WARWICK, RHODE ISLAND

FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

US Army Corps
of Engineers®
New England District

Authority: WRDA Section 206
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Cover Sheet

FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

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Aquatic Ecosystem Restoration
Warwick, RI

The responsible lead Federal agency for this study is the U. S. Army Corps of Engineers New England District. The non-Federal sponsor for the study is the Rhode Island Coastal Resource Management Council. The Corps is also the lead Federal agency for National Environmental Policy Act compliance. This report is a combined feasibility report and environmental assessment complying with requirements of the U.S. Army Corps of Engineers (Corps) and the Council of Environmental Quality, and is intended to reduce duplication and paperwork.

Abstract:
The purpose of the Feasibility and Environmental Assessment was to document the aquatic restoration of Brush Neck Cove planning process. The sponsor, stakeholders and Corps believed that the perceived environmental degradation of Brush Neck and neighboring Buttonwoods Cove is related to reduced tidal flushing and tidal range caused by a restriction at the inlet and sedimentation. The group also believed that removing the soft sediment layer and exposing a coarser underlying material in the coves could improve benthic habitat. However, data collected during the feasibility study suggest that these coves are not tidally restricted and have no reduced water volume exchange; the coves receive the maximum tidal flushing and ranges available and the volume of water entering the coves has not changed with time. The sediment core data revealed minimal to no physical difference between the upper and lower sediment layers; the sediment cores did not contain a distinct coarse substrate layer. The Corps concluded from these data that dredging the inlet or the coves would not result in significant restoration benefits. Therefore, we do not recommend a Federal project at this time and recommend terminating the investigation. The City of Warwick should work together with other Federal, State and local agencies and groups to implement best management practices to minimize sediment, nutrient and bacteria loading and take steps to eradicate invasive species in the study area watershed.

The findings of this negative report have not gone through the formal Corps of Engineers review/quality assurance process. Information, other than the general conclusion that further consideration under the Section 206, Aquatic Ecosystem Restoration Program is not warranted, should be considered preliminary.

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Brush Neck Cove Aquatic Ecosystem Restoration
Executive Summary

This report presents the results of studies for aquatic ecosystem restoration in Brush Neck Cove, Warwick, Rhode Island under the authority contained in Section 206 of the Water Resources Development Act. The Rhode Island Coastal Resource Management Council (CRMC), the non-Federal sponsor, and the U.S. Army Corps of Engineers (Corps) initiated the feasibility phase in March 2005.

This summary is intended to describe the major factors that were considered in the investigation and those that influenced the decisions documented in this report.

MAJOR CONCLUSIONS AND FINDINGS

This study concludes that the dredging of the Brush Neck Cove inlet and basin would not provide sufficient environmental benefits to warrant Federal participation in the implementation of the restoration measures evaluated.

Problems and Opportunities.
Problems identified in Brush Neck and Buttonwoods Coves were:

- Degraded water quality (nutrients, bacteria, dissolved oxygen and turbidity) contributing to aquatic habitat degradation
- Shoaling, sediment loading and resuspension
- Loss of shellfish spawning habitats
- Loss of aesthetic value

Opportunities identified included:

- Restoration of waterfowl habitats
- Restoration of salt marsh habitats

The team considered the possibility that many of these problems were at least partially related to a restriction of tidal flow from the narrow inlet to Brush Neck Cove based on information provided by the sponsor, stakeholders and residents. The general perception was that the inlet had become shallower and narrower with time and that the cove had reduced depth due to sedimentation. Based on this information, the planning objectives were centered around restoring historic tidal flushing, depth and benthic substrate while improving water quality and habitat within the project area.

Planning Objectives
The investigation of problems and opportunities in the study area led to the establishment of the following planning objectives:

- Remove or reduce impacts from high nutrient/organic material sediments within the estuary
- Reduce the impact from stormwater runoff containing nutrients and sediment to the estuary
- Improve flushing and restore tidal range within the estuary
- Stabilize salt marshes and riparian areas to reduce erosion, sediment loading and suspension
- Restore buffer zones and riparian habitats.
- Restore and create salt marsh habitat
- Restore substrates that would support shellfish populations
- Improve water quality to levels sufficient to support high quality shellfish and benthic communities.

Alternatives
A wide range of restoration measures were evaluated to address the planning objectives. Measures are then combined to form alternative plans. However, during data acquisition and analysis, it was determined that the restoration measures would not accomplish the planning objectives and therefore no alternatives were formulated. The measures considered were:

I. Inlet Channel Dredging
   i. Width – 75 feet
   ii. Lengths – 1,000, 4,000, 6,000 feet
   iii. Depths – 4, 5, 6-foot

II. Cove Dredging
   a. Brush Neck Cove
      i. Widths – 100, 200, 300 feet
      ii. Lengths – 2,0000, 2,500, 3,000 feet
      iii. Depths – 4, 5, 6-foot
   b. Buttonwoods Cove
      i. Widths – 100, 200, 300 feet
      ii. Lengths – 250, 500, 750 feet
      iii. Depths – 3, 4, 5-foot

III. Beach Replenishment (dependant on I. or II. above)
   a. Oakland Beach (Corps project)
   b. City Park Beach (City-owned)

IV. Habitat Restoration (dependant on I. or II. above)
   a. Restoring Benthic/Shellfish Substrate (Brush Neck Cove)
   b. Restoring Benthic/Shellfish Substrate (Buttonwood Cove)
   c. Salt Marsh creation/restoration/stabilization (City Park)
   d. Salt Marsh creation/restoration/stabilization (east of Sea View Drive)
   e. Invasive Species Removal (*Phragmites*)

V. Water Quality
   a. Sedimentation Trap Structures
   b. Natural Wetland Filtration Systems
   c. Restore riparian buffer

VI. Other
   a. Rehabilitation of Groins (Oakland Beach)
   b. Dredging at Boat Ramp (Warwick Cove)

During the data collection and evaluation process, it was determined that the entire volume of Brush Neck Cove is exchanged during normal tides and therefore inlet dredging to restore tidal flushing and range would not produce any significant change in the flushing rate. Inlet dredging measures were eliminated from further consideration.

The planning process continued to evaluate the remaining measures including cove dredging to reduce nutrient recycling, improve water quality and provide suitable substrate for shellfish. If coarser material were present below the existing upper organic sediment layers, exposing this material by dredging could improve conditions within the estuary. However, sediment sampling and testing indicated that there was no defined sand or coarse substrate layer within sediment cores, down to 7.0 – 15.9 feet, and that the physical characteristics of historic deeper substrate are not substantially different than the upper newer layers. In addition, nutrient concentrations were relatively low in the upper layer and exposing deeper sediment would not likely result in a substantial decrease in nutrient release or less resuspension of sediment nor is it expected to lessen the biological oxygen demand. Cove dredging was therefore eliminated as a restoration measure.

The beach replenishment and salt marsh restoration/creation measures were also eliminated since they required the reuse of dredged material removed during the inlet or cove dredging. The restoration of shellfish and other benthos was also dependant on dredging, with removal of material to expose an existing suitable substrate layer. The remaining measures (V and VI) are either not in the Corps authority or do not provide significant ecosystem restoration benefits. Other Federal, State and local agencies can address water quality and specific local needs under different authorities and programs.

The planning constraints of the project required suitable sediment for reuse on site and exposure of desirable sediment beneath the existing upper layers. These constraints limited the measures available to formulate alternative plans. Given this, no alternative plans were formulated and no alternatives are recommended. The CRMC was informed of these data and agree that limited benefit is expected. The sponsor does not wish to continue with the project as planned.

The Corps is not recommending any of the restoration measures evaluated since these measures are not expected to substantially restore structure and function of Brush Neck and Buttonwoods Coves.

This findings of this negative report have not gone through the formal Corps of Engineers review/quality assurance process. Information, other than the general conclusion that further consideration under the Section 206, Aquatic Ecosystem Restoration Program is not warranted, should be considered preliminary.

Table of Contents

1.0 Introduction **1**
1.1 Study Authority 1
1.2 Study Area 1
1.3 Study Purpose and Scope 1
1.4 History of the Investigation 1
1.5 Planning Process and Report Organization 2
2.0 Project Need and Objectives **3**
2.1 National Objectives 3
2.2 Public Concerns 3
2.3 Problems and Opportunities 3
2.4 Planning Objectives 6
2.5 Planning Constraints 7
3.0 Initial Screening of Restoration Measures **8**
3.1 Plan Formulation Rationale 8
3.2 Management Measures 8
3.2.1 Inlet Dredging for Improving Tidal Range and Flushing 9
3.2.2 Cove Dredging 13
3.2.3 Salt Marsh Restoration 16
3.3 Conclusion from Preliminary Screening 16
4.0 Affected Environment **18**
4.1 Environmental Setting of the Study Area 18
4.2 Water Quality 19
4.2.1 Bacteria 19
4.2.2 Dissolved Oxygen 21
4.2.3 Nutrients 22
4.2.4 Sediment 22
4.3 Biota 23
4.3.1 Vegetation 23
4.3.2 Fish 25
4.3.3 Benthic Invertebrates and Shellfish 25
4.3.4 Birds 25
4.3.5 Threatened and Endangered Species 28
4.4 Air Quality 28
4.5 Recreation and Aesthetics 28
4.6 Sewer Connections 28
4.7 Historic and Archaeological Resources 28
5.0 Public Involvement, Review and Consultation **29**
6.0 Recommendations **29**
7.0 References **30**

Appendices

Appendix A – Sediment Data
Appendix B – Benthic Invertebrate Data
Appendix C – Historic and Archaeological Resources

List of Tables

Table 1. Dry and Wet Weather Shellfish Fecal Coliform Data Summary 20
Table 2. Oakland and City Park Beach 2000-2001 Fecal Coliform Data Summary. 20
Table 3. Bacteria Data Summary for Brush Neck Cove Tributaries Used in the TMDL Analysis. 21
Table 4. Wintering Waterfowl Abundance by Species Category in Brush Neck Cove 2001-2003. 27
Table 5. Wintering Waterfowl Abundance in Brush Neck Cove 2004-2009. 27

List of Figures

Figure 1. Site Location Map 2
Figure 2. Problems within the Brush Neck and Buttonwoods Cove Watershed. 4
Figure 3. 1975 Survey Digital Terrain Model. 10
Figure 4. 2005/2006 Survey Digital Terrain Model. 10
Figure 5. Difference Map of 1975 and 2005/2006 Surveys 11
Figure 6. Inlet Comparison, 1939 versus 2007 12
Figure 7. Tide Survey Data Collection Locations 12
Figure 8. Tide Survey Data Plot 13
Figure 9. Sediment Sample Locations in Brush Neck Cove and Buttonwoods Cove 14
Figure 10. Greenwich Bay Watershed. 18
Figure 11. Bacteria Sampling Stations for Brush Neck Cove Tributaries Used in the TMDL Analysis 21
Figure 12. Brush Neck Cove Salt Marsh 24
Figure 13. Horseshoe Crab Abundance and Density in Greenwich Bay 26

1.0 Introduction

This chapter provides basic background for the study. It also lists the steps in the U.S. Army Corps of Engineers (Corps) planning process and relates them to the organization of this report.

1.1 Study Authority

Authority to perform this investigation was provided under Section 206 of the Water Resources Development Act of 1996 (PL 104-303) entitled "Aquatic Ecosystem Restoration," which states in part,

> *"The Secretary [of the Army] may carry out an aquatic ecosystem restoration and protection project if the secretary determines that the project – will restore the quality of the environment and is in the public interest; and is cost-effective."*

Implementation of any alternative plan or combination of alternatives is subject to the recommendation and approval of the Corps, as well as approval of the Federal budgets on which its program funding depends.

1.2 Study Area

The study area consists of two adjacent coves, Brush Neck Cove and Buttonwoods Cove, located in the City of Warwick, Rhode Island (Figure 1). The City of Warwick is located in Kent County, Rhode Island and is approximately 12 miles south of Providence. Warwick is the second largest city in the state. Brush Neck and Buttonwoods Coves are located in the West Bay area of Warwick and drain to Greenwich Bay. Brush Neck Cove is approximately a mile in length and has an area of approximately 83 acres. Buttonwoods Cove is approximately ½ mile in length and has an area of about 46 acres.

1.3 Study Purpose and Scope

The purpose of this investigation is to quantify ecosystem restoration benefits and associated costs for various alternatives to restore aquatic habitat in Brush Neck and Buttonwoods Coves in Warwick, Rhode Island. The study scope is to identify a cost effective restoration plan that achieves the study goals and objectives while considering the interests of the sponsor. While stormwater management is not a direct component of this study, as part of its overall efforts to restore the coves, the City of Warwick is actively working to improve conditions through a combination of water quality improvement projects within the watershed.

This study investigates the extent of degradation of water quality, finfish, shellfish and benthic habitat within the coves and considers measures to restore benthic habitat, fish and shellfish resources. The Corps and the Rhode Island Coastal Resources Management Council (CRMC) consulted with other agencies and organizations to identify appropriate restoration measures. The measures investigated include: methods to reduce sediment accumulation, dredging and redistributing sediment to restore tidal flushing and appropriate substrates for shellfish and salt marshes, dredging and isolating nutrient rich or contaminated sediments, and restoring buffer zones. The study considers the contribution of activities in the watershed to habitat degradation.

1.4 History of the Investigation

The CRMC, the non-Federal sponsor, and the Corps initiated the feasibility study in March 2005 after completing a preliminary restoration plan in July 2004. This report presents the results the feasibility study.

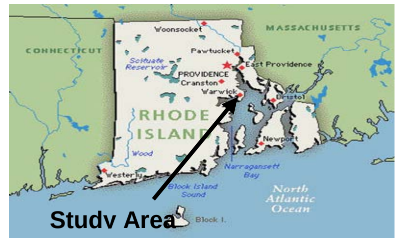

Figure 1. Site Location Map

1.5 Planning Process and Report Organization

The planning process consists of six major steps:

1. Specify water and related land resources problems and opportunities,
2. Inventory, forecast and analysis of water and related land resources conditions within the study area,
3. Formulate alternative plans,
4. Evaluate the effects of the alternative plans,
5. Compare the alternative plans, and
6. Select the recommended plan based upon the comparison of the alternative plans.

Sections of the report relate to the six steps of the planning process as follows:

- Section 2 – Project Need and Objectives, covers the first step in the planning process (Specification of water and related land resources problems and opportunities).
- Section 3 – Initial Screening of Restoration Measures, covers the beginning portion of the third, fifth and sixth steps in the planning process. The Corps did not formulate alternative plans, evaluate plans or compare plans since the restoration measures are not expected to produce significant restoration benefits.
- Section 4 - Affected Environment, covers the second step of the planning process (Inventory, forecast and analysis of water and related land resources in the study area).

2.0 Project Need and Objectives

This section presents the results of the first step of the planning process, the specification of water and related land resources problems and opportunities in the study area. The section concludes with the establishment of planning objectives and planning constraints, which is the basis for the formulation of restoration measures and alternative plans.

2.1 National Objectives

The national or Federal objective of ecosystem restoration projects is to contribute to National Ecosystem Restoration (NER). This objective is to contribute to the nation's ecosystems through ecosystem restoration, with contributions measured by changes in the amounts and quality of habitat.

2.2 Public Concerns

A number of public concerns were identified during the course of the study. Input was received through coordination with the sponsor, coordination with other agencies, public review of draft and interim products, and through public meetings. A discussion of public involvement is included in Section 5, Public Involvement, Review and Consultation.

Public concerns center around the degradation of habitat and water quality over time. Historically, Brush Neck and Buttonwoods Coves supported healthy estuarine habitats and recreationally harvested soft-shell clams (*Mya arenaria*) and quahogs (*Mercenaria mercenaria*). As recently as the 1960s, the coves had a relatively healthy and diverse benthic (bottom) community and fish habitat. Currently, these resources are limited and the fishery is closed. Excessive nutrients and pollutants accumulate in the coves causing eutrophication, algal blooms, high bacteria concentrations, and episodic low dissolved oxygen concentrations that result in fish kills.

The discharge of combined-sewer-overflows and other non-point sources within the Greenwich Bay watershed has contributed to low dissolved oxygen concentrations and catastrophic fish kills, the most recent occurring during the summer of 2003. Various state and local agencies are working together to improve the water quality of the Bay and restore the estuarine habitat of Greenwich Bay and its tributaries.

2.3 Problems and Opportunities

The evaluation of public concerns reflects a range of needs perceived by the public. This section describes these needs in the context of problems and opportunities that can be addressed through improving ecosystem structure and function. This section identifies watershed problems and opportunities related to its capacity to support aquatic fish and wildlife. Figure 2 identifies areas where problems exist in Brush Neck and Buttonwoods Coves.

Restoration opportunities are generated by comparing existing, historic and potential future conditions, or by identifying areas that are functioning below their capacity. The Brush Neck Cove Special Area Management Plan (Ernst et al., 1999; referred to in this document as the SAM Plan), prepared by the CRMC summarized problems and opportunities in Brush Neck Cove and its watershed. The information provided in the SAM Plan, supplemented by meetings of the project team and knowledgeable agencies and individuals, provide the basis for defining the problems and opportunities addressed in this feasibility study.

Figure 2. Problems within the Brush Neck and Buttonwoods Cove Watershed.

Many of the problems identified in the SAM Plan for the Brush Neck Cove are beyond the scope of the authority provided by the Section 206 Aquatic Ecosystem Restoration Authority. The SAM Plan outlines strategies for remedying these problems. One problem identified in the SAM Plan that is beyond the Corps Authority is the density of Individual Sewage Disposal Systems (ISDS). The local communities are addressing this problem. Improvements in water quality that result from the upgrade to sewers will take time to fully develop but they may also be offset by increased development in the watershed. The SAM Plan indicates that, even with sewering the watershed, nitrogen inputs will continue to increase due to increased use of lawn fertilizers as more of the watershed is developed. However, the potential for future improvements in water quality, with the conscious effort of landowners to control fertilizer use, provides an opportunity for the Brush Neck Cove system to support higher quality fish and wildlife habitats.

The purpose of this project is to restore historic tidal flushing, depth and benthic substrate while improving water quality and habitat in Brush Neck and Buttonwoods Coves. Restoring benthic productivity would add a forage base to the system and encourage the use of the area by numerous fish and wildlife species. Restoring salt marsh to this estuarine system would serve as additional habitat for many estuarine dependent species. These functions are diminished when marshes are cut off from tidal flooding and become dominated by *Phragmites*. The targeted effect of this restoration project is to restore previously existing ecological functions and habitat quality to the estuarine system of the coves.

2.3.1 Problems

Degraded Water Quality Contributing to Aquatic Habitat Degradation

The SAM Plan indicates that there are two primary water pollutants of concern in Brush Neck and Buttonwoods Coves: coliform bacteria and nitrogen. The major sources of these pollutants are septic systems and commercial and residential fertilizer application. Internal recycling from sediment can also increase nutrient concentrations in overlying waters. The high coliform concentrations led to the permanent closure of both coves to shellfishing. High nitrogen concentrations lead to eutrophication. Eutrophication is a process whereby water bodies, such as lakes or estuaries receive excess nutrients that stimulate excessive plant growth (e.g. algae or nuisance plants), reducing dissolved oxygen when dead plant material decomposes. Eutrophication can lead to fish kills, shifts in plankton and benthic invertebrate communities, and loss of eelgrass. Elevated nutrient concentrations are believed to adversely affect eelgrass plants by stimulating algal competitors, which limit light transmission.

Most water quality problems can and should be addressed at the source, however, in some cases, water quality problems can be exacerbated by poor flushing. Water quality improvements may be attained by improving flushing.

Potential restoration/remedial measures:

- Remove high nutrient/organic material sediments using thin layer dredging to reduce nutrient flux to the overlying waters.
- Isolate high nutrient/organic material sediments by consolidating them in wetland restoration sites or capping to reduce nutrient flux to the overlying waters.
- Use Best Management Practices (BMPs) to collect nutrients and sediment from runoff and storm drains before they enter the estuary.
- Remove existing shoals near the mouth of the river to improve flushing.
- Restore riparian buffer zones to intercept nutrients before they enter the estuary.

Shoaling, Sediment Loading and Resuspension

Shoaling in the lower portion of the coves and high nutrient concentrations may contribute to a decline in bottom habitat quality for benthic organisms such as shellfish. Excessive sedimentation and resuspension of sediment are also detrimental to eelgrass beds and other benthic life. Excessive sediment accumulation can bury organisms and change the physical and chemical characteristics of benthic substrate. Continual resuspension of sediments can decrease light penetration degrading conditions for plant growth. Eelgrass beds and other submerged aquatic vegetation provide valuable spawning, nursery, cover, and foraging habitat for aquatic and semi-aquatic animals. For the last few decades, submerged aquatic vegetation has disappeared from Brush Neck and Buttonwoods Coves.

Potential restoration/remedial measures:

- Stabilize eroding salt marshes using biological engineering techniques to reduce sediment erosion and suspension.
- Stabilize eroding riparian areas using biological engineering techniques to reduce sediment erosion and suspension.
- Use Best Management Practices (BMPs) to collect sediment from runoff and storm drains before it can be deposited in eelgrass habitats.
- Plant or seed eelgrass.

Loss of Shellfish Spawning Habitats

Brush Neck and Buttonwoods Coves supported ecologically and commercially important species such as quahogs, mussels, razor clams, soft-shelled clams, oysters, and (historically) scallops. Restoration of shellfish and related habitats in the estuary along with improvements in water quality could contribute to the reestablishment of the State of Rhode Island Shellfish Management Area designation.

Potential restoration/remedial measures:

- Remove organic mud from the surface of coarser sediments to restore substrates that will support shellfish populations.
- Restore water quality to levels sufficient to support high quality shellfish and benthic communities.

Loss of Aesthetic Value

Degradation of habitats and water quality in Brush Neck and Buttonwoods Coves reduce their aesthetic values.

Potential restoration/remedial measures:

- Improve water quality.
- Restore buffer zones and riparian habitats.

2.3.2 Opportunities

Restoration of Waterfowl Habitats

The Brush Neck and Buttonwoods Coves are the Focus Area under the Atlantic Coast Joint Venture of the international North American Waterfowl Management Plan (NAWMP). Restoration of eelgrass beds, salt marsh, shellfish and benthic habitats in Brush Neck Cove under the Section 206 project could contribute to the restoration of important waterfowl populations, including migrating and wintering black ducks. Black ducks are themselves the focus of the Black Duck Joint Venture under the NAWMP, attesting to their National significance based on scientific considerations.

Potential restoration measures:

- Restore salt marshes by reducing erosion, restoring tidal elevations, and tidal flushing.
- Restore benthic, fishery, and wetland habitats to improve feeding opportunities for waterfowl.

Restoration of Salt Marsh Habitats

The creation of additional salt marsh habitat in Brush Neck Cove will improve the above described water quality problems:

- Salt marsh vegetation would remove nutrients, nitrogen and phosphate, from all inflows, reducing nutrient loads.
- Selective dredging would provide substrate for the planting of additional salt marsh in Brush Neck Cove.
- Salt marsh creation in conjunction with the conversion from ISDS to municipal sewage treatment in the watershed would improve water quality by reducing the fecal coliform levels in Brush Neck and Buttonwoods Coves.

2.4 Planning Objectives

The water and related land resource problems and opportunities identified in this study are restated as specific planning objectives to provide focus for the formulation of alternatives. These planning objectives reflect the problems and opportunities and represent desired positive changes while incorporating opportunities presented. The planning objectives are specified as follows:

- Remove or reduce impacts from high nutrient/organic material sediments within the estuary
- Reduce the impact from stormwater runoff containing nutrients and sediment to the estuary
- Improve flushing and restore tidal range within the estuary
- Stabilize salt marshes and riparian areas to reduce erosion, sediment loading and suspension
- Restore buffer zones and riparian habitats.
- Restore and create native plant salt marsh habitats
- Restore substrates that will support shellfish populations
- Improve water quality to levels sufficient to support high quality shellfish and benthic communities.

2.5 Planning Constraints

Unlike planning objectives that represent desired positive changes, planning constraints represent restrictions that may prevent the achievement of the objectives. The planning constraints identified in this study are as follows:

- Suitable substrate must be available beneath the upper undesirable organic layer of cove sediment
- Cove sediments must be suitable for reuse on site on beaches or for creation of salt marsh or benthic habitat
- The alternatives must not cause flooding or increase erosion on existing salt marsh habitat, beaches, residential areas or other shoreline properties

3.0 Initial Screening of Restoration Measures

This section describes the development and evaluation of restoration measures to address the planning objectives. It also describes the studies and data used to conclude that substantial ecosystem restoration benefits are not expected from the measures evaluated.

3.1 Plan Formulation Rationale

A wide variety of management measures were developed that would address one or more of the planning objectives. These measures were then evaluated and then screened. Alternative plans are typically developed by combining one or more of the management measures and compared. However, alternative plans were not formulated in this case since substantial ecosystem benefits are not anticipated from the measures evaluated.

3.2 Management Measures

A management measure is a feature or activity at a site, which addresses one or more of the planning objectives. A wide variety of measures were considered. Each measure was assessed and a determination made regarding whether it should be retained in the formulation of alternative plans. The descriptions and results of the evaluations of the measures considered in this study are presented below:

I. Inlet Channel Dredging
    i. Width – 75 feet
    ii. Lengths – 1,000, 4,000, 6,000 feet
    iii. Depths – 4, 5, 6-foot

II. Cove Dredging
  a. Brush Neck Cove
    i. Widths – 100, 200, 300 feet
    ii. Lengths – 2,0000, 2,500, 3,000 feet
    iii. Depths – 4, 5, 6-foot
  b. Buttonwoods Cove
    i. Widths – 100, 200, 300 feet
    ii. Lengths – 250, 500, 750 feet
    iii. Depths – 3, 4, 5-foot

III. Beach Replenishment (dependant on I. or II. above)
  a. Oakland Beach (Corps project)
  b. City Park Beach (City-owned)

IV. Habitat Restoration (dependant on I. or II. above)
  a. Restoring Benthic/Shellfish Substrate (Brush Neck Cove)
  b. Restoring Benthic/Shellfish Substrate (Buttonwood Cove)
  c. Salt Marsh creation/restoration/stabilization (City Park)
  d. Salt Marsh creation/restoration/stabilization (east of Sea View Drive)
  e. Invasive Species Removal (*Phragmites*)

V. Water Quality
  a. Sedimentation Trap Structures
  b. Natural Wetland Filtration Systems
  c. Restore riparian buffer

VI. Other
  a. Rehabilitation of Groins (Oakland Beach)
  b. Dredging at Boat Ramp (Warwick Cove)

Restoration measures are combined to develop restoration alternative plans. Alternative plans are formulated to achieve planning objectives within the defined constraints and capitalize on identified opportunities. An alternative plan consists of a system of structural and/or nonstructural measures, strategies, or programs formulated to meet, fully or partially, the identified study planning objectives subject to the planning constraints. The alternative plan formulation is an ongoing process, as new data and ideas emerge, plans are added, modified or removed from further consideration. Alternative plans are not limited to those the Corps could implement directly under current authorities.

The Corps collected and evaluated data to determine if the measures proposed, singly or combined, would provide substantial ecosystem benefits. Based on these data, the Corps concluded that the proposed measures (identified above) would not provide substantial benefit. Therefore alternative plans were not formulated. The section below describes the rationale used to draw this conclusion.

3.2.1 Inlet Dredging for Improving Tidal Range and Flushing

One of the perceived problems in the Brush Neck/Buttonwoods Cove system was poor tidal flushing, loss of tidal range and water depth resulting in reduced water quality and bottom habitat. Shoaling in the inlet was thought to restrict incoming tide water. Excessive sedimentation was believed to result in reduced cove water depth.

To quantify changes in bathymetry over time and to determine the tidal flushing, two study efforts were undertaken. The first was mapping the system bathymetry and inlet shoreline. This evaluation provided direct information pertaining to the sedimentation of the system and changes to the inlet. The bathymetric change study was completed using a 1975 Corps survey of Brush Neck Cove and survey data from 2005/2006. The digital terrain model maps for each survey are provided in Figures 3 & 4 with side by side comparisons. Elevation data from the 1975 survey were subtracted from the 2005/2006 survey to yield the change over time. A map was generated using these data and is presented in Figure 5. Areas shown in yellow and red indicate bottom elevation has risen since 1978 (accretion), areas in light blue and green remained similar (within a few tenths of a foot), and areas in darker blue and purple indicate a reduction in bottom elevation (erosion). These data show that most of the changes in the Brush Neck Cove bathymetry are small with the most significant change being slight channel migration. Overall the changes are on the order of tenths of a foot (both erosion and accretion). The inlet did not shoal significantly in this time period and only minor accretion is evident from 1975 to 2005/2006.

Other data support this conclusion. Accretion rates for the Greenwich Bay are low and suggest very little accumulation of sediment within the Bay. The rate of accretion for the Greenwich Bay area is 0.55 cm/yr in marsh sediments and 0.23 cm/yr in subtidal areas (Bricker 1996). Assuming the same rate for Brush Neck/Buttonwoods Coves, the average of these two values (0.39 cm/yr or 0.013 ft/yr) suggests that it would take over 75 years to accumulate one foot of sediment.

As an additional evaluation on shoaling of the inlet, aerial photographs from 1939 and 2007 were compared (Figure 6). The shoreline from these photos was coarsely mapped and should not be used for other uses outside this study. The shoreline mapping data suggests that the inlet has widened with time. Although the inlet has widened since 1939 it has also become shallower and thus supports claims that the inlet was historically deeper and narrower. However, the combination of these changes has not likely changed the overall volume of water allowed to pass through the inlet; although the inlet is shallower, the inlet encompasses a larger area. The findings of this mapping effort show that significant bathymetric changes have not occurred in the system, and that the minor changes were likely not enough to impact tidal flushing.

Tidal flushing within the study area was evaluated using a tidal survey conducted on August 25, 2006. Tide elevations were measured at three locations in the Brush Neck Cove/Buttonwoods Cove system. The locations are provided in Figure 7.

Tide elevation data were manually recorded approximately every 15 minutes. These data are plotted in Figure 8, with the predicted tide data for East Greenwich, RI provided on the plot as well. These data show that there is no reduction in tide range from Narragansett Bay into the Cove system. All three measurement points are almost identical with regards to tide range and phase (no lag between high and low tides). This tide elevation survey further demonstrates that there is no tidal restriction in the system, and that the Cove system experiences 100% of the possible tidal flushing possible.

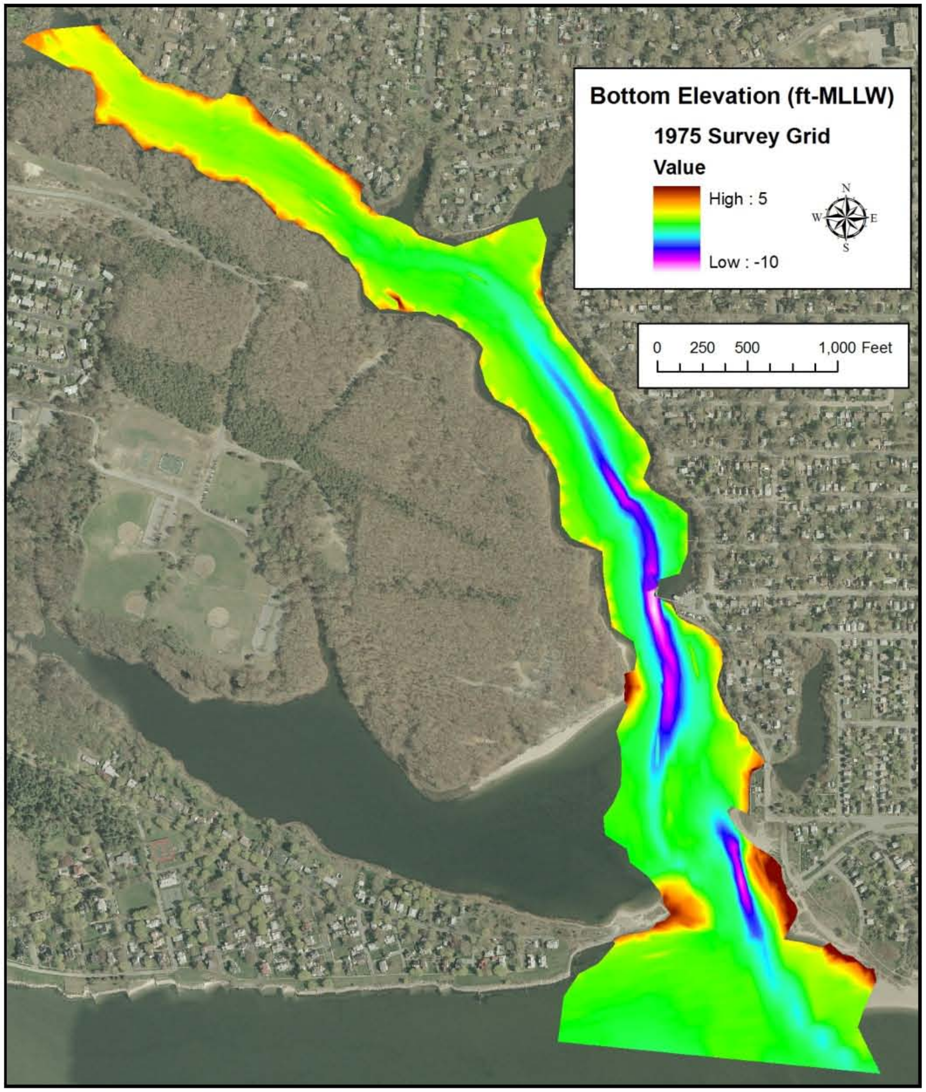

Figure 3. 1975 Survey Digital Terrain Model.

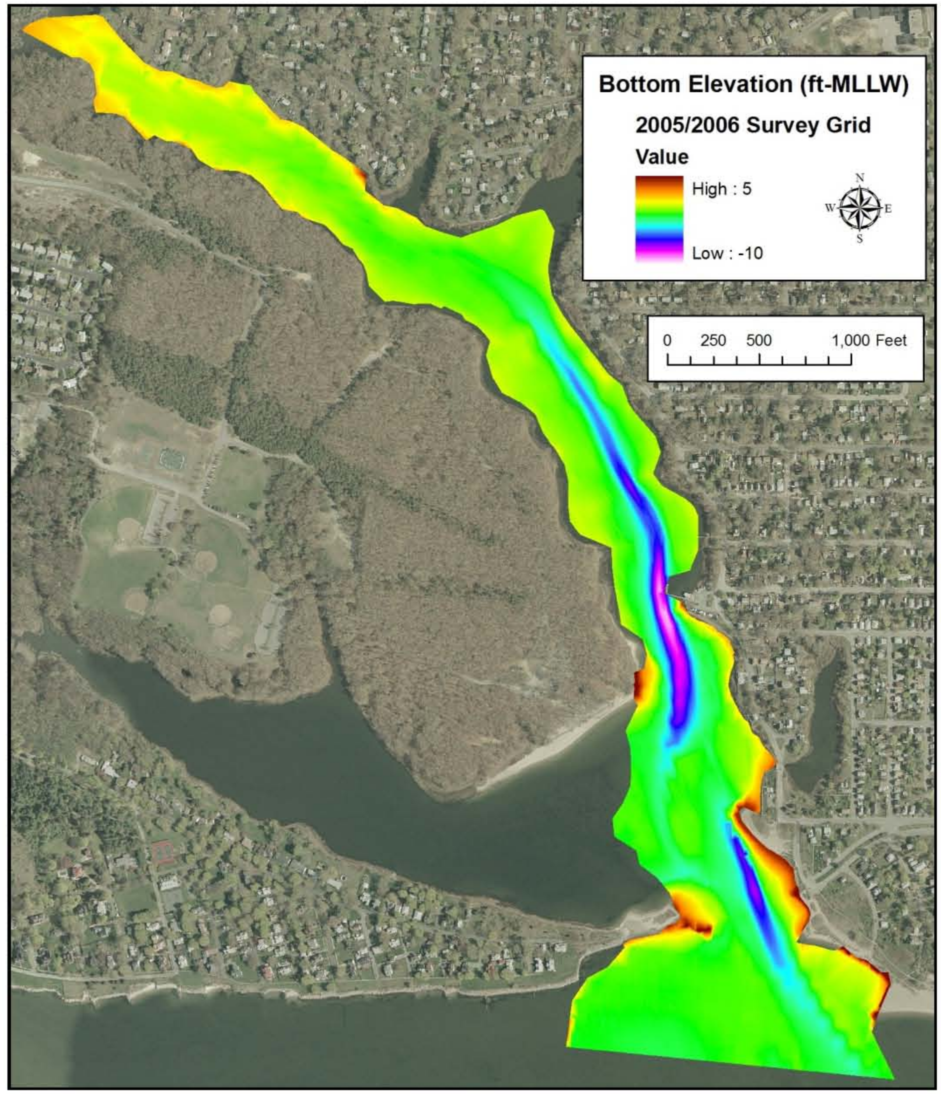

Figure 4. 2005/2006 Survey Digital Terrain Model.

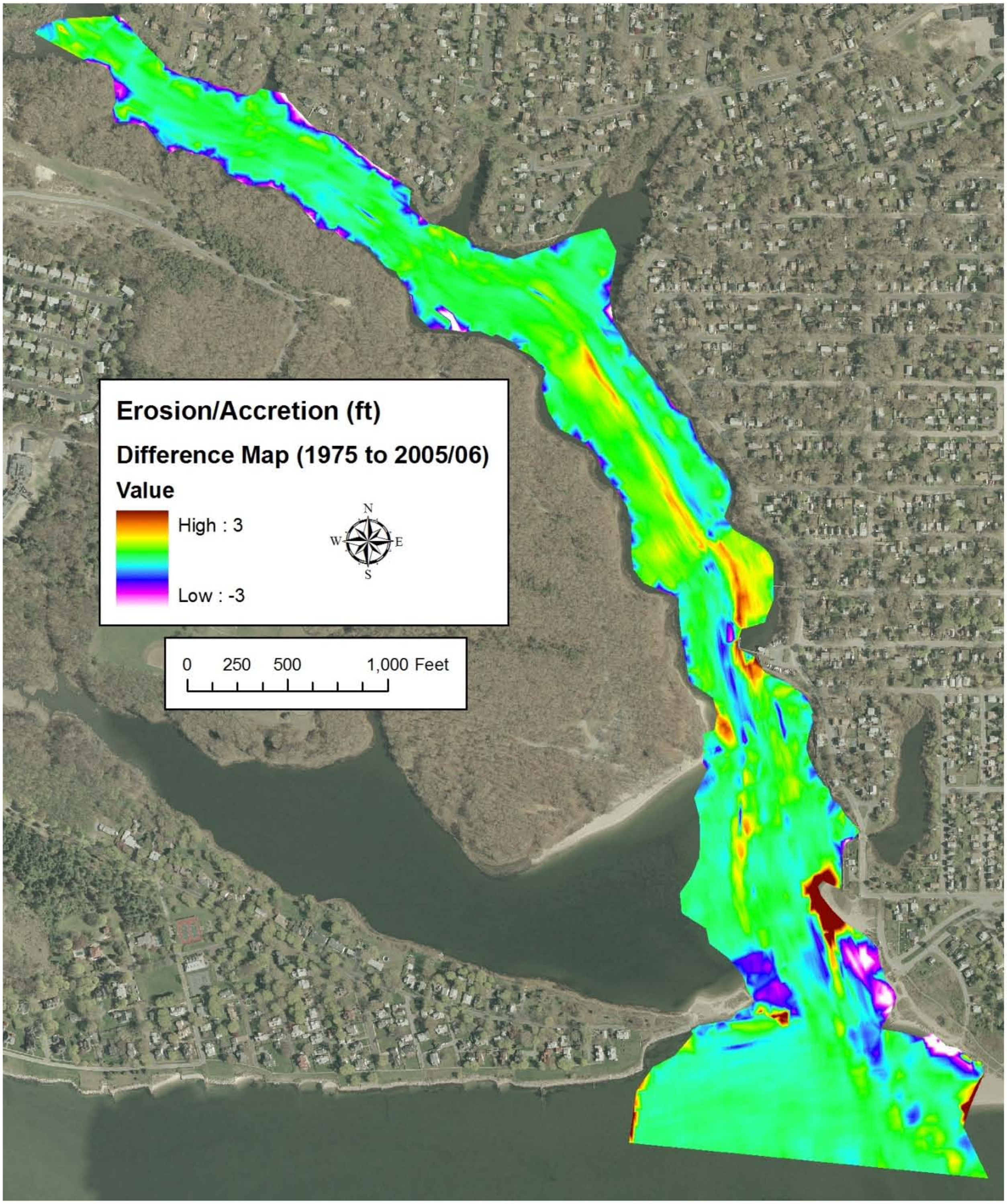

Figure 5. Difference Map of 1975 and 2005/2006 Surveys (difference of Figures 3 & 4)

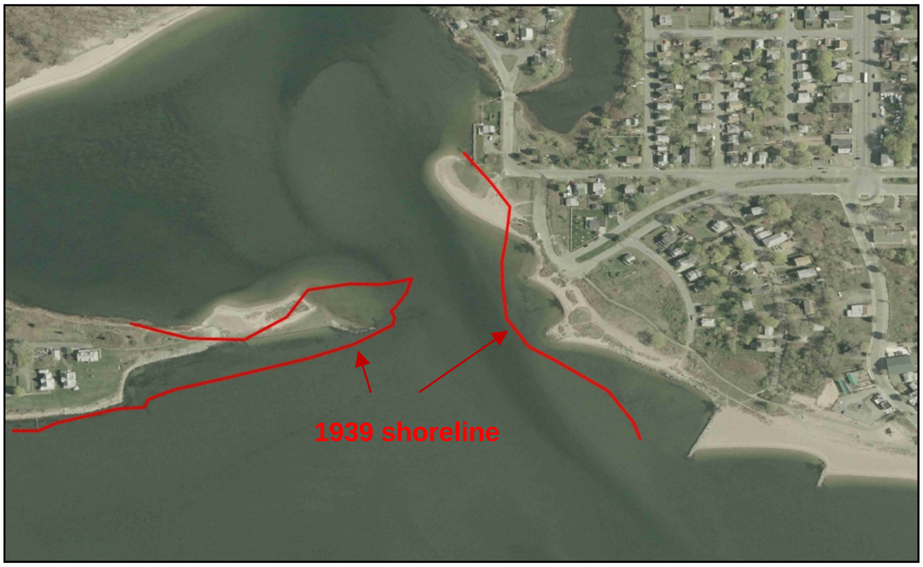

Figure 6. Inlet Comparison, 1939 versus 2007

Figure 7. Tide Survey Data Collection Locations

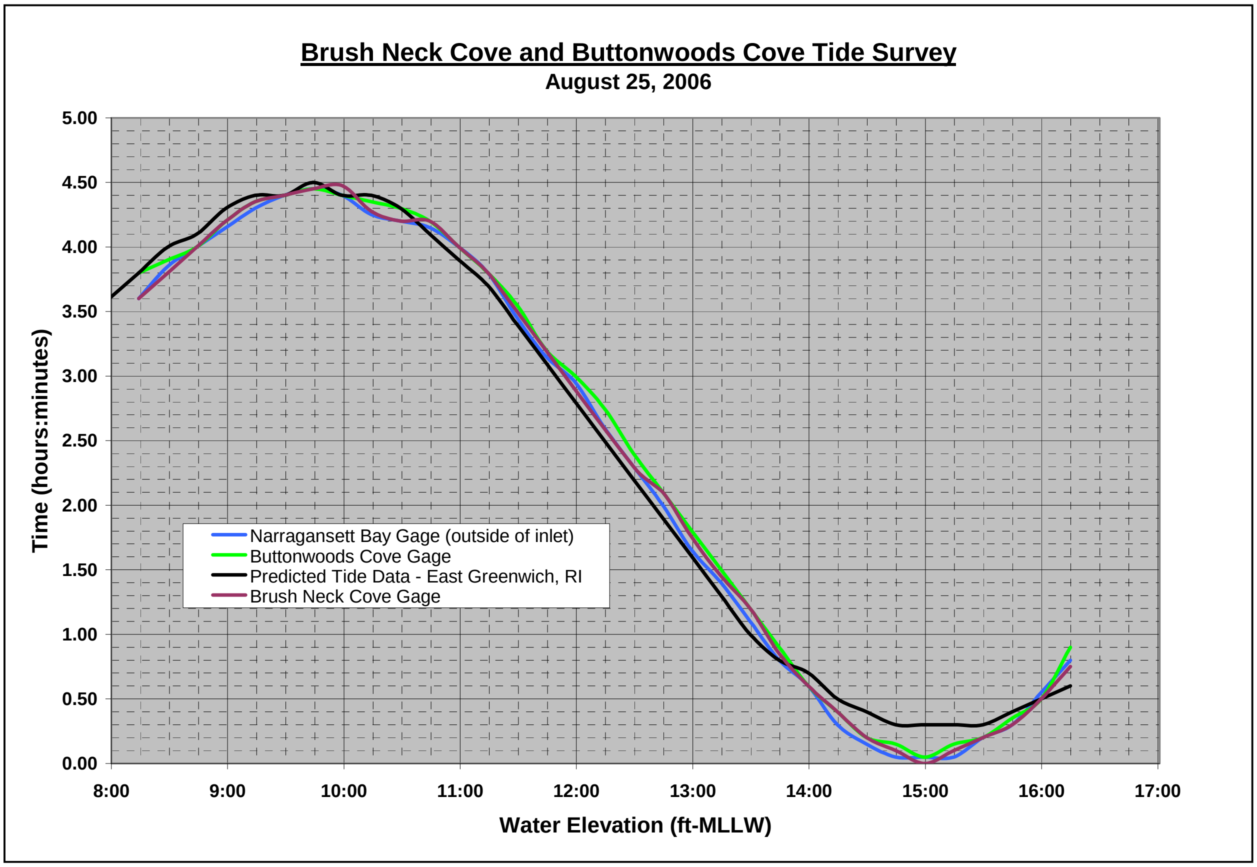

Figure 8. Tide Survey Data Plot

The results of the mapping and the tidal elevation investigations indicate that the existing shoaling condition at the entrance does not restrict the tidal exchange within the coves. These data suggest that dredging the inlet for the single purpose of increasing cove flushing would not provide significant ecosystem restoration benefit. After consultation with the design team and the sponsor, the study efforts were redirected to improve habitat and water quality by removing accumulated sediment/organic material within the coves.

3.2.2 Cove Dredging

Three surveys were conducted (2006, 2007 and 2009) within the Brush Neck and Buttonwoods Cove estuaries to characterize the material for disposal, identify the optimal dredge depth to expose coarse substrate and provide the justification of sediment removal for improved water quality. The surveys are summarized below with results of each study presented by sediment characteristic.

- 2006 Survey - The Corps collected sediment samples from 22 stations in Brush Neck Cove, Buttonwoods Cove and a portion of Greenwich Bay in 2006 to assess grain size (Figure 9). The 22 stations were sampled with a 2-inch diameter push-core sampler to a depth of approximately 1.5 feet. The grain size distribution graphs are presented in Appendix A.

- 2007 Survey – Battelle collected a total of 11 sediment cores within Brush Neck and Buttonwoods Coves in 2007 to characterize the physical and chemical nature of the sediment for disposal. Penetration into the sediment for each of the sampling locations was 10.0 feet and core recovery ranged from 7.0 to 9.3 ft with an average of 8.4 ft. Results of the physical and chemical analysis are provided in Appendix A of this report. Physical features included grain size analysis and visual observation of cores. Identification of coarse substrate within the cores would serve as an indicator of the historic elevation of the cove and would provide the optimal dredge depth to

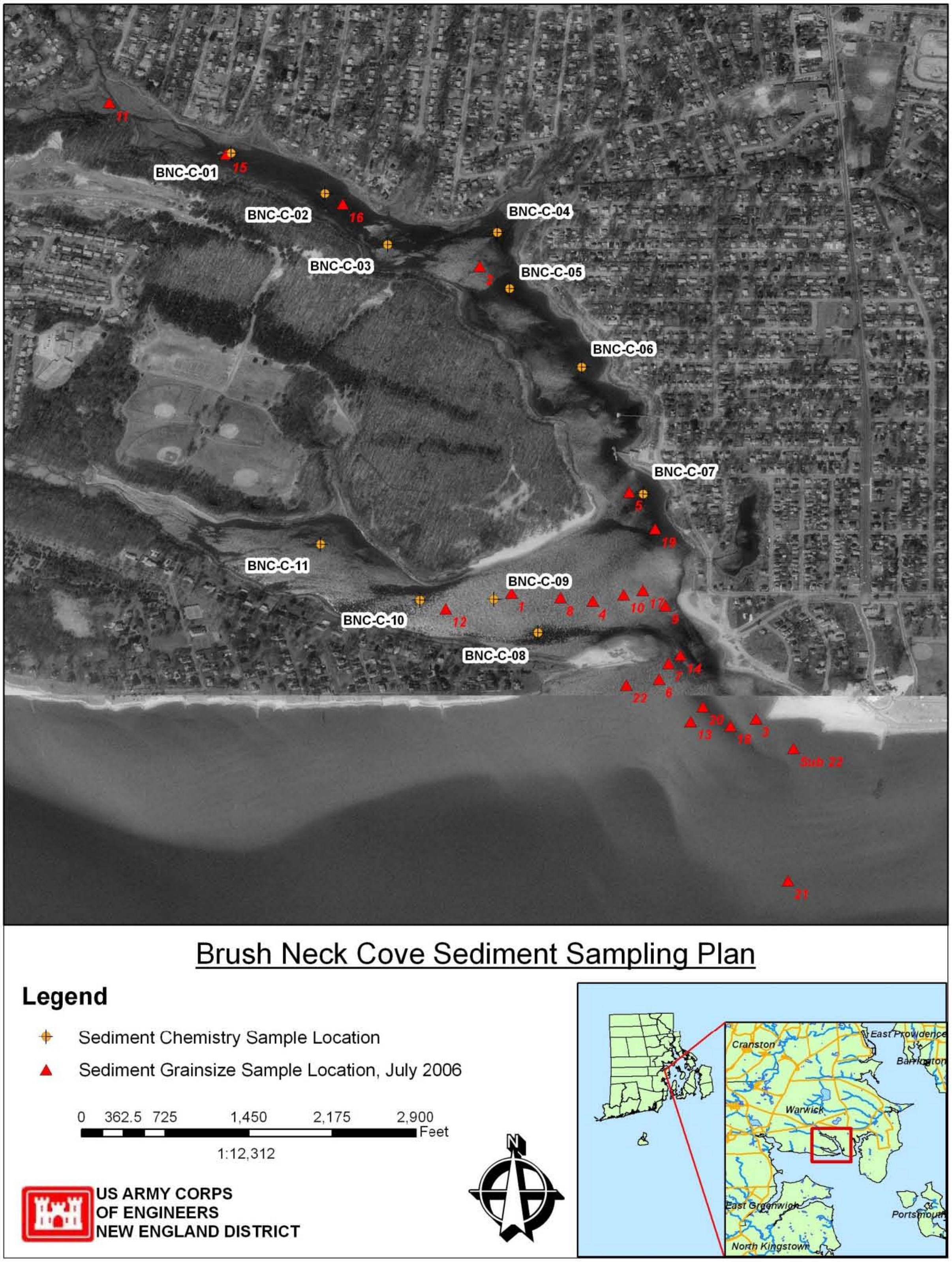

Figure 9. Sediment Sample Locations in Brush Neck Cove and Buttonwoods Cove

expose desirable shellfish and benthic substrate. Chemical data were used to determine the possible reuse of the material for salt marsh creation and beach replenishment. Chemical analysis included total organic carbon (TOC), percent water, percent solids, polychlorinated biphenyl congeners (PCBs), pesticides, metals and polynuclear aromatic hydrocarbons (PAHs).

- 2009 Survey - Scientists collected cores at four locations within Brush Neck Cove to determine if dredging would result in water quality improvement within the coves. All four cores were described and photographed by a trained sedimentologist. Maximum recovery of these cores was 15.9 ft. The top layer (approximately one foot) of three cores was analyzed for TOC, grain size, and nutrients (total phosphorus, ammonium, nitrate and total Kjeldahl nitrogen). The fourth core was not analyzed by the analytical lab because the core recovery was well short of the penetration depth.

Sediment Physical Characteristics
In general, the sediments at the inlet of the project area were dominated by sands while the sediments in upper sections of Brush Neck and Buttonwoods Cove were dominated by silts and clays. There was no obvious substrate layering present in the cores that would be useful to suggest a proposed dredge depth. Only one sample had a noticeable transition zone, BCN-C-09 located near the confluence of Brush Neck and Buttonwoods Coves, from fine sand to coarse sand with some fine gravel and a distinct horizon from 1.8 to 2.5 ft. Laboratory grain size analysis of the 2007 samples confirmed the general description of the cores, with silts and clays comprising the greatest percent (56-89%), except at BCN-C-09 where fine sand comprised much of the core (68%). All cores contained silt and clay percentages above the Rhode Island Rules and Regulations for Dredging and the Management of Dredged Material criteria for beach nourishment (silt/clay criteria is <10%). Most cores contained shell hash at depths varying from 0 to 2.5'. All cores had penetration to ten feet with a recovery of at least seven feet. These data are consistent with the previous sampling in 2006.

Sediment Chemical Characteristics
Total organic carbon (TOC) percentages were low to moderate throughout Brush Neck and Buttonwoods coves. Average values (average of two results per sample) ranged from <0.1% to 2.8%. TOC generally increased with increased distance from Greenwich Bay. Samples with lower silt and clay generally had lower TOC. BCN-C-09 contained the lowest TOC and silt and clay percentages. This location was also the only core that did not emit a distinct sulfur odor. Hyland et al. (2005) suggests that the risk of reduced benthic species diversity is low at TOC concentrations less than 1% and high at 3.5%. These data suggest that TOC concentrations in Brush Neck and Buttonwood Coves are low to moderate and are not at a high risk for species diversity reduction.

Sediment within the coves contain low levels of polychlorinated biphenyl congeners (PCBs), pesticides and metals. Concentrations of PCBs ranged from 3 to 20 ug/g (ppb) and concentration of pesticide were at or below the detection limit of 1 ng/g (ppb). Target metals were detected in all samples and concentrations were relatively similar across samples. Concentrations were below the Rhode Island Rules and Regulations for Dredging and the Management of Dredged Material criteria for beach nourishment.

Polynuclear aromatic hydrocarbons (PAHs) were detected in all samples. Total PAHs ranged from 51 to 638 ng/g (ppb) with the highest concentrations observed at the upstream portion of Brush Neck Cove (BNC-C-01 and BNC-C-02). The highest PAHs were generally fluoranthene and pyrene, and other high molecular weight PAHs. This pattern suggests pyrogenic PAH sources indicative of combusted petroleum products and is similar to what is often observed in urban run-off and would not be applicable for beach nourishment.

Inorganic nitrogen (ammonia and nitrate) concentrations were typical of estuarine environments. Ammonia ranged from 21-81 mg/kg, which is slightly elevated but not uncharacteristic under low to no oxygen conditions. Only one sample contained nitrate nitrogen above the detection limit (2.5 mg/kg;

detection limits ranged from 2.0 to 2.6 mg/kg). Total Kjeldahl nitrogen (TKN) ranged from 1,800 to 2,500 mg/kg, including the duplicate sample. TP ranged from 440 to 580 mg/kg.

Finer materials such as clay and silts generally contain higher concentrations of nutrients and organics and increase the potential for flux from sediment. However, the proportion of the overall nutrient load to these coves from the sediments is not expected to be large given that they flush relatively quickly; the mean residence time for Brush Neck and Buttonwoods Coves is 0.9 days (approximately 22 hours; CRMC 2005). Any benefits from dredging the sediments to reduce internal recycling would be short lived given the high nutrient loading from the watershed.

Although material dredged from these coves could be reused onsite for salt marsh creation, there is no desirable coarse substrate within the core depth that could be exposed by dredging (average core depth 8.4 ft, maximum 15.9 ft). In addition, dredging will not improve nutrient loading, biological oxygen demand or resuspension of sediment since there is no coarse, less nutrient rich layer to expose.

3.2.3 Salt Marsh Restoration

Creation of salt marsh, if large enough, could reduce nitrogen concentrations within the estuary. The Corps considered creating a five-acre (2 hectare) salt marsh in the project area using material provided from dredging the inlet or coves. We estimated the expected nutrient removal capacity of the created marsh in terms of dissolved inorganic nitrogen (DIN) using gain and loss rates in scientific literature (Estuarine Nitrogen Loading Model from Valiela et al., 2004). Based on the expected DIN losses (nitrogen burial and denitrification) and gains (nitrogen fixation and regeneration), the created salt marsh area is likely to reduce annual DIN loading by approximately 42 kg/ha/yr. Multiple loading methods estimate the overall annual DIN loading to Brush Neck Cove at around 9,000 to 15,000 kg/yr (See Affected Environment). In order to reduce this load by as little as 5% (450-750 DIN kg/yr) approximately 11 to 18 ha, or 26 to 44 acres, of salt marsh is required. Creation of five acres of salt marsh would not have measurable impact on nitrogen concentrations.

As previously stated, creation of new marsh would incorporate dredged material from Brush Neck Cove. Sediment core analysis indicates that, with the exception of a few cores taken adjacent to the south end of City Park and Oakland beach that have more sand, most of the sediment is homogeneous with the low levels of PAH contamination and could be used for salt marsh creation. However, increasing existing salt marsh habitat by only two hectares is expected to decrease DIN loading by <0.1% of the existing load (or 84 kg/yr). Although significant reduction in nitrogen is not expected, creation of salt marsh will reduce turbidity directly by the facilitation of sedimentation and potentially improve conditions for eelgrass and juvenile fish habitat, but these benefits alone do not justify dredging.

3.3 Conclusion from Preliminary Screening

The Corps, together with CRMC, concluded that dredging would not provide significant ecosystem benefits in Brush Neck and Buttonwoods Coves. Before conducting the detailed tidal study, inlet dredging was expected to increase tidal flushing and tidal range which would improve water quality, reduce invasive species colonization (*Phragmites* and *Ulva*) and help restore, create and stabilize salt marsh habitat. Once the tidal survey data were analyzed, the Corps concluded that inlet dredging would not provide significant changes to the tidal range or flushing of Brush Neck Cove. The Corps also concluded that dredging of the coves would not provide substantial benthic substrate or water quality benefits based on core analysis.

The proposed beach replenishment and salt marsh restoration/creation measures require the reuse of dredged material removed during the inlet or cove dredging. The restoration of shellfish and other benthos was also dependant on dredging, with removal of material to expose an existing suitable substrate layer. We therefore eliminated the beach replenishment and habitat restoration measures from the alternative plan formulation. The remaining measures evaluated without the aforementioned dredging measures, are either not in the Corps authority or do not provide significant NER benefits. Other Federal, State and local agencies can address these water quality measures under different authorities and programs.

The planning constraints of the project required suitable sediment for reuse on site and exposure of desirable sediment beneath the existing upper layers. These constraints limit the measures available to formulate alternative plans. Given this, no alternative plans were formulated and no alternatives are recommended.

4.0 Affected Environment

This section contains a baseline description of environmental resources of the study area. Information was obtained from sampling, previous studies, and discussions with resource agencies, State and local officials, and stakeholders. The major characteristics of the study area's natural and human resources are provided to promote a general understanding of the area.

4.1 Environmental Setting of the Study Area

Brush Neck and Buttonwoods Coves are located in the City of Warwick, Rhode Island (Figure 1). The City of Warwick is located in Kent County, Rhode Island and is approximately 12 miles south of Providence. Brush Neck and Buttonwoods Coves are part of the Greenwich Bay watershed (Figure 10) and are located in the northern portion of the Bay. Brush Neck Cove is approximately a mile in length and has an area of approximately 86 acres. Buttonwoods Cove is approximately ½ mile in length and has an area of about 54 acres. Both coves are shallow (mean and maximum depth 1.6 and 7.9 ft respectively; CRMC 2005). Oakland Beach is located on the eastern shore of Brush Neck Cove.

The Brush Neck and Buttonwoods Coves watershed is approximately three square miles and is primarily medium to high density residential (61%) (RIDEM 2005). Brush Neck Cove receives water from two main tributaries, Tusctucket Brook and Southern Creek, also known as Carpenter Brook. The TF Green Airport drainage area is partially within the Brush Neck Cove watershed. The major tributary to Buttonwoods Cove is an unnamed tributary.

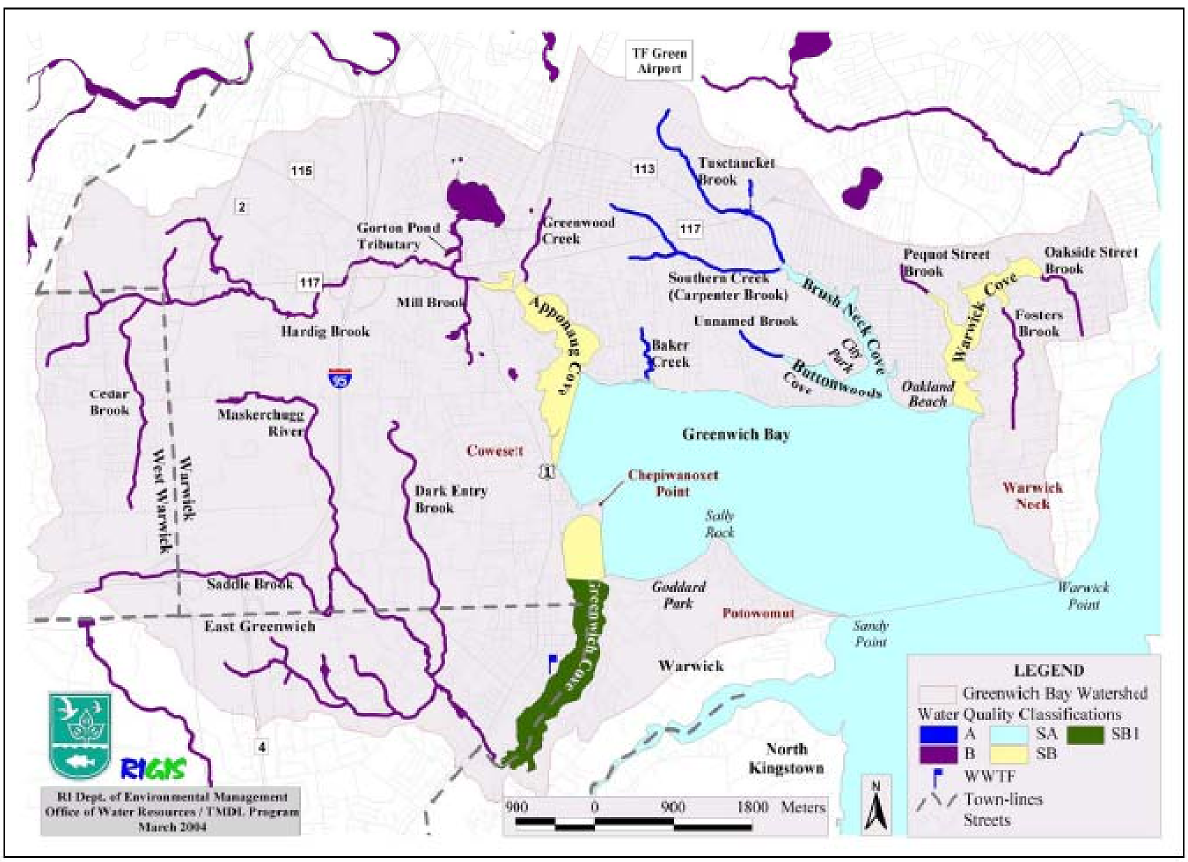

Figure 10. Greenwich Bay Watershed (from RIDEM 2005).

4.2 Water Quality

Review of the existing water quality data for the coves is complicated by three factors:

1. There are limited water quality data specifically for Brush Neck Cove.
2. Most of the water quality data was collected when about 30% of the heavily populated watershed surrounding Brush Neck Cove had Individual Sewage Disposal Systems (ISDS). A recent communication (conversation with Ms Lynn Owen from the Warwick Sewer Department) indicates that in excess of 90% of the watershed surrounding Brush Neck Cove is now connected to municipal sewers and there are no recent data to reflect this change.
3. A significant portion of the nutrient data and nutrient budgets were calculated for Greenwich Bay, of which the coves comprises only about 2% of the surface area and 0.05% of the volume (Greenwich Bay Special Area Management Plan, CRMC 2005)

Brush Neck Cove and its two major inflows, Tuscatucket Brook and Southern Creek are in violation of Environmental Protection Agency (EPA) and the State of Rhode Island Water Quality Standards (WQS). Brush Neck Cove, Greenwich Bay proper and Buttonwoods Cove are assigned the Water Quality Classification SA. Class SA is a designation for seawaters "…that produce shellfish for direct human consumption, are able to be used for primary and secondary recreation, fish and wildlife habitat and have good aesthetic value." Brush Neck Cove is often in violation of these standards with regard to pathogens, nutrients and dissolved oxygen concentration (CRMC 2005).

Sources of nutrients, suspended sediments and other contaminants to the coves are:

1. Dry weather freshwater surface flow from stream (Tuscatucket Brook and Southern Creek and other unnamed inflows),
2. Wet weather flow from storm drains, surface runoff and small unnamed streams,
3. Tidal input from Greenwich Bay and Narragansett Bay, and
4. Groundwater inflow.

4.2.1 Bacteria

In response to consistent elevated pathogen indicators (fecal coliform bacteria), the Rhode Island Department of Environmental Management (RI DEM) developed a Total Maximum Data Load (TMDL) for Greenwich Bay. The TMDL documents the WQS exceedences for 16 distinct waters and includes Brush Neck Cove, Buttonwoods Cove, Southern Creek (Carpenter Brook) and Tuscatucket Brook. The report provides recommended implementation activities focusing on stormwater and wastewater management to bring these waters into compliance. One of the largest sources of bacteria to Greenwich Bay is Brush Neck Cove.

Beach and shellfish closures are common within in the bay, particularly following wet weather. Because of the consistent high levels of fecal coliform, the shellfish beds in Brush Neck and Buttonwoods Coves are permanently closed. Bacteria values exceed the shellfish WQS even under dry weather conditions. Table 1 below summarizes fecal coliform data collected from shellfish sampling locations to evaluate compliance with WQS.

Bacteria concentrations were also assessed at Oakland and City Park Beaches. Samples collected by the Rhode Island Department of Health at Oakland Beach during 2000 and 2001 were evaluated as part of the TMDL. The Department of Health sampled these beaches three times per week. Results are summarized in Table 2. Although these data appear to comply with the beach Department of Health standards, multiple closures did occur. Data presented in the table below are a seasonal summary and closure is based on individual samplings. In 2000 and 2001 there were 10 and 12 days of closure at Oakland Beach and 0 and 19 closures at City Park Beach.

Table 1. Dry (October 2000 – December 2001) and Wet Weather (2001 and 2002) Shellfish Fecal Coliform Data Summary (modified from RIDEM 2005).

Station	Location	Number Samples Dry	Number Samples Wet	Geometric Mean (fc/100 ml) Target	Geometric Mean Observed Dry	Geometric Mean Observed Wet	90th Percentile (fc/100 ml) Target	90th Percentile Observed Dry	90th Percentile Observed Wet
25	Buttonwoods Cove	15	5	14	8	**116**	49	**93**	**354**
26	Brush Neck Cove	15	6	14	14	**228**	49	**73**	**8758**

Bold values exceed WQS

Table 2. Oakland and City Park Beach 2000-2001 Fecal Coliform Data Summary (modified from RIDEM 2005).

Station	Location	Number of Samples Dry	Number of Samples Wet	Geometric Mean (fc/100 ml) Target	Geometric Mean Observed Dry	Geometric Mean Observed Wet	90th Percentile (fc/100 ml) Target	90th Percentile Observed Dry	90th Percentile Observed Wet
East	Oakland Beach	33	23	50	34	44	500	460	240
Middle		23	19		34	42		232	440
West		33	20		17	31		262	155
	City Park Beach	35	22	50	28	29	500	444	240

The Middle station was only sampled in 2000.

Extensive sampling of Greenwich Bay tributaries was conducted to characterize conditions of incoming water by State RIDEM. For Brush Neck Cove tributaries, Tuscatucket Brook and Southern Creek were sampled. Southern Creek contained the highest fecal coliform load in the study assessing Greenwich Bay's Northern Watershed conducted by researchers from the University of Rhode Island's Department of Civil and Environmental Engineering (Wright and Viator 1999). Prior to this study the DEM conducted surveys on these streams and demonstrated impacts from failing septic systems, including a 126-unit condominium complex. O'Rourke (1995) documented that 16% of the 598 septic system inspections within the Brush Neck Cove watershed were in violation.

The recent connections to municipal sewers should improve fecal coliform levels in Brush Neck Cove. Data from 1994, 1995, and 2000 did not show elevated dry weather concentrations in Southern Creek. Data summarized and used in the TMDL assessment for Southern Creek and Tuscatucket Brook is provided in Table 3. Figure 11. shows the sampling location within each of these tributaries. A 100% reduction in bacteria levels is required to meet WQS.

Table 3. Bacteria Data Summary for Brush Neck Cove Tributaries Used in the TMDL Analysis (modified from RIDEM 2005).

Station	Location	Number of Samples Used for Assessment		Geometric Mean (fc/100 ml)			90th Percentile (fc/100 ml)		
					Observed			Observed	
		Dry	Wet	Target	Dry	Wet	Target	Dry	Wet
SC01	Southern Creek	8	28	20	3	**1875**	200	166	**25000**
SC02	Southern Creek	8	30	20	2	**876**	200	148	**17100**
SC03	Southern Creek	10	30	14	11	**1928**	49	**471**	**19200**
TB01	Tuscatucket Brook	8	28	20	9	**157**	200	41	**6240**
TB01A	Tuscatucket Brook	8	28	20	6	**723**	200	87	**4860**
TB04	Tuscatucket Brook		2	20		**1406**	200		**3472**
TB02	Tuscatucket Brook	10	30	14	**19**	**1881**	49	**84**	**14200**
TB03	Tuscatucket Brook	7	8	14	**39**	**448**	49	**257**	**1470**

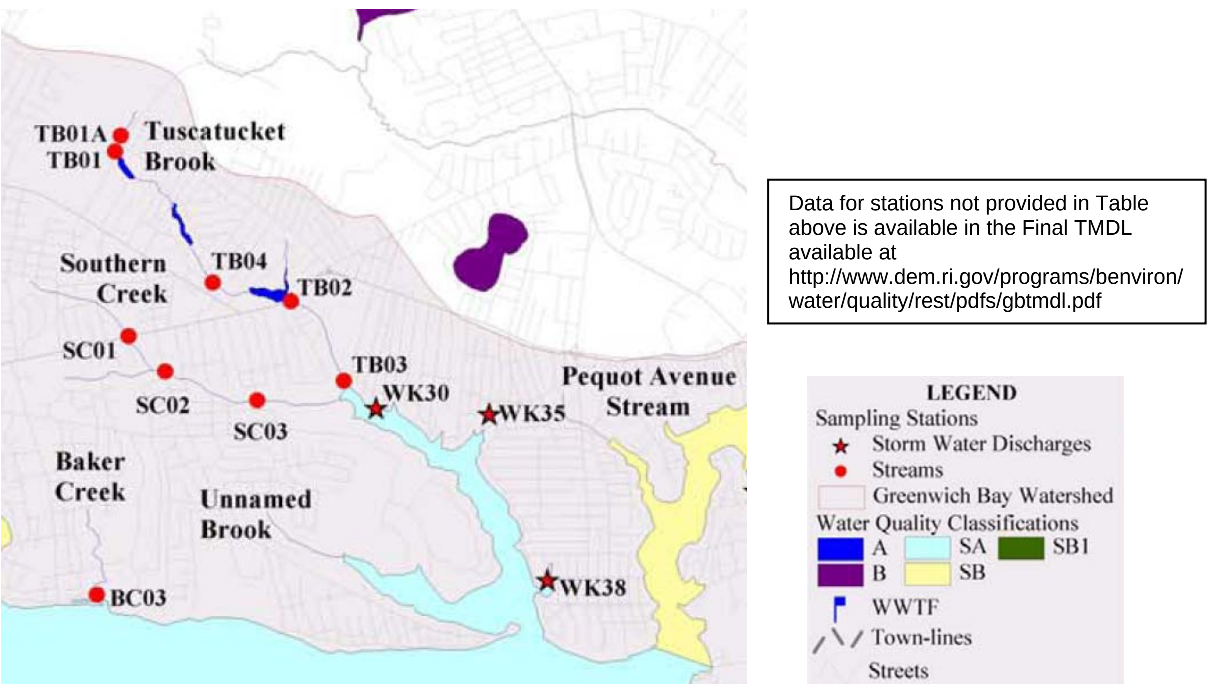

Figure 11. Bacteria Sampling Stations for Brush Neck Cove Tributaries Used in the TMDL Analysis (modified from RIDEM 2005).

4.2.2 Dissolved Oxygen

Brush Neck Cove also suffers from low dissolved oxygen (DO), although cove DO is not as low as some areas within Greenwich Bay. A series of surveys completed between August 1995 and May 1997 determined that of the various portions of Greenwich Bay sampled, Brush Neck Cove had the lowest percentage of dissolved oxygen values below 2 milligrams per liter (mg/L) and no values below 1 mg/L (Granger et al. 2000). The shallow morphometry of the cove is suspected to contribute to low DO.

4.2.3 Nutrients

Both dry weather and wet weather provide significant nitrogen loading to Brush Neck Cove. The SAMP provides an estimate of dissolved inorganic nitrogen (DIN) loading to Greenwich Bay from multiple sources. According to the SAMP, dry weather loading from Southern Creek from two separate studies was 8.4 and 22.1 kilograms per day (kg/d); dry weather loading from Tuscatucket Brook was 4.8 and 10.8 kg/d. The Southern Creek represents the highest dry weather load to Greenwich Bay for the years evaluated 1994 and 1995. Wet weather loading from these tributaries is estimated at 21.2 and 13.8 kg/stormwater event for Southern Creek and Tuscatucket Brook respectively and are the highest of the tributaries and point sources measured under wet conditions. The water column average DIN concentration in Brush Neck/Buttonwoods Cove in Aug/Sept 2000 was 22 micrograms per liter (ug/L) (CRMC 2005).

To obtain a rough estimate of watershed loading to Brush Neck Cove from these main tributaries, the Corps multiplied the wet weather and dry weather loading estimates by the average number of days of dry weather and number of days of rainy weather reported in Providence, RI over a 40 year period (available at http://www.weatherbase.com/weather/weather.php3?s=070527&refer). Using 124 rainy days, loading from these two tributaries is estimated at 4,300 kilograms per hectare per yr (kg/ha/yr). Using 241 dry days and the average from the two studies, loading is estimated at 5,600 kg/yr for a total watershed DIN load of 9,900 kg/yr. Atmospheric deposition would add an additional 230 kg/yr (6.7 DIN kg/ha/yr according to Valiela et al., 2004) for a total of just over 10,000 kg/yr. Approximately 30% of the DIN to Greenwich Bay is attributable to unsewered lands, prior to the relatively recent connection to sewers (Granger et al. 2000).

The total dissolved nitrogen (TDN) load was estimated in a study determining the relationships of nitrogen loadings and other variables with plant structure in New England salt marshes (Wigand et al., 2003). TDN includes DIN and dissolved organic nitrogen (DON). The authors used a nitrogen loading model (NLM) developed and verified for Cape Cod, Massachusetts (Valiela et al., 1997 & 2000) to calculate the annual TDN load. NLM uses wet and dry atmospheric deposition, fertilizer, and wastewater disposal. The model takes into account losses from each of these sources as nitrogen moves through vegetation, soil, vadose zone, and aquifer. The TDN load to Brush Neck Cove and Buttonwoods Cove was calculated at 22,344 kg/yr. Assuming that 40% of the TDN is DIN (average percentage of atmospheric deposition, soils, aquifers and river reported by Valiela et al. 1997), the DIN load to Brush Neck Cove is approximately 8,900 kg/yr. This estimate is similar to the loading derived from the two main tributaries described above. Both of these estimates do not include the nitrogen that is transported from the Bay during incoming tides.

Using a range of literature derived values provided in the most recent SAM Plan (CRMC 2005), a DIN budget was estimated by the Corps for the Brush Neck Cove based on ISDS, atmospheric deposition and fertilizers. The DIN load using these data range from 12,000 to 15,000 kg/yr to Brush Neck Cove. Based on these three methods, loading to Brush Neck Cove is estimated between 9,000 to 15,000 kg/yr.

Water transported from the upper West Passage of Narragansett Bay that flows into Greenwich Bay as a result of wind, tidal currents, gravitational and estuarine circulation may also be a significant source of nutrients to the coves (Granger et al. 2000). The exact contribution to Brush Neck and Buttonwoods Coves from this source on incoming tides is undetermined. It is estimated, however, that the input of nitrogen and phosphorus from Narragansett Bay to Greenwich Bay may be twice as much as the amount from the watershed (Granger et al. 2000). Incoming nitrogen is estimated at 50 to 130 metric tons per year.

4.2.4 Sediment

Data specifically quantifying sediment transport to Brush Neck Cove were not available during the time of this review. However with the large amount of surface runoff from an urban setting being directed into Brush Neck Cove, it is likely large amounts of sediment are transported into the cove. Each rainfall event has the potential to increase turbidity in Brush Neck Cove. This increased turbidity is, at least partially, responsible the disappearance of eelgrass beds that were historically present in Brush Neck Cove. There were at least two attempts to reestablish eelgrass beds in Brush Neck Cove in areas that have historically supported eelgrass. Both of these attempts failed and it is hypothesized that elevated turbidities caused the failure. Granger et al. (2000) concluded that eelgrass will not be supported in conditions where greater than 80% of incident surface radiation (sunlight) is extinguished. Physical and chemical characteristic of cove and inlet substrate was described in the previous section.

4.3 Biota

4.3.1 Vegetation

The Corps examined aerial photographs and wetland maps to identify existing salt marsh habitat and locate areas for potential salt marsh creation. Figure 12 shows the existing salt marsh habitat. The salt marsh areas depicted are a hybrid of salt marsh delineated in 1996 and brackish marsh delineated in 1988.

The locations of the existing salt marsh in Brush Neck Cove are:

1. At the inflows of Southern Creek and Tuscatucket Brook. At their confluence, the salt marsh extends a short distance into Brush Neck Cove with a small isolated portion along the west shore approximately 200 feet downstream.
2. At the two small coves on the east shore of Brush Neck Cove flanking Canfield Ave.
3. Along the southwest shore of Brush Neck Cove within the City Park.

RICRMC considers all salt marsh in Brush Neck Cove to be high quality with the exception of a small area in Area 2 described above (Figure 12). This small area, less than an acre, is designated for restoration.

Wigand et al. (2003) estimates that Brush Neck and Buttonwoods Coves contains 9.1 ha (22 acres) of salt marsh habitat. These marshes contained typical wetland plant species and are dominated by *Spartina patens* (saltmeadow cordgrass) and *Spartina alterniflora* (smooth cordgrass or saltmarsh cordgrass). Five other species were identified in these marsh areas:

- *Distichlis spicata* – saltgrass
- *Limonium nashii* – sea lavander
- *Phragmites australis* – common reed
- *Salicornia europaea* – glasswort
- *Solidago sempervirens* – seaside goldenrod

No submerged aquatic vegetation (SAV) was observed in the project area during various sampling events conducted by the Corps. Additionally, the Rhode Island Geographic Information Systems (GIS) eelgrass data layer (http://www.edc.uri.edu/rigis/data/biota.aspx) does not show any current or historical eelgrass in the project area.

Figure 12. Brush Neck Cove Salt Marsh

4.3.2 Fish

The fish communities in the Brush Neck system were characterized using existing literature and information from Federal and State resource agencies. RI CRMC (2005) reported that the species found in Greenwich Bay (and the project area by extension) are both local populations and migratory species. The abundance and diversity of fish vary seasonally and annually, and depend on the life history of individual species as well as changing environmental conditions. Typical resident fish species in the project area consist of small estuarine fish such as silversides, mummichugs, killifish, and sticklebacks. Larger estuarine migrant and anadromous fish species that have the potential to occur in the project area include winter flounder, striped bass, menhaden, white perch, American eel, herring (alewives and blueback herring), shad, and bluefish.

4.3.3 Benthic Invertebrates and Shellfish

A quantitative survey was performed to document the benthic invertebrate assemblages in the project area. Seven (7) stations were established and at each station, a single 0.04 m^2 VanVeen grab sample was collected. The contents of the grab were screened through a 0.5 mm screen and preserved. Benthic organisms retained on the 0.5 mm screen were identified and enumerated. These data are provided in Appendix B.

Within the study area, macrobenthic communities varied by substrate-type. Typical dominant organisms found in the fine and medium sandy substrates included the polychaetes *Clymenella torquata*, a tube-welling, “head down” deposit feeder; *Leitoscloplos fragilis*, a burrow-dwelling, head down deposit feeder and the tube-dwelling deposit-feeding spionid polychaete *Polydora cornuta*. These species are typically found on stable fine sand substrates in good quality environments.

According the Greenwich Bay Special Area Management Plan (CRMC 2005), shellfish resources within Greenwich Bay include northern quahog (*Mercenaria mercenaria*), soft-shelled clam (*Mya arenaria*), oyster (*Crassostrea virginica*), and mussel (*Mytilus edulis*). No significant populations of shellfish were encountered in Brush Neck Cove or Buttonwoods Cove during this study. Minimal amounts of juvenile soft-shelled clams were documented in the benthic community analysis in stations near the inlet to the coves. A layer of shell hash in the cores indicates that shellfish do inhabit or have historically inhabited the coves. A sparse distribution of oysters was also noted in the intertidal areas near the stone jetties on Oakland Beach.

Horseshoe crabs (*Limulus polyphemus*) utilize Greenwich Bay beaches for spawning. Two areas of Buttonwoods Cove are popular breeding sites: City Park Beach and the opposite shore to the south. These areas are monitored by RIDEM and Save the Bay volunteers. These data are provided in Figure 13.

4.3.4 Birds

The bird population of Brushneck Cove is represented by typical coastal resident and migrant species found in New England. Common coastal species include herring gulls, common terns, great black-backed gulls, semipalmated sandpipers, double-crested cormorants, laughing gulls, and sanderlings. The presence of ospreys was noted during field work in the project area.

In a study conducted by McKinney et al. published in 2006, 321 waterfowl were observed wintering in Brush Neck Cove in 2001-2003. Table 4 shows bird abundance (number of birds ± standard error) reported by McKinney et al. (2006) for Brush Neck Cove by species category. Marsh ducks were the most abundant group. Brush Neck Cove had the second highest species richness (10.3 ± 3.3) of the 32 sites within Narragansett Bay included in the study.

The US EPA Atlantic Ecology Division in Narragansett has been conducting annual surveys since the 2001-2003 surveys conducted by McKinney et al. (2006). Annual data on species abundance from the EPA (2009) is provided in Table 5. Brant, wild geese of the genus *Brant,* are the most abundant overwintering waterfowl in Brush Neck Cove. Survey data are available at http://www.epa.gov/aed/html/research/fowl/data.html.

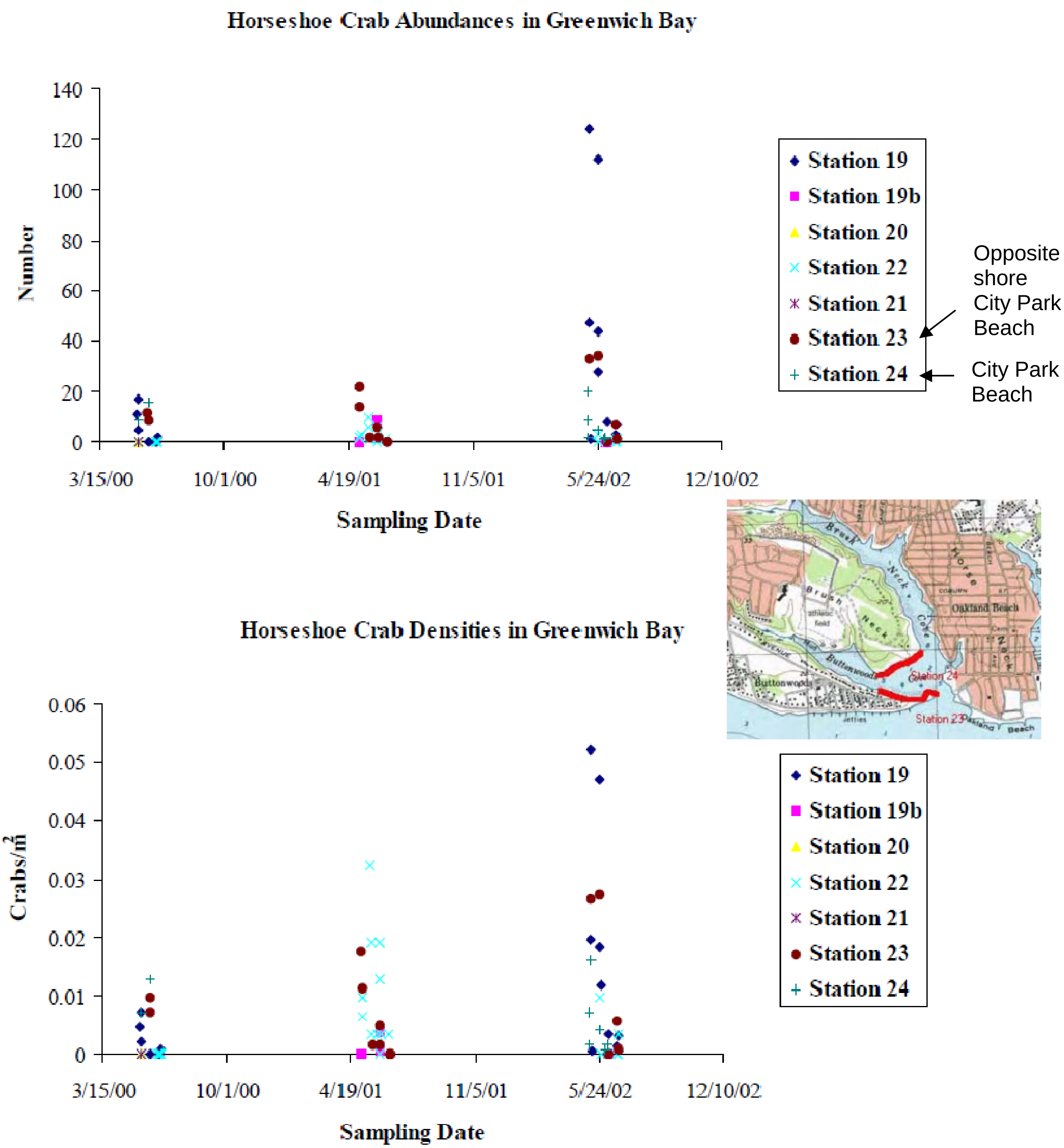

Figure 13. Horseshoe Crab Abundance and Density in Greenwich Bay (modified from CRMC 2005; originally from RIDEM)

Table 4. Wintering Waterfowl Abundance by Species Category in Brush Neck Cove 2001-2003.

Abundance (# ± SE)	Species Category	Species included in category
96.8 ± 56.6	Marsh Ducks	*Anas rubripes* (American black duck), *A. platyrhynchos* (mallard), *A. americana* (American wigeon) and *A. strepera* (gadwall)
30.3 ± 19.2	Open Water	*Bucephala clangula* (common goldeneye), *B. islandica* (Barrow's goldeneye), *Melanitta spp.* (Scoter spp.), *Clangula hyemalis* (long-tailed duck), *Mergus serrator* (red-breasted merganser) and *Aythya spp*. (Scaup spp)
24.4 ± 3.6	Shallow Cove Species	*B. albeola* (bufflehead), *Aythya valisinera* (canvasback) and *M. cucullatus* (hooded merganser)
320.9 ± 177.1	All	All species combined including geese and swans not mentioned above

Table 5. Wintering Waterfowl Abundance in Brush Neck Cove 2004-2009.

SPECIES	COMMON NAME	2004	2005	2006	2007	2008	2009
Bucephala clangula americana	Common Goldeneye	0	0	0	0	2	0
Bucephala albeola	Bufflehead	56	32	69	39	15	0
Mergus cucullatus	Hooded Merganser	6	2	10	7	3	0
Mergus serrator	Red-breasted Merganser	0	0	3	92	1	0
Aythya marila mariloides	Greater Scaup	0	0	1	0	0	0
Anas rubripes	American Black Duck	84	0	240	110	64	0
Anas platyrhynchos	Mallard	580	192	16	24	0	0
Anas americana	American Wigeon	518	8	123	73	33	0
Branta canadensis	Canada Geese	313	141	393	41	71	21
	Gulls	26	0	0	0	0	0
	Swans	0	0	0	2	0	7
	Brant	274	0	950	0	0	0
Total		**1857**	**375**	**1805**	**388**	**189**	**28**

4.3.5 Threatened and Endangered Species

There were no Federal or State threatened or endangered species listed for this area.

4.4 Air Quality

The entire state of Rhode Island is in nonattainment status for the Federal National Ambient Air Quality Standard (NAAQS) for ozone (FHWA 2005). Under provisions of the Federal Clean Air Act, Rhode Island must attain and maintain the Federal ozone NAAQS by 1999. As of 1 December 2006, Warwick, RI is in attainment status for carbon monoxide and all other NAAQS's.

4.5 Recreation and Aesthetics

Brush Neck and Buttonwoods Cove are valuable ecological resources that are utilized by the public for recreational fishing, bird watching, canoeing, kayaking, beach combing, hiking, and swimming. The aesthetic coastal scenery of Rhode Island not only benefits the residents of the coastal communities, but attracts tourists from around the world. There are multiple public access points to the coves including canoe and kayak launches, a state owned boat launch (in Warwick Cove), and access by way of Oakland Beach. There is moderate recreational power boat traffic in the coves during the summer months.

4.6 Sewer Connections

The city of Warwick through the Sewer Authority has implemented a mandatory sewer connection program that will require developed parcels with access to the collection system to tie-in within one year of the notification. As of November 30, 2007, approximately 78% of the parcels within the Brush Neck and Buttonwoods Coves are connected to the city's sewer system.

4.7 Historic and Archaeological Resources

The Corps did not initiate coordination with Rhode Island's State Historic Preservation Office due to the lack of justifiable restoration alternatives. However, the Corps obtained historical summaries from various websites which are presented in Appendix C.

5.0 Public Involvement, Review and Consultation

At the commencement of the feasibility phase, a notice was issued to residents, Federal, State and local agencies and interested groups. The recipients were invited to provide input to the feasibility study, including the scoping of the environmental issues that should be addressed throughout the study.

A coordinated site visit was conducted on March 21, 2006. Participants included individuals from CRMC, RI DEM, Mayor of Warwick, Conservation Commission members, Environmental Protection Agency, Fish and Wildlife Service, and citizens devoted to the protection and improvement of Narragansett Bay and watershed. The Corps' 6-step process, problems and opportunities, measures to be evaluated and the Corps' upcoming data collection activities were explained. Input from the attendees was encouraged.

A stakeholders meeting was held on April 12, 2007. This meeting also summarized the Corps process, results of the data collection to date and restoration measures that are considered, but was an open meeting designed to educate any interested party including residents and agencies.

Several meetings were held with the project sponsor with the most recent meeting describing the Corps' recommendation to discontinue plan formulation since the data analysis suggest that significant restoration benefits are not likely achievable with the measures identified. An email notifying stakeholders of the Corps and CRMC's decision not to proceed with any restoration alternatives at this time.

6.0 Recommendations

The data collected during the feasibility study did not support the presumption that inlet shoaling was restricting tidal flow and degrading habitat within the Brush Neck and Buttonwoods Coves. Sediment coring data did not reveal coarse substrate, suggesting that either current sediment conditions are not substantially different than historical conditions or that a suitable substrate layer is deeper than 16 feet. There is no substantial restoration benefits expected by dredging, therefore the Corps does not recommend proceeding with further evaluation at this time. CRMC should reevaluate these measures if new data demonstrate substantial benefits. The CRMC and the city of Warwick should work together with other Federal, State and local agencies and groups to implement best management practices to minimize further sediment, nutrient and bacteria loading and take steps to eradicate invasive species.

This findings of this negative report have not gone through the formal Corps of Engineers review/quality assurance process. Information, other than the general conclusion that further consideration under the Section 206, Aquatic Ecosystem Restoration Program is not warranted, should be considered preliminary.

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Appendix A

Sediment Data

Battelle
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US ARMY CORPS
OF ENGINEERS
New England District

Contract No. DACW33-03-D-0004
Delivery Order No. 30 October 30, 2007

Draft Final Report

LABORATORY TESTING IN SUPPORT OF ENVIRONMENTAL ASSESSMENT

Sampling and Environmental Testing
Brushneck Cove
Warwick, RI

DRAFT FINAL REPORT

for

Sampling and Environmental Testing—Brushneck Cove, Warwick, RI

Submitted to

Department of the Army
U.S. Army Corps of Engineers
North Atlantic Division
New England District

Contract No. DACW33-03-D-0004
Delivery Order No. 30

October 30, 2007

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TABLE OF CONTENTS

1.0 INTRODUCTION 3
1.1 Project Description 3
1.2 Scope of Work 3
1.3 Organization of this Report 3
2.0 MATERIALS AND METHODS 5
2.1 Sample Collection/Processing 5
2.1.1 Sediment Core Collections 5
2.1.2 Rinsate Blank Sampling 6
2.1.3 Core Processing and Subsampling 6
2.2 Physical and Chemical Testing 8
2.2.1 Grain Size and TOC 8
2.2.2 Organic Contaminants 8
2.2.2.1 Organic Contaminants in Sediment 8
2.2.2.2 Organic Contaminants in Rinsate Blank Sample 8
2.2.3 Metals 9
2.2.3.1 Metals in Sediments 9
2.2.3.2 Metals in Rinsate Blank Sample 9
2.3 Quality Assurance/Quality Control Procedures 11
2.3.1 Measurement Quality Objectives 11
2.3.2 Chain of Custody 11
2.3.3 Data Audits/QA Review 11
2.3.4 Protocol Deviations 12
2.3.4.1 Field Survey 12
2.3.4.2 Physical and Chemical Testing 12
3.0 RESULTS 13
3.1 Grain Size and Total Organic Carbon 13
3.1.1 Polychlorinated Biphenyl Congeners and Chlorinated Pesticides 14
3.1.2 Polynuclear Aromatic Hydrocarbons 16
3.1.3 Metals 17
3.1.4 Quality Control 17
3.1.5 Rinsate Blank 18
4.0 REFERENCES 21

TABLES

Table 2-1. Cross-reference for Station ID and Individual Sample ID. 5
Table 2-2. Sediment Parameters and Target Detection Limits (DL) 10
Table 2-3. Measurement Quality Objectives 11
Table 2-4. Standard Data Reporting Qualifiers. 12
Table 3-1. Summary of Grain Size and TOC Data 13
Table 3-2 Summary of Sediment PCB and Chlorinated Pesticide Data (ng/g dry weight) 14
Table 3-3. Summary of Sediment PAH Data (ng/g dry weight) 16
Table 3-4. Summary of Metals Data (μg/g dry weight) 17
Table 3-5. Summary of Rinsate Blank Data 18

FIGURES

Figure 2-1. Sampling Locations within Buttonwoods Cove and Brushneck Cove, RI. 7

ATTACHMENTS

Attachment A: Results of Physical Measurements: Grain Size and Total Organic Carbon (TOC)
Attachment B: Sediment Chemistry Results
Attachment C: Final Field Sampling Report

1.0 INTRODUCTION

1.1 Project Description

The Corps of Engineers, North Atlantic Division New England District (NAE) is acquiring data for the analysis of environmental impacts associated with the restoration project located in Brushneck Cove, Warwick, RI. The work performed was to assist NAE in gathering physical and chemical data to characterize the sediment to determine the alternatives available for disposal.

1.2 Scope of Work

The project scope of work consisted of sediment core collections from each of the 11 designated sampling locations to project depth (-10ft MLLW?) or refusal. Sediment collections were performed within Brushneck and Buttonwoods Coves to collect material to perform physical and chemical evaluations of the vibracore samples. Sediment cores were collected at each location and analyzed for physical and chemical analyses.

Field Collections— TG&B performed all sediment coring activities under the supervision of a Battelle Chief Scientist.

Physical and Chemical Analyses— Grain size (GS) and total organic carbon (TOC) analysis of all 11 sediment cores were performed by Applied Marine Sciences (AMS) of League City, TX. Battelle conducted metals and organic (polychlorinated biphenyls (PCBs) as congeners, polynuclear aromatic hydrocarbons (PAHs), and chlorinated pesticides) analyses on the 11 sediment cores.

1.3 Organization of this Report

This report was prepared in accordance with the requirements outlined in the NAE Statement of Work (SOW) for Brushneck Cove, RI. This report is organized in four sections and three attachments. Section 1.0 is an introduction and describes the project and scope of work. A summary of the materials and methods used in support of this project is presented in Section 2.0. Results of physical and chemical testing for the sediment samples are discussed in Section 3.0. References are provided in Section 4.0. Complete test results are provided as attachments to this report: Attachment A contains the results of the sediment grain size and TOC testing and Attachment B contains the results of the organic contaminant and metals testing. Attachment C contains the final field survey report for Brushneck Cove. Each attachment contains sample custody and receipt records as appropriate.

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2.0 MATERIALS AND METHODS

2.1 Sample Collection/Processing

On September 5 and 6, 2007, a single core sample was taken at each of the 11 separate locations in Brushneck Cove and Buttonwoods Cove located in Warwick, RI (Table 2-1, Figure 2-1). Sediment cores were transported to Battelle's Duxbury facility for processing. All cores were processed on September 7 and 10, 2007; a representative from NAE (Todd Randall) observed the core processing and provided guidance regarding sub-sampling. The sampled intervals are indicated in the core logs (Attachment C). Cores were cut laterally and characterized. After physical characterization was completed, each sediment core was individually homogenized and divided into subsamples for physical and chemical analyses.

Sediment core collections, rinsate blank collections, and sample processing methods are summarized below. Complete details on the survey/sampling methods can be found in the Brushneck Cove Sampling and Analysis Plan (SAP) (Battelle 2007) and Field Sampling Report (Attachment C).

Table 2-1. Cross-reference for Station ID and Individual Sample ID.

Sampling Area	Station ID	Sample ID
Brushneck Cove	BNC-C-01	GAG-005-A
	BNC-C-02	GAG-006-A
	BNC-C-03	GAG-007-A
	BNC-C-04	GAG-008-A
	BNC-C-05	GAG-009-A
	BNC-C-06	GAG-010-A
	BNC-C-07	GAG-011-A GAG-016-A
Buttonwoods Cove	BNC-C-08	GAG-002-A
	BNC-C-09	GAG-001-A GAG-014-A
	BNC-C-10	GAG-003-A GAG-015-A
	BNC-C-11	GAG-004-A

2.1.1 Sediment Core Collections

Vibracore samples were collected to the depths specified in the SOW and summarized in the Brushneck SAP (Battelle 2007). Battelle and its subcontractor, TG&B, were responsible for collecting all vibracore samples.

Core samples were collected at each of 11 stations (Figure 2-1) using a vibracorer to maximize efficiency and core recovery. The cores were captured in pre-rinsed polycarbonate (Lexan™) liners. Each acceptable core was capped on the bottom while horizontal, and then capped on the top while positioned vertically. All sediment cores were labeled and stored upright (in the containers). During all field activities samples were stored on the vessel in barrels or bags filled with ice. Chain of Custody (COC) for each core section was initiated in the field. Samples were transported from the field to Battelle in the ice filled barrels. Upon arrival at Battelle, samples were placed in a secure, continuously monitored cold room which is maintained at $4^{o}C \pm 2^{o}C$. Core characterization, homogenization, and aliquotting were conducted at Battelle Duxbury (see Section 2.1.3).

2.1.2 Rinsate Blank Sampling

One rinsate blank was collected during the coring survey. All materials to which the vibracore was exposed (e.g., core liners) were decontaminated then rinsed with deionized water. The rinsate blank sample was stored cold (4°C±2°C) until chemical analysis.

2.1.3 Core Processing and Subsampling

Sediment cores were processed and visually characterized at Battelle on September 7 and 10, 2007 under the oversight of the NAE. Cores were cut laterally using electric tin snips and were generally characterized in terms of sediment type (silt, sand, and clay), color, odor, and horizons. In general, the material in each core was found to be similar throughout the length of the core and consisted of dark grey silty, clay with some shell hash. Three cores were found to have a transition to a fine sand; these cores were subsectioned and the sandy layer was retained separately. In one case, the lower layer from the Station BNC-C-09 (sample GAG-014) was also analyzed for grain size and TOC. The other sandy fractions were archived (GAG-015 and GAG-016).

On Monday, September 10, 2007, samples collected for grain size and TOC analyses were shipped to Applied Marine Sciences (AMS), metal samples were shipped to Battelle Sequim, and samples collected for organics analyses were hand delivered to the analytical laboratory at Battelle, Duxbury. The remaining sediment from each core was archived; split samples were stored frozen (-20°C) and cold (4°C±2°C) in 16 oz pre-cleaned glass wide mouth jars. Archive samples will be used for additional compositing and physical and chemical testing, if needed.

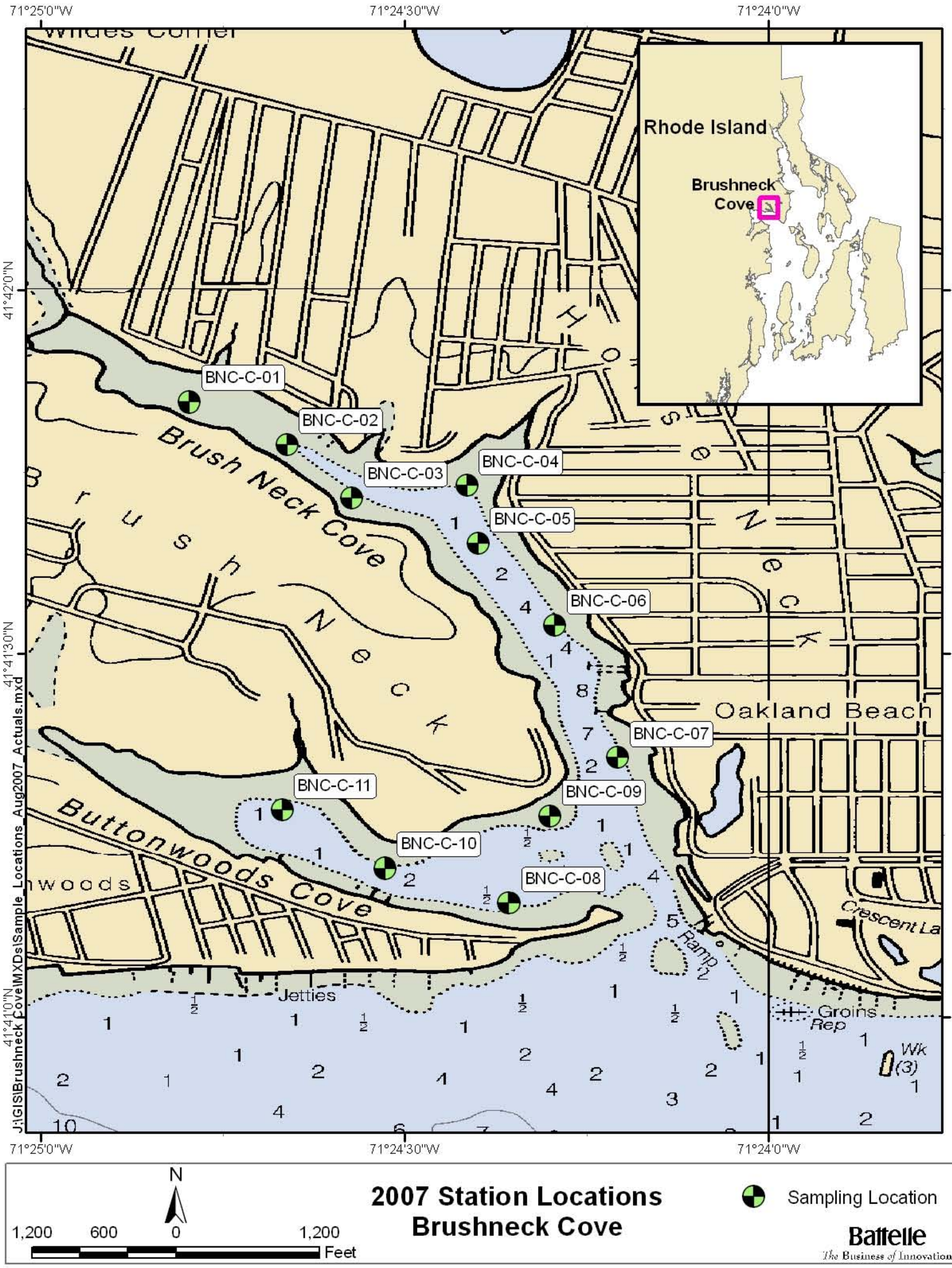

Figure 2-1. Sampling Locations within Buttonwoods Cove and Brushneck Cove, RI.

2.2 Physical and Chemical Testing

This section summarizes the methods used for physical and chemical testing of the Brushneck Cove sediment samples. Physical testing included grain size and percent moisture measurements. Chemical testing on sediment samples included TOC, polychlorinated biphenyl (PCB), chlorinated pesticide, polycyclic aromatic hydrocarbon (PAH), and metals analyses.

Laboratory quality assurance plans that detail the specifics of the analytical requirements were developed for each laboratory. The complete list of parameters and target detection limits is provided in Table 2-2. A routine set of quality control (QC) samples was prepared with each set of samples, by parameter and media, to monitor data quality in terms of accuracy and precision. The frequency and type of QC samples, and QC acceptance criteria, are discussed in greater detail in Section 2.3.

2.2.1 Grain Size and TOC

The 11 individual sediment core samples collected at Brushneck Cove were analyzed by Applied Marine Science (AMS) for gravel, sand, silt, and clay. Grain size was measured according to ASTM D422 for gravel, sand, silt and clay using sieve and hydrometer; visual classifications were estimated according to ASTM D2487, and water content was measured according to ASTM D2216. Results are reported on a dry-weight basis.

Total Organic Carbon (TOC) samples were analyzed according to EPA SW846 Method 9060 by AMS. All samples were analyzed in duplicate from each composite. Results are reported on a dry-weight basis.

2.2.2 Organic Contaminants

2.2.2.1 Organic Contaminants in Sediment

The 11 sediment samples were extracted for PCB congeners, chlorinated pesticides and PAHs following general NOAA Status and Trends (NS&T) methodologies (Peven and Uhler 1993; Battelle SOP 5-192). Approximately 30-grams of wet sediment was fortified with a set of surrogate internal standards (SIS), and extracted three times with methylene chloride using shaker techniques. The combined extract was dried over anhydrous sodium sulfate, concentrated to approximately 1-mL and cleaned using alumina column, activated copper and HPLC. The post-HPLC extract was concentrated to approximately 1-mL, and fortified with a set of internal standards (IS) Extracts were then qualitatively split 50:50, and one half was exchanged into hexane for PCB and chlorinated pesticide analysis by gas chromatography/electron capture detection (GC/ECD) (Battelle SOP 5-128). Extracts for PAH analyses were analyzed directly using gas chromatography/mass spectrometry (GC/MS) in the selected ion mode (Battelle SOP 5-157). All target compounds were quantified by the method of internal standards using IS and results were reported in ng/g dry weight.

Total PCBs were calculated by summing the 18 NOAA congeners (denoted by '*' in Table 2-2) and multiplying the total by 2 (EPA/USACE 2004). Non-detects were included in the sum by using ½ of the MDL reported.

2.2.2.2 Organic Contaminants in Rinsate Blank Sample

One rinsate blank sample was extracted for PCBs, chlorinated pesticides, and PAHs according to Battelle SOP 5-200, *Water Extraction for Trace Level Semi-Volatile Organic Contaminant Analysis*. Approximately 1-L of each water sample was fortified with a set of SIS, and extracted three times with methylene chloride using separatory funnel techniques. The combined extract was dried over anhydrous sodium sulfate and concentrated to approximately 1-mL. The extract was then fortified with a set of internal standards (IS), solvent exchanged into hexane, and analyzed directly by GC/ECD for PCB and chlorinated pesticides (Battelle SOP 5-128). Rinsate blank extracts were analyzed for PAH using GC/MS in the selected ion mode (Battelle SOP 5-157). All target compounds were quantified by the method of internal standards using IS and results are reported in ng/L.

2.2.3 Metals

2.2.3.1 Metals in Sediments

Sediment samples were analyzed for eight metals: arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), and zinc (Zn). Samples were freeze-dried and homogenized using a ball-mill prior to digestion according to Battelle SOP MSL-C-003, *Percent Dry Weight and Homogenizing Dry Sediment, Soil and Tissue*. Sediment samples were digested in accordance with Battelle SOP MSL-I-006, *Mixed Acid Sediment Digestion*. An approximately 200-mg (dry weight) aliquot of each sample was combined with nitric and hydrochloric acids (aqua regia) in a Teflon bomb and heated in an oven at 130ºC (±10ºC) for a minimum of eight hours. After heating and cooling, deionized water was added to the sediment digestate to achieve analysis volume. Digestates were submitted for analysis by three methods.

Digested samples were analyzed for Hg using cold-vapor atomic absorption spectroscopy (CVAA) according to Battelle SOP MSL-I-016, *Total Mercury in Tissues and Sediments by Cold Vapor Atomic Absorption*. This procedure is based on modification of EPA Method 245.5

Digested samples were analyzed for Cr, Cu, Pb, Ni, and Zn using inductively coupled plasma optical emissions spectroscopy (ICP-OES) according to Battelle SOP MSL-I-033, *Determination of Elements in Aqueous and Digestate Samples by ICP-OES*. This procedure is based on two methods modified and adapted for analysis of low level samples: EPA Method 6010B and 200.7.

Digested samples were analyzed for As and Cd using inductively coupled plasma-mass spectrometry (ICP-MS) according to Battelle SOP MSL-I-022, *Determination of Elements in Aqueous and Digestate Samples by ICP/MS*. The base methods for this procedure are EPA Method 1638 and EPA Method 6020 with adaptations for the analysis of trace level metals in digested sediment and tissue samples.

All metals results are reported in µg/g dry weight.

2.2.3.2 Metals in Rinsate Blank Sample

The equipment rinsate blank was analyzed for As, Cd, Cr, Cu, Pb, Hg, Ni, and Zn. The samples were submitted for analyses by two methods.

Samples were analyzed for total Hg by cold vapor atomic fluorescence (CVAF) in accordance with Battelle SOP *MSL-I-013*; *Total Mercury in Aqueous Samples by CVAF based on EPA Method 1631 Revision E*. Samples were analyzed for all other metals by inductively coupled plasma-mass spectrometry (ICP-MS) in accordance with Battelle SOP *MSL-I-022; Determination of Elements in Aqueous and Digestate Samples by ICP/MS*, which was adapted from US EPA Method 1638. Samples were acid solubilized prior to analysis by ICP-MS in accordance with the total recoverable metals (TRM) method in Battelle SOP *MSL-I-022*. The analysis guidelines for this procedure are adapted from USEPA Method 1638 Determination of Trace Elements in Ambient Waters by Inductively Coupled Plasma-Mass Spectrometry. The TRM methodology is adapted from USEPA Method 1640 - Determination of Trace Elements in Ambient Waters by On-Line Chelation Preconcentration and Inductively Coupled Plasma-Mass Spectrometry.

All results for the sample will be reported in µg/L.

Table 2-2. Sediment Parameters and Target Detection Limits (DL)

Parameter	DL	Parameter	DL
Polycyclic Aromatic Hydrocarbons	**ng/g DW (ppb)**	**Chlorinated Pesticides**	**ng/g DW (ppb)**
Naphthalene	10	4,4'-DDD	1
Acenaphthylene	10	4,4'-DDE	1
Acenaphthene	10	4,4'-DDT	1
Fluorene	10	aldrin	1
Anthracene	10	a-chlordane	1
Phenanthrene	10	g-chlordane	1
Fluoranthene	10	lindane	1
Pyrene	10	cis-nonachlor	1
Benzo(a)anthracene	10	trans-nonachlor	1
Chrysene	10	oxychlordane	1
Benzo(b)fluoranthene	10	dieldrin	1
Benzo(k)fluoranthene	10	endosulfan I	1
Benzo(a)pyrene	10	endosulfan II	1
Indeno(1,2,3-cd)pyrene	10	endrin	1
Dibenzo(a,h)anthracene	10	heptachlor	1
Benzo(g,h,i)perylene	10	heptachlor epoxide	1
		hexachlorobenzene	1
		methoxychlor	1
		Toxaphene	25
Polychlorinated Biphenyls	**ng/g DW (ppb)**	**Metals**	**µg/g DW (ppm)**
Cl2(8) *	1	Arsenic	0.4
Cl3(18) *	1	Cadmium	0.07
Cl3(28) *	1	Chromium	0.5
Cl4(44) *	1	Copper	0.5
Cl4(49)	1	Lead	0.5
Cl4(52) *	1	Mercury	0.02
Cl4(66) *	1	Nickel	0.5
Cl5(87)	1	Zinc	1.0
Cl5(101) *	1		
Cl5(105) *	1	**Ancillary Parameters**	**% DW**
Cl5(118) *	1	TOC	0.1
Cl6(128) *	1	Grain Size	NA
Cl6(138) *	1	Percent Moisture	1.0
Cl6(153) *	1		
Cl7(170) *	1		
Cl7(180) *	1		
Cl7(183)	1		
Cl7(184)	1		
Cl7(187) *	1		
Cl8(195) *	1		
Cl9(206) *	1		
Cl10(209) *	1		

NA = Not applicable
ng/g DW (ppb), nanograms per gram dry weight (ppb, parts per billion)
µg/g DW (ppm), micrograms per gram dry weight (ppm, parts per million)
* indicates PCB congeners included in sum of Total PCB

2.3 Quality Assurance/Quality Control Procedures

Field and analytical activities used in the collection and analysis of sediments for physical and chemical testing followed approved SOPs, referenced agency methods, or the SAP (Battelle 2006). Deviations are documented in Section 2.3.4.

2.3.1 Measurement Quality Objectives

Project specific Measurement Quality Objectives (MQOs), against which all data from this project were evaluated, are presented in Table 2-3. Physical and chemical data were evaluated against the MQOs, and data reporting qualifiers (Table 2-4) were applied when the analytical MQOs were exceeded.

2.3.2 Chain of Custody

Sample custody forms accompanied all samples from the field to the laboratory and between laboratories. Copies of custody and laboratory receipt forms are provided in Attachments A, B, and C.

2.3.3 Data Audits/QA Review

All data received internal verification and validation following established procedures at the laboratory where the data were generated. QA/QC narratives and QA/QC checklists as required by the RIM (EPA/USACE 2004) are provided with the sample data in Attachments A and B. These narratives include a discussion of the chemistry QC results; a description of MQO exceedances; and the impact, if any, the exceedances may have on the overall field sample data.

Table 2-3. Measurement Quality Objectives

QC Parameter	Measure or Acceptance Criteria [a]	Corrective Action
Accuracy Method Blank	*Organics & Metals:* <5×MDL *Organics & Metals:* <RL	Reextract, reanalyze, and/or blank subtract[e]; document corrective actions
Accuracy Lab Control Sample (LCS)	*Organics:* 50 to 120% Recovery *Metals:* 75 to 125% Recovery	Reextract, reanalyze, and/or document and justify; all corrective actions documented
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	*Organics:* 50 to 120% Recovery[b] *Metals:* 75 to 125% Recovery[b]	As above
Standard Reference Material (SRM)	*Organics:* ≤30% PD [d] from target concentration plus the 95% confidence interval. *Metals:* Within 25% PD[c] from certified value.	As above
Surrogate Internal Standard (SIS)	*Organics:* 30 - 150% Recovery	As above
Precision Duplicates & MS/MSD	*Organics & Metals:* ≤30% RPD[b] between % recoveries *Organics & Metals:* ≤30% RPD[c] between values *TOC:* RPD ≤ 30% *Grain Size:* RPD ≤ 25%	As above

MDL: method detection limit; PD: percent difference; RPD: relative percent difference
[a] Quality control samples are based on an analytical batch size of 20.
[b] Analyte concentration in MS must be >5× background concentration to be used for data quality assessment.
[c] For analytes detected at concentrations >10× MDL.
[d] Percent Difference (PD) determined using surrogate corrected data. PD only determined for certified analytes.
[e] Blank subtracting is applicable to metals only, and would require the NAE project manager's consultation and approval

Table 2-4. Standard Data Reporting Qualifiers.

Data Qualifier	Definition
J	Analyte detected at level less than the laboratory achieved detection limit (i.e., ssRL for organics and RL for metals) but above Method Detection Limit (MDL).
j	For Metals: analyte detected below the Limit of Quantitation /RL; concentration reported may be an estimate.
E	Estimate, result > highest concentration level in the calibration.
B	Analyte concentration found in the sample at a concentration <5x the level found in the procedural blank (the qualifier is only applied to the affected field samples).
U	Not detected above laboratory achieved method detection limit; ssRL (organics) or RL (metals) reported.
N	QC value outside the accuracy or precision criteria goal.
n	QC value outside the accuracy or precision data quality objective, but meets contingency criteria.

2.3.4 Protocol Deviations

2.3.4.1 Field Survey

None.

2.3.4.2 Physical and Chemical Testing

None.

3.0 RESULTS

This section summarizes results obtained from physical and chemical testing of sediment core and rinsate blank samples collected at Brushneck Cove, RI. Each of the 11 cores were characterized, homogenized, and sampled for grain size, total organic carbon (TOC), organics (PCB/PEST/PAH), and metals analyses.

Chemistry results for the sediments were evaluated against the laboratory based method detection limits (MDL) and reporting limits (RL) such that:

- Organic contaminants and metals not-detected or detected at levels below the Laboratory MDL were reported as the RL and U flagged
- Organic contaminants and metals detected at levels above the Laboratory MDL and below the RL were J flagged (metals results were flagged with a lower case j)

Complete test results are provided as attachments to this report (Attachment A includes grain size and TOC test results and Attachment B includes organic contaminant and metals test results). Results of all physical and chemical tests are summarized below.

3.1 Grain Size and Total Organic Carbon

Grain size and TOC data for the samples are summarized in Table 3-1 and are presented in greater detail in Attachment A. Generally, the sediment composition ranged from dark grey, silty clay in the top portion of the core to fine sand in the lower portion of the core. The most notable transition was observed for Station BNC-C-09 (GAG-001), proximate to Buttonwoods Beach, which exhibited a transition from fine sand to coarse sand with some fine gravel and a distinct horizon from 1.8 to 2.5 feet. The lower portion of material from this core was retained and analyzed separately for grain size and TOC (GAG-014).

Table 3-1. Summary of Grain Size and TOC Data

Sample ID	% Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Silt	% Clay	% Water Content	% Total Solids	% TOC Average[1]
GAG-001	0.56	0.92	7.73	68.34	15.48	6.97	25	80	0.38
GAG-002	1.21	0.17	1.83	21.43	45.68	29.68	77	56	1.67
GAG-003	0.00	0.29	3.58	28.02	39.66	28.45	80	55	1.75
GAG-004	0.00	0.00	1.05	10.35	55.44	33.16	101	50	2.72
GAG-005	0.00	0.91	1.74	19.05	48.17	30.13	84	54	2.76
GAG-006	0.00	0.12	2.08	19.34	46.73	31.73	88	53	2.32
GAG-007	0.00	0.24	3.06	22.65	38.90	35.15	88	53	2.16
GAG-008	0.00	0.00	0.86	12.37	50.00	36.77	96	51	2.30
GAG-009	0.00	0.27	1.29	16.36	47.72	34.36	87	53	1.99
GAG-010	0.00	0.00	1.63	27.48	42.55	28.34	71	59	1.53
GAG-011	0.00	0.00	3.84	40.32	36.98	18.86	56	64	1.09
GAG-014	0.36	1.57	4.23	84.34	9.17	0.33	20	84	0.03
GAG-014 Dup	0.33	1.46	4.34	82.96	10.60	0.31	20	84	NA

NA = Not Applicable; [1] Average of 2 measurements.

As expected, fine-grained sediments typically contained higher levels of TOC. For example, sample GAG-004, had the highest percentage of fine material (88.66% silt + clay) and the highest percentage of TOC (2.72%). Sample GAG-014, representing the sandy, lower portion of Core GAG-001 (Station BNC-

C-09), had the lowest percentage of fine material (9.5% silt + clay) and the lowest percentage of TOC (0.03%). A number of cores also possessed layers of shell hash. The sediments from all but one location (Station BNC-C-09) produced a noticeable sulfur odor.

3.1.1 Polychlorinated Biphenyl Congeners and Chlorinated Pesticides

Low levels of PCB and pesticide compounds were detected in all of the samples collected (Table 3-2). Total PCB concentrations ranged from 3 to 20 ug/g (ppb) with the lowest concentrations corresponding to the sediment sample containing the lowest percent fines (GAG-001; station BNC-C-09). Limited pesticides were detected including DDD, DDE, chlordanes, cis and trans-nonachlor, dieldrin and methoxychlor. In general, pesticide concentrations were at or below the target detection limit of 1 ng/g (ppb).

Table 3-2 Summary of Sediment PCB and Chlorinated Pesticide Data (ng/g dry weight)

Sample ID	GAG-001		GAG-002		GAG-003		GAG-004		GAG-005		GAG-006	
Station ID	BNC-C-09		BNC-C-08		BNC-C010		BNC-C-11		BNC-C-01		BNC-C-02	
	Value	qual	Value	qual	Value	qual	Value	qual	Value	qual	Value	qual
PCBs												
Cl2(08)	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
Cl3(18)	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
Cl3(28)	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
Cl4(44)	0.09	B	0.37		0.43		0.65		0.68		0.73	
Cl4(49)	0.18	BME	2.19	ME	1.65	ME	6.52	ME	1.6	ME	3.06	ME
Cl4(52)	0.18	B	0.22	B	0.31	B	0.46	B	0.42	B	0.45	B
Cl4(66)	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
Cl5(87)	0.09	U	0.32		0.41		0.73		0.34		0.52	
Cl5(101)	0.1		0.33		0.33		0.55		0.28		0.59	
Cl5(105)	0.09	U	0.12	U	0.13	U	0.12	J	0.11	J	0.14	
Cl5(118)	0.08	J	0.24		0.34		0.39		0.42		0.53	
Cl6(128)	0.09	U	0.12	U	0.11	J	0.13	U	0.12	U	0.12	U
Cl6(138)	0.09		0.24		0.36		0.47		0.55		0.55	
Cl6(153)	0.08	J	0.2		0.3		0.41		0.44		0.57	
Cl7(170)	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
Cl7(180)	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.3	
Cl7(183)	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.17	
Cl7(184)	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
Cl7(187)	0.09	U	0.17		0.17		0.25		0.24		0.33	
Cl8(195)	0.09	U	0.17		0.14		0.2		0.11	J	0.48	
Cl9(206)	0.09	U	0.26		0.22		0.29		0.22		0.43	
Cl10(209)	0.09	U	0.26		0.22		0.31		0.15		0.39	
Total PCB	2.96		6.3		7.16		9.48		8.52		12.17	
Pesticides												
4,4 DDD	0.09	U	0.23		0.24		0.51		1.67		1.59	
4,4 DDE	0.1		0.31		0.41		0.49		1.16		1.24	
4,4 DDT	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
Aldrin	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
a-Chlordane	0.09	U	0.12	U	0.13	U	0.13	U	0.93		0.98	
g-Chlordane	0.09	U	0.12	U	0.25		0.39		1.65		1.66	
Lindane	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
cis-Nonachlor	0.09	U	0.12	U	0.13	U	0.13	U	0.51		0.37	
trans-Nonachlor	0.09	U	0.12	U	0.13	U	0.13	U	0.89		0.76	
Oxychlordane	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
Dieldrin	0.09	U	0.3		0.25		0.48		0.34		0.56	

Endosulfan I	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
Sample ID	**GAG-001**		**GAG-002**		**GAG-003**		**GAG-004**		**GAG-005**		**GAG-006**	
Station ID	**BNC-C-09**		**BNC-C-08**		**BNC-C010**		**BNC-C-11**		**BNC-C-01**		**BNC-C-02**	
	Value	**qual**	**Value**	**qual**	**Value**	**qual**	**Value**	**qual**	**Value**	**qual**	**Value**	**qual**
Endosulfan II	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
Endrin	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
Heptachlor	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
Heptachlor epoxide	0.09	U	0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
Hexachlorobenzene	0.76		0.12	U	0.13	U	0.13	U	0.12	U	0.12	U
Methoxychlor	0.09	U	0.99		1.63		1.98		0.89		0.81	
Toxaphene	3.67	U	3.67	U	3.67	U	3.67	U	3.67	U	3.67	U

Sample ID	**GAG-007**		**GAG-008**		**GAG-009**		**GAG-010**		**GAG-011**	
Station ID	**BNC-C-03**		**BNC-C-04**		**BNC-C-05**		**BNC-C-06**		**BNC-C-07**	
	Value	**qual**	**Value**	**qual**	**Value**	**qual**	**Value**	**qual**	**Value**	**qual**
PCBs										
Cl2(08)	0.12	U	0.15	U	0.13	U	0.11	U	0.11	U
Cl3(18)	0.12	U	0.15	U	0.13	U	0.11	U	0.11	U
Cl3(28)	0.12	U	0.15	U	0.13	U	0.11	U	0.11	U
Cl4(44)	0.53		0.78		0.48		0.38		0.33	
Cl4(49)	3.2	ME	3.24	ME	1.34	ME	0.86	ME	1.27	ME
Cl4(52)	0.3	B	0.74	B	0.22	B	0.25	B	0.3	B
Cl4(66)	0.12	U	0.15	U	0.13	U	0.11	U	0.11	U
Cl5(87)	0.47		0.57		0.22		0.11	U	0.21	
Cl5(101)	0.52		1.01		0.28		0.31		0.32	
Cl5(105)	0.12		0.29		0.13	U	0.11	U	0.11	U
Cl5(118)	0.39		0.97		0.21		0.21		0.27	
Cl6(128)	0.12	U	0.39		0.13	U	0.11	U	0.11	U
Cl6(138)	0.49		1.14		0.54		0.25		0.31	
Cl6(153)	0.42		1.28		0.2		0.23		0.31	
Cl7(170)	0.12	U	0.36		0.13	U	0.11	U	0.11	U
Cl7(180)	0.19		0.63		0.13	U	0.11	U	0.14	
Cl7(183)	0.12	U	0.29		0.13	U	0.11	U	0.11	U
Cl7(184)	0.12	U	0.15	U	0.13	U	0.11	U	0.11	U
Cl7(187)	0.19		0.55		0.15		0.1	J	0.15	
Cl8(195)	0.1	J	0.4		0.13	U	0.11	U	0.39	
Cl9(206)	0.13		0.61		0.13	U	0.11	U	0.18	
Cl10(209)	0.12		0.56		0.13	U	0.11	U	0.15	
Total PCB	8.19		20.44		5.8		5.1		6.99	
Pesticides										
4,4 DDD	0.82		2.87		0.31		0.19		0.47	
4,4 DDE	0.77		1.85		0.27		0.19		0.38	
4,4 DDT	0.12	U	0.23		0.13	U	0.11	U	0.11	U
Aldrin	0.12	U	0.15	U	0.13	U	0.11	U	0.11	U
a-Chlordane	0.43		0.7		0.13	U	0.3		0.11	U
g-Chlordane	0.67		1.28		0.25		0.15		0.27	
Lindane	0.12	U	0.15	U	0.13	U	0.11	U	0.11	U
cis-Nonachlor	0.17		0.64		0.08	J	0.11	U	0.19	
trans-Nonachlor	0.29		0.43		0.13	U	0.11	U	0.11	U
Oxychlordane	0.12	U	0.15	U	0.13	U	0.11	U	0.11	U
Dieldrin	0.5		1.38		0.22		0.11	U	0.23	
Endosulfan I	0.12	U	0.15	U	0.13	U	0.11	U	0.11	U
Endosulfan II	0.12	U	0.15	U	0.13	U	0.11	U	0.11	U

Sample ID	GAG-007		GAG-008		GAG-009		GAG-010		GAG-011	
Station ID	BNC-C-03		BNC-C-04		BNC-C-05		BNC-C-06		BNC-C-07	
	Value	qual	Value	qual	Value	qual	Value	qual	Value	qual
Endrin	0.12	U	0.15	U	0.13	U	0.11	U	0.11	U
Heptachlor	0.12	U	0.15	U	0.13	U	0.11	U	0.11	U
Heptachlor epoxide	0.12	U	0.15	U	0.13	U	0.11	U	0.11	U
Hexachlorobenzene	0.12	U	0.15	U	0.13	U	0.11	U	0.11	U
Methoxychlor	1.23		4.22		0.97		2.79		1.32	
Toxaphene	3.67	U	3.67	U	3.67	U	3.67	U	3.67	U

3.1.2 Polynuclear Aromatic Hydrocarbons

PAHs were detected in all sediment samples (Table 3-3). Total PAHs ranged from 51 to 638 ng/g (ppb) with the highest concetentrations observed at the inland-most stations within Brush Neck Cove. All sediment samples, however, appear to have a similar PAH distribution pattern which is dominated by fluoranthene and pyrene, and other high molecular weight PAHs. This pattern suggests pyrogenic PAH sources indicative of combusted petroleum products and similar to what is often observed in urban run-off.

Table 3-3. Summary of Sediment PAH Data (ng/g dry weight)

Sample ID	GAG-001		GAG-002		GAG-003		GAG-004		GAG-005		GAG-006	
Station ID	BNC-C-09		BNC-C-08		BNC-C010		BNC-C-11		BNC-C-01		BNC-C-02	
	Value	qual	Value	qual	Value	Value	qual	qual	Value	qual	Value	qual
Naphthalene	0.97	B	1.81	B	1.86	B	2.55		3.07	B	2.78	B
Acenaphthylene	1.05		1.45		1.31		2.03		7.9		4.05	
Acenaphthene	0.41	U	0.34	J	0.37	J	0.66		1		1.21	
Fluorene	0.48		0.93		1.12		1.52		1.87		2.01	
Anthracene	1.86		2.63		2.65		3.35		7.97		5.93	
Phenanthrene	9.05		8.13		8.08		9.38		20.59		19.78	
Fluoranthene	21.21		23.17		20.67		30.76		115.35		78.48	
Pyrene	18.91		23.2		18.58		29.57		107.46		89.41	
Benzo(a)anthracene	6.77		8.59		6.76		10		45.78		30.84	
Chrysene	8.07		10.05		9		13.03		56.33		41.1	
Benzo(b)fluoranthene	7.19		9.71		9.31		14.17		59.93		50.18	
Benzo(k)fluoranthene	7.28		9.69		9.05		13.96		60.44		49.61	
Benzo(a)pyrene	7.41		9.81		8.42		12.87		58.7		43.31	
Indeno(1,2,3-cd) pyrene	5.35		7.58		7.26		11.17		44.3		38.82	
Dibenz(a,h)anthracene	1.03		1.39		1.41		2.2		8.7		7.31	
Benzo(g,h,i)perylene	4.84		6.62		6.54		10.24		38.69		33.53	
Total PAH [1]	101		125		112		168		638		498	
Sample ID	**GAG-007**		**GAG-008**		**GAG-009**		**GAG-010**		**GAG-011**			
Station ID	**BNC-C-03**		**BNC-C-04**		**BNC-C-05**		**BNC-C-06**		**BNC-C-07**			
	Value	**qual**	**Value**	**qual**	**Value**	**qual**	**Value**	**qual**	**Value**	**qual**		
Naphthalene	1.97	B	4.64		1.66	B	1.14	B	1.49	B		
Acenaphthylene	2.17		8.87		0.92		0.6		1.57			
Acenaphthene	0.64		1.69		0.4	J	0.25	J	0.29	J		
Fluorene	1.2		3.25		0.75		0.51	J	0.78			
Anthracene	3.11		11.6		1.76		1.04		2.27			
Phenanthrene	9.41		29.4		5.72		2.45		7.26			
Fluoranthene	37.13		12.03		21.73		9.35		23.63			

Sample ID	**GAG-007**		**GAG-008**		**GAG-009**		**GAG-010**		**GAG-011**	
Station ID	**BNC-C-03**		**BNC-C-04**		**BNC-C-05**		**BNC-C-06**		**BNC-C-07**	
	Value	**qual**	**Value**	**qual**	**Value**	**qual**	**Value**	**qual**	**Value**	**qual**
Pyrene	38.14		134.97		20.27		8.36		24.14	
Benzo(a)anthracene	13.18		44.67		7.15		2.72		9.15	
Chrysene	18.89		56.51		11.17		4.26		11.99	
Benzo(b)fluoranthene	23.3		69.82		12.37		4.74		10.85	
Benzo(k)fluoranthene	21.33		69.12		11.62		4.36		12.11	
Benzo(a)pyrene	18.6		61.91		10.31		3.58		10.43	
Indeno(1,2,3-cd) pyrene	17.14		53.8		9.66		3.26		7.77	
Dibenz(a,h)anthracene	3.24		10.72		1.69		0.62		1.46	
Benzo(g,h,i)perylene	15.69		47.82		8.87		3.32		7.3	
Total PAH [1]	225		621		126		51		131	

[1] Total PAH is the sum of the 16 PAHs (1/2 MDL included for "U" flagged data)

3.1.3 Metals

Target metals were detected in all samples and concentrations were relatively similar across samples. Metals data is presented in Table 3-4.

Table 3-4. Summary of Metals Data (µg/g dry weight)

Sample ID	**GAG-001**		**GAG-002**		**GAG-003**		**GAG-004**		**GAG-004 Duplicate**		**GAG-005**	
Station ID	**BNC-C-09**		**BNC-C-08**		**BNC-C010**		**BNC-C-11**		**BNC-C-11**		**BNC-C-01**	
	Value	**qual**	**Value**	**qual**	**Value**	**qual**	**Value**	**qual**	**Value**	**qual**	**Value**	**qual**
Arsenic	1.91		5.47		4.87		5.66		6.13		5.36	
Cadmium	0.209		0.507		0.533		0.672		0.698		0.521	
Chromium	13.1		39.0		36.6		50.2		52.2		42.0	
Copper	5.49		10.9		11.1		17.3		17.6		13.3	
Mercury	0.0135	j	0.0314		0.0272		0.0609		0.0590		0.0640	
Nickel	4.71		14.7		13.9		17.5		17.9		14.7	
Lead	4.21		9.14		8.86		14.2		15.0		16.6	
Zinc	23.8		58.2		53.2		72.9		76.1		66.2	
Sample ID	**GAG-006**		**GAG-007**		**GAG-008**		**GAG-009**		**GAG-010**		**GAG-011**	
Station ID	**BNC-C-02**		**BNC-C-03**		**BNC-C-04**		**BNC-C-05**		**BNC-C-06**		**BNC-C-07**	
	Value	**qual**	**Value**	**qual**	**Value**	**qual**	**Value**	**qual**	**Value**	**qual**	**Value**	**qual**
Arsenic	5.47		4.94		6.45		5.71		4.28		3.53	
Cadmium	0.559		0.517		0.570		0.467		0.366		0.373	
Chromium	43.0		41.5		51.1		41.4		34.8		26.6	
Copper	15.0		12.2		16.9		11.3		8.49		9.72	
Mercury	0.0689		0.0318		0.0748		0.0241		0.0182	j	0.0335	
Nickel	14.6		14.6		17.4		14.9		12.7		9.53	
Lead	17.1		11.4		18.8		10.2		7.92		8.97	
Zinc	67.3		58.8		77.3		60.3		49.9		45.8	

3.1.4 Quality Control

In general, results from the QC samples were good and met the MQOs. QA/QC narratives, which include a discussion of the QC results and a description of MQO exceedances and the impact, if any, the exceedances may have on the overall sample data are provided in Attachments A and B.

3.1.5 Rinsate Blank

Target PCB and pesticide compounds were not detected at levels above the Laboratory MDL or RL in the field rinsate blank sample (Table 3-5). PAHs were detected in the rinsate blank; however, the PAH compounds detected in the blank were primarily low molecular weight PAHs. The PAHs detected in the samples were dominated by the high molecular weight compounds, indicating that the impact on sediment data quality is minimal.

Only nickel and lead were detected above the MDL in the rinsate blank (Table 3-5). However, the concentrations of these metals in the rinsate blank were several orders of magnitude lower than the concentrations in the associated sediment samples, indicating that the impact on the sediment data quality is minimal.

Table 3-5. Summary of Rinsate Blank Data

Rinsate Blank-GAG-012					
	Value	**qual**		**Value**	**qual**
PCBs	**ng/L**		**PAHs**	**ng/L**	
Cl2(08)	0.48	U	Naphthalene	91.55	
Cl3(18)	0.48	U	Acenaphthylene	2.39	U
Cl3(28)	0.48	U	Acenaphthene	3.83	
Cl4(44)	0.48	U	Fluorene	29.11	
Cl4(49)	0.48	U	Anthracene	2.39	U
Cl4(52)	0.48	U	Phenanthrene	15.17	
Cl4(66)	0.48	U	Fluoranthene	1.97	J
Cl5(87)	0.48	U	Pyrene	2.	J
Cl5(101)	0.48	U	Benzo(a)anthracene	2.39	U
Cl5(105)	0.48	U	Chrysene	2.39	U
Cl5(118)	0.48	U	Benzo[b]fluoranthene	2.39	U
Cl6(128)	0.48	U	Benzo[k]fluoranthene	4.78	U
Cl6(138)	0.48	U	Benzo[a]pyrene	2.39	U
Cl6(153)	0.48	U	Indeno[1,2,3-c,d]-pyrene	2.39	U
Cl7(170)	0.48	U	Dibenz[a,h]anthracene	2.39	U
Cl7(180)	0.48	U	Benzo[g,h,i]perylene	2.39	U
Cl7(183)	0.47	U	**Metals**	**µg/L**	
Cl7(184)	0.47	U	Arsenic	0.015	U
Cl7(187)	0.48	U	Cadmium	0.001	U
Cl8(195)	0.48	U	Chromium	0.083	U
Cl9(206)	0.48	U	Copper	0.009	j
Cl10(209)	0.48	U	Mercury	0.00019	U
Total PCB	10.49	U	Nickel	0.0606	
			Lead	0.00776	
			Zinc	0.209	U
Pesticides	**ng/L**		**Pesticides cont.**		
4,4 DDD	0.48	U	Dieldrin	0.48	U
4,4 DDE	0.48	U	Endosulfan I	0.48	U
4,4 DDT	0.48	U	Endosulfan II	0.48	U
Aldrin	0.48	U	endrin	0.9	U
a-Chlordane	0.48	U	heptachlor	0.94	U
g-Chlordane	0.48	U	heptachlor epoxide	0.4	U

Rinsate Blank-GAG-012					
	Value	**qual**		**Value**	**qual**
Lindane	0.48	U	Hexachlorobenzene	0.76	U
cis-Nonachlor	0.48	U	methoxychlor	0.47	U
trans-Nonachlor	0.48	U	Toxaphene	95.43	U
Oxychlordane	0.48	U			

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4.0 REFERENCES

Battelle. 2007. Final Sampling and Analysis Plan, Sampling And Environmental Testing - Brushenck Cove Section 206 Project, Warwick, RI. Prepared under Contract No. DACW33-03-D-0004, Delivery Order No. 30. August 29, 2007. 28 pp + Appendices.

USEPA/USACE (U.S. Environmental Protection Agency/U.S. Army Corps of Engineers). 2004. *Final Regional Implementation Manual for the Evaluation of Dredged Material Proposed for Disposal in New England Waters.* April 2004. U.S. Environmental Protection Agency, Region I, and U.S. Army Corps of Engineers, New England Division, Waltham, Massachusetts.

Peven, C.S. and A.D. Uhler. 1993. Analytical procedures followed by Battelle Ocean Sciences and Science Applications International Corporation to quantify organic contaminants. Pp. 141-161 in Lauenstein, G.G., and A.Y. Cantillo (Eds.), Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Project. Volume IV. NOAA Technical Memorandum NOS ORCA 71. National Oceanic and Atmospheric Administration, Silver Spring, MD.

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Attachment A

Results of Physical Measurements: Grain Size and Total Organic Carbon (TOC)

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Table II-7: Quality Control Summary for Analyses of Sediment Grain Size and Total Organic Carbon

Method Reference Numbers: ASTM D422 (Particle Size Analysis of Soils) and EPA 9060A (Total Organic Carbon)

Quality Control (QC) Element	**Acceptance Criteria***	**Criteria Met? Yes/No**	**List Results Outside Criteria (Cross-Reference Results Table in Data Report)**	**Location of Results (Retained at Lab or in Data Package)**
Grain Size: Analytical Replicates	Analyze one sample in duplicate for each group of field samples (RPD<25%)	Yes	None	In Data Package
Total Organic Carbon: Standard Reference Materials	Within the limits provided by vendor	Yes	None	In Data Package
Total Organic Carbon: Analytical Replicates	Analyze samples in duplicate (RPD<30%)	Yes	None	In Data Package

*The Quality Control Acceptance Criteria are general guidelines. If alternative criteria are used, they must be documented in this table.

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Grain Size Results

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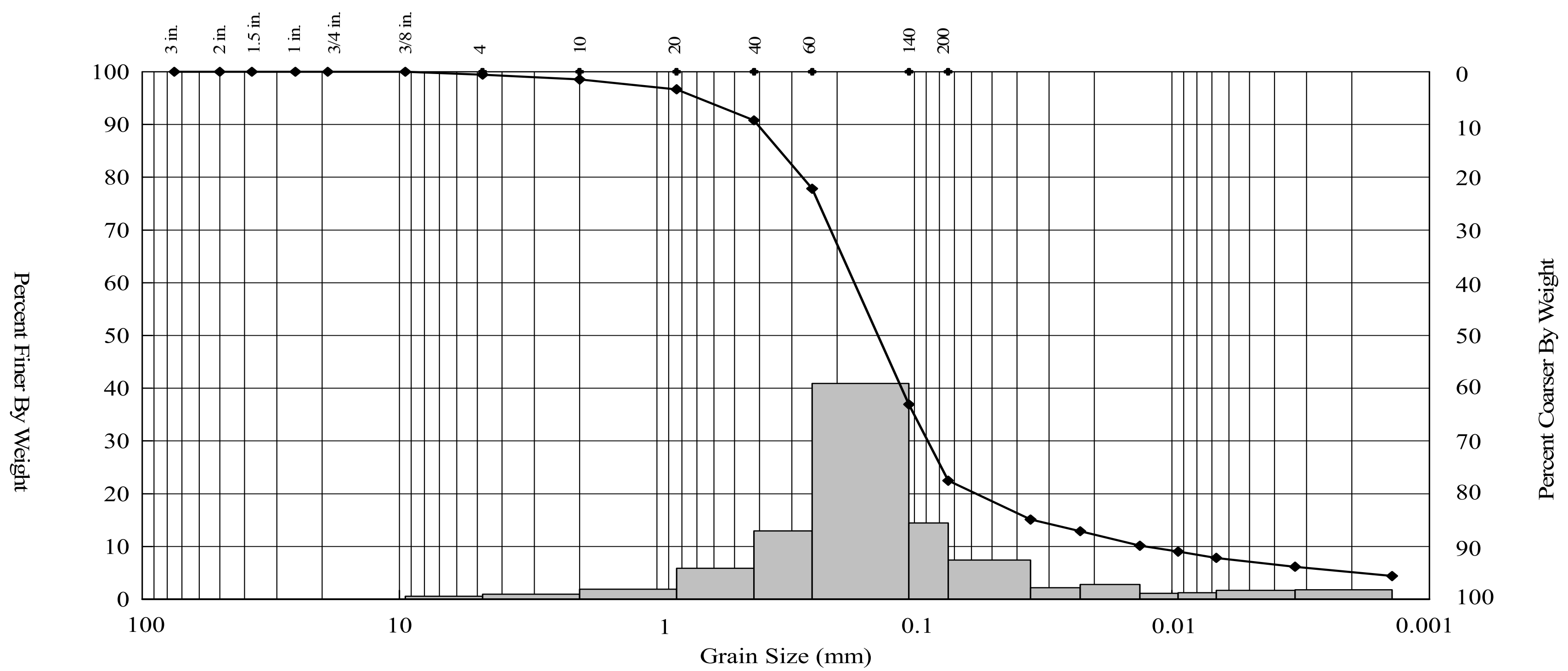
GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.56	0.92	7.73	68.34	15.48	6.97

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
25	80								

Material Description

Silty Sand ("SM"), dark greenish gray (10Y 4/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-001-A
AMS Sample ID:	28690

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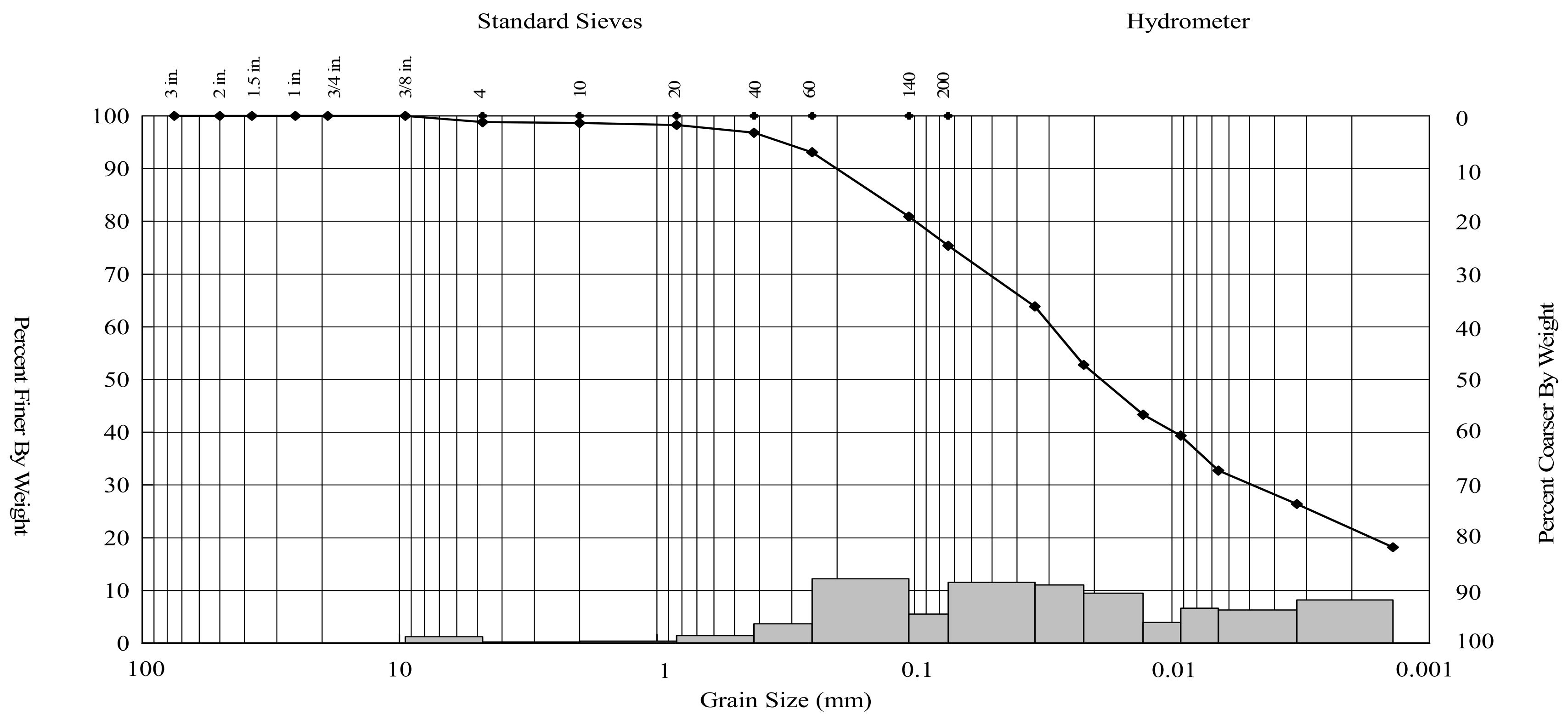
AMS, Inc. Technical Director

Laboratory No. E87956

GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
1.21	0.17	1.83	21.43	45.68	29.68

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
77	56								

Material Description

Elastic Silt with Sand ("MH"), very dark greenish gray (10Y 3/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-002-A
AMS Sample ID:	28691

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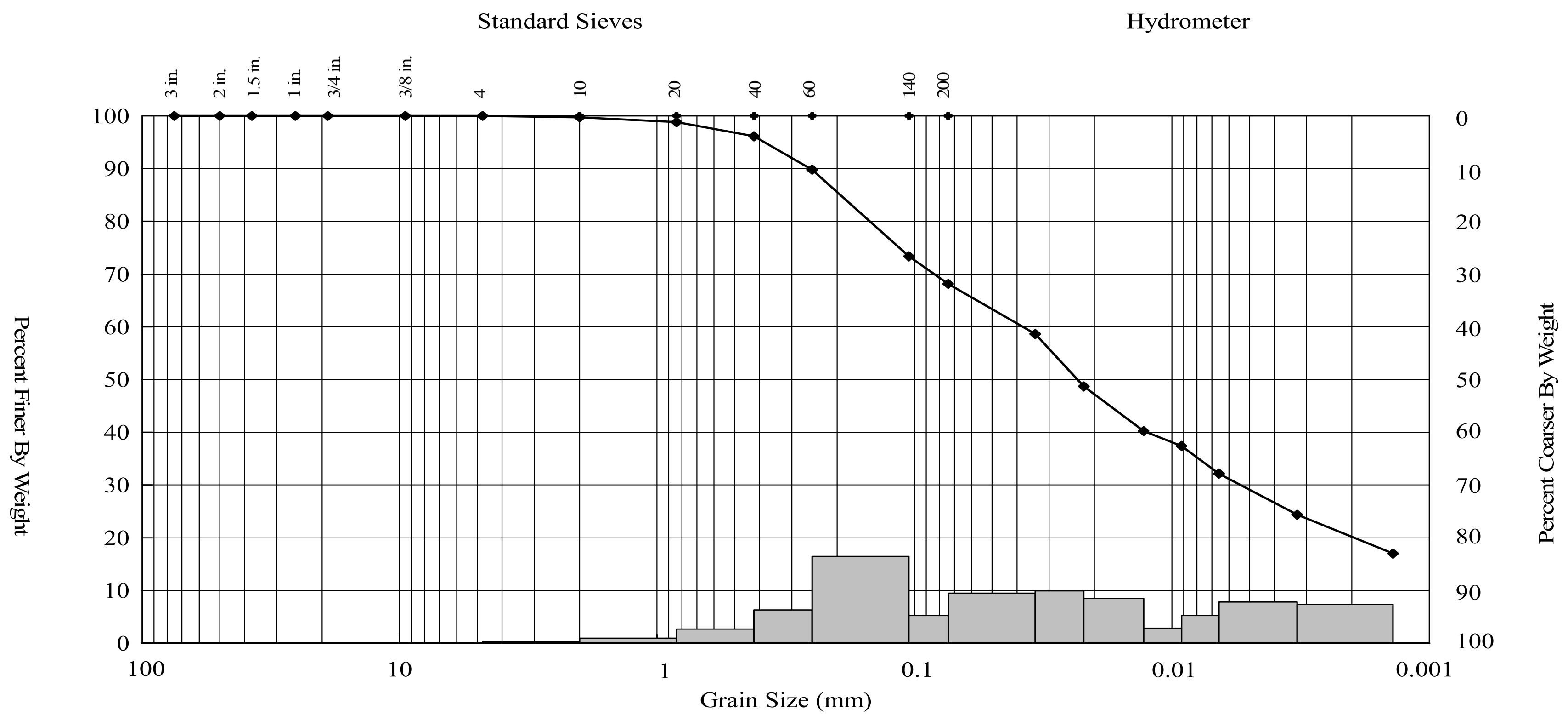

Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.29	3.58	28.02	39.66	28.45

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
80	55								

Material Description

Sandy Elastic Silt ("MH"), very dark greenish gray (10Y 3/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-003-A
AMS Sample ID:	28692

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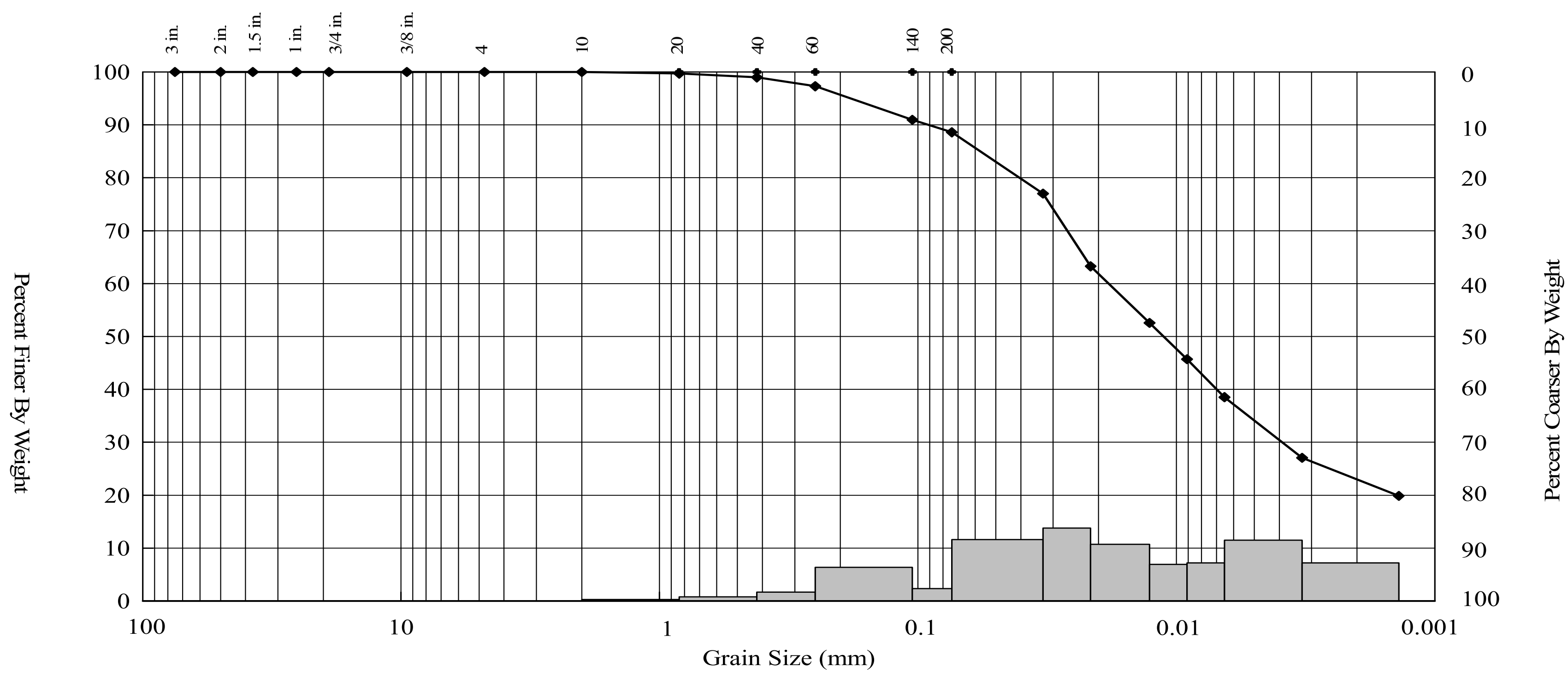
GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.00	1.05	10.35	55.44	33.16

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
101	50								

Material Description

Elastic Silt ("MH"), greenish black (10Y 2.5/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-004-A
AMS Sample ID:	28693

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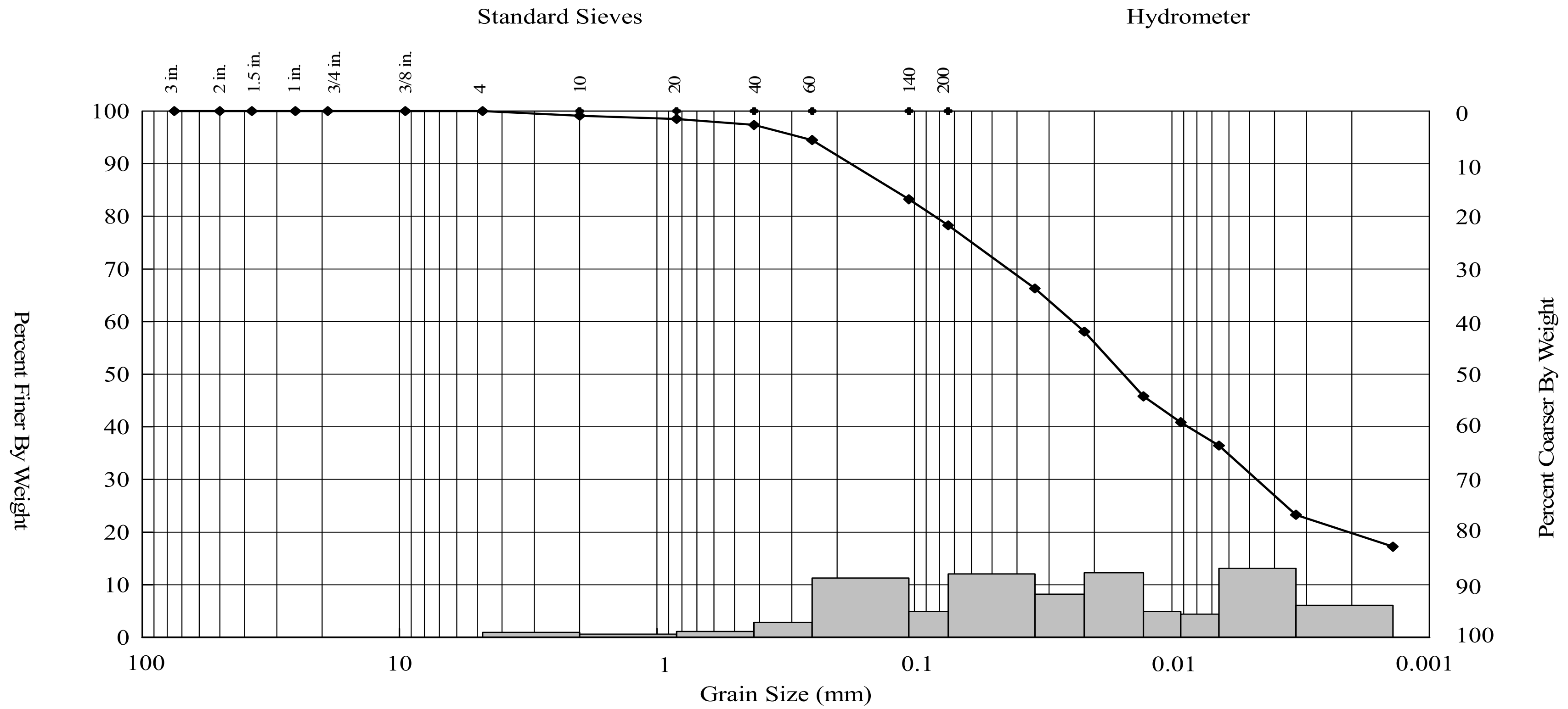

Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.91	1.74	19.05	48.17	30.13

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
84	54								

Material Description

Elastic Silt with Sand ("MH"), greenish black (10Y 2.5/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-005-A
AMS Sample ID:	28694

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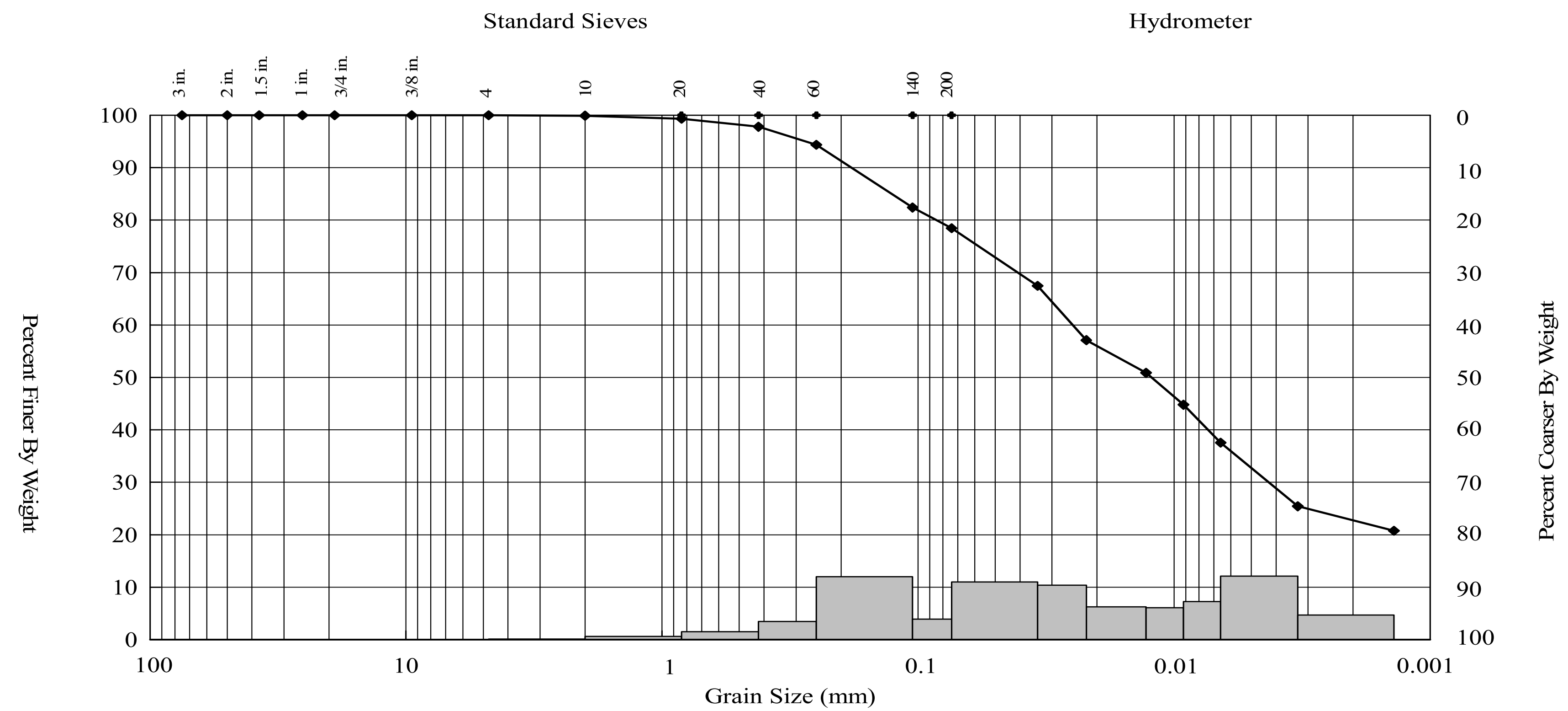

Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.12	2.08	19.34	46.73	31.73

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
88	53								

Material Description

Elastic Silt with Sand ("MH"), very dark greenish gray (10Y 3/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-006-A
AMS Sample ID:	28695

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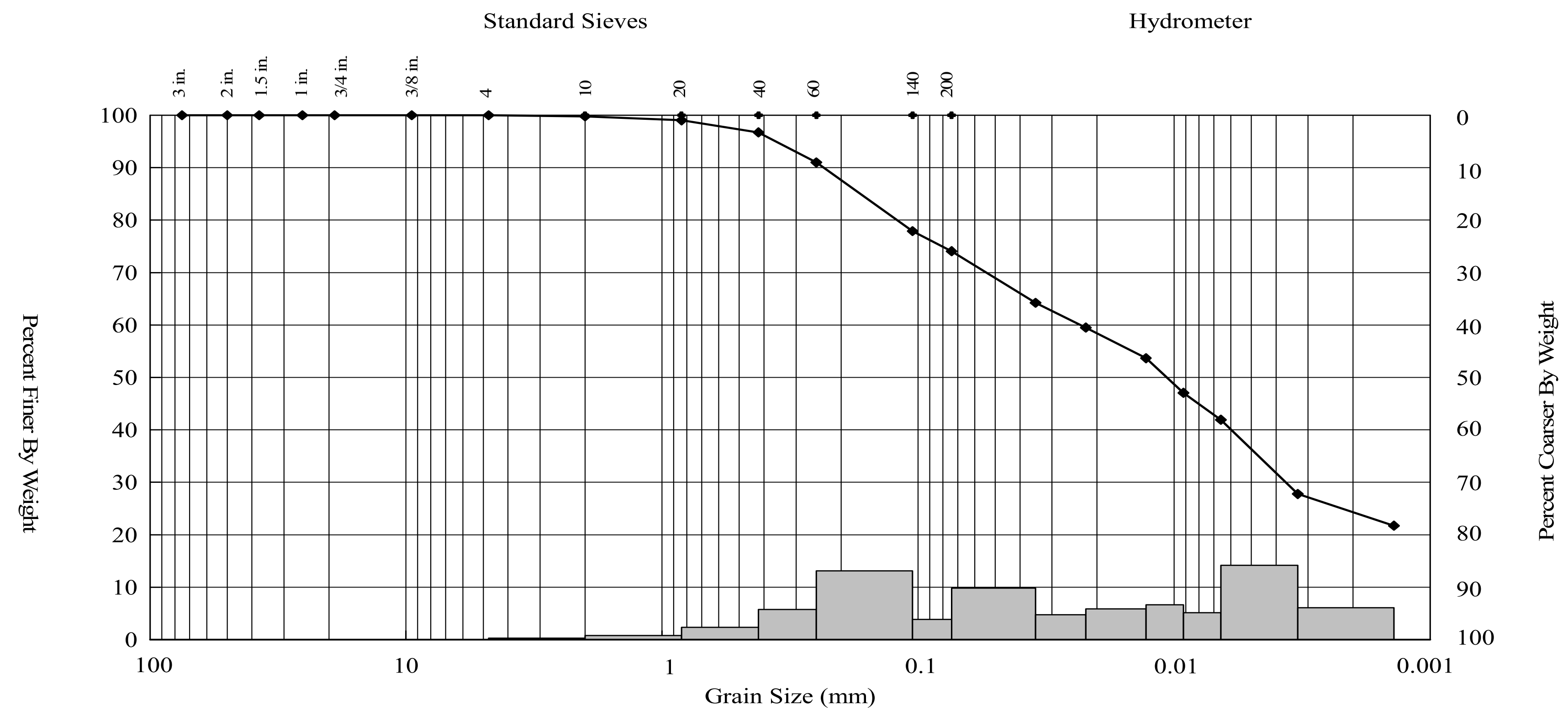

Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.24	3.06	22.65	38.90	35.15

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
88	53								

Material Description

Elastic Silt with Sand ("MH"), very dark greenish gray (10Y 3/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-007-A
AMS Sample ID:	28696

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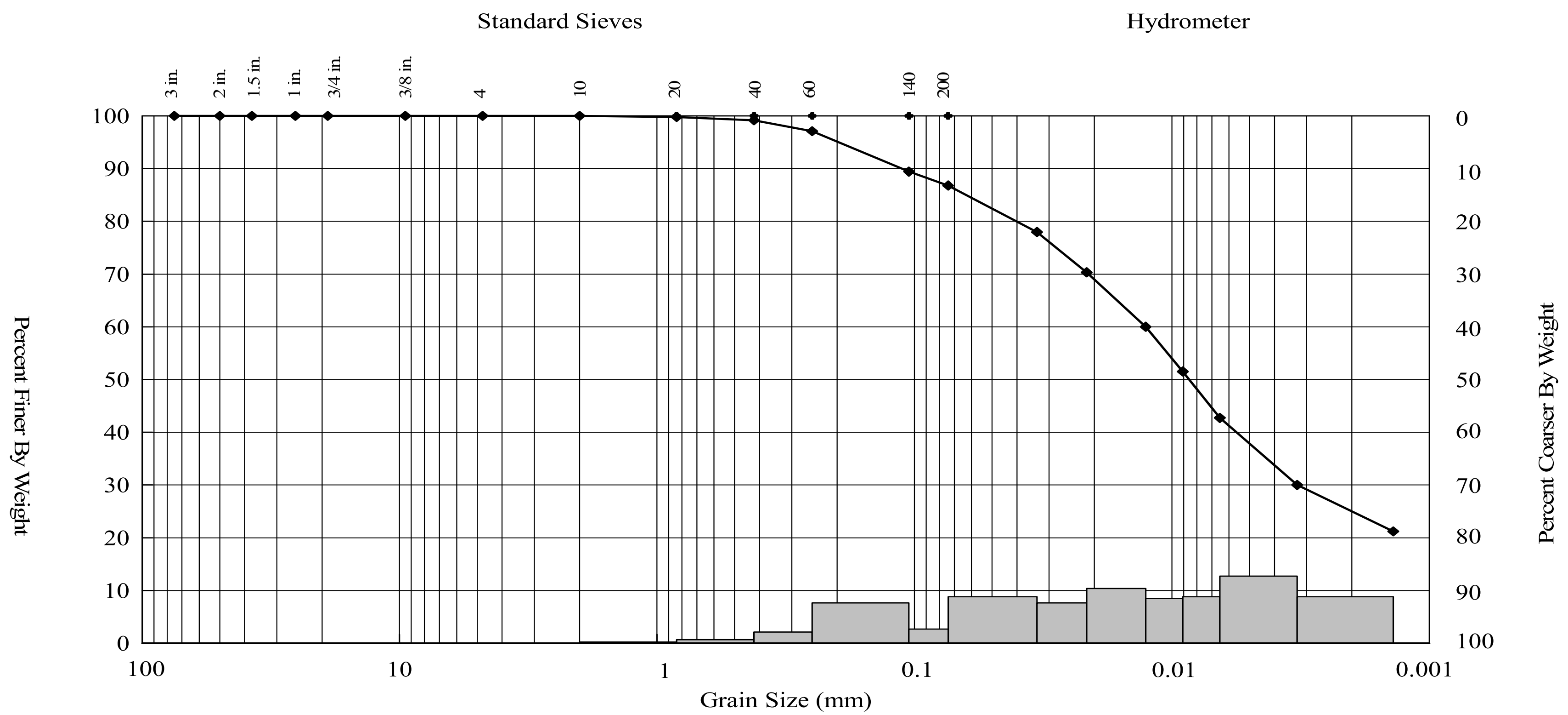

Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.00	0.86	12.37	50.00	36.77

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
96	51								

Material Description

Elastic Silt ("MH"), greenish black (10Y 2.5/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-008-A
AMS Sample ID:	28697

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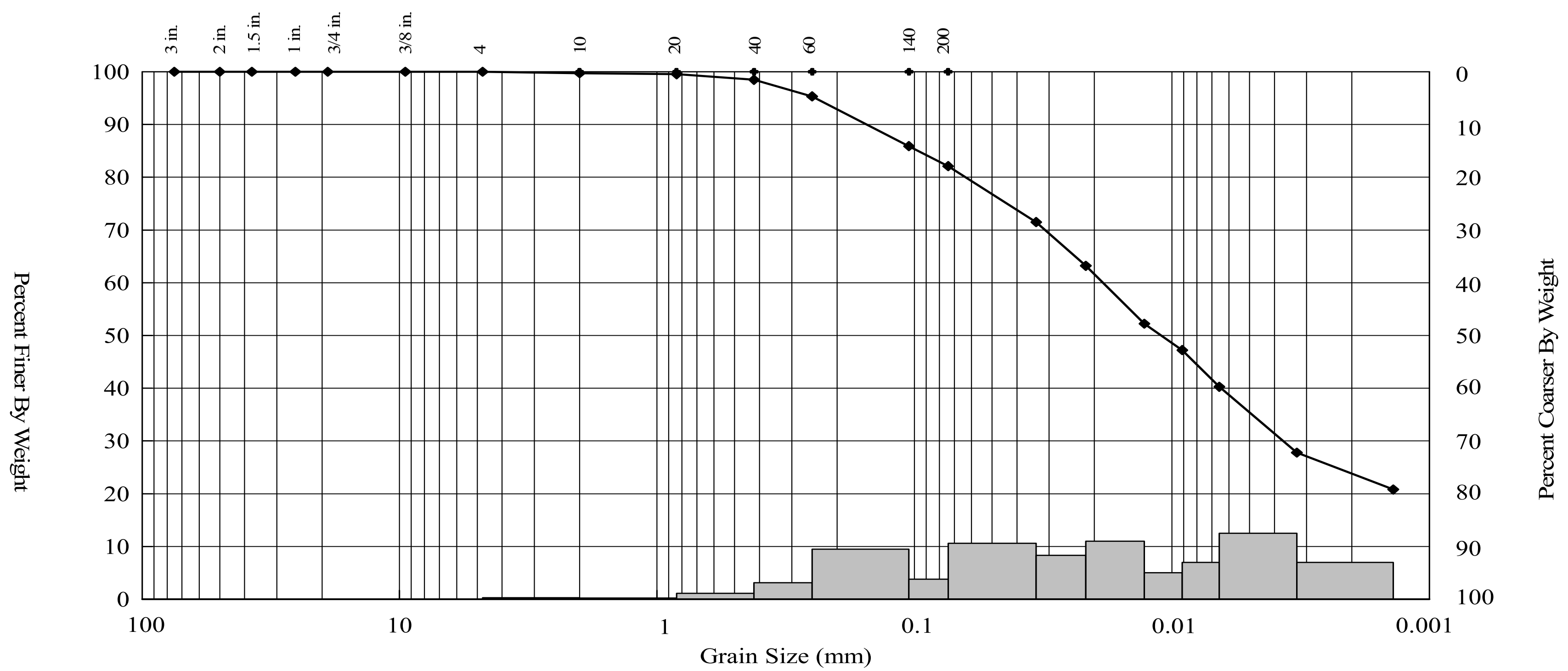

Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.27	1.29	16.36	47.72	34.36

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
87	53								

Material Description

Elastic Silt with Sand ("MH"), very dark greenish gray (10Y 3/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-009-A
AMS Sample ID:	28698

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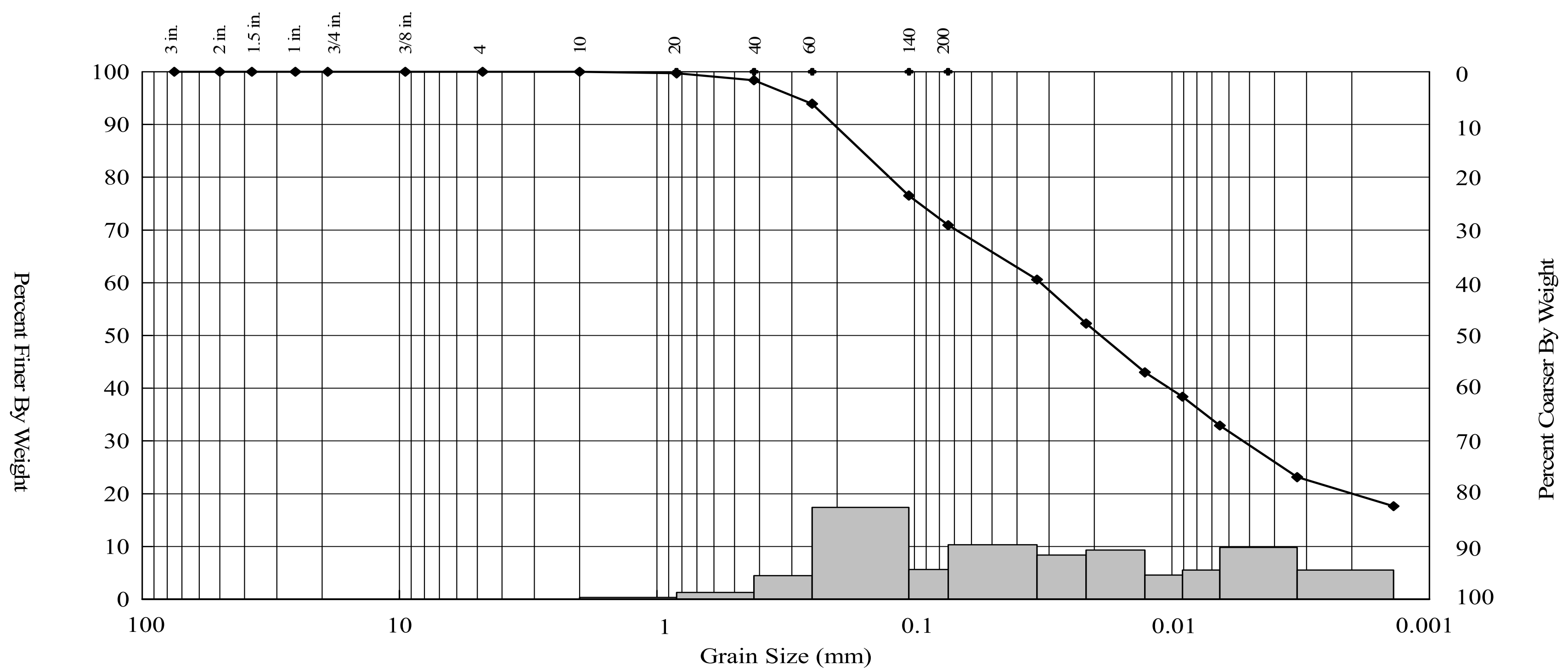

Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.00	1.63	27.48	42.55	28.34

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
71	59								

Material Description

Elastic Silt with Sand ("MH"), very dark greenish gray (10Y 3/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/6/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-010-A
AMS Sample ID:	28699

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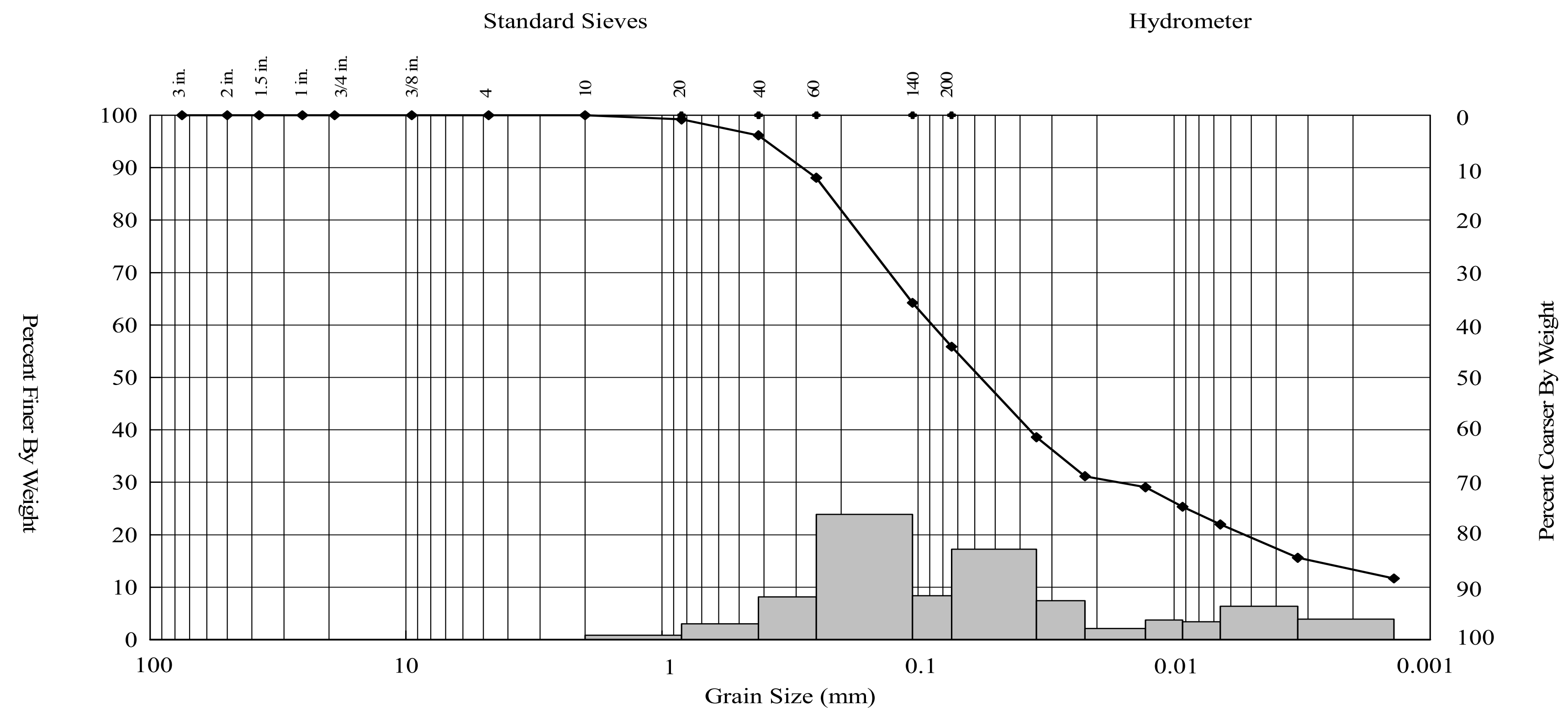

Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.00	3.84	40.32	36.98	18.86

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
56	64								

Material Description

Sandy Elastic Silt ("MH"), greenish black (10Y 2.5/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/6/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-011-A
AMS Sample ID:	28700

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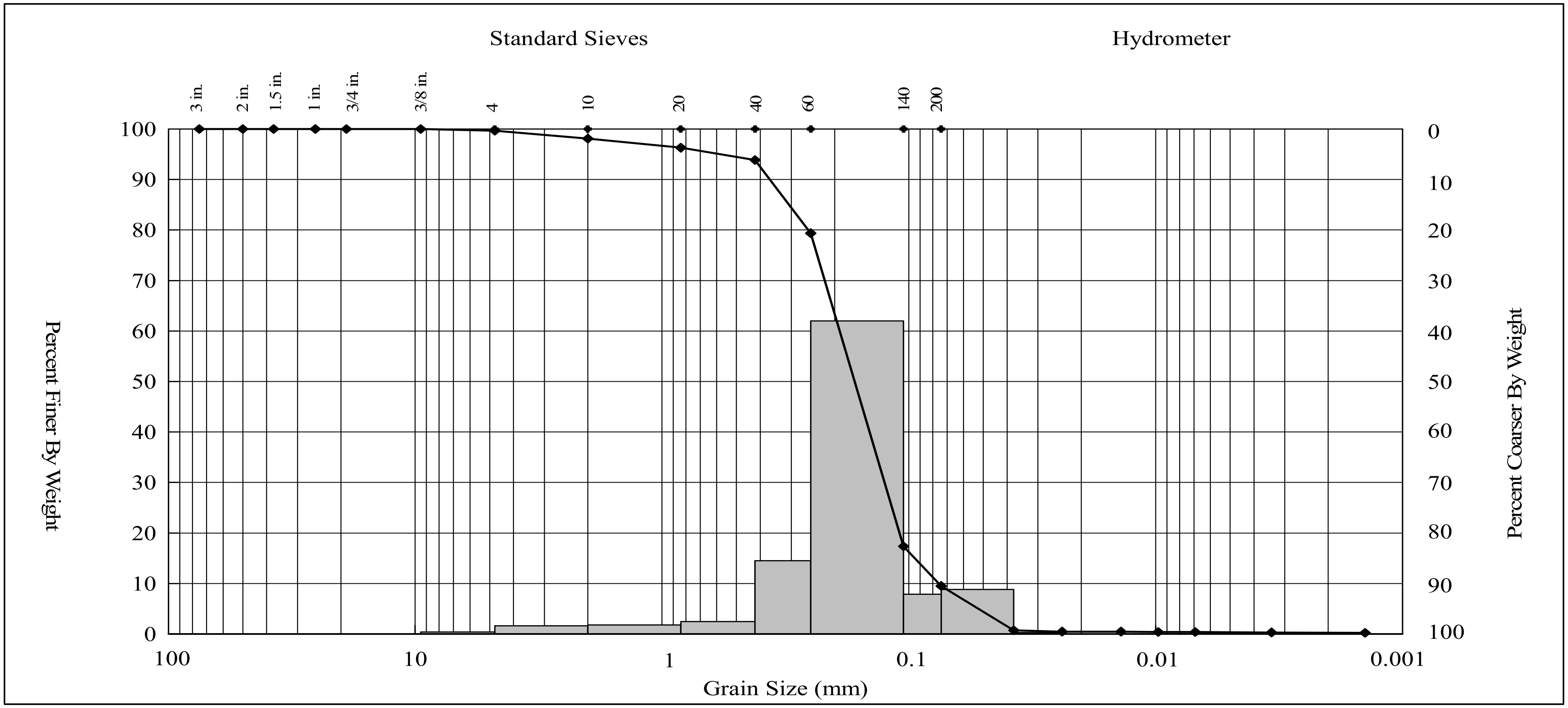
GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.36	1.57	4.23	84.34	9.17	0.33

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
20	84	0.31	0.19	0.17	0.13	0.09	0.08	1.20	2.51

Material Description

Poorly Graded Sand with Silt ("SP-SM"), pale olive (5Y 6/4)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-014-A
AMS Sample ID:	28701

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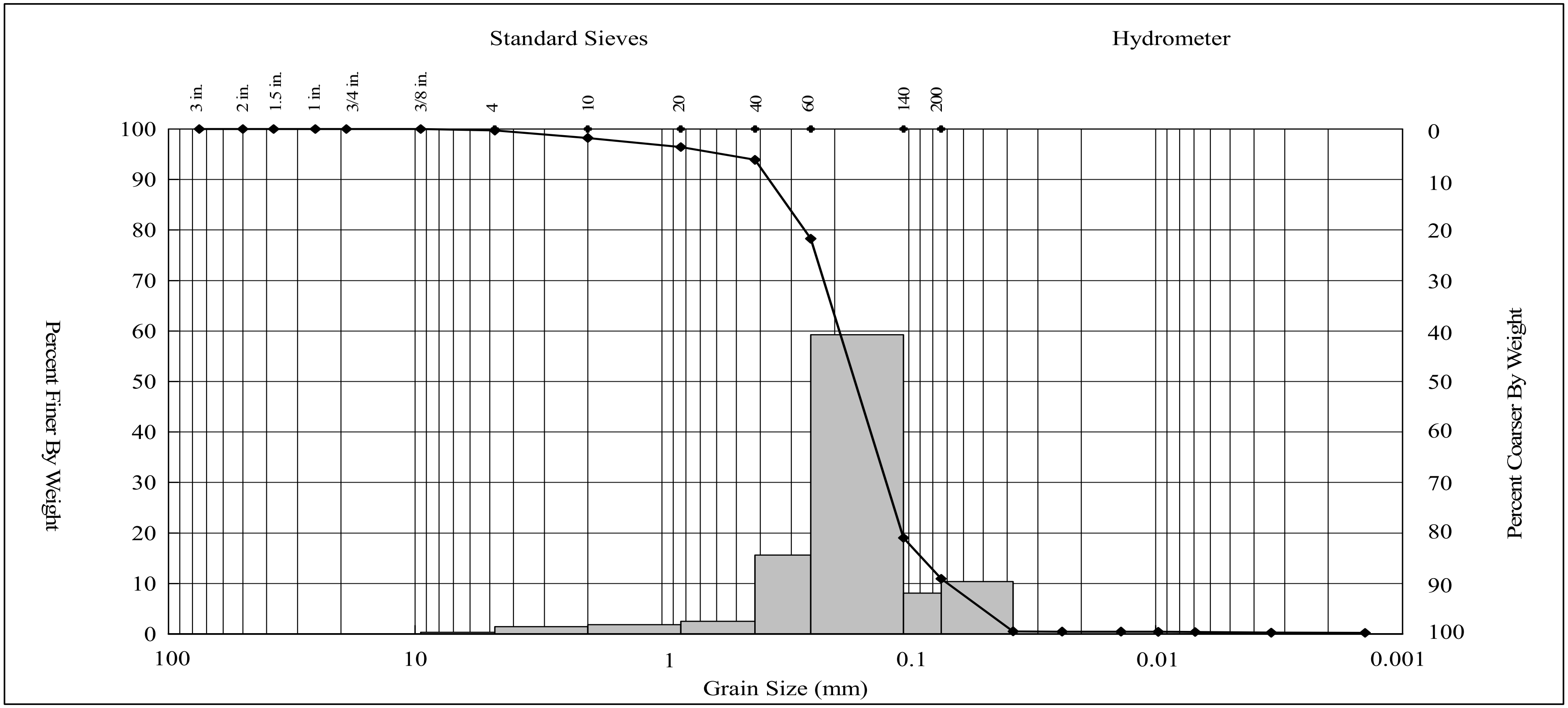

Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.33	1.46	4.34	82.96	10.60	0.31

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
20	84	0.03	0.19	0.17	0.13	0.09	0.07	1.29	2.75

Material Description

Poorly Graded Sand with Silt ("SP-SM"), pale olive (5Y 6/4)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-014-A
AMS Sample ID:	28701-2

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League City, TX 77573
281.554.7272 Tel.
281.554.6356 Fax

These analyses were performed in accordance with ASTM standards, the 2006 DoD Quality Systems Manual (Version 3), and the 2003 NELAC Standard.

K.S. Davis, P.G.

AMS, Inc. Technical Director

Laboratory No. E87956

QUALITY CONTROL RESULTS

Client:	Battelle	AMS Project Number:	07-102
Project Title:	Brushneck Cove	Date Sampled:	9/5/2007
Project Number:	G606430	Date Analyzed:	9/14/2007
Client Sample ID:	GAG-014-A	Matrix:	Sediment
AMS Sample ID:	28701	Method:	ASTM D 422
		Batch:	091407-01

Particle Diameter Range (mm)	U.S. Standard Sieve Mesh #	Size Class	Sample Result (%)	Duplicate Result (%)	RPD (%)	Data Qualifier	QC Limits (% RPD)
4.76	No. 4	Gravel	0.36	0.33	8.70		≤ 25
2.00	No. 10	Coarse Sand	1.57	1.46	7.26		≤ 25
0.425	No. 40	Medium Sand	4.23	4.34	2.57		≤ 25
0.074	No. 200	Fine Sand	84.34	82.96	1.65		≤ 25
<0.074 - 0.005	Hydrometer	Silt	9.17	10.60	14.47		≤ 25
<0.005	Hydrometer	Clay	0.33	0.31	6.25		≤ 25

Samples in Batch: 28690 28692 28694 28696 28698 28700
28691 28693 28695 28697 28699 28701

Qualifiers:
Q - RPD value outside Quality Control Limits
I - Insufficient sample material to perform Quality Control Analyses

Soil Classification: Unified Soil Classification System (USCS) classifications are estimated in accordance with ASTM D 2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) unless the sample contains less than 5% fines (GW, GP, SW, and SP), or the Liquid Limit, Plastic Limit, and Plasticity Index (Atterberg Limits) have been determined in accordance with ASTM D 4318. When these values have been determined the samples are definitively classified using ASTM D 2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

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Total Organic Carbon (TOC) Results

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ANALYTICAL RESULTS

Client:	Battelle	AMS Project Number:	07-102
Project Number:	G606430	Date Sampled:	9/5/2007
Project Name:	Brushneck Cove	Date Received:	9/11/2007
Client Sample ID:	GAG-001-A		
AMS Sample ID:	28702		

Parameter	Result	Unit	Data Qualifier	LOD	LOQ	Method	Matrix	Date Analyzed
Total Organic Carbon	0.38	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007
Total Organic Carbon	0.38	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007

Quality Assurance: These analyses were performed in accordance with EPA guidelines, the 2006 DoD Quality Systems Manual for Environmental Laboratories (Version 3), and the 2003 NELAC Standard, with the following exceptions:

* TOC sample not analyzed in quadruplicate
* TOC spike duplicate not analyzed every 10 samples

KS Davis, P.G.

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ANALYTICAL RESULTS

Client:	Battelle	AMS Project Number:	07-102
Project Number:	G606430	Date Sampled:	9/5/2007
Project Name:	Brushneck Cove	Date Received:	9/11/2007
Client Sample ID:	GAG-002-A		
AMS Sample ID:	28703		

Parameter	Result	Unit	Data Qualifier	LOD	LOQ	Method	Matrix	Date Analyzed
Total Organic Carbon	1.52	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007
Total Organic Carbon	1.81	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007

Quality Assurance: These analyses were performed in accordance with EPA guidelines, the 2006 DoD Quality Systems Manual for Environmental Laboratories (Version 3), and the 2003 NELAC Standard, with the following exceptions:

* TOC sample not analyzed in quadruplicate
* TOC spike duplicate not analyzed every 10 samples

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ANALYTICAL RESULTS

Client:	Battelle	AMS Project Number:	07-102
Project Number:	G606430	Date Sampled:	9/5/2007
Project Name:	Brushneck Cove	Date Received:	9/11/2007
Client Sample ID:	GAG-003-A		
AMS Sample ID:	28704		

Parameter	Result	Unit	Data Qualifier	LOD	LOQ	Method	Matrix	Date Analyzed
Total Organic Carbon	1.69	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007
Total Organic Carbon	1.80	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007

Quality Assurance: These analyses were performed in accordance with EPA guidelines, the 2006 DoD Quality Systems Manual for Environmental Laboratories (Version 3), and the 2003 NELAC Standard, with the following exceptions:

* TOC sample not analyzed in quadruplicate
* TOC spike duplicate not analyzed every 10 samples

KS Davis, P.G.

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ANALYTICAL RESULTS

Client:	Battelle	AMS Project Number:	07-102
Project Number:	G606430	Date Sampled:	9/5/2007
Project Name:	Brushneck Cove	Date Received:	9/11/2007
Client Sample ID:	GAG-004-A		
AMS Sample ID:	28705		

Parameter	Result	Unit	Data Qualifier	LOD	LOQ	Method	Matrix	Date Analyzed
Total Organic Carbon	2.81	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007
Total Organic Carbon	2.62	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007

Quality Assurance: These analyses were performed in accordance with EPA guidelines, the 2006 DoD Quality Systems Manual for Environmental Laboratories (Version 3), and the 2003 NELAC Standard, with the following exceptions:

* TOC sample not analyzed in quadruplicate
* TOC spike duplicate not analyzed every 10 samples

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ANALYTICAL RESULTS

Client:	Battelle	AMS Project Number:	07-102
Project Number:	G606430	Date Sampled:	9/5/2007
Project Name:	Brushneck Cove	Date Received:	9/11/2007
Client Sample ID:	GAG-005-A		
AMS Sample ID:	28706		

Parameter	Result	Unit	Data Qualifier	LOD	LOQ	Method	Matrix	Date Analyzed
Total Organic Carbon	2.77	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007
Total Organic Carbon	2.74	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007

Quality Assurance: These analyses were performed in accordance with EPA guidelines, the 2006 DoD Quality Systems Manual for Environmental Laboratories (Version 3), and the 2003 NELAC Standard, with the following exceptions:

* TOC sample not analyzed in quadruplicate
* TOC spike duplicate not analyzed every 10 samples

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ANALYTICAL RESULTS

Client:	Battelle	AMS Project Number:	07-102
Project Number:	G606430	Date Sampled:	9/5/2007
Project Name:	Brushneck Cove	Date Received:	9/11/2007
Client Sample ID:	GAG-006-A		
AMS Sample ID:	28707		

Parameter	Result	Unit	Data Qualifier	LOD	LOQ	Method	Matrix	Date Analyzed
Total Organic Carbon	2.30	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007
Total Organic Carbon	2.33	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007

Quality Assurance: These analyses were performed in accordance with EPA guidelines, the 2006 DoD Quality Systems Manual for Environmental Laboratories (Version 3), and the 2003 NELAC Standard, with the following exceptions:

* TOC sample not analyzed in quadruplicate
* TOC spike duplicate not analyzed every 10 samples

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ANALYTICAL RESULTS

Client:	Battelle	AMS Project Number:	07-102
Project Number:	G606430	Date Sampled:	9/5/2007
Project Name:	Brushneck Cove	Date Received:	9/11/2007
Client Sample ID:	GAG-007-A		
AMS Sample ID:	28708		

Parameter	Result	Unit	Data Qualifier	LOD	LOQ	Method	Matrix	Date Analyzed
Total Organic Carbon	1.99	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007
Total Organic Carbon	2.33	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007

Quality Assurance: These analyses were performed in accordance with EPA guidelines, the 2006 DoD Quality Systems Manual for Environmental Laboratories (Version 3), and the 2003 NELAC Standard, with the following exceptions:

* TOC sample not analyzed in quadruplicate
* TOC spike duplicate not analyzed every 10 samples

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ANALYTICAL RESULTS

Client:	Battelle	AMS Project Number:	07-102
Project Number:	G606430	Date Sampled:	9/5/2007
Project Name:	Brushneck Cove	Date Received:	9/11/2007
Client Sample ID:	GAG-008-A		
AMS Sample ID:	28709		

Parameter	Result	Unit	Data Qualifier	LOD	LOQ	Method	Matrix	Date Analyzed
Total Organic Carbon	2.20	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007
Total Organic Carbon	2.40	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007

Quality Assurance: These analyses were performed in accordance with EPA guidelines, the 2006 DoD Quality Systems Manual for Environmental Laboratories (Version 3), and the 2003 NELAC Standard, with the following exceptions:

* TOC sample not analyzed in quadruplicate
* TOC spike duplicate not analyzed every 10 samples

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ANALYTICAL RESULTS

Client:	Battelle	AMS Project Number:	07-102
Project Number:	G606430	Date Sampled:	9/5/2007
Project Name:	Brushneck Cove	Date Received:	9/11/2007
Client Sample ID:	GAG-009-A		
AMS Sample ID:	28710		

Parameter	Result	Unit	Data Qualifier	LOD	LOQ	Method	Matrix	Date Analyzed
Total Organic Carbon	2.02	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007
Total Organic Carbon	1.96	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007

Quality Assurance: These analyses were performed in accordance with EPA guidelines, the 2006 DoD Quality Systems Manual for Environmental Laboratories (Version 3), and the 2003 NELAC Standard, with the following exceptions:

* TOC sample not analyzed in quadruplicate
* TOC spike duplicate not analyzed every 10 samples

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ANALYTICAL RESULTS

Client:	Battelle	AMS Project Number:	07-102
Project Number:	G606430	Date Sampled:	9/6/2007
Project Name:	Brushneck Cove	Date Received:	9/11/2007
Client Sample ID:	GAG-010-A		
AMS Sample ID:	28711		

Parameter	Result	Unit	Data Qualifier	LOD	LOQ	Method	Matrix	Date Analyzed
Total Organic Carbon	1.53	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007
Total Organic Carbon	1.53	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007

Quality Assurance: These analyses were performed in accordance with EPA guidelines, the 2006 DoD Quality Systems Manual for Environmental Laboratories (Version 3), and the 2003 NELAC Standard, with the following exceptions:

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* TOC spike duplicate not analyzed every 10 samples

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ANALYTICAL RESULTS

Client:	Battelle	AMS Project Number:	07-102
Project Number:	G606430	Date Sampled:	9/6/2007
Project Name:	Brushneck Cove	Date Received:	9/11/2007
Client Sample ID:	GAG-011-A		
AMS Sample ID:	28712		

Parameter	Result	Unit	Data Qualifier	LOD	LOQ	Method	Matrix	Date Analyzed
Total Organic Carbon	1.05	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007
Total Organic Carbon	1.13	%		0.01	0.03	EPA 9060A	Sediment	9/25/2007

Quality Assurance: These analyses were performed in accordance with EPA guidelines, the 2006 DoD Quality Systems Manual for Environmental Laboratories (Version 3), and the 2003 NELAC Standard, with the following exceptions:

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ANALYTICAL RESULTS

Client:	Battelle	AMS Project Number:	07-102
Project Number:	G606430	Date Sampled:	9/5/2007
Project Name:	Brushneck Cove	Date Received:	9/11/2007
Client Sample ID:	GAG-014-A		
AMS Sample ID:	28713		

Parameter	Result	Unit	Data Qualifier	LOD	LOQ	Method	Matrix	Date Analyzed
Total Organic Carbon	0.03	%	J	0.01	0.03	EPA 9060A	Sediment	9/25/2007
Total Organic Carbon	0.03	%	J	0.01	0.03	EPA 9060A	Sediment	9/25/2007

Quality Assurance: These analyses were performed in accordance with EPA guidelines, the 2006 DoD Quality Systems Manual for Environmental Laboratories (Version 3), and the 2003 NELAC Standard, with the following exceptions:

* TOC sample not analyzed in quadruplicate
* TOC spike duplicate not analyzed every 10 samples

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QUALITY CONTROL RESULTS

Client:	Battelle	AMS Project Number:	07-102
Project Number:	G606430	Date Analyzed:	9/25/2007
Project Name:	Brushneck Cove	Batch ID:	092507-01
Matrix:	Sediment		
Method:	EPA 9060A		

Method Blank (Batch Continuing Blank (CB)), Continuing Calibration Verification (CCV) and Independent Continuing Calibration Verification (ICCV) Results:

AMS Sample ID	Result (%)	CCV Conc. (%)	Relative % Difference (%)	Data Qualifier	LOD (%)	LOQ (%)	QC Limits (%)
CB-01	0.01	0.01	--	**U**	0.01	0.03	≤ 0.03
CCV-01	3.16	3.23	2.19		0.01	0.03	≤ 5 RPD
ICCV-01	2.10	2.00	4.88		0.01	0.03	≤ 5 RPD

Sample Duplicate Results:

AMS Sample ID	Result (%)	Duplicate Result (%)	Relative % Difference (%)	Data Qualifier	LOD (%)	LOQ (%)	QC Limits
28713	0.03	0.03	0.00	**J**	0.01	0.03	≤ 25 RPD

Samples in Batch (AMS ID):

28702	28705	28708	28711
28703	28706	28709	28712
28704	28707	28710	28713

Quality Assurance: These analyses were performed in accordance with EPA guidelines, the 2006 DoD Quality Systems Manual for Environmental Laboratories (Version 3), and the 2003 NELAC Standard, with the following exceptions:

* TOC samples not analyzed in quadruplicate
* TOC spike duplicate not analyzed every 10 samples

Project-specific Quality Assurance requirements supersede those provided by the above quality systems and documents. Measurements of uncertainty are available upon request.

KS Davis, P.G.
AMS, Inc. Technical Director

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QUALITY CONTROL

Client:	Battelle	AMS Project Number: 07-102
Project Number:	G606430	
Project Name:	Brushneck Cove	

Data Qualifiers:

U	Undetected at the Limit of Detection (LOD): The associated value is the Limit of Detection, adjusted by any dilution factor used in the analysis.
J	The analyte was positively identified, but was below the Limit of Quantitation (LOQ). The quantitation is an estimate.
B	Blank contamination: The analyte was detected above one-half the LOD in an associated blank.
Q	One or more Quality Control criteria failed. Data usability should be carefully assessed by the Project Team.
I	Insufficient sample was provided to perform required Quality Control analyses and/or to meet method-specific sample volume recommendations.

Definitions:

LOD	The Limit of Detection (LOD) is determined by quantitative establishment of the Method Detection Limit (MDL), as defined in 40 CFR 136(b).
LOQ	The Limit of Quantitation (LOQ) is the minimum level, concentration or quantity of a target variable (target analyte) that can be quantitatively reported with a specified level of confidence. As defined in DoD QSM §D.1.2.2, the LOQ value must be a minimum of 3 times the LOD, although the specified level of confidence may have a lower quantitative value.

Quality Assurance: These analyses were performed in accordance with EPA guidelines, the 2006 DoD Quality Systems Manual for Environmental Laboratories (Version 3), and the 2003 NELAC Standard, with the following exceptions:

* TOC samples not analyzed in quadruplicate
* TOC spike duplicate not analyzed every 10 samples

Project-specific Quality Assurance requirements supersede those provided by the above quality systems and documents. Measurements of uncertainty are available upon request.

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Attachment B

Sediment Chemistry Results

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PCB/Pesticides Results

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Table II-3: Quality Control Summary for Analyses of Pesticides and PCB in Sediment.

Method Reference Number: 8081B

Quality Control (QC) Element	Acceptance Criteria*	Criteria Met? Yes/No	List results outside criteria (Cross-reference results table in data report)	Location of Results (Retained at Lab or in Data Package)
Initial Calibration	Must be performed prior to the analysis of any QC sample or field sample $r^2 \geq 0.995$	Yes		Retained at lab
Calculation of Method Detection Limits (MDLs)	For each matrix, analyzed once per 12 month period (see Section 5.2 for MDL procedure)	Yes		Retained at lab
Calibration Verification (Second Source)	Once, after initial calibration (< 20% PD)	Yes		Retained at lab
Continuing Calibration	Every 24 hours ($\pm$ 20% D)	Yes		Retained at lab
Standard Reference Materials	+/- 30% PD plus variance	Yes		In Data Package
Method Blank	No target analytes > 5 x MDL	Yes		In Data Package
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One set (MS/MSD) per group of field samples. Must contain all target analytes. (Recovery Limits 50 to 120%; RPD <30%)	Yes		In Data Package
Analytical Replicates	Analyze one sample in duplicate for each group of field samples (RPD < 30%)	Yes		In Data Package
Surrogate Recoveries	Calculate % recovery (30 to 150% recovery)	Yes		In Data Package

* The Quality Control Acceptance Criteria are general guidelines. If alternate criteria are used, they must be documented in this table.

Pesticide/PCB – Sediment QA/QC Summary
Batch 07-0255

PROJECT: USACE/NAE – Brushneck Cove
PARAMETER: Pesticide/PCB
LABORATORY: Battelle, Duxbury, MA
MATRIX: Sediment Composites
SAMPLE CUSTODY: Sediment cores for this project were collected on 9/5/2007 and 9/6/2007. They were composited and the composites were hand delivered to the Chemistry Sample Custodian on 9/10/2007. The samples were received in good condition and no custody issues were noted. Samples were logged into Battelle LIMS and received unique IDs. Composite sediment samples were stored in the walk-in refrigerator until sample preparation could begin.

	Reference Method	Method Blank	Surrogate Recovery	LCS Recovery	MS/MSD Recovery	SRM Percent Difference	Sample Replicate Relative Percent Difference	Detection Limits (ng/g dry wt)
Pesticide /PCB	General NS&T	<5xMDL	30-150% Recovery	50-120% Recovery	50-120% Recovery ≤30% RPD (analyte conc. in MS must be >5x background)	Average PD ≤ 30% (plus variance) (for analytes > 5x MDL)	≤30% RPD (analytes must be > 10 x MDL to be used for data quality assessment)	MDL: 0.06 – 3.67

METHOD: Sediment samples were extracted for PCB and pesticides following general NS&T methods. Approximately 30 g of sediment was spiked with surrogates and extracted three times with dichloromethane using shaker table techniques. The combined extract was dried over anhydrous sodium sulfate, concentrated, processed through activated copper, alumina cleanup column, concentrated, and further purified by GPC/HPLC. The post-HPLC extract was concentrated, fortified with internal standards (IS) and split for the required analyses. Extracts intended for PCB/Pest analysis were solvent exchanged into hexane and then analyzed using gas chromatography/electron capture detector (GC/ECD), following general NS&T methods. Sample data were quantified by the method of internal standards, using the spiked IS compounds. Pesticide/PCB data was originally acquired from batch 07-0243, but because of poor QC results the samples were re-extracted as batch 07-0255 for pesticide/PCB data only.

HOLDING TIMES: Sediment samples were prepared for analysis in one analytical batch and were extracted within 1 – year of sample collection. All extracts were analyzed within 40 days of extraction.

Batch	Extraction Date	Analysis Date
07-0255	10/09/2006	10/13/2007 – 10/15/2007

Pesticide/PCB – Sediment QA/QC Summary
Batch 07-0255

BLANK:

A procedural blank (PB) was prepared with the analytical batch. The PB was analyzed to ensure the sample extraction and analysis methods were free of contamination.

07-0255 – No exceedences noted.

Comments – Trace amounts of several PCB congeners were detected in the blank, but all were less than the laboratory control limit (5 x MDL). Any field sample concentrations that were greater than the reporting limit, but less than 5 times the concentration in the associated blank, were qualified with a "B". This resulted in 14 concentrations being "B" qualified.

LABORATORY CONTROL SAMPLE:

A laboratory control sample (LCS) was prepared with the analytical batch. The percent recoveries of target analytes were calculated to measure data quality in terms of accuracy.

07-0255 – No exceedences noted.

Comments – All percent recoveries of spiked target analytes were within the laboratory control limit (50-120%).

MATRIX SPIKE/MATRIX SPIKE DUPLICATE:

A pair of matrix spike (MS) and matrix spike duplicate (MSD) samples was prepared with each analytical batch. The percent recoveries of target analytes were calculated to measure data quality in terms of accuracy. The RPD between percent recoveries was calculated to measure the data quality in terms of precision.

07-0255 – No percent recovery exceedences noted. No RPD exceedences noted.

Comments – All percent recoveries of spiked target analytes were within the laboratory control limit (50-120%). All RPDs were within the laboratory control limits (< 30%).

REPLICATES:

Duplicate analysis was performed with each analytical batch. RPDs between duplicate analyses were calculated to measure data quality in terms of precision.

07-0255 – No exceedences noted.

Comments – All RPDs were within the laboratory control limits (< 30%).

SRM:

A standard reference material (NIST SRM 1944) was prepared with the analytical batch. The percent difference (PD) between the measured value and the certified range was calculated to measure data quality in terms of accuracy.

07-0255 – No exceedences noted.

Comments – All percent differences were within the laboratory control limits (<30 % difference plus variance).

Pesticide/PCB – Sediment QA/QC Summary
Batch 07-0255

SURROGATES: Two surrogate compounds were added prior to extraction, including PCB 34 and PCB 152. The recovery of each surrogate compound was calculated to measure data quality in terms of accuracy (extraction efficiency).

07-0255 – All surrogate percent recoveries for this batch were within the laboratory control limits (30-150%)

Comments – None.

CALIBRATIONS: The GC/ECD was calibrated with a 6 level curve, with a correlation coefficient of >0.995. Each batch of samples analyzed is bracketed by continuing calibration verification (CCV) sample, run at a frequency of minimally every 24 hours. The PD between the initial calibration (ICAL) and the continuing calibration samples should be <20% for each compound. Additionally an Initial Calibration Check (ICC) sample is run immediately following the ICAL. The ICC is to have a percent difference < 20%.

07-0255 – No ICAL exceedences. No CCV exceedences. No ICC exceedences.

Comments – All calibration criteria were met.

Battelle
The Business of Innovation

Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	GAG-001-C	GAG-002-C	GAG-003-C	GAG-004-C
Battelle ID	Q0237-P1	Q0238-P1	Q0239-P1	Q0240-P1
Sample Type	SA	SA	SA	SA
Collection Date	09/05/07	09/05/07	09/05/07	09/05/07
Extraction Date	10/09/07	10/09/07	10/09/07	10/09/07
Analysis Date	10/13/07	10/14/07	10/14/07	10/14/07
Analytical Instrument	ECD	ECD	ECD	ECD
% Moisture	19.97	42.18	45.77	46.92
% Lipid	NA	NA	NA	NA
Matrix	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
Sample Size	24.31	17.52	16.28	15.95
Size Unit-Basis	G_DRY	G_DRY	G_DRY	G_DRY
Units	UG/KG_DRY	UG/KG_DRY	UG/KG_DRY	UG/KG_DRY
4,4'-DDD	0.09 U	0.23	0.24	0.51
4,4'-DDE	0.1	0.31	0.41	0.49
4,4'-DDT	0.09 U	0.12 U	0.13 U	0.13 U
aldrin	0.09 U	0.12 U	0.13 U	0.13 U
a-chlordane	0.09 U	0.12 U	0.13 U	0.13 U
g-chlordane	0.09 U	0.12 U	0.25	0.39
Lindane	0.09 U	0.12 U	0.13 U	0.13 U
cis-nonachlor	0.09 U	0.12 U	0.13 U	0.13 U
trans-nonachlor	0.09 U	0.12 U	0.13 U	0.13 U
oxychlordane	0.09 U	0.12 U	0.13 U	0.13 U
dieldrin	0.09 U	0.3	0.25	0.48
endosulfan I	0.09 U	0.12 U	0.13 U	0.13 U
endosulfan II	0.09 U	0.12 U	0.13 U	0.13 U
endrin	0.09 U	0.12 U	0.13 U	0.13 U
heptachlor	0.09 U	0.12 U	0.13 U	0.13 U
heptachlor epoxide	0.09 U	0.12 U	0.13 U	0.13 U
Hexachlorobenzene	0.76	0.12 U	0.13 U	0.13 U
methoxychlor	0.09 U	0.99	1.63	1.98
Toxaphene	3.67 U	3.67 U	3.67 U	3.67 U
Cl2(8)	0.09 U	0.12 U	0.13 U	0.13 U
Cl3(18)	0.09 U	0.12 U	0.13 U	0.13 U
Cl3(28)	0.09 U	0.12 U	0.13 U	0.13 U
Cl4(44)	0.09 B	0.37	0.43	0.65
Cl4(49)	0.18 BME	2.19 ME	1.65 ME	6.52 ME
Cl4(52)	0.18 B	0.22 B	0.31 B	0.46 B
Cl4(66)	0.09 U	0.12 U	0.13 U	0.13 U
Cl5(87)	0.09 U	0.32	0.41	0.73
Cl5(101)	0.1	0.33	0.33	0.55
Cl5(105)	0.09 U	0.12 U	0.13 U	0.12 J
Cl5(118)	0.08 J	0.24	0.34	0.39
Cl6(128)	0.09 U	0.12 U	0.11 J	0.13 U
Cl6(138)	0.09	0.24	0.36	0.47
Cl6(153)	0.08 J	0.2	0.3	0.41
Cl7(170)	0.09 U	0.12 U	0.13 U	0.13 U
Cl7(180)	0.09 U	0.12 U	0.13 U	0.13 U
Cl7(183)	0.09 U	0.12 U	0.13 U	0.13 U
Cl7(184)	0.09 U	0.12 U	0.13 U	0.13 U
Cl7(187)	0.09 U	0.17	0.17	0.25
Cl8(195)	0.09 U	0.17	0.14	0.2
Cl9(206)	0.09 U	0.26	0.22	0.29
Cl10(209)	0.09 U	0.26	0.22	0.31

Surrogate Recoveries (%)

Cl3(34)	74	104	104	104
Cl6(152)	72	100	99	97

Battelle
The Business of Innovation

Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	GAG-005-C	GAG-006-C	GAG-007-C	GAG-008-C
Battelle ID	Q0241-P1	Q0242-P1	Q0243-P1	Q0244-P1
Sample Type	SA	SA	SA	SA
Collection Date	09/05/07	09/05/07	09/05/07	09/05/07
Extraction Date	10/09/07	10/09/07	10/09/07	10/09/07
Analysis Date	10/14/07	10/14/07	10/14/07	10/14/07
Analytical Instrument	ECD	ECD	ECD	ECD
% Moisture	42.9	44.39	44.22	53.14
% Lipid	NA	NA	NA	NA
Matrix	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
Sample Size	17.28	16.83	16.98	14.33
Size Unit-Basis	G_DRY	G_DRY	G_DRY	G_DRY
Units	UG/KG_DRY	UG/KG_DRY	UG/KG_DRY	UG/KG_DRY
4,4'-DDD	1.67	1.59	0.82	2.87
4,4'-DDE	1.16	1.24	0.77	1.85
4,4'-DDT	0.12 U	0.12 U	0.12 U	0.23
aldrin	0.12 U	0.12 U	0.12 U	0.15 U
a-chlordane	0.93	0.98	0.43	0.7
g-chlordane	1.65	1.66	0.67	1.28
Lindane	0.12 U	0.12 U	0.12 U	0.15 U
cis-nonachlor	0.51	0.37	0.17	0.64
trans-nonachlor	0.89	0.76	0.29	0.43
oxychlordane	0.12 U	0.12 U	0.12 U	0.15 U
dieldrin	0.34	0.56	0.5	1.38
endosulfan I	0.12 U	0.12 U	0.12 U	0.15 U
endosulfan II	0.12 U	0.12 U	0.12 U	0.15 U
endrin	0.12 U	0.12 U	0.12 U	0.15 U
heptachlor	0.12 U	0.12 U	0.12 U	0.15 U
heptachlor epoxide	0.12 U	0.12 U	0.12 U	0.15 U
Hexachlorobenzene	0.12 U	0.12 U	0.12 U	0.15 U
methoxychlor	0.89	0.81	1.23	4.22
Toxaphene	3.67 U	3.67 U	3.67 U	3.67 U
Cl2(8)	0.12 U	0.12 U	0.12 U	0.15 U
Cl3(18)	0.12 U	0.12 U	0.12 U	0.15 U
Cl3(28)	0.12 U	0.12 U	0.12 U	0.15 U
Cl4(44)	0.68	0.73	0.53	0.78
Cl4(49)	1.6 ME	3.06 ME	3.2 ME	3.24 ME
Cl4(52)	0.42 B	0.45 B	0.3 B	0.74 B
Cl4(66)	0.12 U	0.12 U	0.12 U	0.15 U
Cl5(87)	0.34	0.52	0.47	0.57
Cl5(101)	0.28	0.59	0.52	1.01
Cl5(105)	0.11 J	0.14	0.12	0.29
Cl5(118)	0.42	0.53	0.39	0.97
Cl6(128)	0.12 U	0.12 U	0.12 U	0.39
Cl6(138)	0.55	0.55	0.49	1.14
Cl6(153)	0.44	0.57	0.42	1.28
Cl7(170)	0.12 U	0.12 U	0.12 U	0.36
Cl7(180)	0.12 U	0.3	0.19	0.63
Cl7(183)	0.12 U	0.17	0.12 U	0.29
Cl7(184)	0.12 U	0.12 U	0.12 U	0.15 U
Cl7(187)	0.24	0.33	0.19	0.55
Cl8(195)	0.11 J	0.48	0.1 J	0.4
Cl9(206)	0.22	0.43	0.13	0.61
Cl10(209)	0.15	0.39	0.12	0.56

Surrogate Recoveries (%)

Cl3(34)	85	105	108	106
Cl6(152)	83	94	104	101

Not Surrogate Corrected

Analyzed by Restucci Jr, Richard
10/29/2007

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Battelle
The Business of Innovation

Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	GAG-009-C	GAG-010-C	GAG-011-C
Battelle ID	Q0245-P1	Q0246-P1	Q0247-P1
Sample Type	SA	SA	SA
Collection Date	09/05/07	09/06/07	09/06/07
Extraction Date	10/09/07	10/09/07	10/09/07
Analysis Date	10/14/07	10/15/07	10/15/07
Analytical Instrument	ECD	ECD	ECD
% Moisture	46.86	39.21	35.56
% Lipid	NA	NA	NA
Matrix	SEDIMENT	SEDIMENT	SEDIMENT
Sample Size	16.16	18.33	19.71
Size Unit-Basis	G_DRY	G_DRY	G_DRY
Units	UG/KG_DRY	UG/KG_DRY	UG/KG_DRY
4,4'-DDD	0.31	0.19	0.47
4,4'-DDE	0.27	0.19	0.38
4,4'-DDT	0.13 U	0.11 U	0.11 U
aldrin	0.13 U	0.11 U	0.11 U
a-chlordane	0.13 U	0.3	0.11 U
g-chlordane	0.25	0.15	0.27
Lindane	0.13 U	0.11 U	0.11 U
cis-nonachlor	0.08 J	0.11 U	0.19
trans-nonachlor	0.13 U	0.11 U	0.11 U
oxychlordane	0.13 U	0.11 U	0.11 U
dieldrin	0.22	0.11 U	0.23
endosulfan I	0.13 U	0.11 U	0.11 U
endosulfan II	0.13 U	0.11 U	0.11 U
endrin	0.13 U	0.11 U	0.11 U
heptachlor	0.13 U	0.11 U	0.11 U
heptachlor epoxide	0.13 U	0.11 U	0.11 U
Hexachlorobenzene	0.13 U	0.11 U	0.11 U
methoxychlor	0.97	2.79	1.32
Toxaphene	3.67 U	3.67 U	3.67 U
Cl2(8)	0.13 U	0.11 U	0.11 U
Cl3(18)	0.13 U	0.11 U	0.11 U
Cl3(28)	0.13 U	0.11 U	0.11 U
Cl4(44)	0.48	0.38	0.33
Cl4(49)	1.34 ME	0.86 ME	1.27 ME
Cl4(52)	0.22 B	0.25 B	0.3 B
Cl4(66)	0.13 U	0.11 U	0.11 U
Cl5(87)	0.22	0.11 U	0.21
Cl5(101)	0.28	0.31	0.32
Cl5(105)	0.13 U	0.11 U	0.11 U
Cl5(118)	0.21	0.21	0.27
Cl6(128)	0.13 U	0.11 U	0.11 U
Cl6(138)	0.54	0.25	0.31
Cl6(153)	0.2	0.23	0.31
Cl7(170)	0.13 U	0.11 U	0.11 U
Cl7(180)	0.13 U	0.11 U	0.14
Cl7(183)	0.13 U	0.11 U	0.11 U
Cl7(184)	0.13 U	0.11 U	0.11 U
Cl7(187)	0.15	0.1 J	0.15
Cl8(195)	0.13 U	0.11 U	0.39
Cl9(206)	0.13 U	0.11 U	0.18
Cl10(209)	0.13 U	0.11 U	0.15

Surrogate Recoveries (%)

Cl3(34)	106	108	101
Cl6(152)	102	102	100

Not Surrogate Corrected

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Battelle
The Business of Innovation

Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	Procedural Blank	
Battelle ID	BL021PB-P	
Sample Type	PB	
Collection Date	10/09/07	
Extraction Date	10/09/07	
Analysis Date	10/13/07	
Analytical Instrument	ECD	
% Moisture	41.92	
% Lipid	NA	
Matrix	SEDIMENT	
Sample Size	17.60	
Size Unit-Basis	G_DRY	
Units	UG/KG_DRY	
4,4'-DDD	0.12	U
4,4'-DDE	0.12	U
4,4'-DDT	0.12	U
aldrin	0.12	U
a-chlordane	0.12	U
g-chlordane	0.12	U
Lindane	0.12	U
cis-nonachlor	0.12	U
trans-nonachlor	0.12	U
oxychlordane	0.12	U
dieldrin	0.12	U
endosulfan I	0.12	U
endosulfan II	0.12	U
endrin	0.12	U
heptachlor	0.12	U
heptachlor epoxide	0.12	U
Hexachlorobenzene	0.12	U
methoxychlor	0.12	U
Toxaphene	3.67	U
Cl2(8)	0.12	U
Cl3(18)	0.12	U
Cl3(28)	0.09	J
Cl4(44)	0.06	J
Cl4(49)	0.06	J
Cl4(52)	0.18	
Cl4(66)	0.12	U
Cl5(87)	0.12	U
Cl5(101)	0.12	U
Cl5(105)	0.12	U
Cl5(118)	0.12	U
Cl6(128)	0.12	U
Cl6(138)	0.12	U
Cl6(153)	0.12	U
Cl7(170)	0.12	U
Cl7(180)	0.12	U
Cl7(183)	0.12	U
Cl7(184)	0.12	U
Cl7(187)	0.12	U
Cl8(195)	0.12	U
Cl9(206)	0.12	U
Cl10(209)	0.12	U

Surrogate Recoveries (%)

Cl3(34)	107
Cl6(152)	104

Not Surrogate Corrected

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Battelle
The Business of Innovation

Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	060208-03: Sand, White Quartz, -50+70				
Battelle ID	BL022LCS-P				
Sample Type	LCS				
Collection Date	10/09/07				
Extraction Date	10/09/07				
Analysis Date	10/13/07				
Analytical Instrument	ECD				
% Moisture	NA				
% Lipid	NA				
Matrix	SEDIMENT				
Sample Size	30.20				
Size Unit-Basis	G_DRY				
Units	UG/KG_DRY		Target	% Recovery	Qualifier
4,4'-DDD	5.15		5.30	97	
4,4'-DDE	5.38		5.30	102	
4,4'-DDT	4.94		5.30	93	
aldrin	4.71		5.30	89	
a-chlordane	4.86		5.30	92	
g-chlordane	4.34		5.31	82	
Lindane	3.95		5.30	75	
cis-nonachlor	5.2		5.30	98	
trans-nonachlor	4.83		5.31	91	
oxychlordane	5.1		5.33	96	
dieldrin	5.12		5.30	97	
endosulfan I	4.73		5.30	89	
endosulfan II	5.08		5.30	96	
endrin	4.99		5.30	94	
heptachlor	4.16		5.30	78	
heptachlor epoxide	4.34		5.30	82	
Hexachlorobenzene	5.35		5.31	101	
methoxychlor	5.29		5.30	100	
Toxaphene	3.67	U			
Cl2(8)	5.14		5.31	97	
Cl3(18)	4.6		5.31	87	
Cl3(28)	4.64		5.30	88	
Cl4(44)	5.32		5.31	100	
Cl4(49)	5.15		5.32	97	
Cl4(52)	5.23		5.30	99	
Cl4(66)	5.45		5.30	103	
Cl5(87)	5.29		5.25	101	
Cl5(101)	5.29		5.31	100	
Cl5(105)	5.38		5.30	102	
Cl5(118)	5.5		5.30	104	
Cl6(128)	5.35		5.33	100	
Cl6(138)	5.33		5.31	100	
Cl6(153)	5.47		5.30	103	
Cl7(170)	5.39		5.32	101	
Cl7(180)	5.51		5.32	104	
Cl7(183)	5.44		5.32	102	
Cl7(184)	5.45		5.32	102	
Cl7(187)	5.48		5.31	103	
Cl8(195)	5.36		5.31	101	
Cl9(206)	5		5.31	94	
Cl10(209)	5.05		5.30	95	

Surrogate Recoveries (%)

Cl3(34)	103
Cl6(152)	110

Battelle
The Business of Innovation

Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	070906-01: NIST 1944						
Battelle ID	BL023SRM-P						
Sample Type	SRM						
Collection Date	10/09/07						
Extraction Date	10/09/07						
Analysis Date	10/13/07						
Analytical Instrument	ECD						
% Moisture	NA						
% Lipid	NA						
Matrix	SEDIMENT						
Sample Size	2.03						
Size Unit-Basis	G_DRY		Certified		Passing	Actual	
Units	UG/KG_DRY		Value	+/-	%Difference	%Difference	Qualifier
4,4'-DDD	104.67						
4,4'-DDE	77.89						
4,4'-DDT	156.97		119	11.00	39.24	31.9	
aldrin	1.03	U					
a-chlordane	18.59		16.51	0.83	35.03	12.6	
g-chlordane	102.22						
Lindane	6.08						
cis-nonachlor	8.53						
trans-nonachlor	10.71		8.2	0.51	36.22	30.6	
oxychlordane	1.03	U					
dieldrin	29.64						
endosulfan I	1.03	U					
endosulfan II	1.03	U					
endrin	5.33						
heptachlor	1.03	U					
heptachlor epoxide	1.03	U					
Hexachlorobenzene	7.72		6.03	0.35	35.8	28	
methoxychlor	179.29						
Toxaphene	3.67	U					
Cl2(8)	28.76		22.3	2.30	40.31	29	
Cl3(18)	51.04		51	2.60	35.1	0.1	
Cl3(28)	69.44		80.8	2.70	33.34	14.1	
Cl4(44)	57.78		60.2	2.00	33.32	4	
Cl4(49)	41.81	ME	53	1.70	33.21	21.1	
Cl4(52)	64.29		79.4	2.00	32.52	19	
Cl4(66)	55.19		71.9	4.30	35.98	23.2	
Cl5(87)	21.94		29.9	4.30	44.38	26.6	
Cl5(101)	81.18		73.4	2.50	33.41	10.6	
Cl5(105)	19.4		24.5	1.10	34.49	20.8	
Cl5(118)	44.59		58	4.30	37.41	23.1	
Cl6(128)	9.93	ME	8.47	0.28	33.31	17.2	
Cl6(138)	59.62		62.1	3.00	34.83	4	
Cl6(153)	73.42		74	2.90	33.92	0.8	
Cl7(170)	19.16		22.6	1.40	36.19	15.2	
Cl7(180)	38.67		44.3	1.20	32.71	12.7	
Cl7(183)	15.84		12.19	0.57	34.68	29.9	
Cl7(184)	1.02	U					
Cl7(187)	21.34		25.1	1.00	33.98	15	
Cl8(195)	2.96		3.75	0.39	40.4	21.1	
Cl9(206)	8.05		9.21	0.51	35.54	12.6	
Cl10(209)	5.4	ME	6.81	0.33	34.85	20.7	

Surrogate Recoveries (%)

Cl3(34)	89
Cl6(152)	95

Battelle
The Business of Innovation

Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	GAG-008-C		GAG-008-C				
Battelle ID	Q0244-P1		Q0244MS-P				
Sample Type	SA		MS				
Collection Date	09/05/07		9/5/2007				
Extraction Date	10/09/07		10/9/2007				
Analysis Date	10/14/07		10/14/2007				
Analytical Instrument	ECD		ECD				
% Moisture	53.14		53.14				
% Lipid	NA		NA				
Matrix	SEDIMENT		SEDIMENT				
Sample Size	14.33		7.09				
Size Unit-Basis	G_DRY		G_DRY				
Units	UG/KG_DRY		UG/KG_DRY		Target	% Recovery	Qualifier
4,4'-DDD	2.87		29.67		22.58	119	
4,4'-DDE	1.85		26.54		22.58	109	
4,4'-DDT	0.23		26.36		22.58	116	
aldrin	0.15	U	23.49		22.58	104	
a-chlordane	0.7		24.97		22.58	107	
g-chlordane	1.28		25.67		22.60	108	
Lindane	0.15	U	22.4		22.58	99	
cis-nonachlor	0.64		26.35		22.58	114	
trans-nonachlor	0.43		25.47		22.60	111	
oxychlordane	0.15	U	26.16		22.68	115	
dieldrin	1.38		27.28		22.58	115	
endosulfan I	0.15	U	22.87		22.58	101	
endosulfan II	0.15	U	25.93		22.58	115	
endrin	0.15	U	26.36		22.58	117	
heptachlor	0.15	U	24.25		22.58	107	
heptachlor epoxide	0.15	U	24.09		22.59	107	
Hexachlorobenzene	0.15	U	24.31		22.60	108	
methoxychlor	4.22		30.91		22.57	118	
Toxaphene	3.67	U	3.67	U			
Cl2(8)	0.15	U	24.23		22.63	107	
Cl3(18)	0.15	U	21.56		22.63	95	
Cl3(28)	0.15	U	20.94		22.59	93	
Cl4(44)	0.78		23.63		22.61	101	
Cl4(49)	3.24	ME	28.69	ME	22.66	112	
Cl4(52)	0.74	B	23.19		22.57	99	
Cl4(66)	0.15	U	23.55		22.59	102	
Cl5(87)	0.57		23.93		22.37	104	
Cl5(101)	1.01		23.54		22.61	100	
Cl5(105)	0.29		24.69		22.59	108	
Cl5(118)	0.97		25.27		22.59	108	
Cl6(128)	0.39		24.19		22.70	105	
Cl6(138)	1.14		24.51		22.61	103	
Cl6(153)	1.28		24.66		22.59	103	
Cl7(170)	0.36		24.9		22.68	108	
Cl7(180)	0.63		25.03		22.66	108	
Cl7(183)	0.29		24.63		22.66	107	
Cl7(184)	0.15	U	24.46		22.66	108	
Cl7(187)	0.55		24.2		22.63	105	
Cl8(195)	0.4		24.72		22.63	107	
Cl9(206)	0.61		23.5		22.63	101	
Cl10(209)	0.56		23.15		22.59	100	

Surrogate Recoveries (%)

Cl3(34)	106	108
Cl6(152)	101	110

Not Surrogate Corrected

Analyzed by Restucci Jr, Richard
10/29/2007

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Battelle
The Business of Innovation

Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	GAG-008-C						
Battelle ID	Q0244MSD-P						
Sample Type	MSD						
Collection Date	9/5/2007						
Extraction Date	10/9/2007						
Analysis Date	10/14/2007						
Analytical Instrument	ECD						
% Moisture	53.14						
% Lipid	NA						
Matrix	SEDIMENT						
Sample Size	7.39						
Size Unit-Basis	G_DRY						
Units	UG/KG_DRY		Target	% Recovery	Qualifier	RPD (%)	Qualifier
4,4'-DDD	25.85		21.66	106		11.6	
4,4'-DDE	23.32		21.67	99		9.6	
4,4'-DDT	22.19		21.66	101		13.8	
aldrin	21.9		21.66	101		2.9	
a-chlordane	23.15		21.67	104		2.8	
g-chlordane	23.72		21.69	103		4.7	
Lindane	19.63		21.66	91		8.4	
cis-nonachlor	22.89		21.67	103		10.1	
trans-nonachlor	24.04		21.68	109		1.8	
oxychlordane	24.22		21.76	111		3.5	
dieldrin	23.32		21.66	101		13.0	
endosulfan I	22.75		21.67	105		3.9	
endosulfan II	22.31		21.67	103		11.0	
endrin	22.43		21.66	104		11.8	
heptachlor	21.52		21.66	99		7.8	
heptachlor epoxide	22.24		21.67	103		3.8	
Hexachlorobenzene	22.95		21.68	106		1.9	
methoxychlor	26.99		21.66	105		11.7	
Toxaphene	3.67	U					
Cl2(8)	21.68		21.72	100		6.8	
Cl3(18)	20.95		21.72	96		1.0	
Cl3(28)	19.88		21.67	92		1.1	
Cl4(44)	23.05		21.69	103		2.0	
Cl4(49)	25.44	ME	21.74	102		9.3	
Cl4(52)	22.53		21.65	101		2.0	
Cl4(66)	22.61		21.67	102		0.0	
Cl5(87)	21.25		21.47	96		8.0	
Cl5(101)	22.65		21.69	100		0.0	
Cl5(105)	21.88		21.67	100		7.7	
Cl5(118)	22.41		21.67	99		8.7	
Cl6(128)	21.31		21.78	96		9.0	
Cl6(138)	22.01		21.69	96		7.0	
Cl6(153)	21.88		21.67	95		8.1	
Cl7(170)	22.15		21.76	100		7.7	
Cl7(180)	22.24		21.74	99		8.7	
Cl7(183)	21.76		21.74	99		7.8	
Cl7(184)	21.55		21.74	99		8.7	
Cl7(187)	21.38		21.72	96		9.0	
Cl8(195)	21.75		21.72	98		8.8	
Cl9(206)	20.67		21.72	92		9.3	
Cl10(209)	20.62		21.67	93		7.3	

Surrogate Recoveries (%)

Cl3(34)	107
Cl6(152)	102

Not Surrogate Corrected

Analyzed by Restucci Jr, Richard
10/29/2007

MS: S07-0255ECD-Master_128-Final.xls

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Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	GAG-010-C	GAG-010-C		
Battelle ID	Q0246-P1	Q0246DUP-P1		
Sample Type	SA	QADU		
Collection Date	09/06/07	9/6/2007		
Extraction Date	10/09/07	10/9/2007		
Analysis Date	10/15/07	10/15/2007		
Analytical Instrument	ECD	ECD		
% Moisture	39.21	39.21		
% Lipid	NA	NA		
Matrix	SEDIMENT	SEDIMENT		
Sample Size	18.33	18.41		
Size Unit-Basis	G_DRY	G_DRY		
Units	UG/KG_DRY	UG/KG_DRY	RPD	Qualifier
4,4'-DDD	0.19	0.21	10.0	
4,4'-DDE	0.19	0.2	5.1	
4,4'-DDT	0.11 U	0.11 U	NA	
aldrin	0.11 U	0.11 U	NA	
a-chlordane	0.3	0.28	6.9	
g-chlordane	0.15	0.13	14.3	
Lindane	0.11 U	0.11 U	NA	
cis-nonachlor	0.11 U	0.11 U	NA	
trans-nonachlor	0.11 U	0.11 U	NA	
oxychlordane	0.11 U	0.11 U	NA	
dieldrin	0.11 U	0.2	16.2	
endosulfan I	0.11 U	0.11 U	NA	
endosulfan II	0.11 U	0.11 U	NA	
endrin	0.11 U	0.11 U	NA	
heptachlor	0.11 U	0.11 U	NA	
heptachlor epoxide	0.11 U	0.11 U	NA	
Hexachlorobenzene	0.11 U	0.11 U	NA	
methoxychlor	2.79	2.16	25.5	
Toxaphene	3.67 U	3.67 U	NA	
Cl2(8)	0.11 U	0.11 U	NA	
Cl3(18)	0.11 U	0.11 U	NA	
Cl3(28)	0.11 U	0.11 U	NA	
Cl4(44)	0.38	0.43	12.3	
Cl4(49)	0.86 ME	1.13 ME	27.1	
Cl4(52)	0.25 B	0.22 B	12.8	
Cl4(66)	0.11 U	0.11 U	NA	
Cl5(87)	0.11 U	0.11 U	NA	
Cl5(101)	0.31	0.26	17.5	
Cl5(105)	0.11 U	0.11 U	NA	
Cl5(118)	0.21	0.18	15.4	
Cl6(128)	0.11 U	0.11 U	NA	
Cl6(138)	0.25	0.26	3.9	
Cl6(153)	0.23	0.18	24.4	
Cl7(170)	0.11 U	0.11 U	NA	
Cl7(180)	0.11 U	0.11 U	NA	
Cl7(183)	0.11 U	0.11 U	NA	
Cl7(184)	0.11 U	0.11 U	NA	
Cl7(187)	0.1 J	0.1 J	NA	
Cl8(195)	0.11 U	0.11 U	NA	
Cl9(206)	0.11 U	0.11 U	NA	
Cl10(209)	0.11 U	0.11 U	NA	

Surrogate Recoveries (%)

Cl3(34)	108	104
Cl6(152)	102	98

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Glossary of Data Qualifiers

Flag:	Application:
B	Analyte concentration found in the sample at a concentration <5x the level found in the procedural blank.
D	Dilution Run. Initial run outside linear range of instrument.
E	Estimate, result is greater than the highest concentration level in the calibration.
H	Surrogate diluted out. Used when surrogate recovery is affected by excessive dilution of the sample extract.
J	Analyte detected below the sample-specific Reporting Limit (RL).
m	Confirmation column manually over-ridden by analyst
ME	Significant Matrix Interference - Estimated value.
MI	Significant Matrix Interference - value could not be determined or estimated.
n	Quality Control (QC) value is outside the accuracy or precision Data Quality Objective (DQO), but meets the contingency criteria.
N	Quality Control (QC) value is outside the accuracy or precision Data Quality Objective (DQO)
NA	Not applicable
p	Dual column value exceeds RPD criteria
T	Holding Time (HT) exceeded.
U	Analyte not detected at 3:1 signal:noise ratio.

PAH Results

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Table II-2: Quality Control Summary for Analyses of Polyaromatic Hydrocarbons (PAHs) in Sediment.

Method Reference Number: 8270C

Quality Control (QC) Element	Acceptance Criteria*	Criteria Met? Yes/No	List results outside criteria (Cross-reference results table in data report)	Location of Results (Retained at Lab or in Data Package)
Initial Calibration	Must be performed prior to the analysis of any QC sample or field sample (<25 % RSD for each compound, 15% on average)	Yes		Retained at lab
Calculation of Method Detection Limits (MDLs)	For each matrix, analyzed once per 12 month period (see Section 5.2 for MDL procedure)	Yes		Retained at lab
Calibration Verification (Second Source)	Once, after initial calibration (<25%D)	Yes		In Data Package
Continuing Calibration	At the beginning of every 12 hour shift (<25%D)	Yes		In Data Package
Standard Reference Materials	+/- 30% plus variance	No	Benzo(a)anthracene, chrysene, benzo(a)pyrene, and benzo(g,h,i)perylene were all under-recovered in the SRM.	In Data Package
Method Blank	No target analytes > 5 x MDL	Yes		In Data Package
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One set (MS/MSD) per group of field samples. Must contain all target analytes. (Recovery Limits 50 to 120%; RPD <30%)	Yes		In Data Package
Analytical Replicates	Analyze one sample in duplicate for each group of field samples (RPD < 30%)	Yes		In Data Package
Surrogate Recoveries	Calculate % recovery (30 to 150% recovery)	Yes		In Data Package
Internal Standard Areas	Within 50 to 100% of internal standards in continuing calibration check	Yes		In Data Package

* The Quality Control Acceptance Criteria are general guidelines. If alternate criteria are used, they must be documented in this table.

PAH – SEDIMENT QA/QC SUMMARY
Batch 07-0243

PROJECT: USACE/NAE – Brushneck Cove
PARAMETER: PAH
LABORATORY: Battelle, Duxbury, MA
MATRIX: Sediment Composites
SAMPLE CUSTODY: Sediment cores for this project were collected on 9/5/2007. They were composited and the composites were hand delivered to the Chemistry Sample Custodian on 9/10/2007. The samples were received in good condition and no custody issues were noted. Samples were logged into Battelle LIMS and received unique IDs. Composite sediment samples were stored in the walk-in refrigerator until sample preparation could begin.

	Reference Method	Method Blank	Surrogate Recovery	LCS Recovery	MS Recovery	SRM Percent Difference	Sample Replicate Relative Percent Difference	Detection Limits (ng/g dry wt)
PAH	General NS&T	<5xMDL	30-150% Recovery	50-120% Recovery	50-120% Recovery (analyte conc. in MS must be >5x background)	Average PD ≤ 30% (plus variance) (for analytes > 5 x MDL)	≤30% RPD (analytes must be > 10x MDL to be used for data quality assessment)	MDL: 0.18 – 0.57

METHOD: Sediment samples were extracted for PAH following general NS&T methods. Approximately 30 g of sediment was spiked with surrogates and extracted three times with dichloromethane using shaker table techniques. The combined extract was dried over anhydrous sodium sulfate, concentrated, processed through alumina cleanup column, concentrated, and further purified by GPC/HPLC. The post-HPLC extract was concentrated, fortified with internal standards (IS) and split for the required analyses. Extracts intended for PAH analysis were analyzed using gas chromatography/mass spectrometry (GC/MS) operating in the selected ion monitoring (SIM) mode, following general NS&T methods. Sample data were quantified by the method of internal standards, using the spiked IS compounds.

HOLDING TIMES: Sediment samples were prepared for analysis in one analytical batch and were extracted within 14-days of sample collection. All extracts were analyzed within 40 days of extraction.

Batch	Extraction Date	Analysis Date
07-0243	9/19/2007	10/3/2007 – 10/4/2007

PAH – SEDIMENT QA/QC SUMMARY
Batch 07-0243

BLANK:

A procedural blank (PB) was prepared with each analytical batch. Blanks were analyzed to ensure the sample extraction and analysis methods were free of contamination.

07-0243 – No exceedences noted.

Comments– No target analytes were detected in the procedural blank at a concentration greater than the laboratory control limit (5 x MDL). However, naphthalene was detected in the procedural blank at a concentration greater than the RL. Any field sample concentrations that are greater than the reporting limit, but less than 5 times the concentration in the associated blank have been qualified with a "B". This resulted in 11 samples being "B" qualified. No further corrective action was taken.

LABORATORY CONTROL SAMPLE:

A laboratory control sample (LCS) was prepared with each analytical batch. The percent recoveries of target analytes were calculated to measure data quality in terms of accuracy.

07-0243 – No exceedences noted.

Comments – All target analytes were recovered within the specified laboratory control limits (50-120%).

MATRIX SPIKE/MATRIX SPIKE DUPLICATE:

A pair of matrix spike (MS) and matrix spike duplicate samples (MSD) was prepared with each analytical batch. The percent recoveries of target analytes were calculated to measure data quality in terms of accuracy. The RPD between percent recoveries was calculated to measure the data quality in terms of precision.

07-0243 – No exceedences noted.

Comments – All target analytes were recovered within the specified laboratory control limits (50-120%). All RPDs were within the specified laboratory control range (< 30%).

REPLICATES:

A laboratory replicate (duplicate) sample was prepared with each analytical batch. The RPD between duplicate analyses for each target analyte is calculated to measure data quality in terms of precision.

07-0243 – No exceedences noted.

Comments – All RPDs between the laboratory duplicate samples were within the specified laboratory control limits (≤ 30%), except for phenanthrene. The RPD calculated between the lab duplicate (GAG-010-C) for this compound is 36.1%, however this compound was not detected at a concentration great enough to be used for data quality assessment. The RPD was qualified with an "n" to indicate contingency criteria have been met. No corrective action was required.

PAH – SEDIMENT QA/QC SUMMARY
Batch 07-0243

SRM: A standard reference material (NIST SRM 1944) was prepared with the analytical batch. The percent difference (PD) between the measured value and the certified range was calculated to measure data quality in terms of accuracy.

07-0243 – 4 exceedences noted.

Comments – Percent difference for all certified target analytes were within the control limits ($\leq$ 30% plus variance), except for benzo(a)anthracene, chrysene, benzo(a)pyrene and benzo(g,h,i)perylene, which were all recovered below criteria. Accuracy for these compounds was demonstrated in the LCS, MS, and MSD samples. Chromatography and calculations were reviewed and no discrepancies were found. Exceedences were qualified with an "N". No corrective action was taken.

SURROGATES: Four surrogate compounds were added prior to extraction, including naphthalene-d8, acenaphthen-d10, phenanthrene-d10, and benzo(a)pyrene-d12. The recovery of each surrogate compound was calculated to measure data quality in terms of accuracy (extraction efficiency).

07-0243 – No exceedences noted.

Comments – All surrogate percent recoveries were within the laboratory control limits (30-150%)

CALIBRATIONS: The GC/MS is calibrated with a minimum of a 5 level curve. The RSD between response factors for the individual target analytes must be <30%, with a mean < 15%. Each batch of samples analyzed is bracketed by a calibration check sample, run at a frequency of minimally every 12 hours. This PD between the initial calibration RF and CCV should be <25% for individual analytes. Additionally an initial calibration check sample (ICC) sample is run immediately after each initial calibration. The percent difference between the ICC and the initial calibration should be < 25%.

07-0243 – All calibration criteria have been met.

Comments – None.

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Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	GAG-001-C	GAG-002-C	GAG-003-C	GAG-004-C
Battelle ID	Q0237-P	Q0238-P	Q0239-P	Q0240-P
Sample Type	SA	SA	SA	SA
Collection Date	09/05/07	09/05/07	09/05/07	09/05/07
Extraction Date	09/19/07	09/19/07	09/19/07	09/19/07
Analysis Date	10/03/07	10/03/07	10/03/07	10/03/07
Analytical Instrument	MS	MS	MS	MS
% Moisture	19.97	42.18	45.77	46.92
% Lipid	NA	NA	NA	NA
Matrix	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
Sample Size	24.81	17.55	16.38	16.45
Size Unit-Basis	G_DRY	G_DRY	G_DRY	G_DRY
Units	UG/KG_DRY	UG/KG_DRY	UG/KG_DRY	UG/KG_DRY
Naphthalene	0.97 B	1.81 B	1.86 B	2.55 B
Acenaphthylene	1.05	1.46	1.31	2.03
Acenaphthene	0.41 U	0.34 J	0.37 J	0.66
Fluorene	0.48	0.93	1.12	1.52
Anthracene	1.86	2.63	2.65	3.35
Phenanthrene	9.05	8.13	8.08	9.38
Fluoranthene	21.21	23.17	20.67	30.76
Pyrene	18.91	23.2	18.58	29.57
Benzo(a)anthracene	6.77	8.59	6.76	10
Chrysene	8.07	10.05	9	13.03
Benzo(b)fluoranthene	7.19	9.71	9.31	14.17
Benzo(k)fluoranthene	7.28	9.69	9.05	13.96
Benzo(a)pyrene	7.41	9.81	8.42	12.87
Indeno(1,2,3-cd)pyrene	5.35	7.58	7.26	11.17
Dibenz(a,h)anthracene	1.03	1.39	1.41	2.2
Benzo(g,h,i)perylene	4.84	6.62	6.54	10.24

Surrogate Recoveries (%)

Naphthalene-d8	59	79	74	69
Acenaphthene-d10	58	76	73	67
Phenanthrene-d10	73	90	88	83
Benzo(a)pyrene-d12	71	91	87	86

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Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	GAG-005-C	GAG-006-C	GAG-007-C	GAG-008-C
Battelle ID	Q0241-P	Q0242-P	Q0243-P	Q0244-P
Sample Type	SA	SA	SA	SA
Collection Date	09/05/07	09/05/07	09/05/07	09/05/07
Extraction Date	09/19/07	09/19/07	09/19/07	09/19/07
Analysis Date	10/04/07	10/03/07	10/04/07	10/04/07
Analytical Instrument	MS	MS	MS	MS
% Moisture	42.9	46.83	44.22	53.14
% Lipid	NA	NA	NA	NA
Matrix	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
Sample Size	17.47	15.50	17.38	14.48
Size Unit-Basis	G_DRY	G_DRY	G_DRY	G_DRY
Units	UG/KG_DRY	UG/KG_DRY	UG/KG_DRY	UG/KG_DRY
Naphthalene	3.07 B	2.78 B	1.97 B	4.64
Acenaphthylene	7.9	4.05	2.17	8.87
Acenaphthene	1	1.21	0.64	1.69
Fluorene	1.87	2.01	1.2	3.25
Anthracene	7.97	5.93	3.11	11.6
Phenanthrene	20.59	19.78	9.41	29.4
Fluoranthene	115.35	78.48	37.13	123.03
Pyrene	107.46	89.41	38.14	134.97
Benzo(a)anthracene	45.78	30.84	13.18	44.67
Chrysene	56.33	41.1	18.89	56.51
Benzo(b)fluoranthene	59.93	50.18	23.3	69.82
Benzo(k)fluoranthene	60.44	49.61	21.33	69.12
Benzo(a)pyrene	58.7	43.31	18.6	61.91
Indeno(1,2,3-cd)pyrene	44.3	38.82	17.14	53.8
Dibenz(a,h)anthracene	8.7	7.31	3.24	10.72
Benzo(g,h,i)perylene	38.69	33.53	15.69	47.82

Surrogate Recoveries (%)

Naphthalene-d8	66	66	62	61
Acenaphthene-d10	71	68	65	65
Phenanthrene-d10	91	85	81	85
Benzo(a)pyrene-d12	93	91	82	90

Not Surrogate Corrected

Analyzed by Lizotte Jr, Robert
10/29/2007

Main: S07-0243MS-Master_157-Final.xls

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Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	GAG-009-C	GAG-010-C	GAG-011-C
Battelle ID	Q0245-P	Q0246-P	Q0247-P
Sample Type	SA	SA	SA
Collection Date	09/05/07	09/06/07	09/06/07
Extraction Date	09/19/07	09/19/07	09/19/07
Analysis Date	10/04/07	10/04/07	10/04/07
Analytical Instrument	MS	MS	MS
% Moisture	46.86	39.39	35.56
% Lipid	NA	NA	NA
Matrix	SEDIMENT	SEDIMENT	SEDIMENT
Sample Size	16.28	18.52	19.44
Size Unit-Basis	G_DRY	G_DRY	G_DRY
Units	UG/KG_DRY	UG/KG_DRY	UG/KG_DRY
Naphthalene	1.66 B	1.14 B	1.49 B
Acenaphthylene	0.92	0.6	1.57
Acenaphthene	0.4 J	0.25 J	0.29 J
Fluorene	0.75	0.51 J	0.78
Anthracene	1.76	1.04	2.27
Phenanthrene	5.72	2.45	7.26
Fluoranthene	21.73	9.35	23.63
Pyrene	20.27	8.36	24.14
Benzo(a)anthracene	7.15	2.72	9.15
Chrysene	11.17	4.26	11.99
Benzo(b)fluoranthene	12.37	4.74	10.85
Benzo(k)fluoranthene	11.62	4.36	12.11
Benzo(a)pyrene	10.31	3.58	10.43
Indeno(1,2,3-cd)pyrene	9.66	3.26	7.77
Dibenz(a,h)anthracene	1.69	0.62	1.46
Benzo(g,h,i)perylene	8.87	3.32	7.3

Surrogate Recoveries (%)

Naphthalene-d8	65	68	65
Acenaphthene-d10	68	65	65
Phenanthrene-d10	84	81	83
Benzo(a)pyrene-d12	86	79	83

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Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	Procedural Blank	
Battelle ID	BK952PB-P	
Sample Type	PB	
Collection Date	09/19/07	
Extraction Date	09/19/07	
Analysis Date	10/03/07	
Analytical Instrument	MS	
% Moisture	42.16	
% Lipid	NA	
Matrix	SEDIMENT	
Sample Size	17.65	
Size Unit-Basis	G_DRY	
Units	UG/KG_DRY	
Naphthalene	0.75	
Acenaphthylene	0.57	U
Acenaphthene	0.57	U
Fluorene	0.57	U
Anthracene	0.57	U
Phenanthrene	0.57	U
Fluoranthene	0.57	U
Pyrene	0.57	U
Benzo(a)anthracene	0.57	U
Chrysene	0.57	U
Benzo(b)fluoranthene	0.57	U
Benzo(k)fluoranthene	1.14	U
Benzo(a)pyrene	0.57	U
Indeno(1,2,3-cd)pyrene	0.57	U
Dibenz(a,h)anthracene	0.57	U
Benzo(g,h,i)perylene	0.57	U

Surrogate Recoveries (%)

Naphthalene-d8	77
Acenaphthene-d10	74
Phenanthrene-d10	87
Benzo(a)pyrene-d12	90

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Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	060208-03: Sand, White Quartz, -50+70			
Battelle ID	BK953LCS-P			
Sample Type	LCS			
Collection Date	09/19/07			
Extraction Date	09/19/07			
Analysis Date	10/03/07			
Analytical Instrument	MS			
% Moisture	NA			
% Lipid	NA			
Matrix	SEDIMENT			
Sample Size	28.86			
Size Unit-Basis	G_DRY			
Units	UG/KG_DRY	Target	% Recovery	Qualifier
Naphthalene	46.04	69.31	66	
Acenaphthylene	45.92	69.36	66	
Acenaphthene	48.23	69.35	70	
Fluorene	47.68	69.34	69	
Anthracene	52.26	69.31	75	
Phenanthrene	51.69	69.33	75	
Fluoranthene	58.18	69.33	84	
Pyrene	61.45	69.32	89	
Benzo(a)anthracene	51.57	69.32	74	
Chrysene	49.68	69.33	72	
Benzo(b)fluoranthene	49.94	69.36	72	
Benzo(k)fluoranthene	53.34	69.34	77	
Benzo(a)pyrene	50.36	69.36	73	
Indeno(1,2,3-cd)pyrene	47.92	69.33	69	
Dibenz(a,h)anthracene	49.31	69.34	71	
Benzo(g,h,i)perylene	44.74	69.32	65	

Surrogate Recoveries (%)

Naphthalene-d8	61
Acenaphthene-d10	58
Phenanthrene-d10	69
Benzo(a)pyrene-d12	67

Not Surrogate Corrected

Analyzed by Lizotte Jr, Robert
10/29/2007

LCS: S07-0243MS-Master_157-Final.xls

Battelle
The Business of Innovation

Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	070906-01: NIST 1944					
Battelle ID	BK954SRM-P					
Sample Type	SRM					
Collection Date	09/19/07					
Extraction Date	09/19/07					
Analysis Date	10/03/07					
Analytical Instrument	MS					
% Moisture	NA					
% Lipid	NA					
Matrix	SEDIMENT					
Sample Size	1.98					
Size Unit-Basis	G_DRY	Certified		Passing	Actual	
Units	UG/KG_DRY	Value	+/-	%Difference	%Difference	Qualifier
Naphthalene	890.82	1650	310.04	48.79	46	
Acenaphthylene	574.35					
Acenaphthene	267.54					
Fluorene	308.71					
Anthracene	915.14	1770	329.93	48.64	48.3	
Phenanthrene	3912.47	5270	219.76	34.17	25.8	
Fluoranthene	6914.49	8920	320.23	33.59	22.5	
Pyrene	7668.93	9700	420.01	34.33	20.9	
Benzo(a)anthracene	3055.59	4720	109.98	32.33	35.3	N
Chrysene	3818.76	5900	270.22	34.58	35.3	N
Benzo(b)fluoranthene	2518.18	3870	419.90	40.85	34.9	
Benzo(k)fluoranthene	2875.54	4390	640.06	44.58	34.5	
Benzo(a)pyrene	2615.71	4300	129.86	33.02	39.2	N
Indeno(1,2,3-cd)pyrene	2081.81	2780	100.08	33.6	25.1	
Dibenz(a,h)anthracene	570.85	759	81.97	40.8	24.8	
Benzo(g,h,i)perylene	1834.03	2840	99.97	33.52	35.4	N

Surrogate Recoveries (%)

Naphthalene-d8	75
Acenaphthene-d10	81
Phenanthrene-d10	103
Benzo(a)pyrene-d12	105

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Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	GAG-006-C	GAG-006-C			
Battelle ID	Q0242-P	Q0242MS-P			
Sample Type	SA	MS			
Collection Date	09/05/07	9/5/2007			
Extraction Date	09/19/07	9/19/2007			
Analysis Date	10/03/07	10/3/2007			
Analytical Instrument	MS	MS			
% Moisture	46.83	45.26			
% Lipid	NA	NA			
Matrix	SEDIMENT	SEDIMENT			
Sample Size	15.50	8.38			
Size Unit-Basis	G_DRY	G_DRY			
Units	UG/KG_DRY	UG/KG_DRY	Target	% Recovery	Qualifier
Naphthalene	2.78 B	194.04	238.71	80	
Acenaphthylene	4.05	199.35	238.88	82	
Acenaphthene	1.21	207.49	238.82	86	
Fluorene	2.01	211.56	238.79	88	
Anthracene	5.93	240.58	238.70	98	
Phenanthrene	19.78	246.77	238.78	95	
Fluoranthene	78.48	325.07	238.78	103	
Pyrene	89.41	362.55	238.75	114	
Benzo(a)anthracene	30.84	257.49	238.72	95	
Chrysene	41.1	248.74	238.76	87	
Benzo(b)fluoranthene	50.18	259.88	238.87	88	
Benzo(k)fluoranthene	49.61	274.99	238.79	94	
Benzo(a)pyrene	43.31	272.45	238.85	96	
Indeno(1,2,3-cd)pyrene	38.82	246.49	238.78	87	
Dibenz(a,h)anthracene	7.31	218.78	238.79	89	
Benzo(g,h,i)perylene	33.53	221.32	238.74	79	

Surrogate Recoveries (%)

Naphthalene-d8	66	75
Acenaphthene-d10	68	73
Phenanthrene-d10	85	89
Benzo(a)pyrene-d12	91	94

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Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	GAG-006-C					
Battelle ID	Q0242MSD-P					
Sample Type	MSD					
Collection Date	9/5/2007					
Extraction Date	9/19/2007					
Analysis Date	10/3/2007					
Analytical Instrument	MS					
% Moisture	44.39					
% Lipid	NA					
Matrix	SEDIMENT					
Sample Size	8.4					
Size Unit-Basis	G_DRY					
Units	UG/KG_DRY	Target	% Recovery	Qualifier	RPD (%)	Qualifier
Naphthalene	188.58	238.14	78		2.5	
Acenaphthylene	196.78	238.31	81		1.2	
Acenaphthene	205.65	238.25	86		0.0	
Fluorene	211.45	238.23	88		0.0	
Anthracene	245.7	238.13	101		3.0	
Phenanthrene	248.43	238.21	96		1.0	
Fluoranthene	323.12	238.21	103		0.0	
Pyrene	358.76	238.18	113		0.9	
Benzo(a)anthracene	256.16	238.15	95		0.0	
Chrysene	246.49	238.19	86		1.2	
Benzo(b)fluoranthene	255.55	238.30	86		2.3	
Benzo(k)fluoranthene	271.98	238.23	93		1.1	
Benzo(a)pyrene	265.56	238.29	93		3.2	
Indeno(1,2,3-cd)pyrene	240.06	238.21	84		3.5	
Dibenz(a,h)anthracene	219.85	238.23	89		0.0	
Benzo(g,h,i)perylene	218.23	238.17	78		1.3	

Surrogate Recoveries (%)

Naphthalene-d8	71
Acenaphthene-d10	71
Phenanthrene-d10	90
Benzo(a)pyrene-d12	93

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Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	GAG-010-C		GAG-010-C			
Battelle ID	Q0246-P		Q0246DUP-P			
Sample Type	SA		QADU			
Collection Date	09/06/07		9/6/2007			
Extraction Date	09/19/07		9/19/2007			
Analysis Date	10/04/07		10/4/2007			
Analytical Instrument	MS		MS			
% Moisture	39.39		39.21			
% Lipid	NA		NA			
Matrix	SEDIMENT		SEDIMENT			
Sample Size	18.52		19.18			
Size Unit-Basis	G_DRY		G_DRY			
Units	UG/KG_DRY		UG/KG_DRY		RPD	Qualifier
Naphthalene	1.14	B	1.39	B	19.8	
Acenaphthylene	0.6		0.58		3.4	
Acenaphthene	0.25	J	0.26	J	NA	
Fluorene	0.51	J	0.56		9.3	
Anthracene	1.04		1.24		17.5	
Phenanthrene	2.45		3.53		36.1	n
Fluoranthene	9.35		10.97		15.9	
Pyrene	8.36		9.71		14.9	
Benzo(a)anthracene	2.72		3.68		30.0	
Chrysene	4.26		5.04		16.8	
Benzo(b)fluoranthene	4.74		5.12		7.7	
Benzo(k)fluoranthene	4.36		4.71		7.7	
Benzo(a)pyrene	3.58		4.11		13.8	
Indeno(1,2,3-cd)pyrene	3.26		3.45		5.7	
Dibenz(a,h)anthracene	0.62		0.65		4.7	
Benzo(g,h,i)perylene	3.32		3.45		3.8	

Surrogate Recoveries (%)

Naphthalene-d8	68	71
Acenaphthene-d10	65	69
Phenanthrene-d10	81	84
Benzo(a)pyrene-d12	79	82

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Glossary of Data Qualifiers

Flag:	Application:
B	Analyte concentration found in the sample at a concentration <5x the level found in the procedural blank.
D	Dilution Run. Initial run outside linear range of instrument.
E	Estimate, result is greater than the highest concentration level in the calibration.
H	Surrogate diluted out. Used when surrogate recovery is affected by excessive dilution of the sample extract.
J	Analyte detected below the sample-specific Reporting Limit (RL).
m	Confirmation column manually over-ridden by analyst
ME	Significant Matrix Interference - Estimated value.
MI	Significant Matrix Interference - value could not be determined or estimated.
n	Quality Control (QC) value is outside the accuracy or precision Data Quality Objective (DQO), but meets the contingency criteria.
N	Quality Control (QC) value is outside the accuracy or precision Data Quality Objective (DQO)
NA	Not applicable
p	Dual column value exceeds RPD criteria
T	Holding Time (HT) exceeded.
U	Analyte not detected at 3:1 signal:noise ratio.

Table II-3: Quality Control Summary for Analyses of Pesticides and PCB in Rinsate Blank

Method Reference Number: 8081B

Quality Control (QC) Element	Acceptance Criteria*	Criteria Met? Yes/No	List results outside (Cross-reference results table in data report)	Location of Results (Retained at Lab or in Data Package)
Initial Calibration	Must be performed prior to the analysis of any QC sample or field sample (r^2 > 0.995)	Yes		Retained at Lab
Calculation of Method Detection Limits (MDLs)	For each matrix, analyzed once per 12 month period (see Section 5.2 for MDL procedure)	Yes		Retained at Lab
Calibration Verification (Second Source)	Once, after initial calibration (80 to 120% recovery of each compound)	Yes		Retained at Lab
Continuing Calibration	Every 20 injections ($\pm$ 20 % D)	Yes		Retained at Lab
Standard Reference Materials	Within the limits provided by vendor	NA		In Data Package
Method Blank	No target analytes > RL	Yes		In Data Package
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One set (MS/MSD) per group of field samples. Must contain all target analytes. (Recovery Limits 50 to 120%; RPD <30%)	NA		In Data Package
Analytical Replicates	Analyze one sample in duplicate for each group of field samples (RPD < 30%)	NA		In Data Package
Surrogate Recoveries	Calculate % recovery (30 to 150% recovery)	Yes		In Data Package

* The Quality Control Acceptance Criteria are general guidelines. If alternate criteria are used, they must be documented in this table.

Pesticide/PCB – Rinsate Blank QA/QC Summary
Batch 07-0239

PROJECT: USACE/NAE – Brushneck Cove
PARAMETER: Pesticide/PCB
LABORATORY: Battelle, Duxbury, MA
MATRIX: Rinsate Blank
SAMPLE CUSTODY: A Rinsate blank sample was collected on 9/62007 and delivered to the Chemistry Sample Custodian on 9/7/2007. Upon arrival the cooler temperatures was recorded at 3.0°C. The sample was received in good condition and no custody issues were noted. It was logged into Battelle LIMS to receive a unique ID. The rinsate blank was stored in refrigerator at 4°C until sample preparation could begin.

	Reference Method	Method Blank	Surrogate Recovery	LCS Recovery	Detection Limits (ng/L)
PCB/Pest	General NS&T	<5xMDL	30-150% Recovery	50-120% Recovery	MDL: 0.26 – 0.94 Toxaphene RL: 100.2

METHOD: The rinsate blank sample was analyzed to ensure field collection methods were free of contamination. Approximately 1 L of water was spiked with surrogates and extracted three times with dichloromethane using separatory funnel techniques. The extracts were then concentrated, fortified with internal standard (IS) and split for the required analysis. The split extract for PCB/pesticide analysis was solvent exchanged into hexane, and analyzed using gas chromatography/electron capture detection (GC/ECD), following general NS&T methods. Sample data were quantified by the method of internal standards, using the spiked IS compounds. Data were evaluated against 2007 MDLs.

HOLDING TIMES: The rinsate blank sample was extracted within 7 days of sample collection and analyzed within 40 days of extraction.

Batch	Extraction Date	Analysis Date
07-0239	9/12/2007	9/15/2007

Pesticide/PCB – Rinsate Blank QA/QC Summary
Batch 07-0239

BLANK:

A procedural blank (PB) was prepared with the analytical batch. Blanks are analyzed to ensure the sample extraction and analysis methods were free of contamination.

07-0239 – No exceedences noted.

Comments – No target analytes were detected in the procedural blank.

LABORATORY CONTROL SAMPLE:

A laboratory control sample (LCS) was prepared with the analytical batch. The percent recoveries of target analytes were calculated to measure data quality in terms of accuracy.

07-0239 – No exceedences noted.

Comments – All percent recoveries of spiked target analytes were within the laboratory control limit (50-120%).

SURROGATES:

Two surrogate compounds were added prior to extraction, including PCB 34 and PCB 152. The recovery of each surrogate compound was calculated to measure data quality in terms of accuracy (extraction efficiency).

07-0239 – No exceedences noted.

Comments – Percent recoveries for all surrogate compounds were within the laboratory control limits (30 – 150% recovery).

CALIBRATIONS:

The instrument is calibrated with a 6-level calibration. The co-efficient of determination for the initial calibration (ICAL) must be ≥ 0.995. Continuing calibration verification (CCV) samples are analyzed minimally every 24 hours. The percent difference for the CCV samples must be $\leq 20\%$. Additionally an Instrument Calibration Check (ICC) sample is run after each initial calibration. The percent difference for the ICC also must be $\leq 20\%$.

07-0239 – No ICAL exceedences noted.
No ICC exceedences noted.
No CCV exceedences noted.

Comments - None

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Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	GAG-013	
Battelle ID	Q0236-P	
Sample Type	SA	
Collection Date	09/06/07	
Extraction Date	09/12/07	
Analysis Date	09/15/07	
Analytical Instrument	ECD	
% Moisture	NA	
% Lipid	NA	
Matrix	WATER	
Sample Size	1.05	
Size Unit-Basis	L_LIQUID	
Units	NG/L_LIQUID	
4,4'-DDD	0.48	U
4,4'-DDE	0.48	U
4,4'-DDT	0.48	U
aldrin	0.48	U
a-chlordane	0.48	U
g-chlordane	0.48	U
Lindane	0.48	U
cis-nonachlor	0.48	U
trans-nonachlor	0.48	U
oxychlordane	0.48	U
dieldrin	0.48	U
endosulfan I	0.48	U
endosulfan II	0.48	U
endrin	0.48	U
heptachlor	0.48	U
heptachlor epoxide	0.48	U
Hexachlorobenzene	0.48	U
methoxychlor	0.48	U
Toxaphene	95.43	U
Cl2(8)	0.48	U
Cl3(18)	0.48	U
Cl3(28)	0.48	U
Cl4(44)	0.48	U
Cl4(49)	0.48	U
Cl4(52)	0.48	U
Cl4(66)	0.48	U
Cl5(87)	0.48	U
Cl5(101)	0.48	U
Cl5(105)	0.48	U
Cl5(118)	0.48	U
Cl6(128)	0.48	U
Cl6(138)	0.48	U
Cl6(153)	0.48	U
Cl7(170)	0.48	U
Cl7(180)	0.48	U
Cl7(183)	0.47	U
Cl7(184)	0.47	U
Cl7(187)	0.48	U
Cl8(195)	0.48	U
Cl9(206)	0.48	U
Cl10(209)	0.48	U

Surrogate Recoveries (%)

Cl3(34)	101
Cl6(152)	99

Not Surrogate Corrected

Analyzed by Meara, Michael
10/29/2007

Main: L07-0239ECD-Master_128-Final.xls

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Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	Procedural Blank	
Battelle ID	BK938PB-P	
Sample Type	PB	
Collection Date	09/12/07	
Extraction Date	09/12/07	
Analysis Date	09/15/07	
Analytical Instrument	ECD	
% Moisture	NA	
% Lipid	NA	
Matrix	WATER	
Sample Size	1.00	
Size Unit-Basis	L_LIQUID	
Units	NG/L_LIQUID	
4,4'-DDD	0.5	U
4,4'-DDE	0.5	U
4,4'-DDT	0.5	U
aldrin	0.5	U
a-chlordane	0.5	U
g-chlordane	0.5	U
Lindane	0.5	U
cis-nonachlor	0.5	U
trans-nonachlor	0.5	U
oxychlordane	0.5	U
dieldrin	0.5	U
endosulfan I	0.5	U
endosulfan II	0.5	U
endrin	0.5	U
heptachlor	0.5	U
heptachlor epoxide	0.5	U
Hexachlorobenzene	0.5	U
methoxychlor	0.5	U
Toxaphene	100.2	U
Cl2(8)	0.5	U
Cl3(18)	0.5	U
Cl3(28)	0.5	U
Cl4(44)	0.5	U
Cl4(49)	0.5	U
Cl4(52)	0.5	U
Cl4(66)	0.5	U
Cl5(87)	0.5	U
Cl5(101)	0.5	U
Cl5(105)	0.5	U
Cl5(118)	0.51	U
Cl6(128)	0.5	U
Cl6(138)	0.51	U
Cl6(153)	0.5	U
Cl7(170)	0.5	U
Cl7(180)	0.5	U
Cl7(183)	0.5	U
Cl7(184)	0.5	U
Cl7(187)	0.5	U
Cl8(195)	0.5	U
Cl9(206)	0.5	U
Cl10(209)	0.5	U

Surrogate Recoveries (%)

Cl3(34)	100
Cl6(152)	94

Not Surrogate Corrected

Analyzed by Meara, Michael
10/29/2007

PB: L07-0239ECD-Master_128-Final.xls

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Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	060208-03: Sand, White Quartz, -50+70				
Battelle ID	BK939LCS-P				
Sample Type	LCS				
Collection Date	09/12/07				
Extraction Date	09/12/07				
Analysis Date	09/15/07				
Analytical Instrument	ECD				
% Moisture	NA				
% Lipid	NA				
Matrix	WATER				
Sample Size	1.00				
Size Unit-Basis	L_LIQUID				
Units	NG/L_LIQUID		Target	% Recovery	Qualifier
4,4'-DDD	17.2		20.01	86	
4,4'-DDE	17.78		20.02	89	
4,4'-DDT	18.35		20.01	92	
aldrin	17.19		20.01	86	
a-chlordane	18.29		20.01	91	
g-chlordane	18.47		20.03	92	
Lindane	18.97		20.01	95	
cis-nonachlor	17.08		20.01	85	
trans-nonachlor	18.33		20.03	92	
oxychlordane	18.82		20.10	94	
dieldrin	16.91		20.01	85	
endosulfan I	18.83		20.02	94	
endosulfan II	17.39		20.01	87	
endrin	17.81		20.01	89	
heptachlor	17.64		20.01	88	
heptachlor epoxide	18.49		20.02	92	
Hexachlorobenzene	18.93		20.03	95	
methoxychlor	18.25		20.01	91	
Toxaphene	100.2	U			
Cl2(8)	16.61		20.06	83	
Cl3(18)	16.06		20.06	80	
Cl3(28)	16.35		20.02	82	
Cl4(44)	17.63		20.04	88	
Cl4(49)	17.71		20.08	88	
Cl4(52)	17.87		20.00	89	
Cl4(66)	18.51		20.02	92	
Cl5(87)	17.29		19.83	87	
Cl5(101)	18.53		20.04	92	
Cl5(105)	17.61		20.02	88	
Cl5(118)	18.51		20.02	92	
Cl6(128)	17.98		20.12	89	
Cl6(138)	18.54		20.04	93	
Cl6(153)	18.4		20.02	92	
Cl7(170)	18.3		20.10	91	
Cl7(180)	18.35		20.08	91	
Cl7(183)	17.96		20.08	89	
Cl7(184)	17		20.08	85	
Cl7(187)	17.5		20.06	87	
Cl8(195)	17.08		20.06	85	
Cl9(206)	17.25		20.06	86	
Cl10(209)	17.21		20.02	86	

Surrogate Recoveries (%)

Cl3(34)	96
Cl6(152)	92

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Glossary of Data Qualifiers

Flag:	Application:
B	Analyte concentration found in the sample at a concentration <5x the level found in the procedural blank.
D	Dilution Run. Initial run outside linear range of instrument.
E	Estimate, result is greater than the highest concentration level in the calibration.
H	Surrogate diluted out. Used when surrogate recovery is affected by excessive dilution of the sample extract.
J	Analyte detected below the sample-specific Reporting Limit (RL).
m	Confirmation column manually over-ridden by analyst
ME	Significant Matrix Interference - Estimated value.
MI	Significant Matrix Interference - value could not be determined or estimated.
n	Quality Control (QC) value is outside the accuracy or precision Data Quality Objective (DQO), but meets the contingency criteria.
N	Quality Control (QC) value is outside the accuracy or precision Data Quality Objective (DQO)
NA	Not applicable
p	Dual column value exceeds RPD criteria
T	Holding Time (HT) exceeded.
U	Analyte not detected at 3:1 signal:noise ratio.

Table II-2: Quality Control Summary for Analyses of Polyaromatic Hydrocarbons (PAHs) and other base-neutrals in Rinsate

Method Reference Number: 8270C

Quality Control (QC) Element	Acceptance Criteria*	Criteria Met? Yes/No	List results outside criteria (Cross-reference results table in data report)	Location of Results (Retained at Lab or in Data Package)
Initial Calibration	Must be performed prior to the analysis of any QC sample or field sample (<20 % RSD for each compound)	Yes		Retained at Lab
Calculation of Method Detection Limits (MDLs)	For each matrix, analyzed once per 12 month period (see Section 5.2 for MDL procedure)	Yes		Retained at Lab
Calibration Verification (Second Source)	Once, after initial calibration (80 to 120% recovery of each compound)	Yes		Retained at Lab
Continuing Calibration	At the beginning of every 12 hour shift (± 15 % D)	Yes		Retained at Lab
Standard Reference Materials	Within the limits provided by vendor	NA		In Data Package
Method Blank	No target analytes > RL	Yes		In Data Package
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One set (MS/MSD) per group of field samples. Must contain all target analytes. (Recovery Limits 50 to 120%; RPD <30%)	NA		In Data Package
Analytical Replicates	Analyze one sample in duplicate for each group of field samples (RPD < 30%)	NA		In Data Package
Surrogate Recoveries	Calculate % recovery (30 to 150% recovery)	Yes		In Data Package

* The Quality Control Acceptance Criteria are general guidelines. If alternate criteria are used, they must be documented in this table.

PAH –Rinsate Blank QA/QC SUMMARY
Batch 07-0239

PROJECT: USACE/NAE – Brushneck Cove
PARAMETER: PAH
LABORATORY: Battelle, Duxbury, MA
MATRIX: Rinsate Blank
SAMPLE CUSTODY: A Rinsate blank sample was collected on 9/6/2007 and delivered to the Chemistry Sample Custodian on 9/7/2007. Upon arrival the cooler temperatures was recorded at 3.0°C. The sample was received in good condition and no custody issues were noted. It was logged into Battelle LIMS to receive a unique ID. The rinsate blank was stored in refrigerator at 4°C until sample preparation could begin.

	Reference Method	Method Blank	Surrogate Recovery	LCS Recovery	Detection Limits (ng/L)
PAH	General NS&T	<5xMDL	30-150% Recovery	50-120% Recovery	~0.59 – 1.55

METHOD: The rinsate blank sample was analyzed to ensure field collection methods were free of contamination. Approximately 1 L of water was spiked with surrogates and extracted three times with dichloromethane using separatory funnel techniques. The extracts were then concentrated, fortified with internal standard (IS) and split for the required analysis. Extracts intended for PAH analysis were analyzed using gas chromatography/mass spectrometry (GC/MS) operating in the selected ion monitoring (SIM) mode, following general NS&T methods. Sample data were quantified by the method of internal standards, using the spiked IS compounds.

HOLDING TIMES: The rinsate blank was extracted within 7 days of sample collection, and the extract was analyzed within 40 days of extraction.

Batch	Extraction Date	Analysis Date
07-0239	9/12/2007	10/3/2007 – 10/4/2007

PAH –Rinsate Blank QA/QC SUMMARY
Batch 07-0239

BLANK:

A procedural blank (PB) was prepared with each analytical batch. Blanks were analyzed to ensure the sample extraction and analysis methods were free of contamination.

07-0239 – No target analytes were detected in the procedural blank at a concentration greater than the laboratory control limit (5 x MDL).

Comments – None.

LABORATORY CONTROL SAMPLE:

A laboratory control sample (LCS) was prepared with each analytical batch. The percent recoveries of target analytes were calculated to measure data quality in terms of accuracy.

07-0239 – One exceedence noted.

Comments – All target analytes were recovered within the specified laboratory control limits (50-120%), except for Pyrene. This compound was over-recovered in the LCS. Since this compound was not detected above the reporting limit in the rinsate sample, this exceedence has no impact on the data. No further corrective action was needed.

SURROGATES:

Four surrogate compounds were added prior to extraction, including naphthalene-d8, acenaphthene-d10, phenanthrene-d10, and benzo(a)pyrene-d12. The recovery of each surrogate compound was calculated to measure data quality in terms of accuracy (extraction efficiency).

07-0239 – No exceedences noted.

Comments – All surrogate percent recoveries were within the laboratory control limits (30-150%).

CALIBRATIONS:

The GC/MS is calibrated with a minimum of a 5 level curve. The RSD between response factors for the individual target analytes must be <30%, with a mean < 15%. Each batch of samples analyzed is bracketed by a calibration check sample (CCV), run at a frequency of minimally every 12 hours. This PD between the initial calibration RF and the CCV should be <25% for individual analytes. Additionally an initial calibration check sample (ICC) sample is run immediately after each initial calibration. The percent difference between the ICC and the initial calibration should be < 25%.

07-0239 – No exceedences noted.

Comments – All calibration criteria have been met.

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Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	GAG-013	
Battelle ID	Q0236-P	
Sample Type	SA	
Collection Date	09/06/07	
Extraction Date	09/12/07	
Analysis Date	10/03/07	
Analytical Instrument	MS	
% Moisture	NA	
% Lipid	NA	
Matrix	WATER	
Sample Size	1.05	
Size Unit-Basis	L_LIQUID	
Units	NG/L_LIQUID	
Naphthalene	91.55	
Acenaphthylene	2.39	U
Acenaphthene	3.83	
Fluorene	29.11	
Anthracene	2.39	U
Phenanthrene	15.17	
Fluoranthene	1.97	J
Pyrene	2	J
Benzo(a)anthracene	2.39	U
Chrysene	2.39	U
Benzo(b)fluoranthene	2.39	U
Benzo(k)fluoranthene	4.78	U
Benzo(a)pyrene	2.39	U
Indeno(1,2,3-cd)pyrene	2.39	U
Dibenz(a,h)anthracene	2.39	U
Benzo(g,h,i)perylene	2.39	U

Surrogate Recoveries (%)

Naphthalene-d8	89
Acenaphthene-d10	86
Phenanthrene-d10	97
Benzo(a)pyrene-d12	102

Not Surrogate Corrected

Analyzed by Lizotte Jr, Robert
10/29/2007

Main: L07-0239MS-Master_157-Final.xls

Battelle
The Business of Innovation

Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	Procedural Blank	
Battelle ID	BK938PB-P	
Sample Type	PB	
Collection Date	09/12/07	
Extraction Date	09/12/07	
Analysis Date	10/03/07	
Analytical Instrument	MS	
% Moisture	NA	
% Lipid	NA	
Matrix	WATER	
Sample Size	1.00	
Size Unit-Basis	L_LIQUID	
Units	NG/L_LIQUID	
Naphthalene	2.29	J
Acenaphthylene	2.51	U
Acenaphthene	2.52	U
Fluorene	2.51	U
Anthracene	2.51	U
Phenanthrene	2.51	U
Fluoranthene	2.51	U
Pyrene	2.51	U
Benzo(a)anthracene	2.51	U
Chrysene	2.51	U
Benzo(b)fluoranthene	2.51	U
Benzo(k)fluoranthene	5.02	U
Benzo(a)pyrene	2.51	U
Indeno(1,2,3-cd)pyrene	2.51	U
Dibenz(a,h)anthracene	2.51	U
Benzo(g,h,i)perylene	2.51	U

Surrogate Recoveries (%)

Naphthalene-d8	89
Acenaphthene-d10	88
Phenanthrene-d10	102
Benzo(a)pyrene-d12	105

Battelle
The Business of Innovation

Project Client: USACE - North Atlantic Division
Project Name: Brushneck Cove
Project Number: G606430-DUXSEDCHEM

Client ID	060208-03: Sand, White Quartz, -50+70			
Battelle ID	BK939LCS-P			
Sample Type	LCS			
Collection Date	09/12/07			
Extraction Date	09/12/07			
Analysis Date	10/03/07			
Analytical Instrument	MS			
% Moisture	NA			
% Lipid	NA			
Matrix	WATER			
Sample Size	1.00			
Size Unit-Basis	L_LIQUID			
Units	NG/L_LIQUID	Target	% Recovery	Qualifier
Naphthalene	854.84	1000.20	85	
Acenaphthylene	944.16	1000.90	94	
Acenaphthene	990.71	1000.65	99	
Fluorene	1010.95	1000.55	101	
Anthracene	1158.53	1000.15	116	
Phenanthrene	1083.37	1000.50	108	
Fluoranthene	1189.54	1000.50	119	
Pyrene	1286.88	1000.35	129	N
Benzo(a)anthracene	1069	1000.25	107	
Chrysene	992.87	1000.40	99	
Benzo(b)fluoranthene	1038.07	1000.85	104	
Benzo(k)fluoranthene	1096.56	1000.55	110	
Benzo(a)pyrene	1121.22	1000.80	112	
Indeno(1,2,3-cd)pyrene	1050.81	1000.50	105	
Dibenz(a,h)anthracene	1066.46	1000.55	107	
Benzo(g,h,i)perylene	936.58	1000.30	94	

Surrogate Recoveries (%)

Naphthalene-d8	79
Acenaphthene-d10	78
Phenanthrene-d10	91
Benzo(a)pyrene-d12	94

Glossary of Data Qualifiers

Flag:	Application:
B	Analyte concentration found in the sample at a concentration <5x the level found in the procedural blank.
D	Dilution Run. Initial run outside linear range of instrument.
E	Estimate, result is greater than the highest concentration level in the calibration.
H	Surrogate diluted out. Used when surrogate recovery is affected by excessive dilution of the sample extract.
J	Analyte detected below the sample-specific Reporting Limit (RL).
m	Confirmation column manually over-ridden by analyst
ME	Significant Matrix Interference - Estimated value.
MI	Significant Matrix Interference - value could not be determined or estimated.
n	Quality Control (QC) value is outside the accuracy or precision Data Quality Objective (DQO), but meets the contingency criteria.
N	Quality Control (QC) value is outside the accuracy or precision Data Quality Objective (DQO)
NA	Not applicable
p	Dual column value exceeds RPD criteria
T	Holding Time (HT) exceeded.
U	Analyte not detected at 3:1 signal:noise ratio.

Metals Results

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Analytical Chemistry Data Package
Inorganics Analysis

Project: Bushneck Cove

Analysis of Metals in Sediment and Rinsate Blank Water

Battelle Project No. 53809
CF No. 2799

Battelle
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Marine Sciences Laboratory
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Sequim, WA 98382
(360) 681-4564

CERTIFICATION STATEMENT AND DATA RELEASE

Battelle Marine Sciences Laboratory is releasing the following data set:

BUSHNECK COVE
SEDIMENT CHEMISTRY

METALS IN SEDIMENT AND RINSATE BLANK

We certify that the data contained within this data set is authentic:

Carolynn Suslick for JMB 10/4/07

Jill M. Brandenberger Date
MSL Metals Chemistry Project Manager

10/4/07

~~Janet Cloutier~~ Date
MSL QA Officer

Table II-5: Quality Control Summary for Analyses of Metals in Sediments, Tissue and Water Matrices

USACE NED - Bushneck Cove

Method Reference Numbers: Various Reference Numbers

Quality Control (QC) Element	Acceptance Criteria*	Criteria Met? Yes/No	List results outside criteria (Cross-reference results table in data report)	Location of Results (Retained at Lab or in Data Package)
Linear Range Determination for ICP	Performed Quarterly (NOTE: MSL performs daily for ICP-MS)	Yes		Retained at Lab
Initial Calibration for ICP-MS, ICP-OES, and Hg	Performed Daily (Correlation Coefficient ≥0.995)	Yes		Retained at Lab
Calculation of Method Detection Limits (MDLs)	For each matrix, analyzed once per 12 month period (see Section 5.2 for MDL procedure)	Yes		In Data Package
Initial Calibration Verification/ Continuing Calibration Verification	Hg: 80 to 120% recovery Other metals: 90 to 110% recovery	Yes		Retained at Lab
Initial Calibration Blank/ Continuing Calibration Blank	No target analytes > Instrument Detection Limit (IDL)	No	NOTE: This criteria is not met for one or more CCBs for As, Cu, Ni, and Pb. MSL SOP uses 3x MDL to evaluate ICB/CCB impacts. Sample concentrations exceed 100x CCB concentrations detected above RL; no impact to reported results.	Retained at Lab
Standard Reference Materials	Within the limits provided by vendor. ALTERNATE QC CRITERION OF ±25%	Yes		In Data Package
Method Blank	No target analytes > RL	Yes		In Data Package
Sample Spike/ Sample Duplicate	One set per group of field samples. Must contain all target analytes. Recovery Limits (75 to 125%; RPD < 20% or < 35%)	Yes		In Data Package

Table II-5: Quality Control Summary for Analyses of Metals in Sediments, Tissue and Water Matrices

USACE NED - Bushneck Cove

Method Reference Numbers: Various Reference Numbers

Quality Control (QC) Element	Acceptance Criteria*	Criteria Met? Yes/No	List results outside criteria (Cross-reference results table in data report)	Location of Results (Retained at Lab or in Data Package)
Analytical Replicates	Analyze one sample in duplicate for each group of field samples (RPD < 30%)	No		In Data Package

* The Quality Control Acceptance Criteria are general guidelines. If alternate criteria are used, they must be documented in this table.

QA/QC NARRATIVE

PROJECT:	Bushneck Cove
PARAMETER:	Metals
LABORATORY:	Battelle Marine Sciences Laboratory (MSL), Sequim, Washington
MATRIX:	Sediment
SAMPLE CUSTODY AND PROCESSING:	Eleven sediment samples for metals analyses were received at MSL on 09/11/07. All samples were received in good condition (i.e., no sample containers were broken). Samples were assigned a Battelle central file (CF) identification number (2799) and were entered into Battelle's laboratory information management system.

The following lists information on sample receipt and processing activities:

Lab Sample IDs:	2799*1-11
Description:	Sediment
Sample collection dates:	09/05/07, 09/06/07
Laboratory arrival date:	09/11/07
Cooler temp. on arrival:	3.7°C
Digestion (HNO_3/HCl)	09/24/07
CVAA Analysis Date (Hg)	09/27/07
ICP-OES Analysis Date (Cr, Cu, Pb, Ni, Zn)	09/26/07
ICP-MS Analysis Date (As, Cd)	09/25/07

DATA QUALITY OBJECTIVES:

Analyte	Analytical Method	Range of Recovery	SRM Accuracy	Laboratory Duplicate Precision	RIM RL (µg/g)	Project MDL (2) (µg/g)	Project RL (3) (µg/g)
As	ICP-MS	75-125%	≤25% (1)	≤30% (1)	0.4	0.1	0.3
Cd	ICP-MS	75-125%	≤25% (1)	≤30% (1)	0.07	0.004	0.01
Cr	ICP-OES	75-125%	≤25% (1)	≤30% (1)	0.5	0.05	0.2
Cu	ICP-OES	75-125%	≤25% (1)	≤30% (1)	0.5	0.1	0.3
Hg	CVAA	75-125%	≤25% (1)	≤30% (1)	0.02	0.005	0.02
Ni	ICP-OES	75-125%	≤25% (1)	≤30% (1)	0.5	0.05	0.2
Pb	ICP-OES	75-125%	≤25% (1)	≤30% (1)	0.5	0.1	0.3
Zn	ICP-OES	75-125%	≤25% (1)	≤30% (1)	1	0.2	0.6

(1) Evaluated for analytes >10x the MDL
(2) Reported from the Annual Method Detection Limit (MDL) Study as determined on a dry weight basis using seven replicates of a solid matrix, mixed acid digestion.
(3) Reporting Limit (RL) determined as 3.18 * achieved MDL.

METHODS: Sediment samples were analyzed for eight metals: arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), and zinc (Zn). Samples were freeze-dried and homogenized using a ball-mill prior to digestion according to Battelle SOP MSL-C-003, *Percent Dry Weight and Homogenizing Dry Sediment, Soil and Tissue*. Sediment samples were digested in accordance with Battelle SOP MSL-I-006, *Mixed Acid Sediment Digestion*. An approximately 200-mg (dry weight) aliquot of each sample was combined with nitric and hydrochloric acids (aqua regia) in a Teflon bomb and heated in an oven at 130ºC (±10ºC) for a minimum of eight hours. After heating and cooling, deionized water was added to the sediment digestate to achieve analysis volume. Digestates were submitted for analysis by three methods.

QA/QC NARRATIVE

METHODS:	Digested samples were analyzed for Hg using cold-vapor atomic absorption spectroscopy (CVAA) according to Battelle SOP MSL-I-016, *Total Mercury in Tissues and Sediments by Cold Vapor Atomic Absorption*. This procedure is based on modification of EPA Method 245.5 Digested samples were analyzed for As and Cd using inductively coupled plasma-mass spectrometry (ICP-MS) according to Battelle SOP MSL-I-022, *Determination of Elements in Aqueous and Digestate Samples by ICP/MS*. The base methods for this procedure are EPA Method 1638 and EPA Method 6020 with adaptations for the analysis of trace level metals in digested sediment and tissue samples. Digested samples were analyzed for all other metals using inductively coupled plasma optical emissions spectroscopy (ICP-OES) according to Battelle SOP MSL-I-033, *Determination of Elements in Aqueous and Digestate Samples by ICP-OES*. This procedure is based on two methods modified and adapted for analysis of low level samples: EPA Method 6010B and 200.7.
HOLDING TIMES:	The target holding times of 28 days for Hg and six months for all other metals were achieved for all samples.
DETECTION LIMITS:	Analytical results were reported to laboratory achieved method detection limits (MDL) and achieved reporting limits (RL) defined as 3.18*MDL. Laboratory MDLs are determined annually and are based on seven replicates of a solid matrix, mixed acid digestion. All achieved laboratory reporting limits met RIM target RLs. Data were evaluated and flagged in accordance with the following criteria: U Not detected at or above the Limit of Detection/MDL j Analyte detected below the Limit of Quantitaion /RL; concentration reported may be an estimate N QC value outside the accuracy or precision criteria goal (Spikes ±25%R; SRM ≤25%PD; Replicates ±30%RPD) n QC value outside the accuracy or precision data quality objective, but meets contingency criteria.
METHOD BLANKS:	One method blank was analyzed with the set of sediment samples. Analytes concentrations in the method blank were not detected at a level greater than the MDL. The data are not blank corrected.
LABORATORY CONTROL SAMPLE ACCURACY:	One laboratory control sample (LCS) was analyzed with the set of samples. The percent recoveries for the LCS were within the QC acceptance criterion of 75-125% recovery for all metals.
MATRIX SPIKE ACCURACY:	One sediment was selected for a matrix spike/matrix spike duplicate sample. The percent recoveries for the MS/MSD samples were within the QC acceptance criterion of 75-125% recovery for all metals.
DUPLICATE PRECISION:	Precision for this set of samples was assessed by the analysis of laboratory duplicates and matrix spike duplicates. Precision was expressed as the relative percent difference (RPD) of replicate results. The RPD values for the duplicates were within the QC criterion of ≤30% RPD. The RPD values for the MS/MSD samples were within the QC criterion of ≤20% RPD.

QA/QC NARRATIVE

STANDARD REFERENCE MATERIAL ACCURACY:

SRM accuracy was expressed as the percent difference (PD) between the measured and certified or reference value for the SRM.

The SRM analyzed with this set of sediment samples was SRM 1944 New York/New Jersey Waterway Sediment. This SRM is certified for all metals except Cu and Hg. The reference values are reported for evaluation purposes. The percent differences from the certified or reference values were within the QC acceptance criterion of PD ≤25% for all metals.

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USACE NED - Bushneck Cove
Metals in Sediment

(concentrations in ug/g, dry weight)

Sponsor ID	MSL Code	Site Description	Collection Date	Percent Moisture	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
				Analytical Batch ID:	*ICP-MS*	*ICP-MS*	*ICP-OES*	*ICP-OES*	*CVAA*	*ICP-OES*	*ICP-OES*	*ICP-OES*
				CAS Number:	7440-38-2	7440-43-9	7440-47-3	7440-50-8	7439-97-6	7440-02-0	7439-92-1	7440-66-6
GAG-001-D	2799-1	BNC-C-09	09/05/07	21.6	1.91	0.209	13.1	5.49	0.0135 j	4.71	4.21	23.8
GAG-002-D	2799-2	BNC-C-08	09/05/07	43.9	5.47	0.507	39.0	10.9	0.0314	14.7	9.14	58.2
GAG-003-D	2799-3	BNC-C-10	09/05/07	45.3	4.87	0.533	36.6	11.1	0.0272	13.9	8.86	53.2
GAG-004-D	2799-4r1	BNC-C-11	09/05/07	51.5	5.66	0.672	50.2	17.3	0.0609	17.5	14.2	72.9
GAG-004-D	2799-4r2	BNC-C-11	09/05/07	51.5	6.13	0.698	52.2	17.6	0.0590	17.9	15.0	76.1
GAG-005-D	2799-5	BNC-C-01	09/05/07	47.3	5.36	0.521	42.0	13.3	0.0640	14.7	16.6	66.2
GAG-006-D	2799-6	BNC-C-02	09/05/07	46.2	5.47	0.559	43.0	15.0	0.0689	14.6	17.1	67.3
GAG-007-D	2799-7	BNC-C-03	09/05/07	46.0	4.94	0.517	41.5	12.2	0.0318	14.6	11.4	58.8
GAG-008-D	2799-8	BNC-C-04	09/05/07	48.2	6.45	0.570	51.1	16.9	0.0748	17.4	18.8	77.3
GAG-009-D	2799-9	BNC-C-05	09/05/07	46.6	5.71	0.467	41.4	11.3	0.0241	14.9	10.2	60.3
GAG-010-D	2799-10	BNC-C-06	09/06/07	40.7	4.28	0.366	34.8	8.49	0.0182 j	12.7	7.92	49.9
GAG-011-D	2799-11	BNC-C-07	09/06/07	36.1	3.53	0.373	26.6	9.72	0.0335	9.53	8.97	45.8
Laboratory Achieved Method Detection Limit (MDL)					**0.1**	**0.004**	**0.05**	**0.1**	**0.005**	**0.05**	**0.1**	**0.2**
Reporting Limit (RL = 3.18 * MDL)					0.3	0.01	0.2	0.3	0.02	0.2	0.3	0.6
Target RL					*0.4*	*0.07*	*0.5*	*0.5*	*0.02*	*0.5*	*0.5*	*1*
Procedural Blank												
Blank 092107		Blank			0.1 U	0.004 U	0.05 U	0.1 U	0.005 U	0.05 U	0.1 U	0.2 U
Laboratory Control Sample (Blank Spike)												
LCS092107		LCS			25.7	26.1	25.7	25.3	1.68	25.8	25.7	25.3
Blank 092107		Blank			0.1 U	0.004 U	0.05 U	0.1 U	0.005 U	0.05 U	0.1 U	0.2 U
	Spike Concentration				25	25	25	25	2.0	25	25	25
	Percent Recovery				**103%**	**104%**	**103%**	**101%**	**84%**	**103%**	**103%**	**101%**
MATRIX SPIKE RESULTS												
2799-8 MS		Matrix Spike			53.3	44.8	89.7	59.5	1.81	55.7	56.2	158
2799-8 MSD		Matrix Spike Duplicate			55.4	49.3	98.7	66.0	2.06	62.6	63.0	172
GAG-008-D	2799-8		09/05/07	48.2	6.45	0.570	51.1	16.9	0.075	17.4	18.8	77.3
	Spike Concentration, MS				41.8	41.8	41.8	41.8	1.67	41.8	41.8	83.7
	Spike Concentration, MSD				47.6	47.6	47.6	47.6	1.90	47.6	47.6	95.2
	Percent Recovery, MS				**112%**	**106%**	**92%**	**102%**	**104%**	**92%**	**90%**	**97%**
	Percent Recovery, MSD				**103%**	**102%**	**100%**	**103%**	**105%**	**95%**	**93%**	**99%**
	RPD				**9%**	**3%**	**8%**	**1%**	**1%**	**4%**	**4%**	**3%**

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USACE NED - Bushneck Cove
Metals in Sediment

(concentrations in ug/g, dry weight)

Sponsor ID	MSL Code	Site Description	Collection Date	Percent Moisture	**As**	**Cd**	**Cr**	**Cu**	**Hg**	**Ni**	**Pb**	**Zn**
				Analytical Batch ID:	*ICP-MS*	*ICP-MS*	*ICP-OES*	*ICP-OES*	*CVAA*	*ICP-OES*	*ICP-OES*	*ICP-OES*
				CAS Number:	7440-38-2	7440-43-9	7440-47-3	7440-50-8	7439-97-6	7440-02-0	7439-92-1	7440-66-6
DUPLICATE PRECISION												
GAG-004-D	2799-4r1		09/05/07	51.5	5.66	0.672	50.2	17.3	0.0609	17.5	14.2	72.9
GAG-004-D	2799-4r2		09/05/07	51.5	6.13	0.698	52.2	17.6	0.0590	17.9	15.0	76.1
	MEAN				5.90	0.685	51.2	17.5	0.0600	17.7	14.6	74.5
	RPD				**8%**	**4%**	**4%**	**2%**	**3%**	**3%**	**5%**	**4%**
STANDARD REFERENCE MATERIAL												
1944 092107		SRM			20.8	8.92	224	365	3.53	63.2	278	606
	certified or reference value				18.9	8.80	266	380	3.4	76.1	330	656
	range				±2.8	±1.4	±24	±40	±0.09	±5.60	±48.0	±75
	Percent Difference				**10%**	**1%**	**16%**	**4%**	**4%**	**17%**	**16%**	**8%**

U Not detected at or above the Limit of Detection/MDL
j Analyte detected below the Limit of Quantitaion /RL; concentration reported may be an estimate
N QC value outside the accuracy or precision criteria goal (Spikes ±25%R; SRM ≤25%PD; Replicates ±30%RPD)
n QC value outside the accuracy or precision data quality objective, but meets contingency criteria.

Battelle Marine Science Laboratory

Method Detection Limit Study Summary

Date: 10/2/2007

MATRIX: Solid, Aqua Regia Digestion
UNITS: µg/g dry weight

	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Instrument:	ICP-MS	ICP-MS	ICP-OES	ICP-OES	CVAA	ICP-OES	ICP-OES	ICP-OES
Analysis Date:	2/28/2007	3/20/2007	3/8/2007	2/9/2007	3/8/2007	6/11/2007	6/11/2007	3/8/2007
CAS Code:	7440-38-2	7440-43-9	7440-47-3	7440-50-8	7439-97-6	7440-02-0	7439-92-1	7440-66-6
MDL 1	0.00895	0.0205	0.302	0.106	0.0110	0.127	1.01	0.297
MDL 2	0.0592	0.0240	0.285	0.121	0.0112	0.118	1.02	0.301
MDL 3	0.0290	0.0213	0.307	0.113	0.0107	0.117	1.06	0.313
MDL 4	0.0385	0.0208	0.273	0.108	0.0105	0.124	1.09	0.293
MDL 5	0.0641	0.0215	0.282	0.110	0.00980	NA	1.01	0.393
MDL 6	0.0508	0.0213	0.275	0.107	0.0106	0.114	0.980	0.285
MDL 7	0.120	0.0218	0.296	0.0985	0.0106	0.117	1.05	0.288
MDL 8	0.0409	0.0234	NA	0.0812	0.0114	0.119	1.05	0.278
MEAN	0.0514	0.0218	0.288	0.106	0.0107	0.1192	1.03	0.306
STDEV	0.03275	0.00123	0.0134	0.0118	0.00049	0.00455	0.0356	0.0368
MDL	0.0982	0.00370	0.0422	0.0352	0.00148	0.0143	0.107	0.110
RL	0.312	0.0118	0.134	0.112	0.00469	0.0455	0.340	0.351

ICP-MS - Inductively Coupled Plasma Mass Spectrometry
CVAA = Cold Vapor Atomic Absorption Spectroscopy
ICP-OES = Inductively Coupled Plasma Optical Emissions Spectroscopy
RL = MDL*3.18

Table II-5: Quality Control Summary for Analyses of Metals in Sediments, Tissue and Water Matrices
USACE NED - Bushneck Cove
Method Reference Numbers: Various Reference Numbers

Quality Control (QC) Element	Acceptance Criteria*	Criteria Met? Yes/No	List results outside criteria (Cross-reference results table in data report)	Location of Results (Retained at Lab or in Data Package)
Linear Range Determination for ICP	Performed Quarterly (NOTE: MSL performs daily for ICP-MS)	Yes		Retained at Lab
Initial Calibration for ICP-MS, ICP-OES, and Hg	Performed Daily (Correlation Coefficient ≥0.995)	Yes		Retained at Lab
Calculation of Method Detection Limits (MDLs)	For each matrix, analyzed once per 12 month period (see Section 5.2 for MDL procedure)	Yes		In Data Package
Initial Calibration Verification/ Continuing Calibration Verification	Hg: 80 to 120% recovery Other metals: 90 to 110% recovery	Yes		Retained at Lab
Initial Calibration Blank/ Continuing Calibration Blank	No target analytes > Instrument Detection Limit (IDL)	Yes		Retained at Lab
Standard Reference Materials	Within the limits provided by vendor. ALTERNATE QC CRITERION OF ±25% DIFFERENCE	Yes		In Data Package
Method Blank	No target analytes > RL	Yes		In Data Package
Sample Spike/ Sample Duplicate	One set per group of field samples. Must contain all target analytes. Recovery Limits (75 to 125%; RPD < 20% or < 35%)	Yes	NOTE: The matrix for rinsate blanks is DI water; therefore a blank spike serves as the matrix spike and is not performed in duplicate.	In Data Package
Analytical Replicates	Analyze one sample in duplicate for each group of field samples (RPD < 30%)	No	NOTE: Rinsate blanks are not analyzed in duplicate.	In Data Package

* The Quality Control Acceptance Criteria are general guidelines. If alternate criteria are used, they must be documented in this table

QA/QC NARRATIVE

PROJECT: USACE/NED Bushneck Cove

PARAMETER: Metals

LABORATORY: Battelle Marine Sciences Laboratory, Sequim, Washington

MATRIX: Rinsate Blanks

SAMPLE CUSTODY AND PROCESSING: One rinsate blank for metals analyses was received at MSL on 09/11/07. The preserved sample was received in good condition (i.e., no sample containers were broken), assigned a Battelle central file (CF) identification number (2799), and entered into Battelle's laboratory information management system.

The following lists information on sample receipt and processing activities:

Lab Sample IDs:	2799-12
Description:	Rinsate Blank
Sample collection dates:	09/06/07
Laboratory arrival date:	09/11/07
Cooler temp. on arrival:	3.7°C
CVAF Analysis Date: (Hg)	09/21/07
ICP-MS Analysis Date: (As, Cd, Cr, Cu, Pb, Ni, Zn)	09/25/07

QA/QC DATA QUALITY OBJECTIVES:

Analyte	Analytical Method for Freshwater	MS Range of Recovery[1]	SRM Percent Difference[1]	Replicate Precision[1]	NED Reporting Limits (µg/L)	Lab Detection Limits (µg/L) [2]	Lab Reporting Limits (µg/L) [3]
Arsenic	ICP-MS	75-125%	≤25%	≤30%	1	0.015	0.05
Cadmium	ICP-MS	75-125%	≤25%	≤30%	1	0.001	0.003
Chromium	ICP-MS	75-125%	≤25%	≤30%	1	0.08	0.3
Copper	ICP-MS	75-125%	≤25%	≤30%	0.6	0.004	0.013
Mercury	CVAF	75-125%	≤25%	≤30%	0.4	0.000188	0.0006
Nickel	ICP-MS	75-125%	≤25%	≤30%	1	0.013	0.04
Lead	ICP-MS	75-125%	≤25%	≤30%	1	0.001	0.003
Zinc	ICP-MS	75-125%	≤25%	≤30%	1	0.2	0.7

1 Evaluated for analytes >10x the MDL
2 Reported from the Water Method Detection Limit (MDL) Study as determined using seven replicates of spiked DI water.
3 Lab Reporting Limit (RL) determined as 3.18 * achieved MDL.

METHODS: The equipment rinsate blank was analyzed for arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), and zinc (Zn). The samples were submitted for analyses by two methods.

Samples were analyzed for total Hg by cold vapor atomic fluorescence (CVAF) in accordance with Battelle SOP *MSL-I-013*; *Total Mercury in Aqueous Samples by CVAF based on EPA Method 1631 Revision E.*

Samples were analyzed for all other metals by inductively coupled plasma-mass spectrometry (ICP-MS) in accordance with Battelle SOP *MSL-I-022; Determination of Elements in Aqueous and Digestate Samples by ICP/MS*, which was adapted from US EPA Method 1638.

All data are reported in units of µg/L for each sample.

QA/QC NARRATIVE

HOLDING TIMES:	Established holding times of 90 days for Hg and six months for trace metals were achieved.
DETECTION LIMITS:	Laboratory achieved detection limit are reported from the annual MDL study for freshwater. The reporting limits provided are determined as 3.18 times the laboratory achieved MDL. Data were evaluated and flagged to the following criteria: U Not detected above laboratory achieved MDL; MDL reported. j Analyte detected is less than the achieved RL, but greater than MDL N QC value outside the accuracy or precision criteria goal (Spikes ±25%R; SRM ≤25%PD; Replicates ±30%RPD) n QC value outside the accuracy or precision data quality objective, but meets contingency criteria.
METHOD BLANKS:	One method blank was analyzed with this batch of samples. Method blank concentrations were all less than the RL. Samples were not blank corrected.
BLANK SPIKE /LABORATORY CONTROL SAMPLES:	A minimum of one laboratory control samples (LCS) or ongoing precision and recovery (OPR) sample was prepared and analyzed with this batch of samples. Percent recoveries for the LCS sample were within the QC acceptance criteria of 75% to 125% for all metals.
MATRIX SPIKE ACCURACY:	The sample matrix for rinsate blanks is deionized water; therefore LCS samples serve as matrix spikes.
STANDARD REFERENCE MATERIAL ACCURACY:	Two standard reference materials were analyzed with this batch of samples. SRM 1641d for Hg and SRM 1640 for metals analyzed by ICP-MS. Accuracy for SRMs was expressed as the percent difference (PD) between the measured and certified values. One replicate of SRM 1641d for Hg was analyzed with this batch of samples. The percent difference for the SRM recovery was 6% and within the QC acceptance criterion of ± 25%. One replicate of SRM 1640 was analyzed with this batch of samples. The percent differences were within the QC acceptance criterion of ± 25% for all metal.

BATTELLE MARINE SCIENCES LABORATORIES
Jill Brandenberger, Project Manager
1529 West Sequim Bay Rd.
Sequim, Washington 98382
(360) 681-4564

USACE NED - Bushneck Cove
Metals in Rinsate Water
Samples Received on 09/11/07

(concentrations in µg/L)

Sponsor ID	MSL Code	Site Description	Collection Date	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
			Instrument:	*ICP-MS*	*ICP-MS*	*ICP-MS*	*ICP-MS*	*CVAF*	*ICP-MS*	*ICP-MS*	*ICP-MS*
			CAS Number:	7440-38-2	7440-43-9	7440-47-3	7440-50-8	7439-97-6	7440-02-0	7439-92-1	7440-66-6
GAG-012	2799-12	Rinsate Blank	09/06/07	0.015 U	0.001 U	0.083 U	0.00900 j	0.000188 U	0.0606	0.00776	0.209 U
Detection Limits											
Laboratory Achieved Method Detection Limit (MDL				**0.015**	**0.001**	**0.083**	**0.004**	**0.000188**	**0.013**	**0.001**	**0.209**
Reporting Limit (RL = 3.18 * MDL)				0.05	0.003	0.3	0.013	0.0006	0.04	0.003	0.7
Procedural Blank											
BLANK092007 or TRM BLKR1				0.015 U	0.001 U	0.083 U	0.004 U	0.000188 U	0.013 U	0.001 U	0.209 U
Blank Spike/Matrix Spike Sample											
OPR092007run1 (Hg) or TRM +5ppb				1.97	1.98	1.67	1.93	0.00549	1.91	2.04	2.05
OPR092007run2 (Hg)				NA	NA	NA	NA	0.00544	NA	NA	NA
BLANK092007 or TRM BLKR1				0.015 U	0.001 U	0.083 U	0.004 U	0.000188 U	0.013 U	0.001 U	0.209 U
	Spiking Level			2	2	2	2	0.00512	2	2	2
	Percent Recovery			**99%**	**99%**	**84%**	**96%**	**104%**	**96%**	**102%**	**102%**
	Percent Recovery			NA	NA	NA	NA	**103%**	NA	NA	NA
STANDARD REFERENCE MATERIAL											
1641d092007 (Hg) or 1640TRM				28.18	23.82	38.48	85.73	1470	27.31	29.15	58.03
	certified or reference value			26.67	22.79	38.6	85.2	1590	27.4	27.89	53.2
	range			±0.410	± 0.96	±1.6	± 1.2	±18	± 0.8	± 0.14	± 1.1
	Percent Difference			**6%**	**5%**	**0%**	**1%**	**8%**	**0%**	**5%**	**9%**

U Not detected above laboratory achieved MDL; MDL reported
j Analyte detected below the Limit of Quantitaion /RL; concentration reported may be an estimate
N QC value outside the accuracy or precision criteria goal (Spikes ±30%R; SRM ≤25%PD; Replicates ±30%RPD)
n QC value outside the accuracy or precision data quality objective, but meets contingency criteria.
-- Not available/applicable

Battelle Marine Science Laboratory

Method Detection Limit Study Summary

Date: 10/2/2007

MATRIX: Freshwater (TRM)

	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Instrument:	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	CVAF	ICP-MS	ICP-MS	ICP-MS	ICP-MS
	3/6/2007	3/6/2007	3/6/2007	3/6/2007	3/6/2007	1/25/2007	3/6/2007	3/6/2007	3/6/2007	3/6/2007
CAS Code:	7440-22-4	7440-38-2	7440-43-9	7440-47-3	7440-50-8	7439-97-6	7440-02-0	7439-92-1	7782-49-2	7440-66-6
MDL 1	0.0106	0.278	0.00936	0.309	0.0553	0.000736	0.0757	0.00895	0.310	0.224
MDL 2	0.00951	0.285	0.00918	0.354	0.0526	0.000573	0.0713	0.00946	0.305	0.222
MDL 3	0.00912	0.289	0.00869	0.315	0.0535	0.000596	0.0710	0.00882	0.312	0.226
MDL 4	0.0101	0.285	0.00843	0.339	0.0519	0.000660	0.0773	0.00832	0.311	0.205
MDL 5	0.00965	0.287	0.00863	0.341	0.0547	0.000652	0.0807	0.00897	0.314	0.210
MDL 6	0.00901	0.291	0.00903	0.275	0.0549	0.000702	0.0730	0.00935	0.322	0.390
MDL 7	0.00934	0.279	0.00928	0.330	0.0537	0.000599	0.0801	0.00902	0.312	0.208
MEAN	0.00962	0.285	0.00894	0.323	0.0538	0.000645	0.0756	0.0090	0.312	0.241
STDEV	0.000563	0.00485	0.00036	0.0263	0.00125	0.000060	0.0040	0.00037	0.0051	0.0664
MDL	0.00177	0.0152	0.00113	0.0827	0.00394	0.000188	0.0125	0.00117	0.0161	0.209

cc: Project Manager/Central File
Login File 2799

SAMPLE LOGIN

(SOP# MSL-A-001)

Project Manager: Brandenberger
Date Received: 09/11/07
Batch: 1

PROJECT: Brushneck Cove

SPONSOR CODE	Site Description	BATTELLE CODE	MATRIX	STORAGE LOCATION	PARAMETERS REQUESTED	COLLECTION DATE	INITIALS
GAG-001-D ✓	na	2799-1 ✓	sediment ✓	Deep Freezer B-1	metals	09/05/07 ✓	CS/MLFM
GAG-002-D	na	2799-2	sediment	Deep Freezer B-1	metals	09/05/07	CS/MLFM
GAG-003-D	na	2799-3	sediment	Deep Freezer B-1	metals	09/05/07	CS/MLFM
GAG-004-D	na	2799-4	sediment	Deep Freezer B-1	metals	09/05/07	CS/MLFM
GAG-005-D	na	2799-5	sediment	Deep Freezer B-1	metals	09/05/07	CS/MLFM
GAG-006-D	na	2799-6	sediment	Deep Freezer B-1	metals	09/05/07	CS/MLFM
GAG-007-D	na	2799-7	sediment	Deep Freezer B-1	metals	09/05/07	CS/MLFM
GAG-008-D	na	2799-8	sediment	Deep Freezer B-1	metals	09/05/07	CS/MLFM
GAG-009-D	na	2799-9	sediment	Deep Freezer B-1	metals	09/05/07	CS/MLFM
GAG-010-D	na	2799-10	sediment	Deep Freezer B-1	metals	09/06/07 ✓	CS/MLFM
GAG-011-D ✓	na	2799-11	sediment	Deep Freezer B-1	metals	09/06/07 ✓	CS/MLFM
GAG-012 ✓	na	2799-12 ✓	water ✓	Prep Lab L-4-A	metals	09/06/07 ✓	CS/MLFM

√ 12 8/

Page 1 of 1

Chain of Custody

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Project Number: G606430	Project Name: **Brushneck Cove**

Sampler's Signature:

ANALYSIS REQUESTED → "NUMBER OF CONTAINERS"

Collection Date/Time	Battelle ID	Client ID	Sample Description	PEST	PCB	TPH	PAH	VOA	TBT	METALS	TOC	Grain Size	ACIDIFIED	PRESERVED	Total No. of Containers
9/5/07 10:50	GAG-001-D	2799-1	Sediment Composite of Top portion of core GAG-001							X					1
9/5/07 11:20	GAG-002-D	2	Sediment Composite of Single Core							X					1
9/5/07 11:45	GAG-003-D	3	Sediment Composite of Single Core							X					1
9/5/07 12:25	GAG-004-D	4	Sediment Composite of Single Core							X					1
9/5/07 13:20	GAG-005-D	5	Sediment Composite of Single Core							X					1
9/5/07 13:50	GAG-006-D	6	Sediment Composite of Single Core							X					1
9/5/07 14:25	GAG-007-D	7	Sediment Composite of Single Core							X					1
9/5/07 15:15	GAG-008-D	8	Sediment Composite of Single Core							X					1
9/5/07 15:45	GAG-009-D	9	Sediment Composite of Single Core							X					1
9/6/07 8:20	GAG-010-D	10	Sediment Composite of Single Core							X					1
9/6/07 8:46	GAG-011-D	11	Sediment Composite of Single Core							X					1
9/6/07 9:45	GAG-012	2799-12	Metals Equipment Blank							X					1

Relinquished By:	Date/Time	Received By:	Date/Time
Jessie M Fahy	9/10/07 1500	Battelle MSL G Susick	9/11/07 1230

Relinquished By:	Date/Time	Received By:	Date/Time

Comments:

Battelle

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Duxbury Operations
397 Washington Street
Duxbury, Massachusetts 02332
Telephone 781-934-0571
Fax: 781-934-2124

September 10, 2007

Ms. Jill Brandenberger
Ms. Carolynn Suslick (Sample Custodian)
Battelle Marine Sciences Laboratory (MSL)
1529 West Sequim Bay Road (Room MSL5)
Sequim, Washington 98382

Subject: USACE NAE DO #30, Brushneck Cove Sediments for Metals Analyses

Dear Jill:

Enclosed please find **11 sediment samples and one (1) rinsate blank** collected in support of the Brushneck Cove project. Sediment samples must be analyzed for 8 metals, (see Brushneck Cove SAP for further details). Samples were collected from September 5 -6, 2007; custody records are enclosed with the samples. Please return the signed custody forms to Lynda Short at Battelle.

Sample results are due within 4-weeks of receipt of samples at your laboratory. Final data are required in electronic and hardcopy formats. The electronic copies of the data will include your standard excel spreadsheet data summary as well as the electronic data deliverable (EDD) in the DMSmart EDD format. If you have any questions regarding these samples please call me at (781) 952-5295.

Sincerely,

Lynda M. Short

Lynda Short
Project Manager

LOG-IN CHECKLIST Bushneck Cove Bat 1 Reference SOP# MSL-A-001

Central File #: New 2799 Sample No(s): 1-12 Project Manager: JMB

TO BE COMPLETED BY PROJECT MANAGER (prior to arrival when possible)

Matrix: sed/seawater WP# W82099

Yes	No	
	✓	Navy-type Project (requires high-level sample tracking procedures)
	✓	Filter Samples: Amount: Entire sample Half of sample
✓		Freeze dry sample(s) - samples will be weighed and placed in ultralow temp freezer (Lab# 130)
	✓	Special instructions:

Sample Preservation Instructions: Samples preserved in field

Date To Archive: ______ Date To Dispose: ______

TO BE COMPLETED UPON SAMPLE ARRIVAL/LOG-IN

Yes	No	N/A	Indicate in Appropriate Box
	✓		Was a custody seal present?
		✓	Was the custody seal intact?
✓			Was cooler(s) temperature(s) within acceptable range of 4±2°C or frozen? 3.7 °C (if multiple coolers, note temp. of each) °C
		✓	Was Project Manager notified of any custody/login discrepancies (cooler temp, sponsor codes, etc)? Comment/Remedy:
✓			Were all chain of custody forms signed and dated?
	✓		Were samples filtered at MSL?

Sample condition(s): Acceptable Other (explain):

Container type: Teflon WAT Poly Glass Spex SED Other:

Notes: labels & tape added to spex jars by sampler

Completed By: C Andin Date/Time: 9/11/07 1230

SAMPLE PRESERVATION

- [ ] Sample(s) were preserved at MSL
- [x] Sample(s) were preserved prior to arrival at MSL (noted on CoC / Sample / per PM Instruction) WAT
- [ ] Random pH checked for ~10% of samples (use dip paper) Sample IDs:
- [ ] Complete pH check required for project (use pH meter and record on pH Record form)

If preservation necessary, record Acid Lot#

Type:
- [ ] 0.2% HNO3 Notes:
- [ ] 0.5% HCl (Hg samples) Notes:
- [x] Refrigerate/Freeze Notes: SEDS - dup fzr B-1
- [ ] Other Notes:

Completed By: C Andin Date/Time: 9/11/07 1230

Wat - prep Lab L4A

Revsed 033006

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Attachment C

Final Field Sampling Report

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US ARMY CORPS
OF ENGINEERS
New England District

Contract No. DACW33-03-D-0004

Delivery Order No. 30

October 22, 2007

Final Field Sampling Report

Laboratory Testing in Support of Sampling and Environmental Testing – Brushneck Cove Section 206 Project, Warwick, RI

FINAL FIELD SAMPLING REPORT

Laboratory Testing in Support of Environmental Assessment Sampling and Environmental Testing- Brushneck Cove Section 206 Project, Warwick, RI.

Submitted to:

Department of the Army
U.S. Army Corps of Engineers
North Atlantic Division
New England District

Contract Number: DACW33-03-D-0004
Delivery Order Number: DO#30

Prepared by:

Battelle
397 Washington Street
Duxbury, MA 02332
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October 22, 2007

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TABLE OF CONTENTS

1.0 Introduction 7
  1.1 Site Description 7
  1.2 Project Objectives and Field Activity Summary 7
2.0 Methods 8
  2.1 Sample Collections 8
  2.2 Core Processing 9
3.0 Survey Chronology 11
4.0 Survey Results 12
5.0 Analytical Results 13
6.0 Problems experienced, actions taken, and recommendations 13
  6.1 Logistical 13
  6.2 Technical 13
7.0 References 13

LIST OF TABLES

Table 1. Target Sample Locations and Estimated Project Depths for Brushneck Cove Section 206 Project, Warwick, RI, Sediment Sampling. 8
Table 2. Survey Personnel for Brushneck Cove Section 206 Project, Warwick, RI, Sediment Sampling. 8
Table 3. Summary of Sediment Collection Data from the Brushneck Cove Section 206 Project, Warwick, RI, Sediment Sampling 11
Table 4. Summary of Grain Size Analyses for Brushneck Cove Sediment Cores. 13

LIST OF FIGURES

Figure 1. Sampling Locations within Brushneck Cove and Buttonwoods Cove located in Warwick, RI. 10

APPENDICES

Appendix A: Sampling and Core Characterization Logs
Appendix B: Daily Operations Logs
Appendix C: Chain of Custody Logs (COCs)
Appendix D: Grain Size Analysis Results

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1.0 INTRODUCTION

This report covers the activities conducted at the request of the US Army Corps of Engineers, New England District (NAE) to support a proposed restoration project for Brushneck Cove Section 206 Project, Warwick, RI.

The proposed work consists of taking sediment cores to depths of approximately 10 feet or refusal from 11 locations within Brushneck and Buttonwoods Coves (Table 1 and Figure 1).

Each of the 11 cores were characterized, homogenized, and sampled for grain size, total organic carbon (TOC), organics (PCB/PEST/PAH), and metals analyses. The data collected from these cores will be used by NAE to determine the alternatives available for disposal of sediment resulting from the restoration efforts.

1.1 Site Description

Brushneck Cove is located within the city of Warwick, Rhode Island. The study area encompasses Brushneck Cove, Buttonwoods Cove and Oakland Beach. The coves are tributaries of Greenwich Bay bordering Warwick City Park and the suburban developments of Oakland Beach and Buttonwoods. Warwick is approximately 15 miles southwest of Providence, RI.

1.2 Project Objectives and Field Activity Summary

This Survey Report details the field sampling and sample preparation activities. On September 5 and 6, 2007, a single core sample was taken at each of the 11 separate locations in Brushneck Cove and Buttonwoods Cove located in Warwick, RI. Cores were collected using a vibracore to the specified project depth or refusal. Upon collection all cores were capped, sealed, labeled, and stored upright until processing could begin. All cores were returned to Battelle's Duxbury facility for characterization and sub-sampling for grain size analyses.

Table 2 lists survey personnel and responsibilities. Sampled locations are shown in Figure 1. This report describes the activities conducted during sampling and provides a synopsis of some preliminary observations from the survey. A description of survey methods is provided in Section 2. A chronological summary of survey activities for sampling is provided in Section 3. Preliminary survey results are provided in Section 4. Analytical results are provided in Section 5. A description of survey problems, corrective actions, and recommendations for future surveys, can be found in Section 6. Sampling and Core Characterization Logs are presented in Appendix A. Daily Operations Logs are presented in Appendix B and Chain of Custody (COC) Logs are presented in Appendix C. The grain size laboratory data report is attached in Appendix D.

Table 1. Target Sample Locations and Estimated Project Depths for Brushneck Cove Section 206 Project, Warwick, RI, Sediment Sampling.

Sampling Location	Estimated Penetration (feet) from Water/Sediment Interface	Longitude NAD 83	Latitude NAD 83
BNC-C-01	10	-71.41325535750	41.69741341260
BNC-C-02	10	-71.41102050130	41.69644492560
BNC-C-03	10	-71.40952836300	41.69522970920
BNC-C-04	10	-71.40690425120	41.69551680750
BNC-C-05	10	-71.40661700910	41.69417634440
BNC-C-06	10	-71.40490002820	41.69230196940
BNC-C-07	10	-71.40344366770	41.68925766530
BNC-C-08	10	-71.40594137840	41.68594710170
BNC-C-09	10	-71.40499035790	41.68791891410
BNC-C-10	10	-71.40876694210	41.68672265390
BNC-C-11	10	-71.41112367790	41.68805687510

Table 2. Survey Personnel for Brushneck Cove Section 206 Project, Warwick, RI, Sediment Sampling.

	Battelle Staff		*TG&B and the R/V Carolina Skiff*	
Date	**Chief Scientist/ Geologist**	**Research Scientist**	**Captain**	**Senior Sampling Staff**
	Matt Fitzpatrick	Mike McKee	Mark Avakian	Jeff Balmer
9/5/2007	M/C	M/C	M/C	M/C
9/6/2007	M/C	M/C	M/C	M/C

M= Mobilization/ demobilization
C= Vibracore sampling
NA= Not Applicable

2.0 METHODS

Details on the survey/sampling methods can be found in the final Brushneck Cove Sampling and Analysis Plan (Battelle 2007).

2.1 Sample Collections

Core samples were collected at each of 11 stations (Figure 1) using a vibracorer to maximize efficiency and core recovery. The cores were captured in pre-rinsed polycarbonate (Lexan™) liners. Each acceptable core was capped on the bottom while horizontal, positioned vertically and capped on top, labeled, and stored upright (in the containers). During all field activities samples were stored on the vessel in barrels or bags filled with ice. Samples were transported from the field to Battelle, Duxbury in the ice filled barrels. Upon arrival at Battelle, samples were placed in a secure, continuously monitored cold room which is maintained at $4^{o}C \pm 2^{o}C$.

Sediment collection data are summarized in Table 3; sampling and core characterization log forms associated with the sediment collections are presented in Appendix A.

Rinsate Blank Collections

One rinsate blank of the vibracore was collected during sampling activities. The rinsate was submitted for metals and organics (PAH/PCB/pesticide) analyses. The vibracore rinsate was collected by pouring several liters of MilliQ water over the sediment catcher devise and into a length of Lexan liner (~2.5 feet) which was capped at one end. The rinsate was then decanted into the appropriate sample jars. The metals blank was acidified in the field.

2.2 Core Processing

Details on the sediment processing methods can be found in the Brushneck Cove Sampling and Analysis Plan (Battelle, 2007). Sample collection information is indicated in the sample core and characterization logs in Appendix A and on the Chains of Custody in Appendix C.

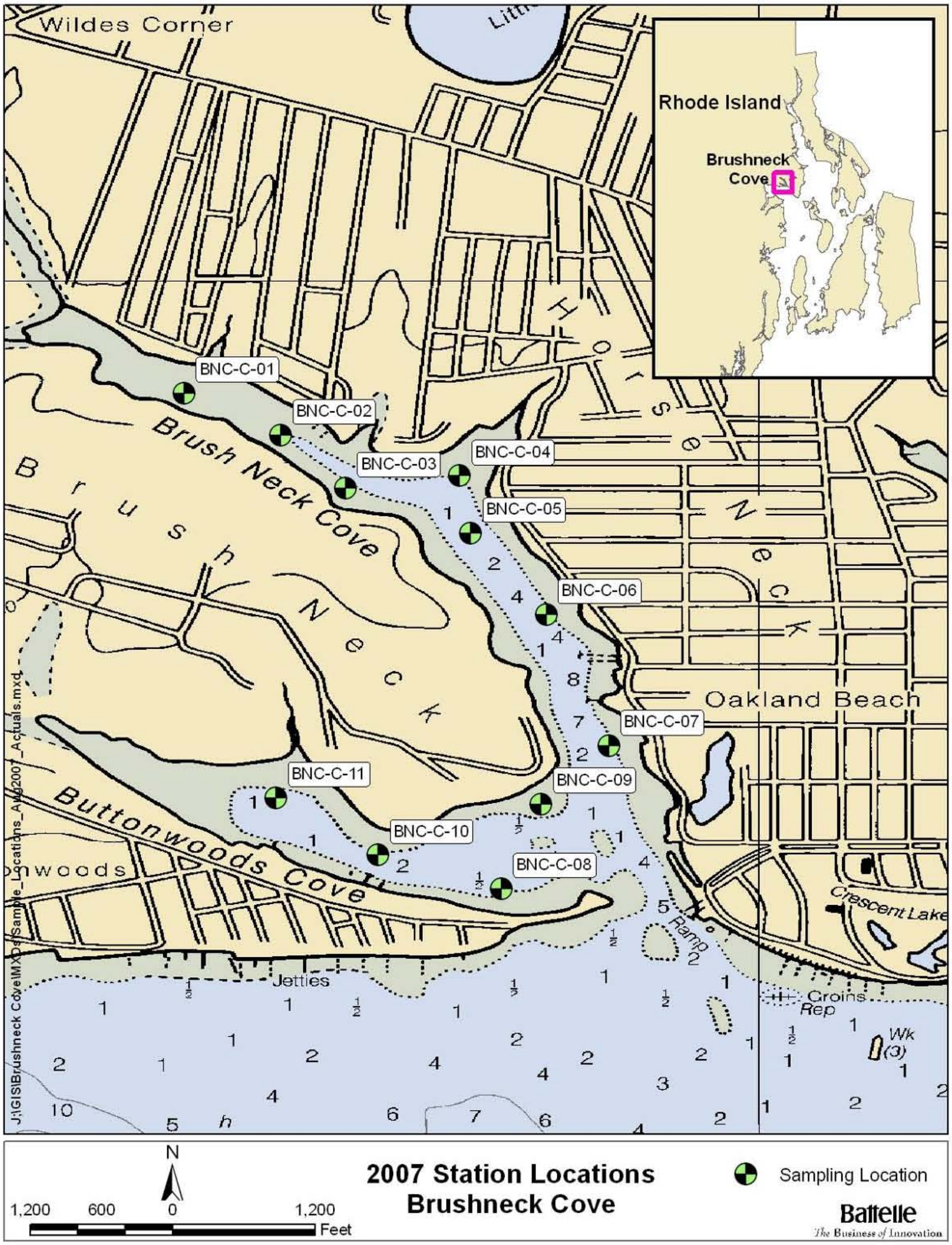

Figure 1. Sampling Locations within Brushneck Cove and Buttonwoods Cove located in Warwick, RI.

Table 3. Summary of Sediment Collection Data from the Brushneck Cove Section 206 Project, Warwick, RI, Sediment Sampling

Station ID	Sample ID	Latitude (NAD 83)	Longitude (NAD 83)	Date	Time (EDT)	Measured Water Depth (Ft)	Tide (Ft)	Penetration (Ft)	Recovery (Ft)
BNC-C-01	GAG-005-A	41°41.8455	71°24.7953	9/5/07	13:01	2.2	3.03	10.0	8.4
BNC-C-02	GAG-006-A	41°41.7870	71°24.6611	9/5/07	13:40	3.5	3.45	10.0	8.9
BNC-C-03	GAG-007-A	41°41.7138	71°24.5717	9/5/07	14:15	4.4	3.88	10.0	8.4
BNC-C-04	GAG-008-A	41°41.7307	71°24.4134	9/5/07	15:02	4.1	4.25	10.0	9.3
BNC-C-05	GAG-009-A	41°41.6510	71°24.3977	9/5/07	15:30	7.4	4.3	10.0	8.3
BNC-C-06	GAG-010-A	41°41.5380	71°24.2932	9/6/07	08:04	3.0	0.95	10.0	8.0
BNC-C-07	GAG-011-A GAG-016-A	41°41.3557	71°24.2065	9/6/07	08:40	2.5	0.81	10.0	8.3
BNC-C-08	GAG-002-A	41°41.1564	71°24.3557	9/5/07	11:00	3.3	1.48	10.0	8.6
BNC-C-09	GAG-001-A GAG-014-A	41°41.2751	71°24.3000	9/5/07	10:05	2.7	1.2	10.0	7.0
BNC-C-10	GAG-003-A GAG-015-A	41°41.2037	71°24.5260	9/5/07	11:31	2.3	1.75	10.0	8.6
BNC-C-11	GAG-004-A	41°41.2838	71° 24.6676	9/5/07	12:15	2.5	2.24	10.0	8.5

3.0 SURVEY CHRONOLOGY

Note: All times are recorded as Eastern Daylight Time

Wednesday, September, 5, 2007

0900 Battelle staff and TG&B staff meet at boat ramp, mobilize and launch the *R/V Carolina Skiff*.
0930 Board *R/V Carolina Skiff*, conduct health and safety briefing and depart for Station BNC-C-09.
1005 Arrive on Station BNC-C-09.
1025 Collect core from Station BNC-C-09; recovery not acceptable and core discarded.
1050 Second core collected from Station BNC-C-09; recovery acceptable and core retained.
1055 Depart for Station BNC-C-08.
1100 Arrive on Station BNC-C-08.
1120 Collect core from Station BNC-C-08; recovery acceptable and core retained.
1125 Depart for Station BNC-C-10.
1131 Arrive on Station BNC-C-10.
1145 Collect core from Station BNC-C-10; recovery acceptable and core retained.
1151 Depart for Station BNC-C-11.
1215 Arrive at Station BNC-C-11.
1225 Collect core from Station BNC-C-11; recovery acceptable and core retained.
1240 Depart for Station BNC-C-01.
1301 Arrive on Station BNC-C-01.

1320 Collect core from Station BNC-C-01; recovery acceptable and core retained.
1330 Depart for Station BNC-C-02.
1340 Arrive on Station BNC-C-02.
1350 Collect core from Station BNC-C-02; recovery acceptable and core is retained.
1405 Depart for Station BNC-C-03.
1415 Arrive on Station BNC-C-03.
1425 Collect core from Station BNC-C-03; recovery acceptable and core is retained.
1440 Depart for Station BNC-C-04.
1502 Arrive on Station BNC-C-04.
1515 Collect core from Station BNC-C-04; recovery acceptable and core is retained.
1525 Depart for Station BNC-C-05.
1530 Arrive on Station BNC-C-05.
1545 Collect core from Station BNC-C-05; recovery acceptable and core is retained.
1554 Secure sampling gear and depart for boat ramp.
1625 Arrive at boat ramp, offload core samples, and secure boat.
1630 Complete Day 1.

Thursday, September 6, 2006

0700 Battelle staff and TG&B staff meet at boat ramp, mobilize and launch the *R/V Carolina Skiff*.
0804 Arrive on Station BNC-C-06.
0820 Collect core from Station BNC-C-06; recovery acceptable and core retained.
0835 Depart for Station BNC-C-07.
0840 Arrive on Station BNC-C-07.
0846 Collect core from Station BNC-C-07; recovery acceptable and core retained.
0910 Secure sampling gear and depart for boat ramp.
0930 Arrive at boat ramp and offload core samples.
0945 Collect rinsate blanks.
1005 Complete Day 2.

4.0 SURVEY RESULTS

One core sample was collected at each of the 11 planned locations in Brushneck Cove and Buttonwoods Cove. Sampling was completed in 1.5 days. A summary of the coring survey data, which includes date, time and location, is presented in Table 3. All cores were processed on September 7 and September 10, 2007, at Battelle's Duxbury facility. A representative from ACOE NAE (Todd Randall) observed the core processing and provided guidance regarding sub-sampling. The sampled intervals are indicated in the core logs (Appendix A). Cores were cut laterally and characterized in terms of gross grain size (sand, silt, and clay), color, and odor. Samples were then homogenized and sampled for grain size, TOC, organics (PCB/PEST/PAH), and metals analyses. On Monday, September 10, 2007, samples collected for grain size and TOC analyses were shipped to Applied Marine Sciences (AMS), metal samples were shipped to Battelle Sequim, and samples collected for organics analyses were hand delivered to the analytical laboratory at Battelle, Duxbury. Samples were also archived in 16 ounce glass jars and stored in both a cold room and freezer for potential further analyses.

5.0 ANALYTICAL RESULTS

The grain size results are summarized in Table 4 and are presented in greater detail in Appendix D. Generally, the sediment composition ranged from clay in the bottom portion of the core to silt and fine sand in the upper portion of the core. A number of cores also possessed layers of shell hash. The sediments from all but one location (Station BNC-C-09) produced a noticeable sulfur odor. Station BNC-C-09, proximate to Buttonwoods Beach, exhibited a transition from fine sand to coarse sand with some fine gravel and a distinct horizon from 1.8 to 2.5 feet.

Table 4. Summary of Grain Size Analyses for Brushneck Cove Sediment Cores.

Sampling Location	% Gravel	% Coarse Sand	% Medium Sand	% Fine Sand	% Silt	% Clay	% Water Content	% Total Solids
GAG-001-A	0.56	0.92	7.73	68.34	15.48	6.97	25	80
GAG-002-A	1.21	0.17	1.83	21.43	45.68	29.68	77	56
GAG-003-A	0.00	0.29	3.58	28.02	39.66	28.45	80	55
GAG-004-A	0.00	0.00	1.05	10.35	55.44	33.16	101	50
GAG-005-A	0.00	0.91	1.74	19.05	48.17	30.13	84	54
GAG-006-A	0.00	0.12	2.08	19.34	46.73	31.73	88	53
GAG-007-A	0.00	0.24	3.06	22.65	38.90	35.15	88	53
GAG-008-A	0.00	0.00	0.86	12.37	50.00	36.77	96	51
GAG-009-A	0.00	0.27	1.29	16.36	47.72	34.36	87	53
GAG-010-A	0.00	0.00	1.63	27.48	42.55	28.34	71	59
GAG-011-A	0.00	0.00	3.84	40.32	36.98	18.86	56	64
GAG-014-A	0.36	1.57	4.23	84.34	9.17	0.33	20	84
GAG-014-A	0.33	1.46	4.34	82.96	10.60	0.31	20	84

6.0 PROBLEMS EXPERIENCED, ACTIONS TAKEN, AND RECOMMENDATIONS

6.1 Logistical

None.

6.2 Technical

None.

7.0 REFERENCES

NAE Brushneck Cove Sampling and Analysis Plan. (Battelle, 2007).

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Appendix A

Sampling and Core Characterization Logs

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Battelle
The Business of Innovation

Project #:	G606430	Vessel:	R/V Carolina Skiff
Project Name:	Brushneck Cove	Chief Scientist:	M. Fitzpatrick
Location:	Warwick, RI	Survey Duration (Date & Time):	
Client:	USACE NAE		

Station ID:	BNC-C-09	Time On Station:	1005	Attempt: 2		Feet
Station Descriptor:		Date: ①	9/5/07	1	Total Penetration:	10.0
Core Sample ID:	GAG001	Northing (NAD 83):	41° 41.27~~58~~		Recovery:	7.0
Logged by:	MRF	Easting (NAD 83):	71° 24. ~~7999~~ 3000		Time of collection:	1050
Collection Mechanism:	Vibracore	GPS Accuracy:	~~4??~~	2	Total Penetration:	
		Water Depth (ft):	~~2.05~~ 2.7		Recovery:	
		Tide (ft):	~~.9~~ 1.2		Time of collection:	
		Time Depart Station:	1055			

As Sampled depth below mudline (ft)*	Adjusted Depth below mudline (ft)*	Lithology - Include USCS code	Type	Color	Consistency	Maximum particle size	Odor	Sample IDs	Comments
0–1.8 (transitions 1.8)	shell hash		Sandy clay	Dk Grey 10YR 3/1	very firm to hard	fine sand	No odor		7ft core; grey sandy clay w/ small layer of shell hash @ 0.6-0.7ft
1.8 ↓ 2.5			fine sand ↓ course sand ↓ fine sand	grey / light brown	Very firm to hard	gravel (sm pebble)	No Odor		1st 1.8ft; ↓ grey to brown sand transition (1.8-2.5ft) med to course
2.5 – 7ft			↓		↓	↓	↓	GAG-001	↓ fine brown sand in light grey fine sand to 7ft 2.5YR 6/4
7ft – 10			↓					GAG-014	

Depth scale: 2, 4, 6, 8, 10, 12

Comments:
① poor recovery on 1st attempt

Bottom half - subsample for TOC/GS 1.7ft to 7ft GAG-014

Top half - full suite 0.0-1.7ft

Battelle
The Business of Innovation

Project #:	G606430	Vessel:	R/V Carolina Skiff
Project Name:	Brushneck Cove	Chief Scientist:	M. Fitzpatrick
Location:	Warwick, RI	Survey Duration (Date & Time):	
Client:	USACE NAE		

Station ID:	BNC-C-08	Time On Station:	1100	Attempt: 1 of 1	Feet
Station Descriptor:		Date:	9/5/07	1 Total Penetration:	10
Core Sample ID:	GAG-002	Northing (NAD 83):	41 41 1564	Recovery:	8.6
Logged by:	MRF	Easting (NAD 83):	71 24 3557	Time of collection:	1120
Collection Mechanism:	Vibracore	GPS Accuracy:		2 Total Penetration:	
		Water Depth (ft):	3.3	Recovery:	
		Tide (ft):	~~2.17~~ 1.48	Time of collection:	
		Time Depart Station:	1125		

As Sampled depth below mudline (ft)*	Adjusted Depth below mudline (ft)*	Lithology - Include USCS code	Type	Color	Consistency	Maximum particle size	Odor	Sample IDs	Comments
0–0.7			Clayey Silt	DK grey/Black 2.5Y 2.5/1	med to firm	fine	strong sulfide up to 2ft	GAG-002	0-0.7ft clayey silt DK grey to black soft to med ~~silty clay~~ w/ sm amts of fine sand
0.7–8.7			Silty Clay	DK grey; Slighty DK grey	firm	fine	low sulfide		0.7ft to bottom med-firm silty clay DK grey w/ trace amts

Depth scale: 2, 4, 6, 8, 10, 12

8.7 — 8.7 ft

Comments:

Waypoint – 1683

Page ___ of ___

Battelle
The Business of Innovation

Project #:	*G606430*	**Vessel:**	*R/V Carolina Skiff*
Project Name:	*Brushneck Cove*	**Chief Scientist:**	*M. Fitzpatrick*
Location:	*Warwick, RI*	**Survey Duration (Date & Time):**	
Client:	*USACE NAE*		

Station ID:	BNC-C-10	Time On Station:	1131	Attempt:	1 of 1	Feet
Station Descriptor:		Date:	9/5/07	1	Total Penetration:	10.0
Core Sample ID:	GAG-003	Northing (NAD 83):	41 41.2037		Recovery:	8.6
Logged by:	MRF	Easting (NAD 83):	71 24.5260		Time of collection:	1145
Collection Mechanism:	Vibracore	GPS Accuracy:		2	Total Penetration:	
		Water Depth (ft):	~~2.25~~ 2.3		Recovery:	
		Tide (ft):	1.75		Time of collection:	
		Time Depart Station:	1151			

As Sampled depth below mudline (ft)*	Adjusted Depth below mudline (ft)*	Lithology - Include USCS code	Type	Color	Consistency	Maximum particle size	Odor	Sample IDs	Comments
0–0.5			very fine sandy silt	Black	med to loose	fine	salty sulfide	GAG-003	0-0.5 black very fine sandy silt
0.5–0.6			shell	hash					0.5-0.6 shell hash 2.5Y 2.5/1
2	2		silty clay	DK grey	firm	fine			0.6-5.6 - firm silty clay 5.6-6.1 mod to firm silty clay 2.5Y 3/2
4	4						no odor	GAG-015	
6	6				med to firm	fine			6.1 ft - transition to fine sand grey brown 2.5Y 4/2
8	8		grey fine sand	grey brown (yellow grey)		fine			
10	10								
12	12								

Comments:

Waypoint 1684

* archiving bottom 2ft of sand GAG-015 0-5.5 ft sampled Bottom archived

Battelle
The Business of Innovation

Project #:	*G606430*	**Vessel:**	*R/V Carolina Skiff*
Project Name:	*Brushneck Cove*	**Chief Scientist:**	*M. Fitzpatrick*
Location:	*Warwick, RI*	**Survey Duration (Date & Time):**	
Client:	*USACE NAE*		

Station ID:	BNC-C-11	Time On Station:	1215	Attempt: 1 of 1	Feet
Station Descriptor:		Date:	9/5/07	1	Total Penetration: 10.0
Core Sample ID:	GAG-004	Northing (NAD 83):	41°41.2838		Recovery: 8.5
Logged by:	MRF	Easting (NAD 83):	71° 24.6676		Time of collection: 1225
Collection Mechanism:	Vibracore	GPS Accuracy:		2	Total Penetration:
		Water Depth (ft):	2.5		Recovery:
		Tide (ft):	2.24		Time of collection:
		Time Depart Station:	1240		

As Sampled depth below mudline (ft)*	Adjusted Depth below mudline (ft)*	Lithology - Include USCS code	Type	Color	Consistency	Maximum particle size	Odor	Sample IDs	Comments
0.0			Silt	Black	med to loose	fine	No odor		0-0.5 - Black silt
2	2		silty cl	DK grey 2.5y 2.5/1	med firm	fine	sulfur to about 3ft	↑	0.5-8.9ft Dk grey silty clay grades to slightly lighter dk grey
4	4		↓	↓	↓			GAG-004	
6	6				very firm			↓	
8	8								
8.9									
10	10								
12	12								

Comments:

Waypoint 1686

Photographed top 1st bottom 2nd

Battelle
The Business of Innovation

Project #:	G606430	Vessel:	R/V Carolina Skiff
Project Name:	Brushneck Cove	Chief Scientist:	M. Fitzpatrick
Location:	Warwick, RI	Survey Duration (Date & Time):	
Client:	USACE NAE		

Station ID:	BNC-C-01	Time On Station:	1301	Attempt: 1 of 1	Feet
Station Descriptor:		Date:	9/5/07	1 Total Penetration:	10.0
Core Sample ID:	GAG-005	Northing (NAD 83):	41°41.8455	Recovery:	8.4
Logged by:	MRF	Easting (NAD 83):	71°24.7953	Time of collection:	1320
Collection Mechanism:	Vibracore	GPS Accuracy:		2 Total Penetration:	
		Water Depth (ft):	2.2	Recovery:	
		Tide (ft):	3.03	Time of collection:	
		Time Depart Station:	1330		

0.0

As Sampled depth below mudline (ft)*	Adjusted Depth below mudline (ft)*	Lithology - Include USCS code	Type	Color	Consistency	Maximum particle size	Odor	Sample IDs	Comments
			clay SILT	Black	loose to med firm	fine	sulfur		0-0.7 Black clayey silt
2	2		SILTY clay	Dark Grey 2.5Y 2.5/1	firm		some sulfur	GAG-005	0.7-8.7 dark clay increase in firmness as you move towards bottom. Shell hash @ 2.5ft
4	4				very firm	fine			
6	6								
8	8								sm. amount of peat
10	10								
12	12								

8.7

Comments:

Waypoint 1689

Battelle
The Business of Innovation

Project #:	*G606430*	**Vessel:**	*R/V Carolina Skiff*
Project Name:	*Brushneck Cove*	**Chief Scientist:**	*M. Fitzpatrick*
Location:	*Warwick, RI*	**Survey Duration (Date & Time):**	
Client:	*USACE NAE*		

Station ID:	BNC-C-02	Time On Station:	1340	Attempt:	1 of 1
Station Descriptor:		Date:	9/5/07		Feet
Core Sample ID:	GA6006	Northing (NAD 83):	41°41.7870	1 Total Penetration:	10.0
Logged by:	MRF	Easting (NAD 83):	71°24.6611	Recovery:	8.9
Collection Mechanism:	Vibracore	GPS Accuracy:		Time of collection:	1350
		Water Depth (ft):	3.5'	2 Total Penetration:	
		Tide (ft):	3.45	Recovery:	
		Time Depart Station:	1405	Time of collection:	

As Sampled depth below mudline (ft)*	Adjusted Depth below mudline (ft)*	Lithology - Include USCS code	Type	Color	Consistency	Maximum particle size	Odor	Sample IDs	Comments
0.0 → 0.6			clayey silt	Black	loose	fine	sulfur		0-0.6 - Black clayey silt
									0.9 - 2ft shells/shellhash
2	2		silty clay	Dk grey	firm			↑ GA6-006 ↓	0.6 - 8.8 - Dk grey silty clay firmness increases as more towards bottom
4	4					fine	✓		
6	6			2.5Y 2.5/1 gradient into					
8	8			2.5Y 3/1	very firm				
8.8									
10	10								
12	12								

Comments:

Waypoint 1691

Battelle
The Business of Innovation

Project #:	*G606430*	**Vessel:**	*R/V Carolina Skiff*
Project Name:	*Brushneck Cove*	**Chief Scientist:**	*M. Fitzpatrick*
Location:	*Warwick, RI*	**Survey Duration (Date & Time):**	
Client:	*USACE NAE*		

Station ID:	BWC-C-03	Time On Station:	1415	Attempt:		Feet
Station Descriptor:		Date:	9/5/07	1	Total Penetration:	10
Core Sample ID:	GAG-007	Northing (NAD 83):	41°41.7138		Recovery:	8.4
Logged by:	MRF	Easting (NAD 83):	71°24.5717		Time of collection:	1425
Collection Mechanism:	Vibracore	GPS Accuracy:		2	Total Penetration:	
		Water Depth (ft):	4.4		Recovery:	
		Tide (ft):	3.88		Time of collection:	
		Time Depart Station:	1440			

As Sampled depth below mudline (ft)*	Adjusted Depth below mudline (ft)*	Lithology - Include USCS code	Type	Color	Consistency	Maximum particle size	Odor	Sample IDs	Comments
0.0			SILT	BLACK	loose	fine	sulfur		0-0.5 - Black SILT
									0.85 - 1.0 sand patch w/ shells
2	2		clay	DK grey 10YR 3/1	firm	fine	sulfur	GAG-007	1.0 - 8.4 firm silty clay Dk grey
4	4								
6	6								
8	8								
8.4									
10	10								
12	12								

Comments:

Waypoint ~~#~~ 1698

Page ____ of ____

Battelle
The Business of Innovation

Project #:	G606430	Vessel:	R/V Carolina Skiff
Project Name:	Brushneck Cove	Chief Scientist:	M. Fitzpatrick
Location:	Warwick, RI	Survey Duration (Date & Time):	
Client:	USACE NAE		

Station ID:	BNC-C-04	Time On Station:	15:02	Attempt:	1 of 1 — Feet
Station Descriptor:		Date:	9/5/07	1 Total Penetration:	10.0
Core Sample ID:	GAG-008	Northing (NAD 83):	41°41.7307	Recovery:	9.3
Logged by:	MRF	Easting (NAD 83):	71°24.9134	Time of collection:	1515
Collection Mechanism:	Vibracore	GPS Accuracy:		2 Total Penetration:	
		Water Depth (ft):	4.1'	Recovery:	
		Tide (ft):	4.25	Time of collection:	
		Time Depart Station:	1525		

As Sampled depth below mudline (ft)*	Adjusted Depth below mudline (ft)*	Lithology - Include USCS code	Type	Color	Consistency	Maximum particle size	Odor	Sample IDs	Comments
0.0			clayey SILT	Black	loose				0-1.1 ft Black/Dk grey clayey SILT loose
2	2		SILTY CLAY	DK grey	med firmness	fine	strong sulfur	GAG-008	1.1 ft-3 ft Dk grey silty clay ~~loose~~ med firmness
4	4		Silty clay	DK grey 2.5Y 2.5/1	firm ↓ very firm				3 ft-9.5 ft firm Dk grey silty clay
6	6								
8	8								
9.5									
10	10								Shell @ 5.8 ft
12	12								

Comments:

Way point: 1693

Battelle
The Business of Innovation

Project #:	G606430	Vessel:	R/V Carolina Skiff
Project Name:	Brushneck Cove	Chief Scientist:	M. Fitzpatrick
Location:	Warwick, RI	Survey Duration (Date & Time):	
Client:	USACE NAE		

Station ID:	BNC-C-05	Time On Station:	1530	Attempt:	1 of 1 — Feet
Station Descriptor:		Date:	9/5/07	1 Total Penetration:	10.0
Core Sample ID:	GAG-009	Northing (NAD 83):	41°41.6510	Recovery:	8.3
Logged by:	MRF	Easting (NAD 83):	71°24.3977	Time of collection:	1545
Collection Mechanism:	Vibracore	GPS Accuracy:		2 Total Penetration:	
		Water Depth (ft):	7.4	Recovery:	
		Tide (ft):	4.3	Time of collection:	
		Time Depart Station:	1554		

As Sampled depth below mudline (ft)*	Adjusted Depth below mudline (ft)*	Lithology - Include USCS code	Type	Color	Consistency	Maximum particle size	Odor	Sample IDs	Comments
0.0			~~Black~~ Silt	Black	loose	fine	sulfur		0-0.4 Black Silty Organic Matter
			Silty CLAY	2.5Y 2.5/1 DK GREY	firm				0.4-1.4 - DK grey Silty Clay mod. firmness
2	2							GAG-008	1.4-8.5ft DK grey Silty clay firm ⇒ very firm
4	4			2.5Y 3/1 DK Grey		fine	sulfur odor		
6	6				very firm				
8	8								
8.5									
10	10								
12	12								

Comments:

Waypoint

Battelle *The Business of Innovation*	**Project #:**	*G606430*	**Vessel:**	*R/V Carolina Skiff*
	Project Name:	*Brushneck Cove*	**Chief Scientist:**	*M. Fitzpatrick*
	Location:	*Warwick, RI*	**Survey Duration (Date & Time):**	
	Client:	*USACE NAE*		

Station ID:	BNC-C-06	Time On Station:	0804	Attempt: 1 of 1	Feet
Station Descriptor:		Date:	9/6/07	1 Total Penetration:	10.0
Core Sample ID:	GAG-010	Northing (NAD 83):	41°41.5380	Recovery:	8.0
Logged by:	MRF	Easting (NAD 83):	71°24.2932	Time of collection:	0820
Collection Mechanism:	Vibracore	GPS Accuracy:		2 Total Penetration:	
		Water Depth (ft):	3.0	Recovery:	
		Tide (ft):	.95	Time of collection:	
		Time Depart Station:	0835		

As Sampled depth below mudline (ft)*	Adjusted Depth below mudline (ft)*	Lithology - Include USCS code	Type	Color	Consistency	Maximum particle size	Odor	Sample IDs	Comments
0.0–0.5			clayey silt	Black	loose to mod firm	fine	sulfur		0-0.5 - Black Silt w/ clay + shell hash
0.5–8.2			Silty clay	Dk Grey 2.5Y 3/1	firm; very firm	fine	sulfur	GAG-010	0.5-8.2 Dk grey silty clay Sm amts of shell hash up to 4 ft Razor clam 4.4-4.6
8.2									

Depth scale: 2, 4, 6, 8, 10, 12

Comments:

Depart Dock @ ~0730

Waypoint 1696

Battelle
The Business of Innovation

Project #:	G606430	Vessel:	R/V Carolina Skiff
Project Name:	Brushneck Cove	Chief Scientist:	M. Fitzpatrick
Location:	Warwick, RI	Survey Duration (Date & Time):	
Client:	USACE NAE		

Station ID:	BNC-C-07	Time On Station:	0840	Attempt:	1 of 1
Station Descriptor:		Date:	9/6/07	1 Total Penetration (Feet):	10.0
Core Sample ID:	GAG-011	Northing (NAD 83):	41°41.3557	Recovery:	8.3
Logged by:	MRF	Easting (NAD 83):	71°24.2065	Time of collection:	0846
Collection Mechanism:	Vibracore	GPS Accuracy:		2 Total Penetration:	
		Water Depth (ft):	2.5'	Recovery:	
		Tide (ft):	.81	Time of collection:	
		Time Depart Station:	0910		

As Sampled depth below mudline (ft)*	Adjusted Depth below mudline (ft)*	Lithology - Include USCS code	Type	Color	Consistency	Maximum particle size	Odor	Sample IDs	Comments
0.0–0.6			clayey SILT	Black	loose	fine	sulfur		0-0.6 Black clayey-SILT loose w/ shell hash
0.6–7.2			Silty clay	DK. grey 2.5Y 3/1	firm ↓ very firm	fine	sulfur	GAG-011	0.6-7.2 DK grey silty-clay
7.2–8.4			Sand	Grey Brown 10YR 5/1	firm	fine	slight sulfur	GAG-016	7.2-8.4 - fine sand grey-brown. Archived

Depth scale: 0, 2, 4, 6, 8, 10, 12

Comments:

Waypoint 1697

Depart for dock

Arrive dock @ 0930

collect blanks @ 0945

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Appendix B

Daily Operations Logs

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Field Log Form

Project: Laboratory Testing In Support of Environmental Assessment-Brushneck Cove, RI
Project #: G606430

DATE _INITIALS MRF 9/5/07 **START TIME STOP TIME** 0930-1630
FIELD LOCATION:
Brushneck Cove, Warwick, RI

VESSEL NAME R/V Carolina Skiff

PERSONNEL	AFFILIATION
Matt Fitzpatrick	Battelle
Mark Avakian	TG&B
Jeff Balmer	TG&B
Mike Mickee	Battelle

WEATHER

TIME	TEMP °C	PRECIP	SKY	WIND
0953	~65°f	none	Clear	N ~5

COMMENTS
Depart dock @ 0930 pick up mike @ other ramp @ 0953
Return to dock @ 1625

Project: Laboratory Testing In Support of Environmental Assessment-Brushneck Cove, RI
Project #: G606430

CHECK dGPS against at least one reference checkpoint at beginning and end of each day.

dGPS Reference Checkpoint Name ______________________
Benchmark Location:

Time	Units and Datum	Northing / Latitude	Easting / Longitude
Beginning of day			
End of day			

Comments - No USGS geodetic benchmark
Waypoints marked as ref by TG&B

Date/Time 09/05/07 Vessel R/V Carolina Skiff
Unit Make/Model Leica MX 420 dGPS

HEALTH AND SAFETY BRIEFING:

Conducted @ 0930 - covered slips, trips
hard hats, PFDs, eyewear, steel toe boots

Field Log Form

Project: Laboratory Testing In Support of Environmental Assessment-Brushneck Cove, RI
Project #: G606430

DATE _INITIALS MM 9/6/07 **START TIME STOP TIME** 0700 / 1005
FIELD LOCATION:
Brushneck Cove, Warwick, RI

VESSEL NAME R/V Carolina Skiff

PERSONNEL	AFFILIATION
Matt Fitzpatrick	Battelle
Mike McKee	Battelle
Mark Avakian	TG & B
Jeff Balmer	TG & B

WEATHER

TIME	TEMP °C	PRECIP	SKY	WIND
0800	~65°F	none	overcast	SW ~15

COMMENTS
Depart dock @ 0730
Complete survey @ 0900
Return to dock @ 0930

Project: Laboratory Testing In Support of Environmental Assessment-Brushneck Cove, RI
Project #: G606430

CHECK dGPS against at least one reference checkpoint at beginning and end of each day.

dGPS Reference Checkpoint Name ______
Benchmark Location:

Time	Units and Datum	Northing / Latitude	Easting / Longitude
Beginning of day			
End of day			

Comments - No USGS geodetic benchmark available.
Waypoints marked by TG & B

Date/Time 09/06/07 Vessel R/V Carolina Skiff
Unit Make/Model Leica MX 420 dGPS

HEALTH AND SAFETY BRIEFING:

Conducted @ ~0715 - covered slips, trips, PFDs, hard hats, eyewear, steel toe boots

Site Safety and Health Plan Receipt and Acceptance Form

Personnel Accident prevention Guidelines for Marine Operations Conducted in Support of the U.S. Army Corps of Engineers Laboratory Testing in Support of Environmental Assessment Sampling and Environmental Testing, Brushneck Cove, Warwick, RI.

I have received a copy of the Accident prevention Plan prepared for the above-referenced site and activities. I have read and understood its contents and I agree that I will abide by its requirements.

Name (Print): Matthew R Fitzpatrick

Signature: Matthew R Fitzpatrick Date: 9/5/07

Representing (Print): Battelle
Company Name

Site Safety and Health Plan Receipt and Acceptance Form

Personnel Accident prevention Guidelines for Marine Operations Conducted in Support of the U.S. Army Corps of Engineers Laboratory Testing in Support of Environmental Assessment Sampling and Environmental Testing, Brushneck Cove, Warwick, RI.

I have received a copy of the Accident prevention Plan prepared for the above-referenced site and activities. I have read and understood its contents and I agree that I will abide by its requirements.

Name (Print): Michael P. McKee

Signature: Michael P. M

Date: 09/05/07

Representing (Print): Battelle

Company Name

Site Safety and Health Plan Receipt and Acceptance Form

Personnel Accident prevention Guidelines for Marine Operations Conducted in Support of the U.S. Army Corps of Engineers Laboratory Testing in Support of Environmental Assessment Sampling and Environmental Testing, Brushneck Cove, Warwick, RI.

I have received a copy of the Accident prevention Plan prepared for the above-referenced site and activities. I have read and understood its contents and I agree that I will abide by its requirements.

Name (Print): Mark Avakian

Signature: Mark A

Date: Sept 6 2007

Representing (Print): TG&B
Company Name

Site Safety and Health Plan Receipt and Acceptance Form

Personnel Accident prevention Guidelines for Marine Operations Conducted in Support of the U.S. Army Corps of Engineers Laboratory Testing in Support of Environmental Assessment Sampling and Environmental Testing, Brushneck Cove, Warwick, RI.

I have received a copy of the Accident prevention Plan prepared for the above-referenced site and activities. I have read and understood its contents and I agree that I will abide by its requirements.

Name (Print): Jeff Balmer

Signature: [signature] Date: 9/6/07

Representing (Print): TG+B
Company Name

Appendix C

Chains of Custody

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Chain of Custody

Battelle

. . . *Putting Technology To Work*

Project Number: G606430	Project Name: **Brushneck Cove**

Sampler's Signature: [illegible]

ANALYSIS REQUESTED → "NUMBER OF CONTAINERS"

Collection Date/Time	Battelle ID	Client ID	Sample Description	PEST	PCB	TPH	PAH	VOA	TBT	METALS	TOC/GRAIN SIZE	Sediment Core	ACIDIFIED	PRESERVED	Total No. of Containers
9/5/07 10:50	GAG-001		Core from Station BNC-C-09 (cut into 2 sections)									X			2
9/5/07 11:20	GAG-002		Core from Station BNC-C-08 (cut into 2 sections)									X			2
9/5/07 11:45	GAG-003		Core from Station BNC-C-10 (cut into 2 sections)									X			2
9/5/07 12:25	GAG-004		Core from Station BNC-C-11 (cut into 2 sections)									X			2
9/5/07 13:20	GAG-005		Core from Station BNC-C-01 (cut into 2 sections)									X			2
9/5/07 13:50	GAG-006		Core from Station BNC-C-02 (cut into 2 sections)									X			2
9/5/07 14:25	GAG-007		Core from Station BNC-C-03 (cut into 2 sections)									X			2
9/5/07 15:15	GAG-008		Core from Station BNC-C-04 (cut into 2 sections)									X			2
9/5/07 15:45	GAG-009		Core from Station BNC-C-05 (cut into 2 sections)									X			2
9/6/07 8:20	GAG-010		Core from Station BNC-C-06 (cut into 2 sections)									X			2
9/6/07 8:46	GAG-011		Core from Station BNC-C-07 (cut into 2 sections)									X			2
9/6/07 9:45	GAG-012		Metals Equipment Blank							X					1
9/6/07 9:45	GAG-013		Organics Equipment Blank	X	X		X								1

Reliquished By:	Date/Time	Received By:	Date/Time
[illegible]	9/6/07 1200	[illegible]	9/6/07 1200
Reliquished By:	Date/Time	Received By:	Date/Time

Comments:

Chain of Custody

Battelle
. . . *Putting Technology To Work*

Project Number: G606430	Project Name: **Brushneck Cove**

Sampler's Signature:

ANALYSIS REQUESTED → "NUMBER OF CONTAINERS"

Collection Date/Time	Battelle ID	Client ID	Sample Description	PEST	PCB	TPH	PAH	VOA	TBT	METALS	TOC	Grain Size	ACIDIFIED	PRESERVED	Total No. of Containers
9/5/07 10:50	GAG-001-A		Sediment Composite of Top portion of core GAG-001									x			1
9/5/07 11:20	GAG-002-A		Sediment Composite of Single Core									x			1
9/5/07 11:45	GAG-003-A		Sediment Composite of Single Core									x			1
9/5/07 12:25	GAG-004-A		Sediment Composite of Single Core									x			1
9/5/07 13:20	GAG-005-A		Sediment Composite of Single Core									x			1
9/5/07 13:50	GAG-006-A		Sediment Composite of Single Core									x			1
9/5/07 14:25	GAG-007-A		Sediment Composite of Single Core									x			1
9/5/07 15:15	GAG-008-A		Sediment Composite of Single Core									x			1
9/5/07 15:45	GAG-009-A		Sediment Composite of Single Core									x			1
9/6/07 8:20	GAG-010-A		Sediment Composite of Single Core									x			1
9/6/07 8:46	GAG-011-A		Sediment Composite of Single Core									x			1
9/5/07 10:50	GAG-014-A		Sediment Composite of bottom portion of GAG-014									x			1

Reliquished By:	Date/Time	Received By:	Date/Time
Jessica M Fahy	9/10/07 1500		
Reliquished By:	Date/Time	Received By:	Date/Time

Comments:

Ref:
Dep: 3196

Date: 09/10/2007
Wgt: 11.0 LBS
DV: 0.00

SHIPPING: 11.18
SPECIAL: 1.26
HANDLING: 0.00
TOTAL: 12.44

Svcs: PRIORITY OVERNIGHT
TRCK: 9276 8114 5797

Chain of Custody

Battelle

. . . Putting Technology To Work

Project Number: G606430	Project Name: **Brushneck Cove**
Sampler's Signature:	ANALYSIS REQUESTED → "NUMBER OF CONTAINERS"

Collection Date/Time	Battelle ID	Client ID	Sample Description	PEST	PCB	TPH	PAH	VOA	TBT	METALS	TOC	Grain Size	ACIDIFIED	PRESERVED	Total No. of Containers
9/5/07 10:50	GAG-001-B		Sediment Composite of Top portion of core GAG-001								x				1
9/5/07 11:20	GAG-002-B		Sediment Composite of Single Core								x				1
9/5/07 11:45	GAG-003-B		Sediment Composite of Single Core								x				1
9/5/07 12:25	GAG-004-B		Sediment Composite of Single Core								x				1
9/5/07 13:20	GAG-005-B		Sediment Composite of Single Core								x				1
9/5/07 13:50	GAG-006-B		Sediment Composite of Single Core								x				1
9/5/07 14:25	GAG-007-B		Sediment Composite of Single Core								x				1
9/5/07 15:15	GAG-008-B		Sediment Composite of Single Core								x				1
9/5/07 15:45	GAG-009-B		Sediment Composite of Single Core								x				1
9/6/07 8:20	GAG-010-B		Sediment Composite of Single Core								x				1
9/6/07 8:46	GAG-011-B		Sediment Composite of Single Core								x				1
9/5/07 10:50	GAG-014-B		Sediment Composite of bottom portion of GAG-014								x				1

Reliquished By:	Date/Time	Received By:	Date/Time
Jessica M Jahy	9/10/07 1500		
Reliquished By:	Date/Time	Received By:	Date/Time

Comments:

Ref:
Dep: 3196

Date: 09/10/2007
Wgt: 37.0 LBS
DV: 0.00

SHIPPING: 36.59
SPECIAL: 0.00
HANDLING: 0.00
TOTAL: 36.59

Svcs: PRIORITY OVERNIGHT
TRCK: 9276 8114 5786

Chain of Custody

Battelle
. . . Putting Technology To Work

Project Number: G606430	Project Name: **Brushneck Cove**
Sampler's Signature:	ANALYSIS REQUESTED → "NUMBER OF CONTAINERS"

Collection Date/Time	Battelle ID	Client ID	Sample Description	PEST	PCB	TPH	PAH	VOA	TBT	METALS	TOC	Grain Size	ACIDIFIED	PRESERVED	Total No. of Containers
9/5/07 10:50	GAG-001-D		Sediment Composite of Top portion of core GAG-001							X					1
9/5/07 11:20	GAG-002-D		Sediment Composite of Single Core							X					1
9/5/07 11:45	GAG-003-D		Sediment Composite of Single Core							X					1
9/5/07 12:25	GAG-004-D		Sediment Composite of Single Core							X					1
9/5/07 13:20	GAG-005-D		Sediment Composite of Single Core							X					1
9/5/07 13:50	GAG-006-D		Sediment Composite of Single Core							X					1
9/5/07 14:25	GAG-007-D		Sediment Composite of Single Core							X					1
9/5/07 15:15	GAG-008-D		Sediment Composite of Single Core							X					1
9/5/07 15:45	GAG-009-D		Sediment Composite of Single Core							X					1
9/6/07 8:20	GAG-010-D		Sediment Composite of Single Core							X					1
9/6/07 8:46	GAG-011-D		Sediment Composite of Single Core							X					1
9/6/07 9:45	GAG-012		Metals Equipment Blank							X					1

Reliquished By:	Date/Time	Received By:	Date/Time
Jessie M Fohy	9/10/07 1500		
Reliquished By:	Date/Time	Received By:	Date/Time

Comments:

Chain of Custody

Battelle
. . . Putting Technology To Work

Project Number: G606430	Project Name: **Brushneck Cove**

Sampler's Signature:

ANALYSIS REQUESTED → "NUMBER OF CONTAINERS"

Collection Date/Time	Battelle ID	Client ID	Sample Description	PEST	PCB	TPH	PAH	VOA	TBT	METALS	TOC	Grain Size	ACIDIFIED	PRESERVED	Total No. of Containers
9/5/07 10:50	GAG-001-D		Sediment Composite of Top portion of core GAG-001							X					1
9/5/07 11:20	GAG-002-D		Sediment Composite of Single Core							X					1
9/5/07 11:45	GAG-003-D		Sediment Composite of Single Core							X					1
9/5/07 12:25	GAG-004-D		Sediment Composite of Single Core							X					1
9/5/07 13:20	GAG-005-D		Sediment Composite of Single Core							X					1
9/5/07 13:50	GAG-006-D		Sediment Composite of Single Core							X					1
9/5/07 14:25	GAG-007-D		Sediment Composite of Single Core							X					1
9/5/07 15:15	GAG-008-D		Sediment Composite of Single Core							X					1
9/5/07 15:45	GAG-009-D		Sediment Composite of Single Core							X					1
9/6/07 8:20	GAG-010-D		Sediment Composite of Single Core							X					1
9/6/07 8:46	GAG-011-D		Sediment Composite of Single Core							X					1
9/6/07 9:45	GAG-012		Metals Equipment Blank							X					1

Reliquished By:	Date/Time	Received By:	Date/Time
Jessie M Fahy	9/10/07 1500		
Reliquished By:	Date/Time	Received By:	Date/Time

Comments:

Battelle

. . . Putting Technology To Work

Project Number: G606430	Project Name: **Brushneck Cove**

Sampler's Signature:

ANALYSIS REQUESTED → "NUMBER OF CONTAINERS"

Collection Date/Time	Battelle ID	Client ID	Sample Description	PEST	PCB	TPH	PAH	VOA	TBT	METALS	Archive Cold	Archive Frozen	ACIDIFIED	PRESERVED	Total No. of Containers
9/5/07 15:45		GAG-009-E	Sediment Composite of Single Core									x			1
9/6/07 8:20		GAG-010-E	Sediment Composite of Single Core									x			1
9/6/07 8:46		GAG-011-E	Sediment Composite of Single Core									x			1
9/5/07 10:50		GAG-014-E	Sediment Composite of Bottom Portion of Core GAG-001									x			1
9/5/07 11:45		GAG-015-E	Sediment Composite of Bottom Portion of Core GAG-003									x			1
9/6/07 8:46		GAG-016-E	Sediment Composite of Bottom Portion of Core GAG-011									x			1
9/5/07 10:50		GAG-001-F	Sediment Composite of Top portion of core GAG-001								x				1
9/5/07 11:20		GAG-002-F	Sediment Composite of Single Core								x				1
9/5/07 11:45		GAG-003-F	Sediment Composite of Single Core								x				1
9/5/07 12:25		GAG-004-F	Sediment Composite of Single Core								x				1
9/5/07 13:20		GAG-005-F	Sediment Composite of Single Core								x				1
9/5/07 13:50		GAG-006-F	Sediment Composite of Single Core								x				1
9/5/07 14:25		GAG-007-F	Sediment Composite of Single Core								x				1
9/5/07 15:15		GAG-008-F	Sediment Composite of Single Core								x				1
9/5/07 15:45		GAG-009-~~E~~ F	Sediment Composite of Single Core								x				1
9/6/07 8:20		GAG-010-~~E~~ F	Sediment Composite of Single Core								x				1
9/6/07 8:46		GAG-011-~~E~~ F	Sediment Composite of Single Core								x				1
9/5/07 10:50		GAG-014-~~E~~ F	Sediment Composite of Bottom Portion of Core GAG-001								x				1
9/5/07 11:45		GAG-015-~~E~~ F	Sediment Composite of Bottom Portion of Core GAG-003								x				1
9/6/07 8:46		GAG-016-~~E~~ F	Sediment Composite of Bottom Portion of Core GAG-011								x				1

Reliquished By:	Date/Time	Received By:	Date/Time
Jessie M Foley	9/10/07 1500		

Reliquished By:	Date/Time	Received By:	Date/Time

Comments:

Chain ustody

Battelle
. . . Putting Technology To Work

Project Number: G606430	Project Name: **Brushneck Cove**
Sampler's Signature: Matthew R Ribgbeck	ANALYSIS REQUESTED → "NUMBER OF CONTAINERS"

Collection Date/Time	Battelle ID	Client ID	Sample Description	PEST	PCB	TPH	PAH	VOA	TBT	METALS	TOC/GRAIN SIZE	Sediment Core	ACIDIFIED	PRESERVED	Total No. of Containers
9/5/07 10:50	GAG-001		Core from Station BNC-C-09 (cut into 2 sections)									X			2
9/5/07 11:20	GAG-002		Core from Station BNC-C-08 (cut into 2 sections)									X			2
9/5/07 11:45	GAG-003		Core from Station BNC-C-10 (cut into 2 sections)									X			2
9/5/07 12:25	GAG-004		Core from Station BNC-C-11 (cut into 2 sections)									X			2
9/5/07 13:20	GAG-005		Core from Station BNC-C-01 (cut into 2 sections)									X			2
9/5/07 13:50	GAG-006		Core from Station BNC-C-02 (cut into 2 sections)									X			2
9/5/07 14:25	GAG-007		Core from Station BNC-C-03 (cut into 2 sections)									X			2
9/5/07 15:15	GAG-008		Core from Station BNC-C-04 (cut into 2 sections)									X			2
9/5/07 15:45	GAG-009		Core from Station BNC-C-05 (cut into 2 sections)									X			2
9/6/07 8:20	GAG-010		Core from Station BNC-C-06 (cut into 2 sections)									X			2
9/6/07 8:46	GAG-011		Core from Station BNC-C-07 (cut into 2 sections)									X			2
9/6/07 9:45	GAG-012		Metals Equipment Blank							X					1
9/6/07 9:45	GAG-013		Organics Equipment Blank	X	X		X								1

Reliquished By:	Date/Time	Received By:	Date/Time
Matthew R Ribgbeck	9/6/07 1200		
Reliquished By:	Date/Time	Received By:	Date/Time

Comments

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Appendix D

Grain Size Analysis Results

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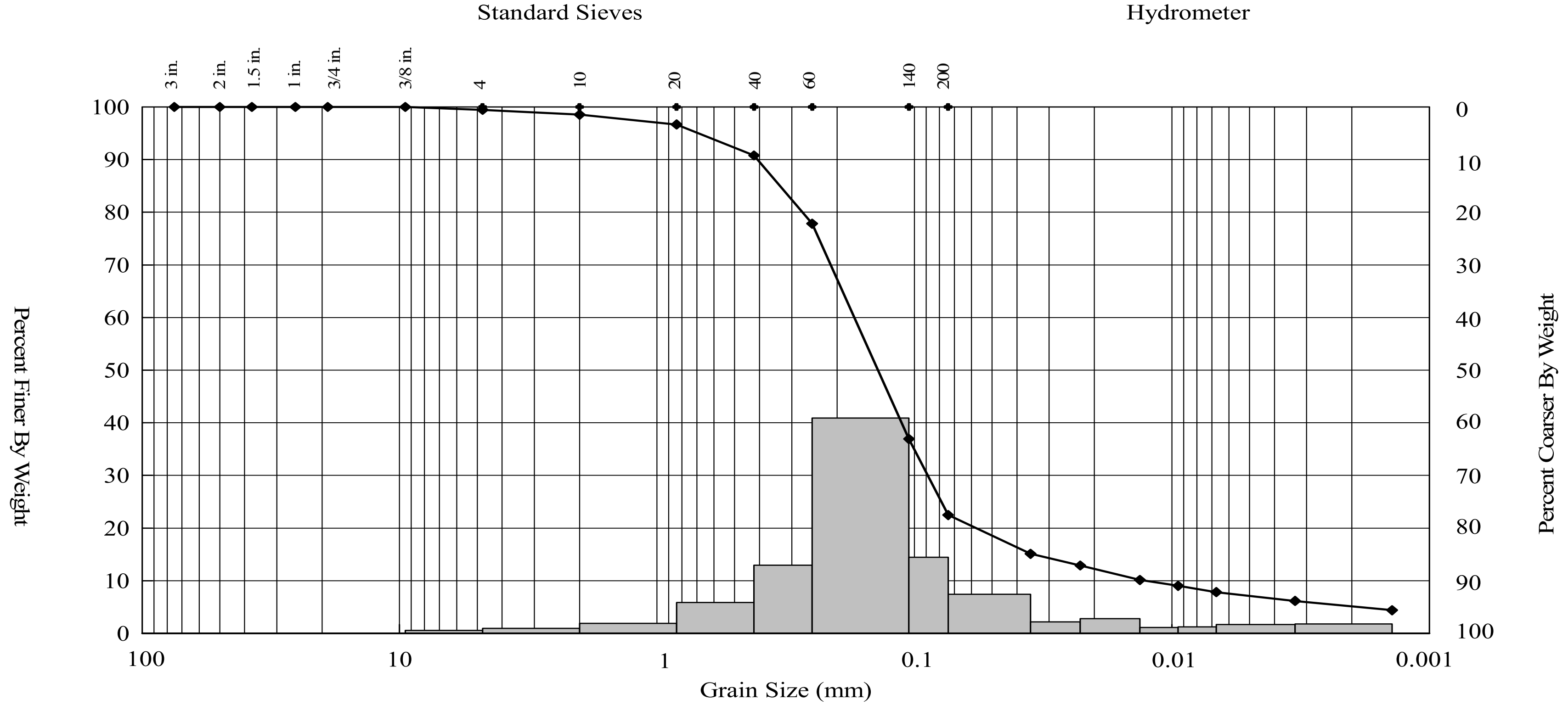
GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.56	0.92	7.73	68.34	15.48	6.97

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
25	80								

Material Description

Silty Sand ("SM"), dark greenish gray (10Y 4/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-001-A
AMS Sample ID:	28690

APPLIED MARINE SCIENCES, INC.
502 N. Hwy 3, Suite B
League City, TX 77573
281.554.7272 Tel.
281.554.6356 Fax

These analyses were performed in accordance with ASTM standards, the 2006 DoD Quality Systems Manual (Version 3), and the 2003 NELAC Standard.

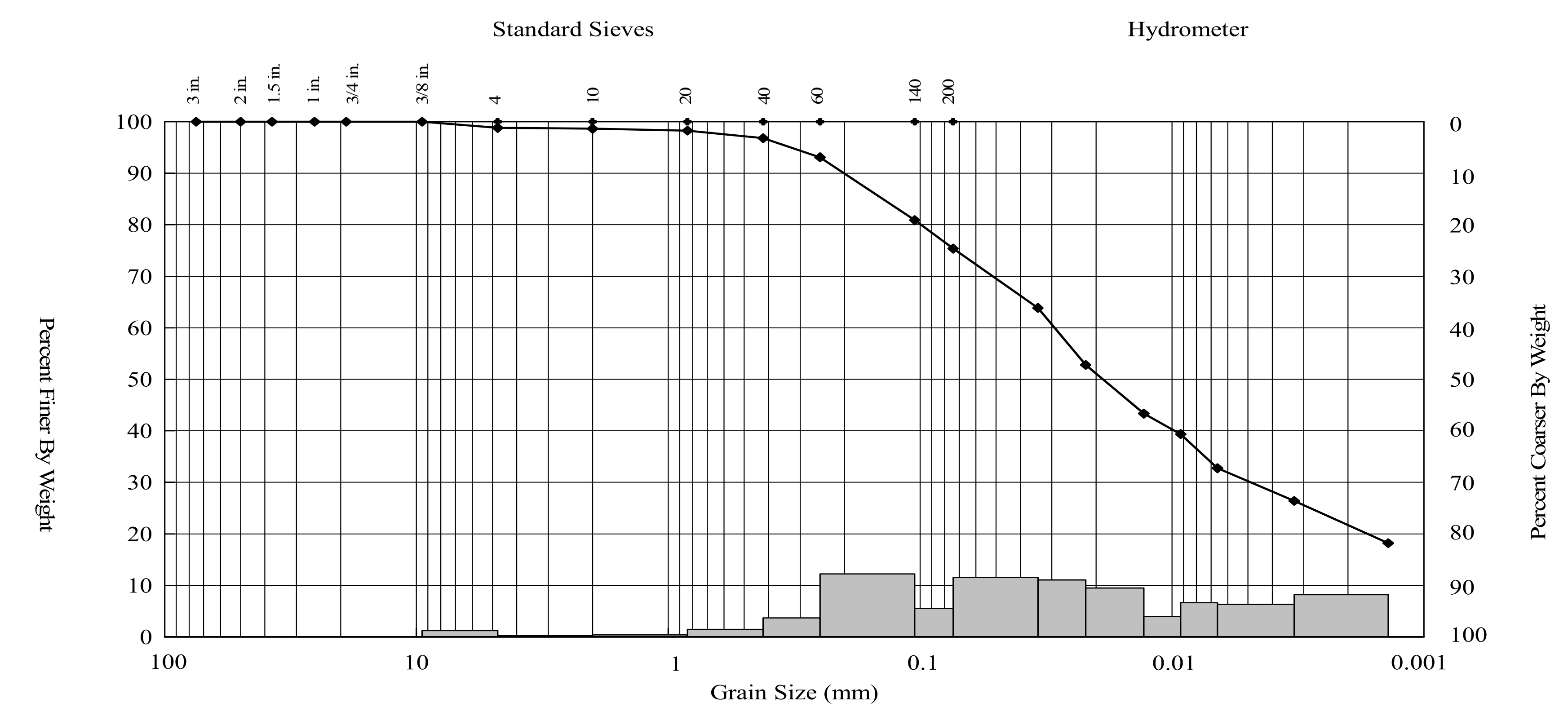
K.S. Davis, P.G.

AMS, Inc. Technical Director

ACCREDITED IN ACCORDANCE WITH nelac

Laboratory No. E87956

GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
1.21	0.17	1.83	21.43	45.68	29.68

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
77	56								

Material Description

Elastic Silt with Sand ("MH"), very dark greenish gray (10Y 3/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-002-A
AMS Sample ID:	28691

APPLIED MARINE SCIENCES, INC.
502 N. Hwy 3, Suite B
League City, TX 77573
281.554.7272 Tel.
281.554.6356 Fax

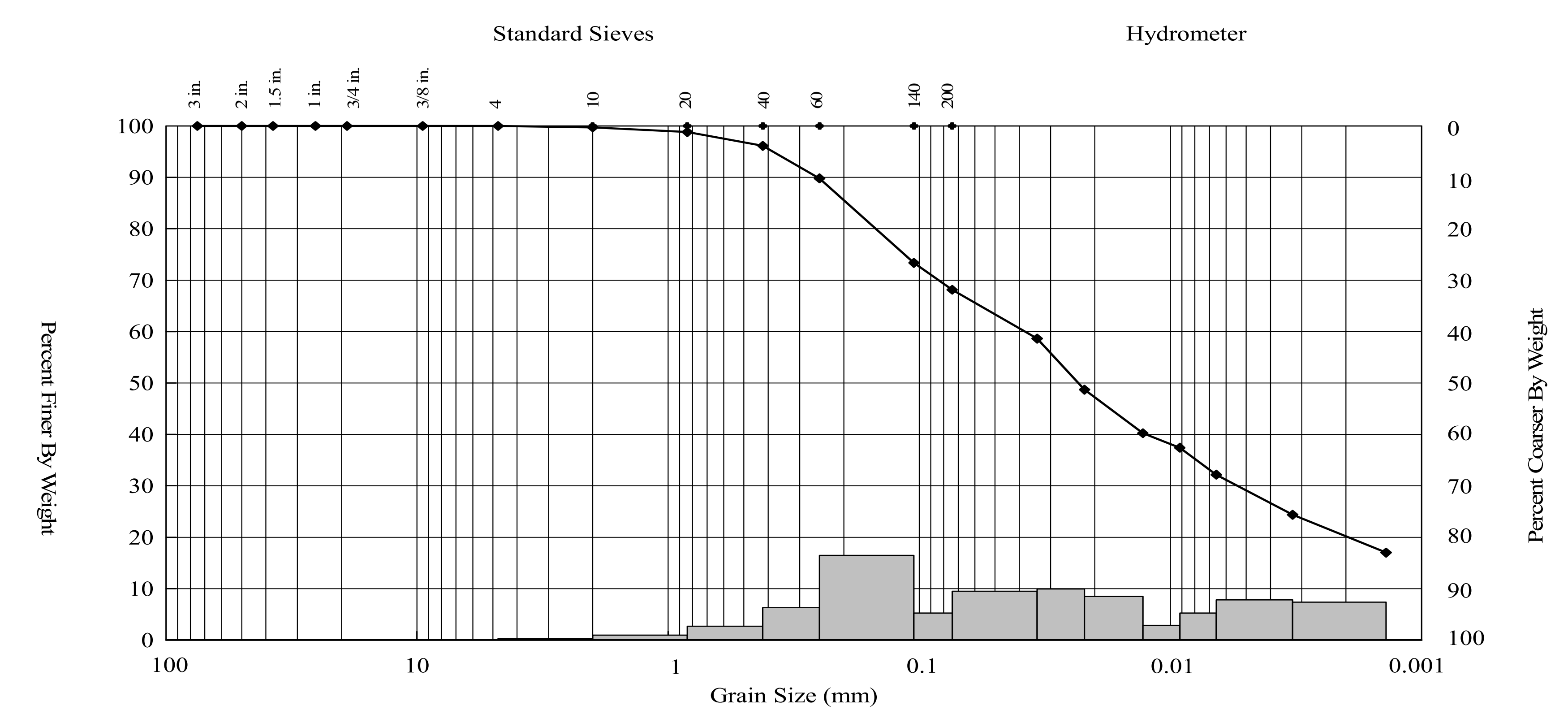
These analyses were performed in accordance with ASTM standards, the 2006 DoD Quality Systems Manual (Version 3), and the 2003 NELAC Standard.

K.S. Davis, P.G.

AMS, Inc. Technical Director

Laboratory No. E87956

GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.29	3.58	28.02	39.66	28.45

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
80	55								

Material Description

Sandy Elastic Silt ("MH"), very dark greenish gray (10Y 3/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-003-A
AMS Sample ID:	28692

APPLIED MARINE SCIENCES, INC.
502 N. Hwy 3, Suite B
League City, TX 77573
281.554.7272 Tel.
281.554.6356 Fax

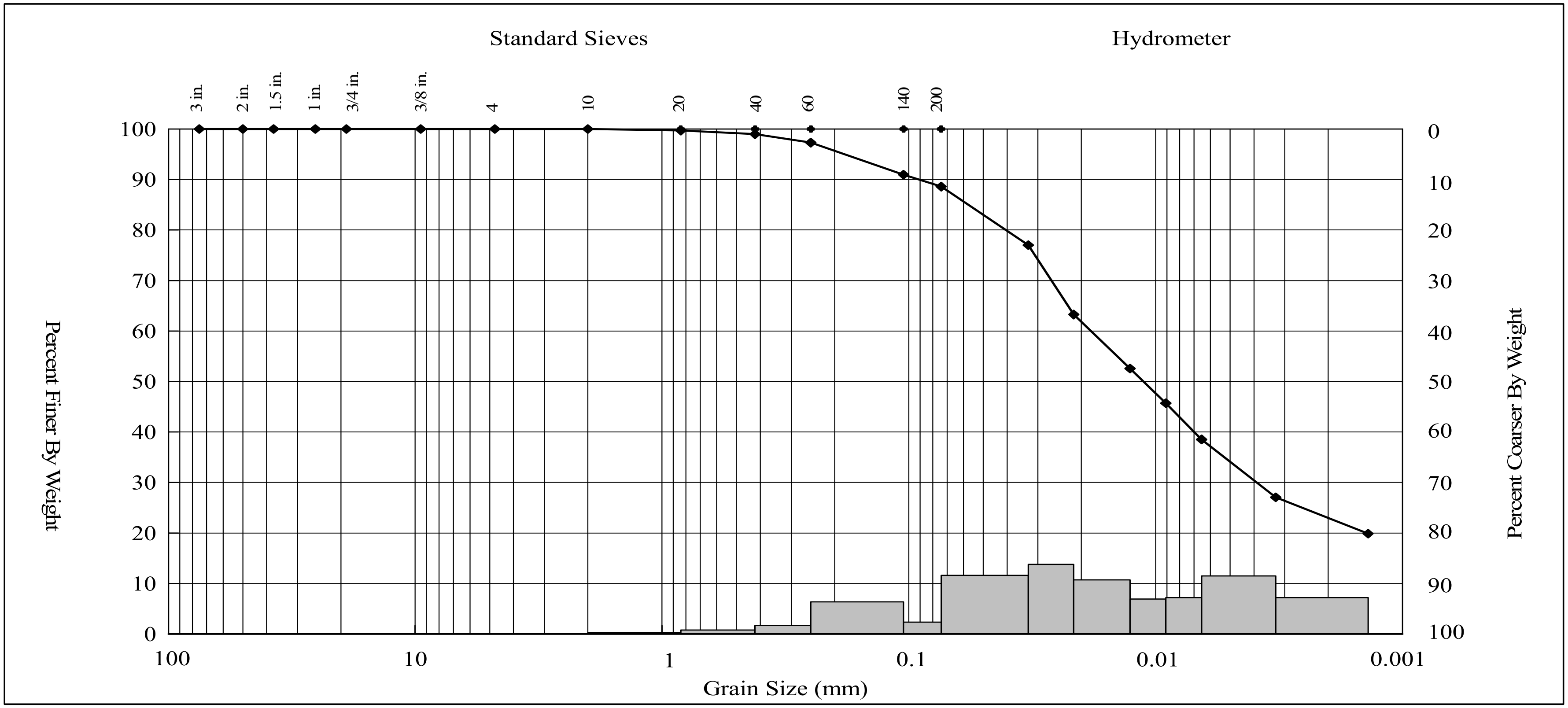
These analyses were performed in accordance with ASTM standards, the 2006 DoD Quality Systems Manual (Version 3), and the 2003 NELAC Standard.

K.S. Davis, P.G.

AMS, Inc. Technical Director

Laboratory No. E87956

GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.00	1.05	10.35	55.44	33.16

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
101	50								

Material Description

Elastic Silt ("MH"), greenish black (10Y 2.5/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-004-A
AMS Sample ID:	28693

APPLIED MARINE SCIENCES, INC.
502 N. Hwy 3, Suite B
League City, TX 77573
281.554.7272 Tel.
281.554.6356 Fax

These analyses were performed in accordance with ASTM standards, the 2006 DoD Quality Systems Manual (Version 3), and the 2003 NELAC Standard.

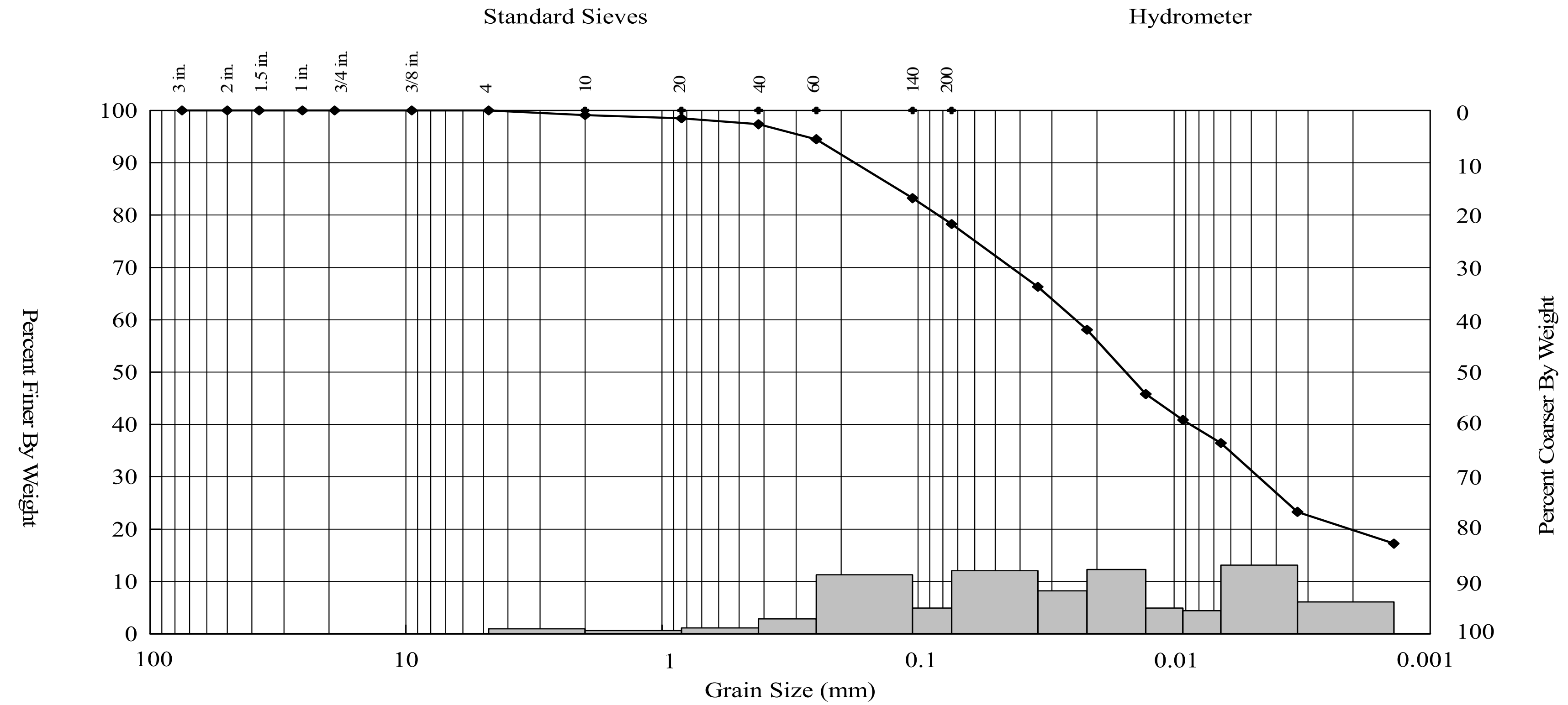
K.S. Davis, P.G.

AMS, Inc. Technical Director

ACCREDITED IN ACCORDANCE WITH nelac

Laboratory No. E87956

GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.91	1.74	19.05	48.17	30.13

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
84	54								

Material Description

Elastic Silt with Sand ("MH"), greenish black (10Y 2.5/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-005-A
AMS Sample ID:	28694

APPLIED MARINE SCIENCES, INC.
502 N. Hwy 3, Suite B
League City, TX 77573
281.554.7272 Tel.
281.554.6356 Fax

These analyses were performed in accordance with ASTM standards, the 2006 DoD Quality Systems Manual (Version 3), and the 2003 NELAC Standard.

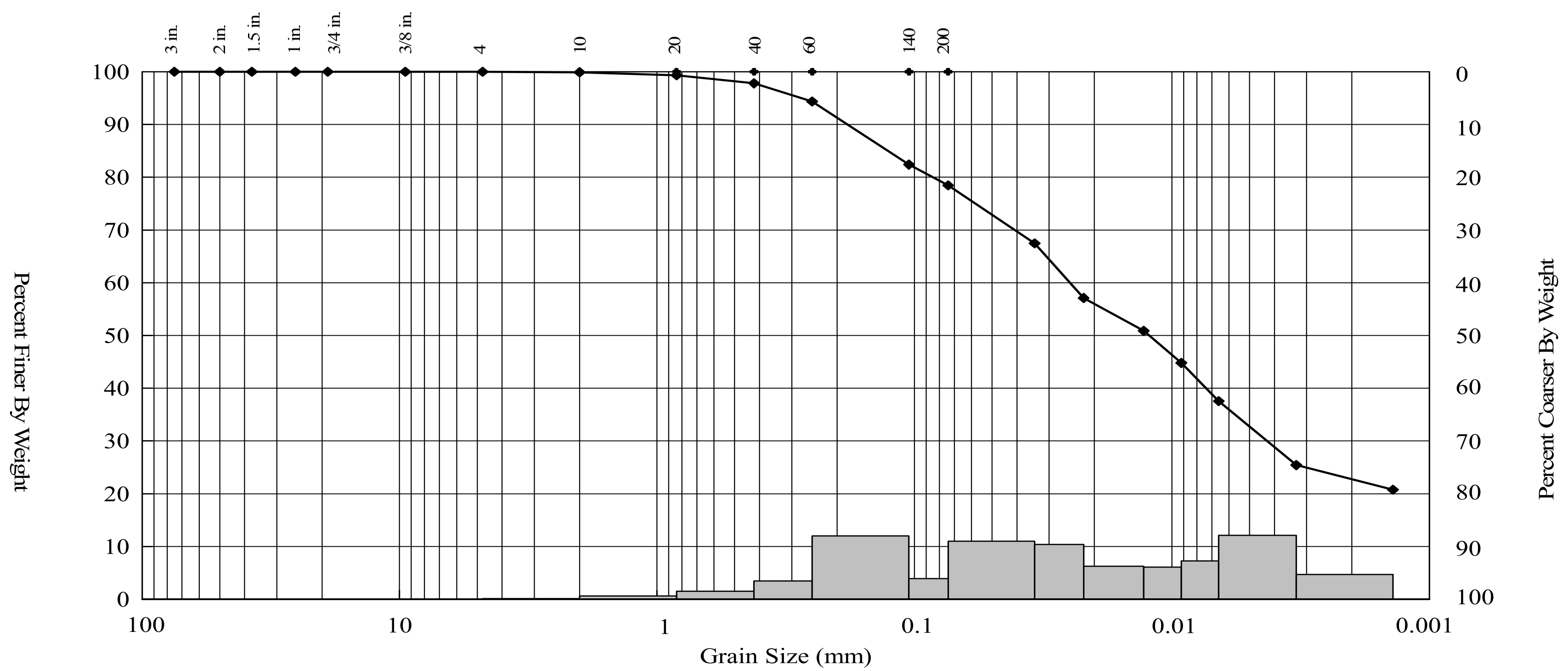
K.S. Davis, P.G.

AMS, Inc. Technical Director

ACCREDITED IN ACCORDANCE WITH nelac

Laboratory No. E87956

GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.12	2.08	19.34	46.73	31.73

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
88	53								

Material Description

Elastic Silt with Sand ("MH"), very dark greenish gray (10Y 3/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-006-A
AMS Sample ID:	28695

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These analyses were performed in accordance with ASTM standards, the 2006 DoD Quality Systems Manual (Version 3), and the 2003 NELAC Standard.

K.S. Davis, P.G.

AMS, Inc. Technical Director

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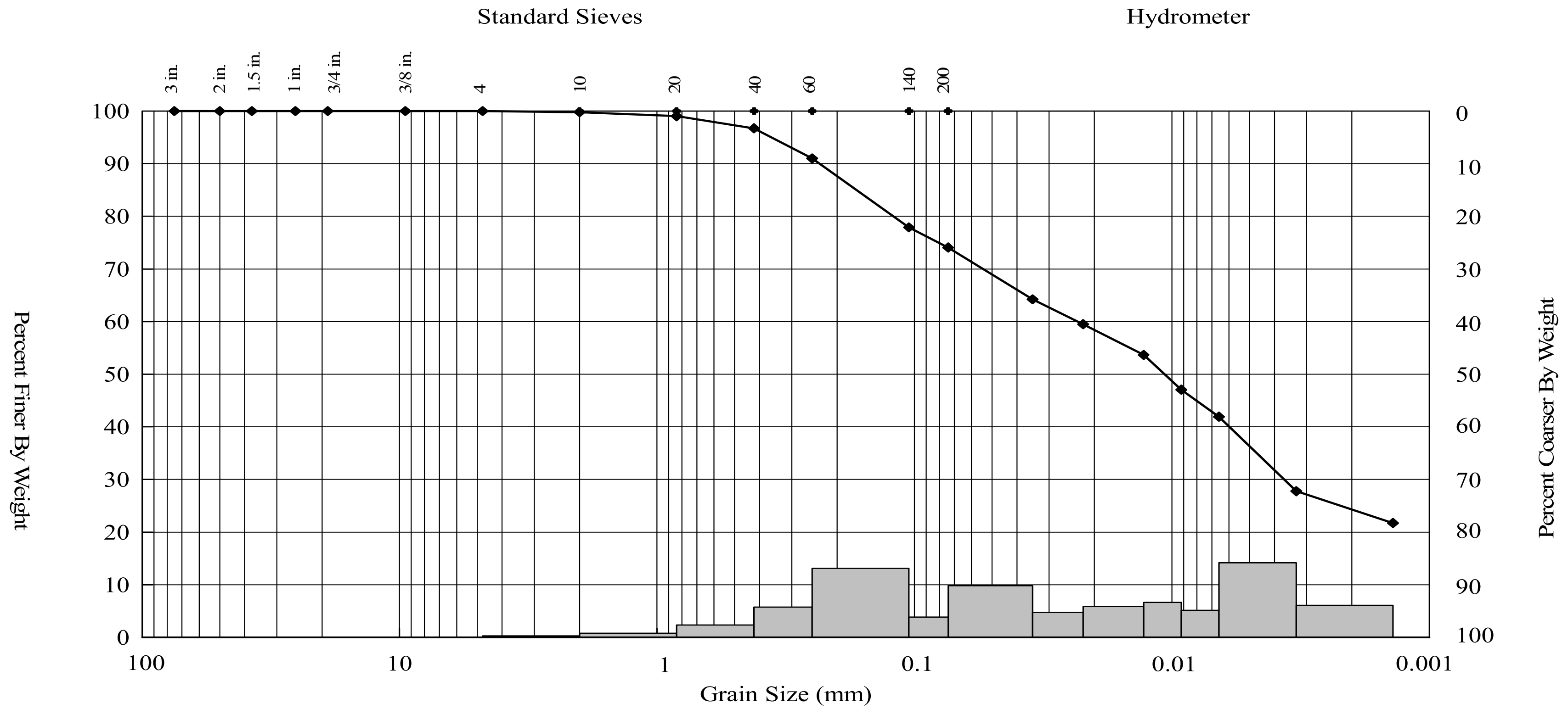
Laboratory No. E87956

GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.24	3.06	22.65	38.90	35.15

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
88	53								

Material Description

Elastic Silt with Sand ("MH"), very dark greenish gray (10Y 3/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-007-A
AMS Sample ID:	28696

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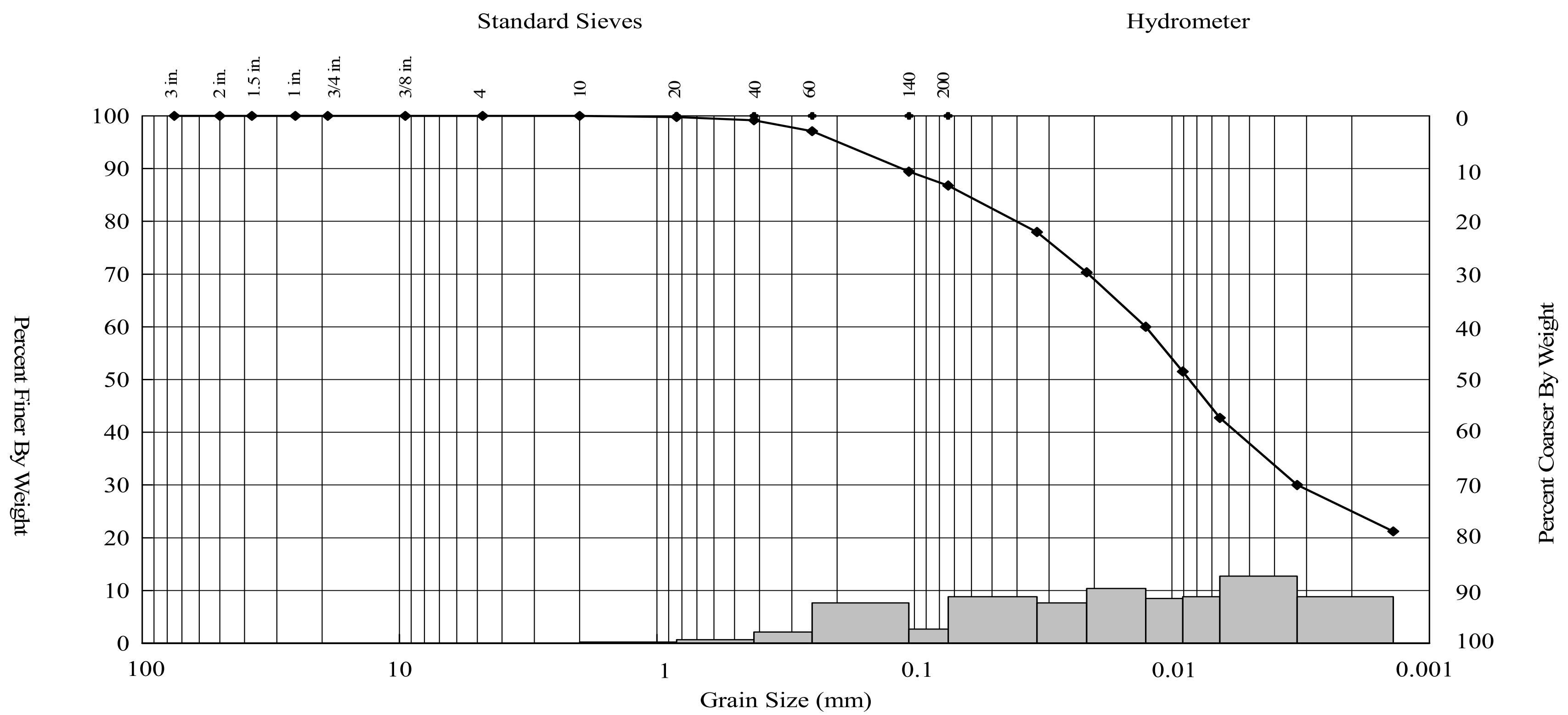
GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.00	0.86	12.37	50.00	36.77

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
96	51								

Material Description

Elastic Silt ("MH"), greenish black (10Y 2.5/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-008-A
AMS Sample ID:	28697

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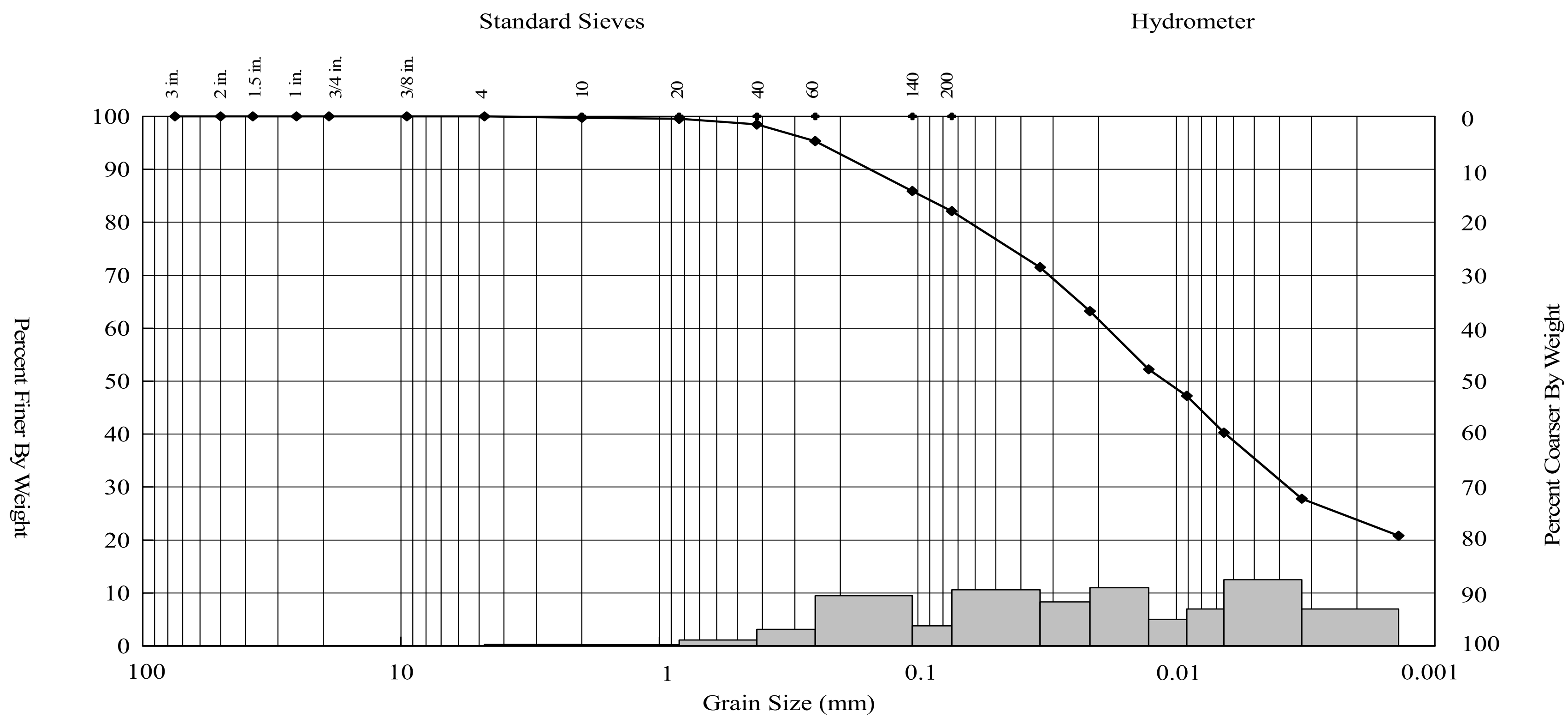
GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.27	1.29	16.36	47.72	34.36

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
87	53								

Material Description

Elastic Silt with Sand ("MH"), very dark greenish gray (10Y 3/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-009-A
AMS Sample ID:	28698

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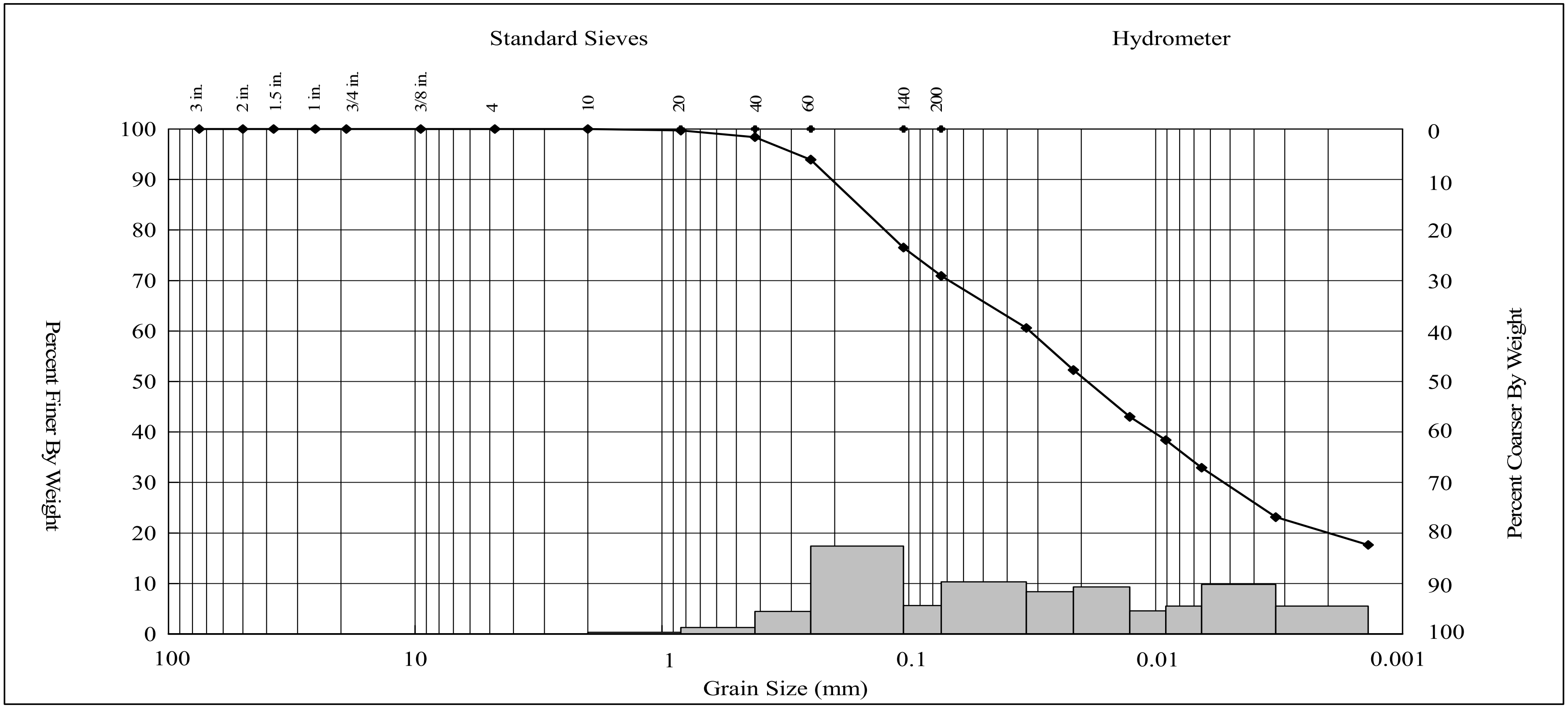
Laboratory No. E87956

GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.00	1.63	27.48	42.55	28.34

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
71	59								

Material Description

Elastic Silt with Sand ("MH"), very dark greenish gray (10Y 3/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/6/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-010-A
AMS Sample ID:	28699

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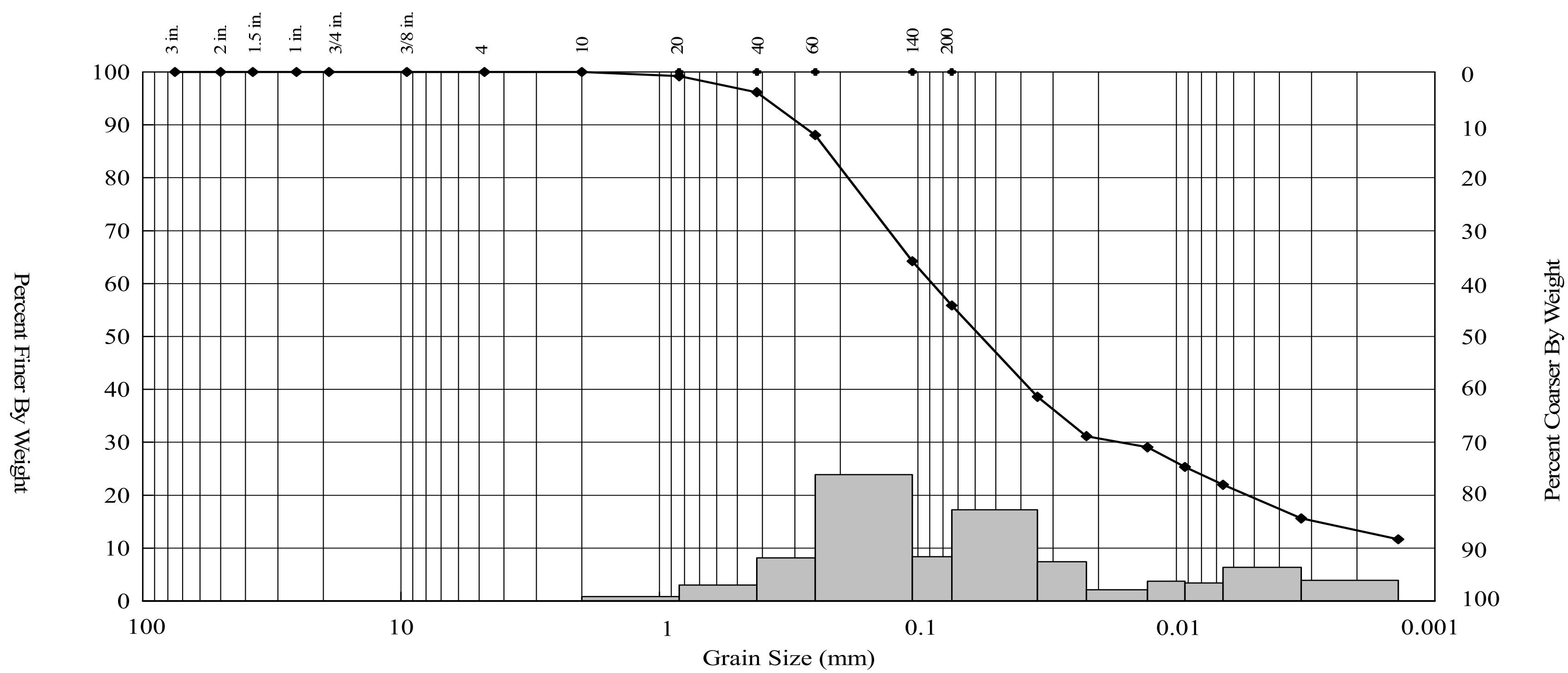
GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.00	0.00	3.84	40.32	36.98	18.86

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
56	64								

Material Description

Sandy Elastic Silt ("MH"), greenish black (10Y 2.5/1)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/6/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-011-A
AMS Sample ID:	28700

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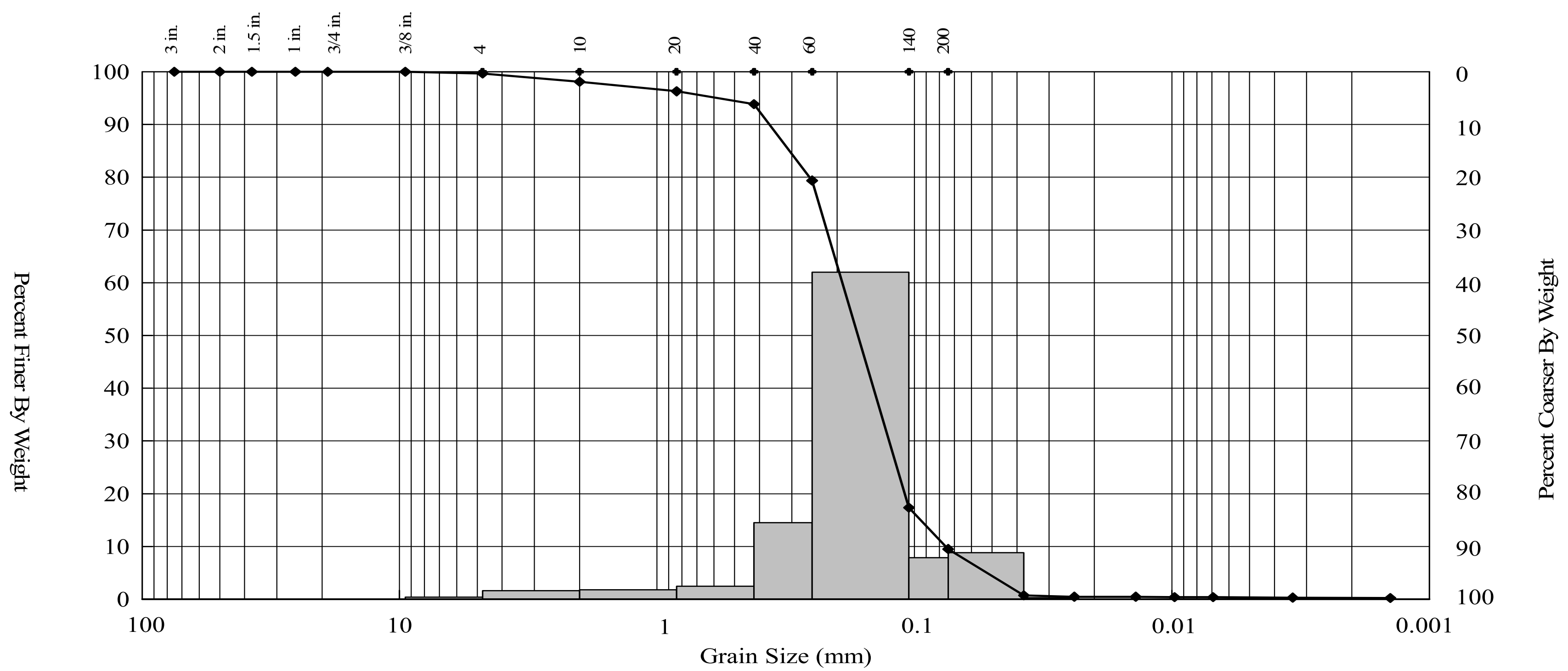
GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)	
	Coarse	Medium	Fine	Silt	Clay
0.36	1.57	4.23	84.34	9.17	0.33

Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
20	84	0.31	0.19	0.17	0.13	0.09	0.08	1.20	2.51

Material Description

Poorly Graded Sand with Silt ("SP-SM"), pale olive (5Y 6/4)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-014-A
AMS Sample ID:	28701

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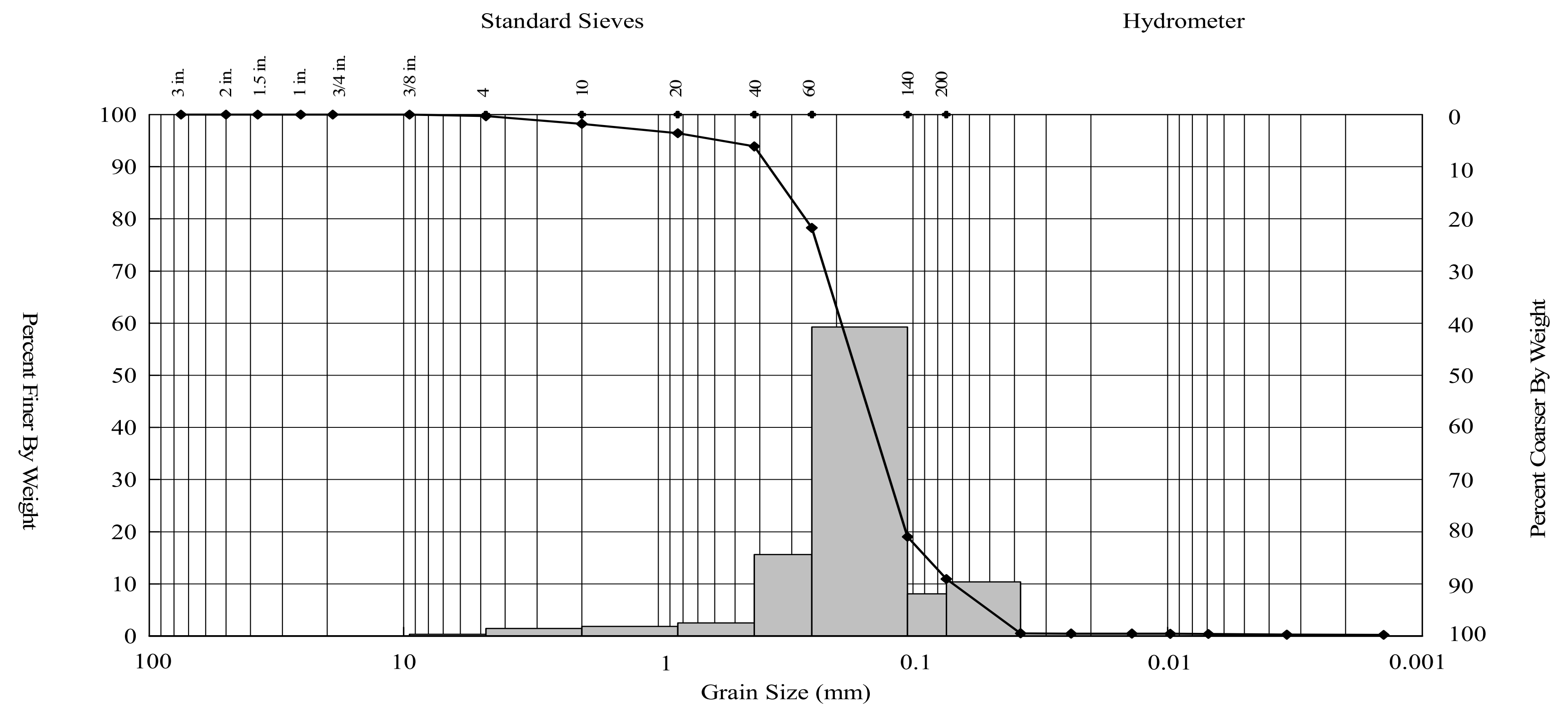
GEOTECHNICAL RESULTS



Gravel (%)	Sand (%)			Fines (%)			
	Coarse	Medium	Fine	Silt		Clay	
0.33	1.46	4.34	82.96	10.60		0.31	
Water Cont. (%)	Total Solids (%)	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
20	84	0.03	0.19	0.17	0.13	0.09	0.07	1.29	2.75

Material Description

Poorly Graded Sand with Silt ("SP-SM"), pale olive (5Y 6/4)

Client:	Battelle
Client Project Title:	Brushneck Cove
Client Project Number:	G606430
AMS Project Number:	07-102
Date Sampled:	9/5/2007
Date Analyzed:	9/14/2007
Matrix, Method:	Sediment, ASTM D 422
Client Sample ID:	GAG-014-A
AMS Sample ID:	28701-2

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QUALITY CONTROL RESULTS

Client:	Battelle	AMS Project Number:	07-102
Project Title:	Brushneck Cove	Date Sampled:	9/5/2007
Project Number:	G606430	Date Analyzed:	9/14/2007
Client Sample ID:	GAG-014-A	Matrix:	Sediment
AMS Sample ID:	28701	Method:	ASTM D 422
		Batch:	091407-01

Particle Diameter Range (mm)	U.S. Standard Sieve Mesh #	Size Class	Sample Result (%)	Duplicate Result (%)	RPD (%)	Data Qualifier	QC Limits (% RPD)
4.76	No. 4	Gravel	0.36	0.33	8.70		≤ 25
2.00	No. 10	Coarse Sand	1.57	1.46	7.26		≤ 25
0.425	No. 40	Medium Sand	4.23	4.34	2.57		≤ 25
0.074	No. 200	Fine Sand	84.34	82.96	1.65		≤ 25
<0.074 - 0.005	Hydrometer	Silt	9.17	10.60	14.47		≤ 25
<0.005	Hydrometer	Clay	0.33	0.31	6.25		≤ 25

Samples in Batch:

28690	28692	28694	28696	28698	28700
28691	28693	28695	28697	28699	28701

Qualifiers:

Q - RPD value outside Quality Control Limits

I - Insufficient sample material to perform Quality Control Analyses

Soil Classification: Unified Soil Classification System (USCS) classifications are estimated in accordance with ASTM D 2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) unless the sample contains less than 5% fines (GW, GP, SW, and SP), or the Liquid Limit, Plastic Limit, and Plasticity Index (Atterberg Limits) have been determined in accordance with ASTM D 4318. When these values have been determined the samples are definitively classified using ASTM D 2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

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FINAL REPORT
IN SUPPORT OF
DESIGN AND PERMITTING, BRUSHNECK COVE
WARWICK, RHODE ISLAND

Contract No. W912WJ-09-D-0001-0016

Prepared For:
United States Army Corp of Engineers
New England District
696 Virginia Road
Concord, MA 01742

Prepared By:
Woods Hole Group, Inc.
81 Technology Park Drive
East Falmouth, MA 02536

January 2010

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FINAL REPORT
IN SUPPORT OF
DESIGN AND PERMITTING, BRUSHNECK COVE
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Table of Content

1.0 INTRODUCTION 1

2.0 BACKGROUND 1

3.0 SEDIMENT SAMPLING METHODOLOGY AND PROCEDURES 1

3.1 SAMPLING METHODOLOGY 1

3.2 SAMPLE COLLECTION 4

3.3 SAMPLE PROCESSING 4

3.3.1 Analytical Sub-Sampling 4

3.3.2 Core Descriptions 6

3.4 SAFETY, TECHNICAL PROBLEMS ENCOUNTERED, SOW MODIFICATIONS DURING FIELD SAMPLING 8

4.0 PHYSICAL AND CHEMICAL ANALYSES 8

4.1 GRAIN SIZE AND TOC 9

4.2 NUTRIENTS 9

4.2.1 Nutrient Analysis 9

5.0 PROTOCOL DEVIATIONS DURING CHEMICAL TESTING 10

5.1 CHEMICAL TESTING DEVIATIONS 10

6.0 PHYSICAL AND CHEMICAL TESTING RESULTS 10

6.1 SEDIMENT CHEMISTRY 10

6.1.1 Grain Size 10

6.1.2 Total Organic Carbon 11

6.1.3 Nutrients 11

APPENDIX A WEEKLY SAFETY BRIEFING 1

APPENDIX B CHAIN OF CUSTODY FORMS 1

APPENDIX C ENVIRONMENTAL SAMPLING LOGS / CORE DESCRPTIONS 1

APPENDIX D PHOTOGRAPHS OF SEDIMENT CORES 1

APPENDIX E LABORATORY REPORT 1

List of Figures

Figure 1 Basemap of the project site with proposed core locations. 2

Figure 2 Sediment coring barge equipped with vibracoring rig (in a-frame) and anchoring spuds. 3

Figure 3 Location sediment cores at Brushneck Cove. 7
Figure D1 Core A, 0-5 ft (top) 2
Figure D2 Core A, 5-10ft (middle) 2
Figure D3 Core A, 10-15.7ft (bottom) 3
Figure D4 Core B, 0-5ft (top)..........3
Figure D5 Core B, 5-10ft (middle)..........4
Figure D6 Core B, 10-15.9ft (bottom) 4
Figure D7 Core C, 0-5ft (top)..........5
Figure D8 Core C, 5-10ft (middle)..........5
Figure D9 Core C, 10-12.6ft (bottom) 6
Figure D10 Core D, 0-5ft (top) 7
Figure D11 Core D, 5-9.2ft (bottom) 7

List of Tables

Table 1. Coordinates and field data for sediment cores. 5
Table 2. Brushneck Cove sediment analytes, containers, and composite types 6
Table 3. Bulk Sediment Testing Parameters..........8
Table 4. Grain Size, Total Organic Carbon and Moisture Content for Brushneck Cove 11
Table 5. Nutrient Test Results for Brushneck Cove 11

1.0 INTRODUCTION

This sampling effort was conducted under New England District Army Corps of Engineers (NAE) Contract W912WJ-09-D-0001-0016 as defined in the Task Order Statement of Work (SOW) dated April 28, 2009. The objective of this work was to acquire data to support design for the proposed dredging of sediments within Brushneck Cove (Figure 1). The work performed consisted of taking sediment cores according to the depths and locations specified in Table 1 of the SOW from three locations within Brushneck Cove, to be analyzed for the physical and chemical parameters listed in Table 3 of this report. This data was used to characterize the sediments, and to establish the depth from the current water/sediment interface to a layer of sandy material.

2.0 BACKGROUND

Brushneck Cove is located in Warwick, Rhode Island. The study area encompasses Brushneck Cove, Buttonwoods Cove and Oakland Beach. The Coves are tributaries of Greenwich Bay. Warwick is approximately 15 miles southwest of Providence, RI. A total of 11 cores were collected during a 2007 field sampling effort, 7 from Brushneck cove and 4 from Buttonwoods Cove. All of these cores were taken to 10 feet below the water/sediment interface. The sediments from Buttonwoods Cove generally ranged from dark grey, silty clay in the upper portion of the core to fine sand in the lower portion of the core. The sediments from Brushneck Cove generally contained black silt in the upper portion of the core and clay in the bottom. A number of locations also possessed a layer of shell hash.

3.0 SEDIMENT SAMPLING METHODOLOGY AND PROCEDURES

3.1 SAMPLING METHODOLOGY

Mobilization for this effort began on September 30th, 2009. Sampling operations took place on October 1st, 2009 and were conducted by TG&B Marine Services with oversight and support from WHG personnel. Onsite health and safety oversight was provided by WHG employee Dave Walsh. A safety meeting was conducted at the start of field activities, and when personnel changes occurred. The safety briefing logs are provided in Appendix A.

Sediment core samples were collected in Brushneck Cove from a shallow draft barge specially outfitted for vibracoring. The barge was equipped with an A-frame, winches, anchoring spuds, and coring equipment (Figure 2). Coring equipment used in the subaqueous portions of the sampling area consisted of a gasoline engine powered pneumatic vibracoring device. Sample positioning was accomplished using a Leica MX 420 DGPS unit with a Leica Smart antenna (1-3 meter accuracy). All cores were collected in clear polycarbonate liners. The GPS systems accuracy was checked to be within the systems' accuracy margins.

Figure 1 Basemap of the project site with proposed core locations.

Figure 2 **Sediment coring barge equipped with vibracoring rig (in a-frame) and anchoring spuds.**

3.2 SAMPLE COLLECTION

Sediment core samples were collected, to the extent possible, according to the locations, penetration, and recovery lengths specified in the project SOW (Table 1 and Figure 3). The actual sediment core locations, penetration, and recovery core lengths are presented in Table 1.

Sampling equipment was cleaned prior to sampling and between each sample station. The sampling core liners were clean “as-received” direct from the supplier. Upon collection each core sample was immediately capped and kept upright. At the staging area the cores were secured in an upright position to allow suspended sediment to settle. After settling the clear excess water was carefully drained by drilling a small hole into the core tube just above the sediment – water interface. Following draining, the core length was measured using a stadia rod and the data recorded on an Environmental Sampling Log sheet.

3.3 SAMPLE PROCESSING

3.3.1 Analytical Sub-Sampling

Sample processing occurred at a staging area set up in the parking lot of a small boat access ramp to Warwick Cove at the end of Bay Ave. After a core had settled, drained, and measured, it was placed horizontally into a jig and secured by hand. Using electric shears the core liner was cut lengthwise in two places, 180° apart, to effectively split the core liner. Clean stainless steel wire was then used to slice the length of the core into 2 halves. The exposed sample was then placed into clean plastic trays for sampling and examination.

In accordance with the SOW, the sediment cores collected from Brushneck Cove were sampled Total Organic Carbon (TOC), Grain Size and Nutrients: Ammonia, Nitrate, Total Kjeldahl Nitrogen (TKN) and Total Phosphorus (TP). These analytes, and their associated sample containers are outlined in Table 2. Prior to sample collection, sample containers were prepared and labeled. Cores were prepared and processed according to the analytical sampling outlined in the SOW and Table 1.

Immediately after a core was split and exposed to the atmosphere, one half of the core was set aside for physical description and the other for analytical sampling once. Only the top organic layer was taken for analytical sampling. This layer was homogenized in a stainless steel pan and then the sample was divided up into different containers, as specified in Table 2, for grain size, TOC and nutrients. A field duplicate was collected for quality control for grain size, TOC and nutrients; sediment core A was the source of the sediment duplicate.

All sample processing equipment was cleaned between discrete sample collections. Cleaning was performed using an Alconox and tap water solution followed by a fresh water rinse then a deionized water rinse. Each sample composite and/or composite interval was homogenized using clean stainless steel containers, spatulas and spoons before being placed into their respective containers. Each day of sampling on site, sample containers were sealed, Chain of Custody forms completed, and samples placed into coolers with ice while awaiting shipment to

Table 1. Coordinates and field data for sediment cores.

Sample	Date Time	Latitude (DD)	Longitude (DD)	Water Depth (feet)	SOW Core Penetration (feet)	Core Penetration (feet)	Recovered Core Length (feet)	Analytical Sampling Interval (feet)
A	10/1/2009 10:10	41.69514	-71.408637	2.5	20	20	15.7	0-1.36
B	10/1/2009 13:07	41.6933	-71.406122	2.5	20	20	15.9	0-1.10
C	10/1/2009 13:50	41.69092	-71.40447	5.5	20	20	12.6	0-0.94
D*	10/1/2009 15:45	41.6904	-71.404487	6.8	-	20	9.2	na

***See section 3.4 for an explanation of Sample D.**

Table 2. Brushneck Cove sediment analytes, containers, and composite types

Analytical Parameter	Sample Container
TOC	8 oz. glass jar
Ammonia, Nitrate, TKN, TP	
Grain Size	plastic bag

Alpha Analytical Laboratory in Mansfield, MA. Chain of Custody forms are included in Appendix B.

3.3.2 Core Descriptions

The Brushneck Cove sediment cores were described and photographed by a trained sedimentologist once the cores were split. The core description process involved recording the physical sediment characteristics of the core on the Environmental Sampling Logs (Appendix C). Cores were examined from the top of the core, downward to the bottom, using a stadia rod to definite layer thicknesses and depth below the surface (top of core at sediment–water/air interface). The three primary physical sediment characteristics that were described were texture (grain size), sorting, and color. In addition to the grain size characterization, an ASTM soil classification was assigned to each physical sediment layer. The presence of strata (layering), organic material and detritus, and chemical sheen and/or odors were also recorded.

WHG sampling personnel reviewed the cores descriptions with the NAE field representative, when available, to discuss any unique or questionable cores, and to provide guidance with potential impacts to, or changes in the analytical sampling plan. This proactive approach is thought to provide more consistent, less skewed data for the composite grouping, and is the reason why Composite H was modified.

Each Brushneck Cove split core that was described was also photographed. All photos contained the core with the 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. The photographs of the complete cores are provided in Appendix D.

Figure 3 Location sediment cores at Brushneck Cove.

3.4 SAFETY, TECHNICAL PROBLEMS ENCOUNTERED, SOW MODIFICATIONS DURING FIELD SAMPLING

There were no safety incidents or near misses during the Brushneck Cove field sampling. Sediment sampling was conducted without any major problems. There were two minor issues that did not prevent satisfactory completion of the SOW. These 2 issues are described in more detail below.

1) In some locations, core penetration and recovery did not meet the requirements of the SOW (Table 2). Per the SOW, WHG/TG&B performed three attempts at these locations. In the event that all three attempts came up short for penetration and/or recovery, the longest recovery length was used for sampling.

2) Three attempts were made at Site C and all three core recoveries were well short of the penetration depth. A decision was made to move the barge to a new site, Core D, closer to the mouth of Brushneck Cove in an attempt to obtain a core with better recovery. Unfortunately the recovery was worse than the previous three attempts, however, a well defined sand layer was observed as noted in the corelogs.

4.0 PHYSICAL AND CHEMICAL ANALYSES

This section summarizes the methods used for physical and chemical testing of sediment samples collected from Brushneck Cove. Physical testing included grain size, and percent moisture measurements. Chemical testing included total organic carbon (TOC) and nutrient analyses. The laboratory quality assurance plan that details the specifics of the analytical requirements were developed by Alpha Analytical and is on file at NAE. The complete list of parameters and target detection limits is provided in Table 3. A routine set of quality control (QC) samples was prepared with each set of samples, by parameter and media, to monitor data quality in terms of accuracy and precision.

Table 3. Bulk Sediment Testing Parameters

Parameter(s)		Analytical Method	Reporting Limit
Sieve Analysis	Wet Sieve (#4, 10, 20, 40, 60, 140, 200)	ASTM D422	N/A
Water Content		ASTM D2216	N/A
Nutrients			
Nitrogen, Ammonia		4500NH3-BH	7.5 ppm
Nitrogen, Nitrate		4500NO3-F	1.0 ppm
Total Kjeldahl Nitrogen		4500N-C	150 ppm
Total Phosphorous		4500P-E	6.0 ppm
Total Organic Carbon		9060	0.01%
Percent Moisture		Gravimetric	0.1%

4.1 GRAIN SIZE AND TOC

The three Brushneck Cove sediment samples were analyzed for grain size distribution (sieve # 4, 10, 20, 40, 60, 140 and 200 as well as hydrometer) and percent moisture. Grain size was measured according to ASTM D422 for gravel, sand, silt and clay, using sieve and hydrometer. Water content analysis was performed using method ASTM D2216. Results were reported on a dry-weight basis and included distribution curves for the grain size. TOC was measured according to EPA SW846 Method 9060 by AMS. All TOC samples were analyzed in duplicate. Results for TOC were reported on a dry-weight basis.

4.2 NUTRIENTS

4.2.1 Nutrient Analysis

Ammonia

Ammonia was analyzed following Alpha Analytical SOP *Nitrogen, Ammonia* (SOP 09-14, Rev 1, November, 2009). Sediment samples were buffered at a pH of 9.5 with borate buffer solution then distilled with boric acid solution. The ammonia in the distillate was then determined colorimetrically by phenate reduction.

Nitrate

Nitrate was analyzed following Alpha Analytical SOP *Nitrate, Nitrite and Nitrate/Nitrite Nitrogen* (SOP 7-26, October, 2009). Nitrate was quantitively reduced to nitrite by passage of the sample through a copperized cadmium column. The nitrite was then determined by diazotizing with sulfanilamide and coupling with N-(1-napthyl) ethylendiamine dihydrochloride. Nitrate is calculated as the difference between the reduced and non reduced sample.

Total Kjeldahl Nitrogen

Total Kjeldahl Nitrogen (TKN) was analyzed following Alpha Analytical SOP *Nitrogen, Total Kjeldahl* (SOP 07-15, July, 2009). Organic nitrogen in the sediment samples was converted to ammonia via heating in the presence of concentrated sulfuric acid. The digestate was then distilled and the ammonia distillate was determined colorimetrically by the phenate method.

Total Phosphorous

Total Phosphorous was analyzed following the Alpha Analytical SOP *Total Phosphorous – Dissolved Phosphorous* (SOP 07-35, Rev 1 August, 2009). Sediment samples were digested by persulfate oxidation technique following ASTM method 8M4500P-E. Total phosphate in the digestate was determined colorimetrically.

5.0 PROTOCOL DEVIATIONS DURING CHEMICAL TESTING

5.1 CHEMICAL TESTING DEVIATIONS

The samples were received in accordance with the Chain of Custody (COC) and no significant deviations were encountered during the preparation or analysis unless otherwise noted below. Sample receipt, container information, and the COC are located at the back of the laboratory report in Appendix B.

Total Organic Carbon

The WG383172-4 MS recoveries (67% and 44%) associated with Sample B are below the acceptance criteria (75%-125%). However, all instrument checks (ie., CCV's, CCB's) as well as all applicable batch QC were within criteria. For example, the blank was agreeable and the associated LCS recoveries (94% and 124%) were within the acceptance window of 75%-125%. Additionally, the sample was duplicated and RPD values (5.7% and 5.13%) were within the acceptable window of 25%. Therefore, the data is considered acceptable and no further action was required.

Phosphorus, Total

Samples A, A DUP, B and C have elevated detection limits due to the dilutions required to quantitate the results within the calibration range.

6.0 PHYSICAL AND CHEMICAL TESTING RESULTS

This section summarizes results obtained from physical and chemical testing of sediment from samples collected at Brushneck Cove, RI. Chemistry results were evaluated against the laboratory based method detection limits (MDL) and reporting detection limits (RDL) such that:

- Nutrients not-detected or detected at levels below the MDL were reported as the RDL and U flagged

Results for all analyses along with results of QC samples are provided in Appendix E. Results of all physical and chemical tests are summarized below.

6.1 SEDIMENT CHEMISTRY

This section summarizes results obtained from the physical and chemical analysis of the sediment samples collected from Brushneck Cove, RI. The three (3) sediment samples were analyzed for grain size, TOC, moisture content and nutrients. All data received internal validation following established procedures at the laboratory. In general, the quality of the data is acceptable.

6.1.1 Grain Size

Grain size data for the Brushneck Cove samples showed that the samples were comprised predominantly of silt and clay (ie., passing through the # 200 sieve) with that fraction varying between 59.3-70.3% among the 3 samples (Table 4).

6.1.2 Total Organic Carbon

The total organic carbon (TOC) content varied from 0.814 - 1.79% among the samples analyzed indicating that the organic carbon levels in these sediments are fairly low. The moisture/solids analyses showed the samples had an equal amount (Sample C) or slightly more (Samples A & B) water than solids content (Table 4).

Table 4. Grain Size, Total Organic Carbon and Moisture Content for Brushneck Cove

	General Chemistry		Grain Size Analysis							Total Organic Carbon	
Sample ID	% Solids, Total	% Moisture	Sieve, #4	Sieve, #10	Sieve, #20	Sieve, #40	Sieve, #60	Sieve, #140	Sieve, #200	% Total Organic Carbon (Rep1)	% Total Organic Carbon (Rep2)
A	42.2	58	100	99.1	97.8	96.1	90.4	75.5	70.3	1.4	1.47
B	39.3	57	97.5	96.8	95.6	93.1	87.6	74.6	68.5	0.814	0.862
C	50	50	99.9	99.4	98.5	96.1	89.5	68.5	59.3	1.17	1.37
DUP A	46.2	54	100	99.5	98.3	95.9	89	70.3	64.4	1.79	1.33

6.1.3 Nutrients

The nutrient test results, summarized in Table 5, show ammonia nitrogen to range from 21-81 mg/kg among the three locations. Nitrate nitrogen ranged from non-detectable for Samples B & C to just slightly above the detection limit for Sample A (2.5 mg/kg). Total Kjeldahl nitrogen ranged from 1800-2800 mg/kg and total phosphorus ranged from 440-580 mg/kg for the 3 test samples.

Table 5. Nutrient Test Results for Brushneck Cove

Sample ID	Nitrogen, Ammonia (mg/kg)	Nitrogen, Nitrate (mg/kg)	Nitrogen, Total Kjeldahl (mg/kg)	Total Phosphorus (mg/kg)
A	59	2.5	2200	580
B	-	2.6(U)	-	570
B	81	-	2800	-
C	44	2(U)	1800	440
DUP A	21	2.1(U)	2500	520

APPENDIX A WEEKLY SAFETY BRIEFING

WEEKLY SAFETY MEETING

Date Held: 8 5 ?
Time: 10 1/1/09

CONTRACTOR: ______ Contract No.
PERSONNEL PRESENT (check): Contractor ✓ Sub. ✓ Government ____

SUBJECTS DISCUSSED (check items that were discussed during meeting):

USACE EM385-1-1 ______ (Specific sections: ______)
On-site Accident Prevention Plan (or Site Safety and Health Plan) ✓
Individual protective equipment (steel-toed boots, safety glasses, etc..) ✓
Prevention of slips/falls ✓
Back injury/safe lifting techniques ✓
Fire prevention _____
First aid ✓
Tripping hazards ✓
Equipment inspection and maintenance _____
Hoisting equipment, winch and crane safety _____
Ropes, hooks, chains, and slings _____
Water safety ✓
Boat safety ✓
HAZMAT, Toxic hazards, contaminated sediments, MSDS, respiratory, ventilation _____
Biological hazards (poison ivy, ticks, wasps, mosquitoes etc) ✓
Staging, ladders, concrete forms, safety nets, handrails ____
Hand tools, power tools, machinery, chain saws _____
Vehicle operation safety _____
Electrical grounding, temporary wiring, GFCI _____
Lockouts/safe clearance procedures _____
Welding, cutting _____
Excavation hazards/rescue _____
Loose rock/steep slopes _____
Explosives _____
Sanitation and waste disposal _____
Clean-up, trash ✓

Other safety issues of concern specific to contract that was discussed during meeting:

All persons attending meeting the meeting must sign below or on the back of the form.

Contractor Representative Signature Mitchell Hull Date: ______
CE Inspector/QA (if present at meeting) ____________ Date: ________

Accident Prevention Plan
Approval/Signoff Form for
Professional Services Support for
Sampling and Testing In Support of Design and Permitting, Brushneck Cove Section 206 Restoration Project, Warwick, Rhode Island

Contract No. W912WJ-09-D-0001-0016

08:51, 10/1/2009 - safety briefing held @ Boat ramp on Bay Ave, Warwick.

I understand, agree to, and will abide by the information set forth in this Accident Prevention Plan, and the information discussed in the Weekly Health and Safety Briefing.

No.	Name	Signature	Date	Company
1	Len Perry	[signature]	10-1-09	TG+B
2	Charles Perry	[signature]	10-1-09	TG+B
3	Mitchell Buck	[signature]	10-1-09	WHG
4	DAVID WALSH	[signature]	10/1/09	WHG
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				

Signing of this form acknowledges that I have read, understand, and will comply with all aspects of the Accident Prevention Plan.

APPENDIX B CHAIN OF CUSTODY FORMS

CHAIN OF CUSTODY

PAGE 1 OF 2

ALPHA ANALYTICAL

WESTBORO, MA TEL: 508-898-9220 FAX: 508-898-9193
MANSFIELD, MA TEL: 508-822-9300 FAX: 508-822-3288

Date Rec'd in Lab:

ALPHA Job #:

Client Information

Client: Woods Hole Group
Address: 81 Technology Park Dr
E. Falmouth, MA 02536
Phone: 508-540-8080
Fax: 508-540-1001
Email: mbuck@whgrp.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: Brushneck Cove
Project Location: Brushneck Cove, RI
Project #: TO-8016
Project Manager: Lee Weishar
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due: Time:

Report Information - Data Deliverables

☐ FAX ☒ EMAIL
☒ ADEx ☐ Add'l Deliverables

Billing Information

☒ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTOCOLS

☐ Yes ☐ No Are MCP Analytical Methods Required?
☐ Yes ☐ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

SAMPLE HANDLING
Filtration
☐ Done
☐ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

ANALYSIS: Grain Size | TOC | Ammonia/Nitrate/TKN/P

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	Grain Size	TOC	Ammonia/Nitrate/TKN/P	Sample Specific Comments	TOTAL # BOTTLES
	A - TOC	10/1/09	1750	S	MAB		X			1
	A - Nutrient	10/1/09	1750	S	MAB			X		1
	A - Grain	10/1/09	1750	S	MAB	X				1
	A DUP-TOC	10/1/09	1806	S	MAB		X			1
	A DUP - Nutrient	10/1/09	1806	S	MAB			X		1
	A DUP - Grain	10/1/09	1806	S	MAB	X				1
	B - TOC	10/1/09	1818	S	MAB		X			1
	B - Nutrient	10/1/09	1818	S	MAB			X		1
	B - Grain	10/1/09	1818	S	MAB	X				1
	C - TOC	10/1/09	1840	S	MAB		X			1
					Container Type	O	G	G		
					Preservative	A	A	A		

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP *or* CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
Mitchell Buck	10/2/09 - 1010	Paul Gilbert	10/2/09 1010

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Payment Terms. See reverse side.

FORM NO: 01-01 (rev. 30-JUL-07)

CHAIN OF COUSTODY

ALPHA ANALYTICAL

WESTBORO, MA
TEL: 508-898-9220
FAX: 508-898-9193

MANSFIELD, MA
TEL: 508-822-9300
FAX: 508-822-3288

Date Rec'd in Lab:

ALPHA Job #:

Client Information

Client: Woods Hole Group

Address: 81 Technology Park Dr
E Falmouth MA 02536

Phone: 508-540-8080

Fax: 508-540-1001

Email: mbuck@whgrp.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: Brushneck Cove

Project Location: Brushneck Cove, RI

Project #: TO-0016

Project Manager: Lee Weishar

ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH *(only confirmed if pre-approved!)*

Date Due: **Time:**

Report Information - Data Deliverables

☐ FAX ☒ EMAIL
☒ ADEx ☐ Add'l Deliverables

Billing Information

☒ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program *Criteria*

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTOCOLS

☐ Yes ☐ No Are MCP Analytical Methods Required?
☐ Yes ☐ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

SAMPLE HANDLING
Filtration
☐ Done
☐ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	ANALYSIS: Grain Size	Ammonia/Nitrate/TKN/P										Sample Specific Comments	TOTAL # BOTTLES
	C - Nutrient	10/1/09	13:40	S	MAB		X											1
	C - Grain	10/1/09	16:40	S	MAB	X												1
	Container Type					O	G											
	Preservative					A	A											

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP *or* CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
Mitchell Buck	10/2/09 - 10:10	Paul Gilbert	10/2/09 10:10

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Payment Terms. See reverse side.

FORM NO: 01-01 (rev. 30-JUL-07)

APPENDIX C ENVIRONMENTAL SAMPLING LOGS / CORE DESCRPTIONS

ENVIRONMENTAL SAMPLING LOG

PROJECT: Brushneck Cove, RI Coring DATE: 10/1/2009
SAMPLING PERSONNEL: D.Walsh, M.Buck
SEA STATE: calm WEATHER CODE: sunny, clear
POSITIONING METHOD: DGPS

SAMPLE NUMBER: A SAMPLER TYPE: VC
TIME: 10:10 SOUNDING: 2.5 ft
COORDINATES:
LATITUDE: 41.695142 LONGITUDE: -71.408637

PENETRATION: 20 RECOVERY: 15.7 NO. OF ATTEMPTS: 2

SAMPLE DESCRIPTION: CORE LENGTH = 15.7 (feet)

0-0.5' Black/very dark grey organic clay w/some fine sand

0.5-1.3' Mixture of dark grey & dark olive grey organic clay w/some fine sand. Occassional Shell Hash, H_2S Odor

1.3-3.0' Clay w/low % fine sand & organic detritus, some occassional shell frags and whole shells. H_2S odor. Well consolidated/firm, olive grey.

3.0-5.0' clay w/occassional shell frags, some sand (low 100%). Low organic content. color is olive grey to grey

5.0-10.0' Clay w/occassional shell frags, some trace % sand (fine) and organic detritus. color is grey. Slight H_2S odor.

10.0-11.4' Clay - same description as above

11.4-12.48' Clay with higher % of shell frags and whole shells (oyster) and woody detritus. Clay is grey. oyster shells concentrated at 12.0' & 12.48'

12.48-12.64' Fine to medium sand, well sorted, color is light brown

12.64-14.40' Silt, clayey, color is dark grey. some fine sand, layering and organic detritus

14.40-14.7 silt, clayey, color is dark greyish brown. organic detritus and some fine sand.

14.7-15.7 Silt & fine sand layered, well sorted. silt is dark brown, sand is light brown - light grey. As a whole, layer is a silty sand - fine sand.

ENVIRONMENTAL SAMPLING LOG

PROJECT: Brushneck Cove, RI Coring DATE: 10/1/2009
SAMPLING PERSONNEL: D.Walsh, M.Buck
SEA STATE: Calm WEATHER CODE: sunny, clear
POSITIONING METHOD: DGPS

SAMPLE NUMBER: B SAMPLER TYPE: VC
TIME: 13:07 SOUNDING: 2.5
COORDINATES:
LATITUDE: 41.693297 LONGITUDE: -71.406122

PENETRATION: 20 RECOVERY: 15.9 NO. OF ATTEMPTS: 3

SAMPLE DESCRIPTION: CORE LENGTH = 15.9 (feet)

0-0.6' - organic clay w/low % sand (trace?). Color is Black/very dark grey.
0.6-1.10' - olive grey clay w/organics, H_2S odor. clay has low % of sand, sand is fine grained. Large woody plant debris at 1.10'
1.10-5.0' - Olive grey clay w/low % fine sand. Low organics, but organic detritus and shell frags. H_2S odor. some whole shells (some sort of snail?). Very consistent layer, clay is well consolidated & firm.
5.0'-10.0' - Grey clay, homogenous w/organic detritus and occasional shell frags. H_2S odor. Very consistent layer. Clay is firm.
10.0'-15.56' - Grey silty clay w/low % fine sand. Color is grey. silty clay matrix is homogenous, but sand % varies throughout core (down core). organic detritus.
15.56-15.8' - Clayey silt w/organic detritus (higher %) than overlaying strata. color is grey.
15.8-15.9' - silty sand to fine sand w/organic detritus, color is dark greyish brown, well sorted.

ENVIRONMENTAL SAMPLING LOG

PROJECT: Brushneck Cove, RI Coring DATE: 10/1/2009
SAMPLING PERSONNEL: D.Walsh, M.Buck
SEA STATE: calm WEATHER CODE: sunny, clear
POSITIONING METHOD: DGPS

SAMPLE NUMBER: C SAMPLER TYPE: VC
TIME: 13:50 SOUNDING: 5.5
COORDINATES:
LATITUDE: 41.690917 LONGITUDE: -71.404470

PENETRATION: 20 RECOVERY: 12.6 NO. OF ATTEMPTS: 3

SAMPLE DESCRIPTION: CORE LENGTH = 12.6 (feet)

0-0.4' Black to very dark grey sandy clay w/organic decay - no visible veg. frags. some shell Hash

0.4-1.66' Grey to olive grey sandy clay / clayey sand(?), H_2S odor. Clay matrix is moderately well consolidated, Firm.

1.66-3.0' grey/olive grey sandy clay - low % sand then overlaying layer at 0.4-1.66'. H_2S odor.

3.0'-5.0' Clay. olive grey color, clay is firm, more consolidated than overlaying clay. Clay has a low % of fine sand, but much lower than clay matrix b/t 0.4-3.0'.

5-10.0' silty clay w/firm sand (low %, <5%). color is grey. fine sand % varies throughout core, Low % organic detritus. Clay - silty clay matrix is homogenous

10.0-12.6' Clay matrix, homogenous w/fine sand lenses (<0.02' thick) occaissionally troughout core. Large shell frag at 11.26'. Organic detritus throughout. fine sand at 12.6', sand is well sorted.

ENVIRONMENTAL SAMPLING LOG

PROJECT: Brushneck Cove, RI Coring DATE: 10/1/2009
SAMPLING PERSONNEL: D.Walsh, M.Buck
SEA STATE: calm WEATHER CODE: sunny, clear
POSITIONING METHOD: DGPS

SAMPLE NUMBER: D SAMPLER TYPE: VC
TIME: 15:45 SOUNDING: 6.8
COORDINATES:
LATITUDE: 41.690395 LONGITUDE: -71.404487

PENETRATION: 20 RECOVERY: 9.2 NO. OF ATTEMPTS: ~~3~~ 1

SAMPLE DESCRIPTION: CORE LENGTH = 9.2 (feet)

0-0.3' fine to medium grained sand, well sorted, organic debris: (grasses) and large shell frags. ~~co~~ color is dark grey to very dark grey.

0.3-5.0' clay w/ low % fine-medium ~~on~~ sand. organic detritus. color is grey

5.0-6.96' clay matrix w/fine to medium sand (well sorted) and organic detritus. color is grey.

6.96-7.38' clayey sand - sand w/low % clay. (Transition layer) sand is well sorted. color is grey to brownish grey.

7.38'-7.76' sand. fine grained, very well sorted, color is brown to orange brown (FE-ox stain)

7.76-9.2' sand. fine grained, very well sorted. color is light brown. core washout starts at 9.2'.

APPENDIX D PHOTOGRAPHS OF SEDIMENT CORES

Figure D1 Core A, 0-5 ft (top)

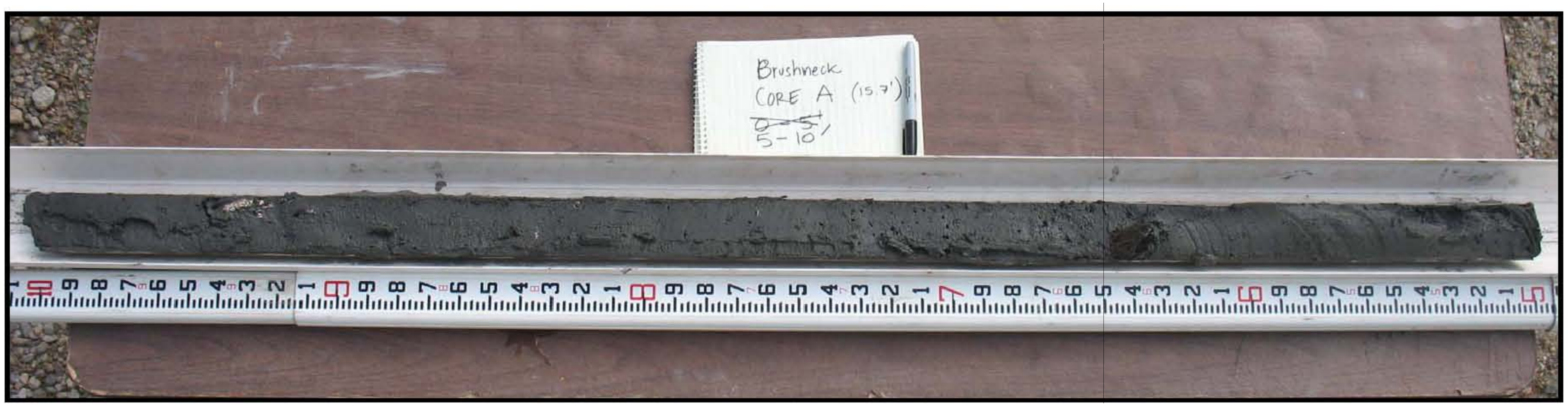


Figure D2 Core A, 5-10ft (middle)

Figure D3 Core A, 10-15.7ft (bottom)

Figure D4 Core B, 0-5ft (top)

Figure D5 Core B, 5-10ft (middle)

Figure D6 Core B, 10-15.9ft (bottom)

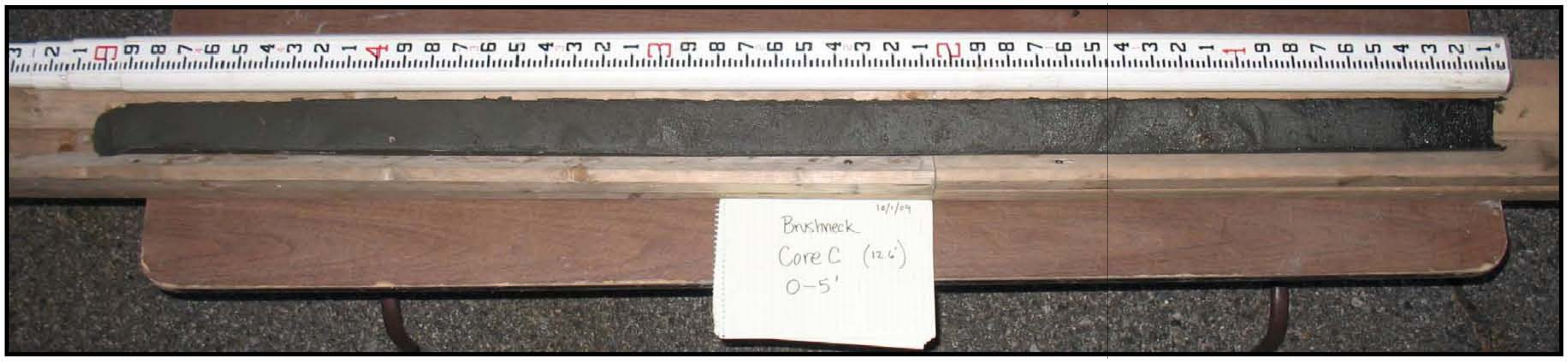


Figure D7 Core C, 0-5ft (top)

Figure D8 Core C, 5-10ft (middle)

Figure D9 Core C, 10-12.6ft (bottom)

Figure D10 Core D, 0-5ft (top)

Figure D11 Core D, 5-9.2ft (bottom)

APPENDIX E LABORATORY REPORT

ANALYTICAL REPORT

Lab Number:	L0914033
Client:	Woods Hole Group 81 Technology Park Drive East Falmouth, MA 02536
ATTN:	Lee Weishar
Project Name:	BRUSHNECK COVE
Project Number:	TO-0016
Report Date:	11/02/09

Certifications & Approvals: MA (M-MA030), NY (11627), CT (PH-0141), NH (2206), NJ (MA015), RI (LAO00299), ME (MA0030), PA (Registration #68-02089), LA NELAC (03090), FL NELAC (E87814), US Army Corps of Engineers.

320 Forbes Boulevard, Mansfield, MA 02048-1806
508-822-9300 (Fax) 508-822-3288 800-624-9220 - www.alphalab.com

Project Name: BRUSHNECK COVE
Project Number: TO-0016

Lab Number: L0914033
Report Date: 11/02/09

Alpha Sample ID	Client ID	Sample Location	Collection Date/Time
L0914033-01	A	BRUSHNECK COVE, RI	10/01/09 17:50
L0914033-02	A DUP	BRUSHNECK COVE, RI	10/01/09 18:06
L0914033-03	B	BRUSHNECK COVE, RI	10/01/09 18:18
L0914033-04	C	BRUSHNECK COVE, RI	10/01/09 18:40

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

For additional information, please contact Client Services at 800-624-9220.

Report Submission

This report replaces the report issued on 10/26/09. Per client request, excess sediment from sample L0914033-03 (initially collected for TOC analysis) was analyzed for grain size with hydrometer and percent moisture. Sufficient sediment was available to include duplicate analysis. These data are reported.

Sample Receipt

The samples were frozen from October 2, 2009 through October 4, 2009.

Total Organic Carbon

Project Name:	BRUSHNECK COVE	**Lab Number:**	L0914033
Project Number:	TO-0016	**Report Date:**	11/02/09

Case Narrative (continued)

The WG383172-4 MS recoveries (67% and 44%), associated with L0914033-03, are below the acceptance criteria, possibly due to the sample matrix. The associated LCS recovery is within criteria. No further action was required.

Phosphorus, Total
L0914033-01 through -04 have elevated detection limits due to the dilutions required to quantitate the results within the calibration range.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Kathleen M. O'Brien

Title: Technical Director/Representative Date: 11/02/09

ALPHA ANALYTICAL

INORGANICS
&
MISCELLANEOUS

Project Name: BRUSHNECK COVE
Project Number: TO-0016

Lab Number: L0914033
Report Date: 11/02/09

SAMPLE RESULTS

Lab ID: L0914033-01
Client ID: A
Sample Location: BRUSHNECK COVE, RI
Matrix: Sediment

Date Collected: 10/01/09 17:50
Date Received: 10/02/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Organic Carbon - Mansfield Lab									
Total Organic Carbon (Rep1)	1.40		%	0.010	1	-	10/23/09 18:00	1,9060	ES
Total Organic Carbon (Rep2)	1.47		%	0.010	1	-	10/23/09 18:00	1,9060	ES
Grain Size Analysis - Mansfield Lab									
Sieve, #4	100		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #10	99.1		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #20	97.8		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #40	96.1		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #60	90.4		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #140	75.5		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #200	70.3		%	0.100	1	-	10/05/09 00:00	12,D422	SE
General Chemistry - Westborough Lab									
Nitrogen, Ammonia	59		mg/kg	16	1	10/13/09 15:15	10/13/09 22:56	30,4500NH3-BH	AT
Nitrogen, Nitrate	2.5		mg/kg	2.4	1	10/06/09 22:00	10/07/09 01:39	30,4500NO3-F	DD
Nitrogen, Total Kjeldahl	2200		mg/kg	260	1	10/13/09 14:30	10/13/09 23:40	30,4500N-C	AT
Phosphorus, Total	580		mg/kg	32	2.7	-	10/12/09 15:45	30,4500P-E	NM
General Chemistry - Mansfield Lab									
Solids, Total	42.2		%	0.100	1	-	10/08/09 11:55	30,2540G	KB

Project Name: BRUSHNECK COVE
Project Number: TO-0016

Lab Number: L0914033
Report Date: 11/02/09

SAMPLE RESULTS

Lab ID: L0914033-01
Client ID: A
Sample Location: BRUSHNECK COVE, RI
Matrix: Sediment

Date Collected: 10/01/09 17:50
Date Received: 10/02/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Mansfield Lab									
Moisture	58		%	0.10	1	-	10/08/09 11:55	30,2540G	KB

Project Name: BRUSHNECK COVE
Project Number: TO-0016

Lab Number: L0914033
Report Date: 11/02/09

SAMPLE RESULTS

Lab ID: L0914033-02
Client ID: A DUP
Sample Location: BRUSHNECK COVE, RI
Matrix: Sediment

Date Collected: 10/01/09 18:06
Date Received: 10/02/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Organic Carbon - Mansfield Lab									
Total Organic Carbon (Rep1)	1.79		%	0.010	1	-	10/23/09 18:00	1,9060	ES
Total Organic Carbon (Rep2)	1.33		%	0.010	1	-	10/23/09 18:00	1,9060	ES
Grain Size Analysis - Mansfield Lab									
Sieve, #4	100		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #10	99.5		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #20	98.3		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #40	95.9		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #60	89.0		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #140	70.3		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #200	64.4		%	0.100	1	-	10/05/09 00:00	12,D422	SE
General Chemistry - Westborough Lab									
Nitrogen, Ammonia	21		mg/kg	14	1	10/13/09 15:15	10/13/09 22:37	30,4500NH3-BH	AT
Nitrogen, Nitrate	ND		mg/kg	2.1	1	10/06/09 22:00	10/07/09 01:40	30,4500NO3-F	DD
Nitrogen, Total Kjeldahl	2500		mg/kg	280	1	10/13/09 14:30	10/13/09 23:41	30,4500N-C	AT
Phosphorus, Total	520		mg/kg	23	2.1	-	10/12/09 15:45	30,4500P-E	NM
General Chemistry - Mansfield Lab									
Solids, Total	46.2		%	0.100	1	-	10/08/09 11:55	30,2540G	KB

Project Name: BRUSHNECK COVE | **Lab Number:** L0914033
Project Number: TO-0016 | **Report Date:** 11/02/09

SAMPLE RESULTS

Lab ID: L0914033-02
Client ID: A DUP
Sample Location: BRUSHNECK COVE, RI
Matrix: Sediment

Date Collected: 10/01/09 18:06
Date Received: 10/02/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Mansfield Lab									
Moisture	54		%	0.10	1	-	10/08/09 11:55	30,2540G	KB

Project Name: BRUSHNECK COVE
Project Number: TO-0016

Lab Number: L0914033
Report Date: 11/02/09

SAMPLE RESULTS

Lab ID: L0914033-03
Client ID: B
Sample Location: BRUSHNECK COVE, RI
Matrix: Sediment

Date Collected: 10/01/09 18:18
Date Received: 10/02/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Organic Carbon - Mansfield Lab									
Total Organic Carbon (Rep1)	0.814		%	0.010	1	-	10/23/09 18:00	1,9060	ES
Total Organic Carbon (Rep2)	0.862		%	0.010	1	-	10/23/09 18:00	1,9060	ES
Grain Size Analysis - Mansfield Lab									
Sieve, #4	97.5		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #10	96.8		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #20	95.6		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #40	93.1		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #60	87.6		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #140	74.6		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #200	68.5		%	0.100	1	-	10/05/09 00:00	12,D422	SE
General Chemistry - Westborough Lab									
Nitrogen, Ammonia	81		mg/kg	18	1	10/14/09 11:20	10/15/09 22:08	30,4500NH3-BH	AT
Nitrogen, Nitrate	ND		mg/kg	2.6	1	10/06/09 22:00	10/07/09 01:41	30,4500NO3-F	DD
Nitrogen, Total Kjeldahl	2800		mg/kg	370	1	10/14/09 14:35	10/15/09 21:47	30,4500N-C	AT
Phosphorus, Total	570		mg/kg	32	2.5	-	10/12/09 15:45	30,4500P-E	NM
General Chemistry - Mansfield Lab									
Solids, Total	39.3		%	0.100	1	-	10/08/09 11:55	30,2540G	KB

Project Name: BRUSHNECK COVE
Project Number: TO-0016

Lab Number: L0914033
Report Date: 11/02/09

SAMPLE RESULTS

Lab ID: L0914033-03
Client ID: B
Sample Location: BRUSHNECK COVE, RI
Matrix: Sediment

Date Collected: 10/01/09 18:18
Date Received: 10/02/09
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Mansfield Lab									
Moisture	57		%	0.10	1	-	10/08/09 11:55	30,2540G	KB

Project Name:	BRUSHNECK COVE	**Lab Number:**	L0914033
Project Number:	TO-0016	**Report Date:**	11/02/09

SAMPLE RESULTS

Lab ID:	L0914033-04	Date Collected:	10/01/09 18:40
Client ID:	C	Date Received:	10/02/09
Sample Location:	BRUSHNECK COVE, RI	Field Prep:	Not Specified
Matrix:	Sediment		

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Organic Carbon - Mansfield Lab									
Total Organic Carbon (Rep1)	1.17		%	0.010	1	-	10/23/09 18:00	1,9060	ES
Total Organic Carbon (Rep2)	1.37		%	0.010	1	-	10/23/09 18:00	1,9060	ES
Grain Size Analysis - Mansfield Lab									
Sieve, #4	99.9		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #10	99.4		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #20	98.5		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #40	96.1		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #60	89.5		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #140	68.5		%	0.100	1	-	10/05/09 00:00	12,D422	SE
Sieve, #200	59.3		%	0.100	1	-	10/05/09 00:00	12,D422	SE
General Chemistry - Westborough Lab									
Nitrogen, Ammonia	44		mg/kg	14	1	10/13/09 15:15	10/13/09 22:38	30,4500NH3-BH	AT
Nitrogen, Nitrate	ND		mg/kg	2.0	1	10/06/09 22:00	10/07/09 01:42	30,4500NO3-F	DD
Nitrogen, Total Kjeldahl	1800		mg/kg	230	1	10/13/09 14:30	10/13/09 23:47	30,4500N-C	AT
Phosphorus, Total	440		mg/kg	20	2	-	10/12/09 15:45	30,4500P-E	NM
General Chemistry - Mansfield Lab									
Solids, Total	50.0		%	0.100	1	-	10/08/09 11:55	30,2540G	KB

Project Name:	BRUSHNECK COVE	**Lab Number:**	L0914033
Project Number:	TO-0016	**Report Date:**	11/02/09

SAMPLE RESULTS

Lab ID:	L0914033-04	Date Collected:	10/01/09 18:40
Client ID:	C	Date Received:	10/02/09
Sample Location:	BRUSHNECK COVE, RI	Field Prep:	Not Specified
Matrix:	Sediment		

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Mansfield Lab									
Moisture	50		%	0.10	1	-	10/08/09 11:55	30,2540G	KB

Project Name: BRUSHNECK COVE | **Lab Number:** L0914033
Project Number: TO-0016 | **Report Date:** 11/02/09

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Organic Carbon - Mansfield Lab for sample(s): 01-04 Batch: WG383172-1									
Total Organic Carbon (Rep1)	ND		%	0.010	1	-	10/23/09 18:00	1,9060	ES
Total Organic Carbon (Rep2)	ND		%	0.010	1	-	10/23/09 18:00	1,9060	ES
General Chemistry - Westborough Lab for sample(s): 01-04 Batch: WG383184-2									
Nitrogen, Nitrate	ND		mg/kg	1.0	1	10/06/09 22:00	10/07/09 01:37	30,4500NO3-F	DD
General Chemistry - Westborough Lab for sample(s): 01-04 Batch: WG383989-1									
Phosphorus, Total	ND		mg/kg	6.0	1.2	-	10/12/09 15:45	30,4500P-E	NM
General Chemistry - Westborough Lab for sample(s): 01-02,04 Batch: WG384198-1									
Nitrogen, Ammonia	ND		mg/kg	7.5	1	10/13/09 15:15	10/13/09 22:21	30,4500NH3-BH	AT
General Chemistry - Westborough Lab for sample(s): 01-02,04 Batch: WG384202-1									
Nitrogen, Total Kjeldahl	ND		mg/kg	150	1	10/13/09 14:30	10/13/09 23:26	30,4500N-C	AT
General Chemistry - Westborough Lab for sample(s): 03 Batch: WG384334-1									
Nitrogen, Total Kjeldahl	ND		mg/kg	150	1	10/14/09 14:35	10/15/09 21:44	30,4500N-C	AT
General Chemistry - Westborough Lab for sample(s): 03 Batch: WG384371-1									
Nitrogen, Ammonia	ND		mg/kg	7.5	1	10/14/09 11:20	10/15/09 22:05	30,4500NH3-BH	AT

Lab Control Sample Analysis
Batch Quality Control

Project Name: BRUSHNECK COVE
Project Number: TO-0016

Lab Number: L0914033
Report Date: 11/02/09

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-04 Batch: WG383184-1								
Nitrogen, Nitrate	99		-			-		
General Chemistry - Westborough Lab Associated sample(s): 01-04 Batch: WG383989-2								
Phosphorus, Total	113		-		75-128	-		
General Chemistry - Westborough Lab Associated sample(s): 01-02,04 Batch: WG384198-2								
Nitrogen, Ammonia	93		-			-		
General Chemistry - Westborough Lab Associated sample(s): 01-02,04 Batch: WG384202-2								
Nitrogen, Total Kjeldahl	92		-			-		
General Chemistry - Westborough Lab Associated sample(s): 03 Batch: WG384334-2								
Nitrogen, Total Kjeldahl	88		-			-		
General Chemistry - Westborough Lab Associated sample(s): 03 Batch: WG384371-2								
Nitrogen, Ammonia	96		-			-		

Matrix Spike Analysis
Batch Quality Control

Project Name: BRUSHNECK COVE
Project Number: TO-0016

Lab Number: L0914033
Report Date: 11/02/09

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
Total Organic Carbon - Mansfield Lab Associated sample(s): 01-04 QC Batch ID: WG383172-4 QC Sample: L0914033-03 Client ID: B												
Total Organic Carbon (Rep1)	0.814	2.8	2.70	**67**	Q	-	-		75-125	-		25
Total Organic Carbon (Rep2)	0.862	3.8	2.47	**44**	Q	-	-		75-125	-		25
General Chemistry - Westborough Lab Associated sample(s): 01-04 QC Batch ID: WG383184-3 QC Sample: L0914033-03 Client ID: B												
Nitrogen, Nitrate	ND	207	200	95		-	-			-		
General Chemistry - Westborough Lab Associated sample(s): 01-04 QC Batch ID: WG383989-4 QC Sample: L0914033-03 Client ID: B												
Phosphorus, Total	570	2850	3200	92		-	-			-		
General Chemistry - Westborough Lab Associated sample(s): 01-02,04 QC Batch ID: WG384198-4 QC Sample: L0914033-04 Client ID: C												
Nitrogen, Ammonia	44	790	790	94		-	-			-		
General Chemistry - Westborough Lab Associated sample(s): 01-02,04 QC Batch ID: WG384202-4 QC Sample: L0914033-02 Client ID: A DUP												
Nitrogen, Total Kjeldahl	2500	7139	9000	90		-	-			-		
General Chemistry - Westborough Lab Associated sample(s): 03 QC Batch ID: WG384334-3 QC Sample: L0914033-03 Client ID: B												
Nitrogen, Total Kjeldahl	2800	9959	12000	96		-	-			-		
General Chemistry - Westborough Lab Associated sample(s): 03 QC Batch ID: WG384371-3 QC Sample: L0914033-03 Client ID: B												
Nitrogen, Ammonia	81	1000	1000	91		-	-			-		

Lab Duplicate Analysis
Batch Quality Control

Project Name: BRUSHNECK COVE
Project Number: TO-0016
Lab Number: L0914033
Report Date: 11/02/09

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
Grain Size Analysis - Mansfield Lab Associated sample(s): 01-04 QC Batch ID: WG382969-1 QC Sample: L0914033-03 Client ID: B						
Sieve, #4	97.5	97.4	%	0		20
Sieve, #10	96.8	96.7	%	0		20
Sieve, #20	95.6	95.9	%	0		20
Sieve, #40	93.1	93.1	%	0		20
Sieve, #60	87.6	88.1	%	1		20
Sieve, #140	74.6	77.4	%	4		20
Sieve, #200	68.5	72.3	%	5		20
Total Organic Carbon - Mansfield Lab Associated sample(s): 01-04 QC Batch ID: WG383172-3 QC Sample: L0914033-03 Client ID: B						
Total Organic Carbon (Rep1)	0.814	0.779	%	4		25
Total Organic Carbon (Rep2)	0.862	0.820	%	5		25
General Chemistry - Westborough Lab Associated sample(s): 01-04 QC Batch ID: WG383184-4 QC Sample: L0914033-03 Client ID: B						
Nitrogen, Nitrate	ND	ND	mg/kg	NC		
General Chemistry - Mansfield Lab Associated sample(s): 01-04 QC Batch ID: WG383480-1 QC Sample: L0914033-01 Client ID: A						
Solids, Total	42.2	42.5	%	1		20
General Chemistry - Westborough Lab Associated sample(s): 01-04 QC Batch ID: WG383989-3 QC Sample: L0914033-03 Client ID: B						
Phosphorus, Total	570	560	mg/kg	2		
General Chemistry - Westborough Lab Associated sample(s): 01-02,04 QC Batch ID: WG384198-3 QC Sample: L0913863-43 Client ID: DUP Sample						
Nitrogen, Ammonia	27	25	mg/kg	8		

Lab Duplicate Analysis
Batch Quality Control

Project Name: BRUSHNECK COVE
Project Number: TO-0016
Lab Number: L0914033
Report Date: 11/02/09

Parameter	Native Sample	Duplicate Sample	Units	RPD	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-02,04 QC Batch ID: WG384202-3 QC Sample: L0913863-43 Client ID: DUP Sample					
Nitrogen, Total Kjeldahl	1500	1400	mg/kg	7	
General Chemistry - Westborough Lab Associated sample(s): 03 QC Batch ID: WG384334-4 QC Sample: L0914033-03 Client ID: B					
Nitrogen, Total Kjeldahl	2800	2900	mg/kg	4	
General Chemistry - Westborough Lab Associated sample(s): 03 QC Batch ID: WG384371-4 QC Sample: L0914033-03 Client ID: B					
Nitrogen, Ammonia	81	78	mg/kg	4	
General Chemistry - Mansfield Lab Associated sample(s): 01-04 QC Batch ID: WG385959-1 QC Sample: L0914033-03 Client ID: B					
Moisture	57.3	57	%	6	10

Project Name:	BRUSHNECK COVE	Lab Number:	L0914033
Project Number:	TO-0016	Report Date:	11/02/09

S.R.M. Standard Quality Control

Standard Reference Material (SRM): WG383172-2

Parameter	% Recovery	Qual	QC Criteria
Total Organic Carbon (Rep1)	94		75-125
Total Organic Carbon (Rep2)	124		75-125

Project Name: BRUSHNECK COVE
Project Number: TO-0016

Lab Number: L0914033
Report Date: 11/02/09

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Cooler Information

Cooler	Custody Seal
A	Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis
L0914033-01A	Glass 250ml unpreserved	A	N/A	2.5	Y	Absent	A2-MOISTURE-2540(7),A2-TS(7),A2-TOC-9060-2REPS(28)
L0914033-01B	Bag	A	N/A	2.5	Y	Absent	A2-HYDROMETER(),A2-SIEVE_#10(7),A2-SIEVE_#140(7),A2-SIEVE_#60(7),A2-SIEVE_#4(7),A2-SIEVE_#40(7),A2-SIEVE_#20(7),A2-SIEVE_#200(7)
L0914033-01C	Amber 250ml unpreserved	A	N/A	2.5	Y	Absent	TKN-4500(28),TPHOS-4500(28),NO3-4500(2),NH3-4500(28)
L0914033-02A	Glass 250ml unpreserved	A	N/A	2.5	Y	Absent	A2-MOISTURE-2540(7),A2-TS(7),A2-TOC-9060-2REPS(28)
L0914033-02B	Bag	A	N/A	2.5	Y	Absent	A2-HYDROMETER(),A2-SIEVE_#10(7),A2-SIEVE_#140(7),A2-SIEVE_#60(7),A2-SIEVE_#4(7),A2-SIEVE_#40(7),A2-SIEVE_#20(7),A2-SIEVE_#200(7)
L0914033-02C	Amber 250ml unpreserved	A	N/A	2.5	Y	Absent	TKN-4500(28),NO3-4500(2),NH3-4500(28)
L0914033-03A	Glass 250ml unpreserved	A	N/A	2.5	Y	Absent	A2-MOISTURE-2540(7),A2-TS(7),A2-TOC-9060-2REPS(28)
L0914033-03B	Bag	A	N/A	2.5	Y	Absent	A2-HYDROMETER(),A2-SIEVE_#10(7),A2-SIEVE_#140(7),A2-SIEVE_#60(7),A2-SIEVE_#4(7),A2-SIEVE_#40(7),A2-SIEVE_#20(7),A2-SIEVE_#200(7)
L0914033-03C	Amber 250ml unpreserved	A	N/A	2.5	Y	Absent	TKN-4500(28),NO3-4500(2),NH3-4500(28)
L0914033-04A	Glass 250ml unpreserved	A	N/A	2.5	Y	Absent	A2-MOISTURE-2540(7),A2-TS(7),A2-TOC-9060-2REPS(28)
L0914033-04B	Bag	A	N/A	2.5	Y	Absent	A2-HYDROMETER(),A2-SIEVE_#10(7),A2-SIEVE_#140(7),A2-SIEVE_#60(7),A2-SIEVE_#4(7),A2-SIEVE_#40(7),A2-SIEVE_#20(7),A2-SIEVE_#200(7)
L0914033-04C	Amber 250ml unpreserved	A	N/A	2.5	Y	Absent	TKN-4500(28),NO3-4500(2),NH3-4500(28)

*Hold days indicated by values in parentheses

Project Name:	BRUSHNECK COVE	**Lab Number:**	L0914033
Project Number:	TO-0016	**Report Date:**	11/02/09

GLOSSARY

Acronyms

EPA - Environmental Protection Agency.

LCS - Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

LCSD - Laboratory Control Sample Duplicate: Refer to LCS.

MS - Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.

MSD - Matrix Spike Sample Duplicate: Refer to MS.

NA - Not Applicable.

NC - Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.

ND - Not detected at the reported detection limit for the sample.

NI - Not Ignitable.

RDL - Reported Detection Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

RPD - Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

A - Spectra identified as "Aldol Condensation Product".

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than five times (5x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

H - The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.

P - The RPD between the results for the two columns exceeds the method-specified criteria.

Q - The quality control sample exceeds the associated acceptance criteria. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RDL. (Metals only.)

R - Analytical results are from sample re-analysis.

RE - Analytical results are from sample re-extraction.

J - Estimated value. This represents an estimated concentration for Tentatively Identified Compounds (TICs).

Report Format: Data Usability Report

Project Name:	BRUSHNECK COVE	**Lab Number:**	L0914033
Project Number:	TO-0016	**Report Date:**	11/02/09

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IIIA, 1997.

12 Annual Book of ASTM Standards. American Society for Testing and Materials.

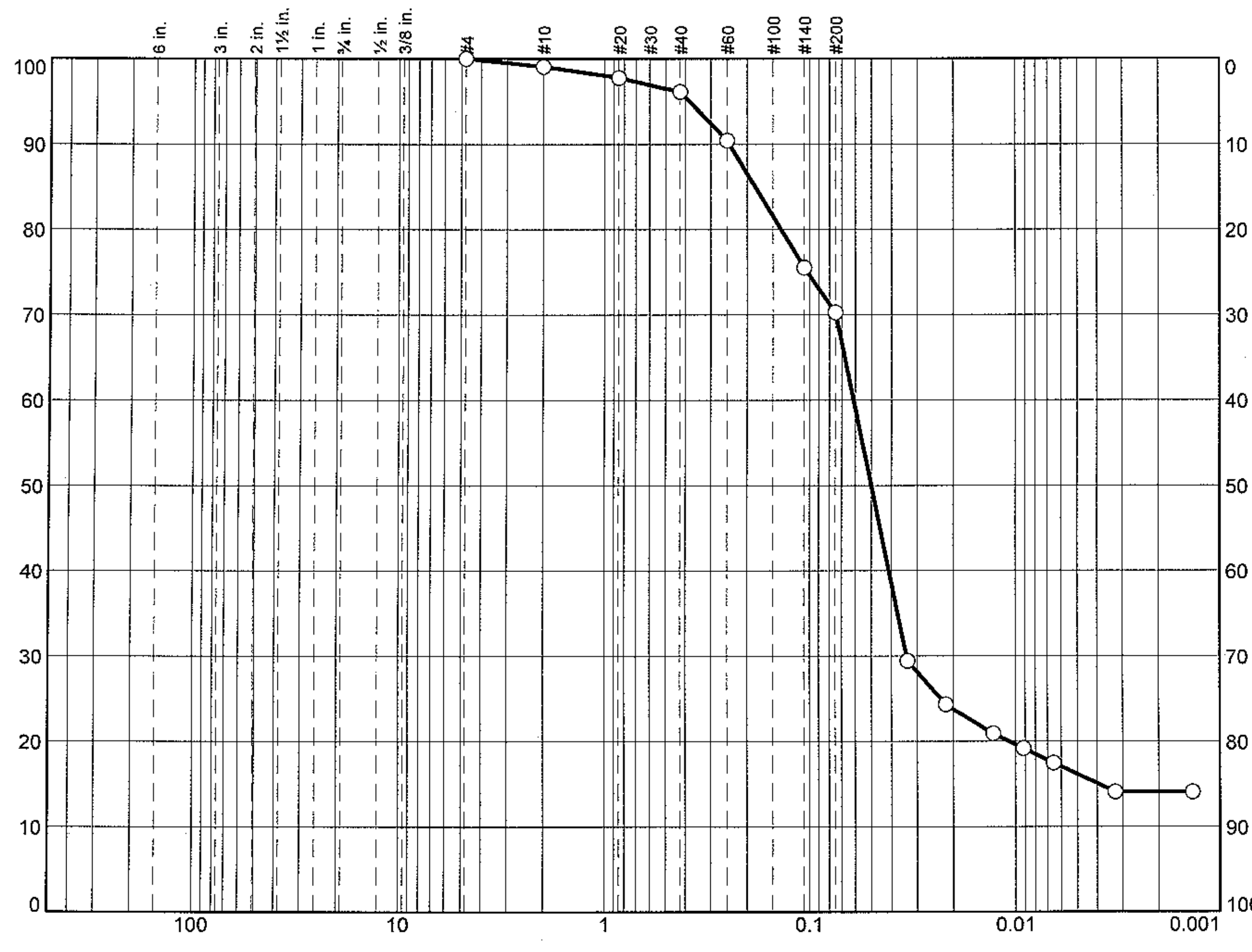
30 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WPCF. 18th Edition. 1992.

LIMITATION OF LIABILITIES

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Wet Sieve Hydrometer
ASTM 422D

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.9	3.0	25.8	54.2	16.1

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.1830	0.0612	0.0502	0.0338	0.0040			

	Material Description	USCS	AASHTO
○			

Project No. L0914033 **Client:** Woods Hole Group
Project: Brushneck Cove

○ **Source of Sample:** A **Sample Number:** L0914033-01

Remarks:

Alpha Analytical

Mansfield, MA

Figure

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2009

Client: Woods Hole Group
Project: Brushneck Cove
Project Number: L0914033
Location: A
Sample Number: L0914033-01
Sieve opening list: BS Bulk Sieve

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare** = 25.26
Tare Wt. = 4.55
Minus #200 from wash = 68.6%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer	Percent Retained
66.00	0.00	#4	520.83	520.83	100.0	0.0
		#10	482.71	482.09	99.1	0.9
		#20	411.91	411.05	97.8	2.2
		#40	379.04	377.96	96.1	3.9
		#60	373.90	370.13	90.4	9.6
		#140	357.19	347.37	75.5	24.5
		#200	350.03	346.56	70.3	29.7

Hydrometer Test Data

Hydrometer test uses material passing #200
Percent passing #200 based upon complete sample = 70.3
Weight of hydrometer sample =66.00
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -0.04
Meniscus correction only = -3.0
Specific gravity of solids = 2.65
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 - 0.2645 x Rm

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer	Percent Retained
2.00	22.0	1.0170	1.0172	0.0133	14.0	12.6	0.0334	29.4	70.6
5.00	22.0	1.0140	1.0142	0.0133	11.0	13.4	0.0218	24.3	75.7
15.00	22.0	1.0120	1.0122	0.0133	9.0	13.9	0.0128	20.9	79.1
30.00	22.0	1.0110	1.0112	0.0133	8.0	14.2	0.0092	19.2	80.8
60.00	22.0	1.0100	1.0102	0.0133	7.0	14.4	0.0065	17.5	82.5
250.00	22.0	1.0080	1.0082	0.0133	5.0	15.0	0.0033	14.0	86.0
1440.00	22.0	1.0080	1.0082	0.0133	5.0	15.0	0.0014	14.0	86.0

Fractional Components

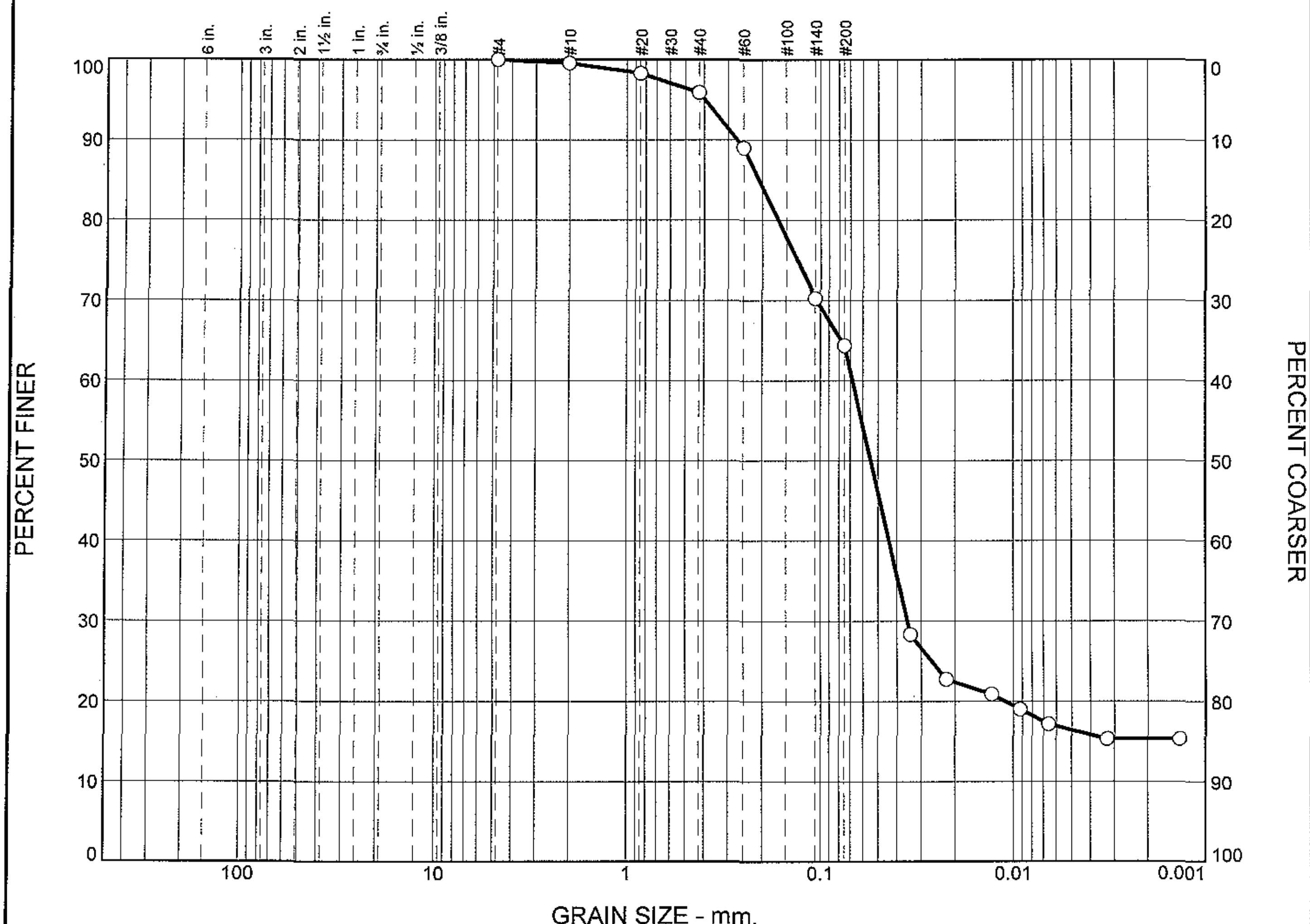
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.9	3.0	25.8	29.7	54.2	16.1	70.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0040	0.0108	0.0338	0.0502	0.0612	0.1372	0.1830	0.2441	0.3829

Fineness Modulus
0.32

Alpha Analytical

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.5	3.6	31.5	48.0	16.4

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2081	0.0681	0.0548	0.0354				

Material Description	USCS	AASHTO
○		

Project No. L0914033 **Client:** Woods Hole Group
Project: Brushneck Cove

○ **Source of Sample:** A DUP **Sample Number:** L0914033-02

Remarks:

Alpha Analytical

Mansfield, MA

Figure

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2009

Client: Woods Hole Group
Project: Brushneck Cove
Project Number: L0914033
Location: A DUP
Sample Number: L0914033-02
Sieve opening list: BS Bulk Sieve

Sieve Test Data

Post #200 Wash Test Weights (grams): **Dry Sample and Tare** = 25.08
Tare Wt. = 4.55
Minus #200 from wash = 63.0%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer	Percent Retained
55.52	0.00	#4	521.72	521.72	100.0	0.0
		#10	484.97	484.72	99.5	0.5
		#20	406.13	405.44	98.3	1.7
		#40	362.98	361.64	95.9	4.1
		#60	370.31	366.49	89.0	11.0
		#140	353.34	342.93	70.3	29.7
		#200	348.47	345.21	64.4	35.6

Hydrometer Test Data

Hydrometer test uses material passing #200
Percent passing #200 based upon complete sample = 64.4
Weight of hydrometer sample =55.52
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -0.04
Meniscus correction only = -3.0
Specific gravity of solids = 2.65
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 - 0.2645 x Rm

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer	Percent Retained
2.00	22.0	1.0150	1.0152	0.0133	12.0	13.1	0.0341	28.3	71.7
5.00	22.0	1.0120	1.0122	0.0133	9.0	13.9	0.0222	22.7	77.3
15.00	22.0	1.0110	1.0112	0.0133	8.0	14.2	0.0129	20.9	79.1
30.00	22.0	1.0100	1.0102	0.0133	7.0	14.4	0.0092	19.0	81.0
60.00	22.0	1.0090	1.0092	0.0133	6.0	14.7	0.0066	17.2	82.8
250.00	22.0	1.0080	1.0082	0.0133	5.0	15.0	0.0033	15.3	84.7
1440.00	22.0	1.0080	1.0082	0.0133	5.0	15.0	0,0014	15.3	84.7

Fractional Components

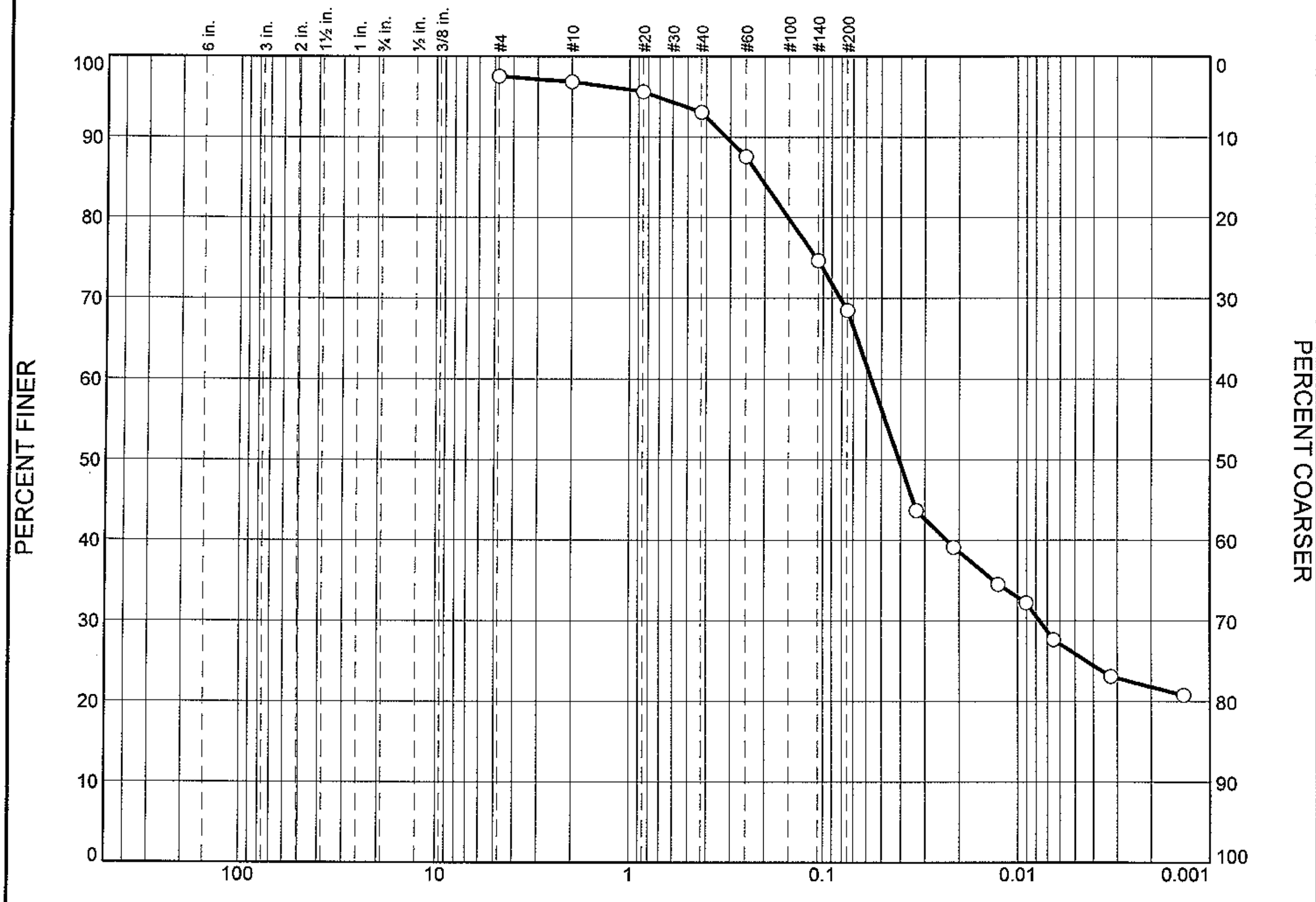
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	0.0	0.0	0.5	3.6	31.5	35.6	48.0	16.4	64.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
		0.0110	0.0354	0.0548	0.0681	0.1655	0.2081	0.2698	0.3967

Fineness Modulus
0.35

Alpha Analytical

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				0.7	3.7	24.6	42.6	25.9

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2108	0.0567	0.0408	0.0077				

	Material Description	USCS	AASHTO
○			

Project No. L0914033 **Client:** Woods Hole Group
Project: Brushneck Cove

○ **Source of Sample:** B **Sample Number:** L0914033-03

Remarks:

Alpha Analytical

Mansfield, MA

Figure

GRAIN SIZE DISTRIBUTION TEST DATA

11/2/2009

Client: Woods Hole Group
Project: Brushneck Cove
Project Number: L0914033
Location: B
Sample Number: L0914033-03
Sieve opening list: BS Bulk Sieve

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer	Percent Retained
48.02	0.00	#4	521.98	520.79	97.5	2.5
		#10	482.33	482.00	96.8	3.2
		#20	411.59	411.01	95.6	4.4
		#40	379.21	377.98	93.1	6.9
		#60	372.61	369.97	87.6	12.4
		#140	353.44	347.23	74.6	25.4
		#200	349.44	346.49	68.5	31.5

Hydrometer Test Data

Hydrometer test uses material passing #200
Percent passing #200 based upon complete sample = 68.5
Weight of hydrometer sample =48.02
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -0.04
Meniscus correction only = -3.0
Specific gravity of solids = 2.65
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 - 0.2645 x **Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer	Percent Retained
2.00	21.0	1.0190	1.0191	0.0135	16.0	12.1	0.0331	43.7	56.3
5.00	21.0	1.0170	1.0171	0.0135	14.0	12.6	0.0214	39.1	60.9
15.00	21.0	1.0150	1.0151	0.0135	12.0	13.1	0.0126	34.5	65.5
30.00	21.0	1.0140	1.0141	0.0135	11.0	13.4	0.0090	32.2	67.8
60.00	21.0	1.0120	1.0121	0.0135	9.0	13.9	0.0065	27.6	72.4
250.00	21.0	1.0100	1.0101	0.0135	7.0	14.4	0.0032	23.1	76.9
1440.00	21.0	1.0090	1.0091	0.0135	6.0	14.7	0.0014	20.8	79.2

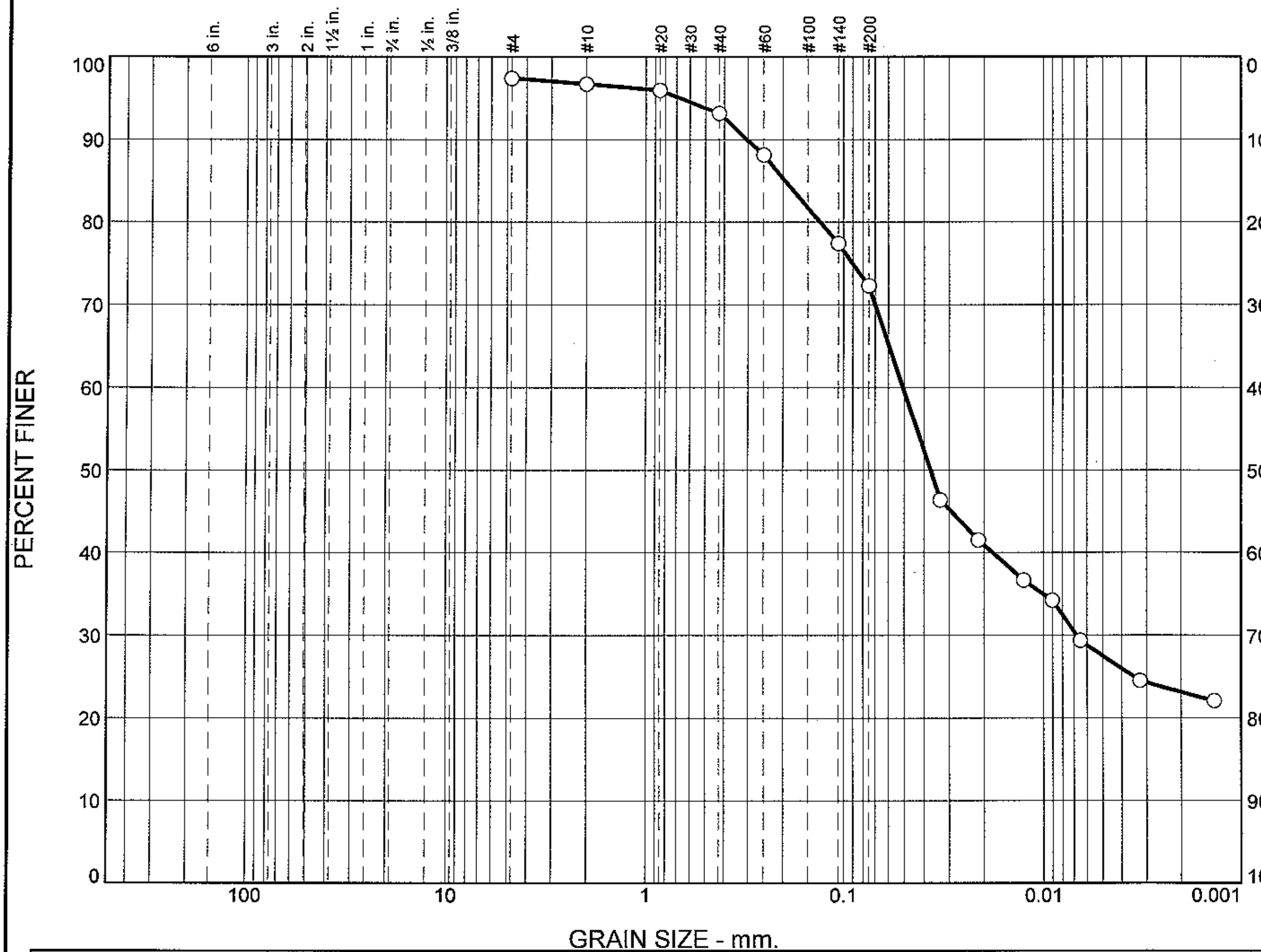
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
				0.7	3.7	24.6	29.0	42.6	25.9	68.5

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0077	0.0408	0.0567	0.1513	0.2108	0.3162	0.7174

Fineness Modulus
0.46

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				0.7	3.6	20.8	44.8	27.5

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.1951	0.0509	0.0371	0.0068				

Material Description	USCS	AASHTO
○		

Project No. L0914033 **Client:** Woods Hole Group
Project: Brushneck Cove

○ **Source of Sample:** B **Sample Number:** WG382969-1

Remarks:

Alpha Analytical

Mansfield, MA

Figure

GRAIN SIZE DISTRIBUTION TEST DATA

11/2/2009

Client: Woods Hole Group
Project: Brushneck Cove
Project Number: L0914033
Location: B
Sample Number: WG382969-1
Sieve opening list: BS Bulk Sieve

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer	Percent Retained
47.73	0.00	#4	522.94	521.70	97.4	2.6
		#10	485.01	484.68	96.7	3.3
		#20	484.79	484.42	95.9	4.1
		#40	362.99	361.66	93.1	6.9
		#60	368.73	366.32	88.1	11.9
		#140	348.00	342.89	77.4	22.6
		#200	347.59	345.15	72.3	27.7

Hydrometer Test Data

Hydrometer test uses material passing #200
Percent passing #200 based upon complete sample = 72.3
Weight of hydrometer sample =47.73
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -0.04
Meniscus correction only = -3.0
Specific gravity of solids = 2.65
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 - 0.2645 x **Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer	Percent Retained
2.00	21.0	1.0190	1.0191	0.0135	16.0	12.1	0.0331	46.4	53.6
5.00	21.0	1.0170	1.0171	0.0135	14.0	12.6	0.0214	41.5	58.5
15.00	21.0	1.0150	1.0151	0.0135	12.0	13.1	0.0126	36.6	63.4
30.00	21.0	1.0140	1.0141	0.0135	11.0	13.4	0.0090	34.2	65.8
60.00	21.0	1.0120	1.0121	0.0135	9.0	13.9	0.0065	29.3	70.7
250.00	21.0	1.0100	1.0101	0.0135	7.0	14.4	0.0032	24.5	75.5
1440.00	21.0	1.0090	1.0091	0.0135	6.0	14.7	0.0014	22.1	77.9

Fractional Components

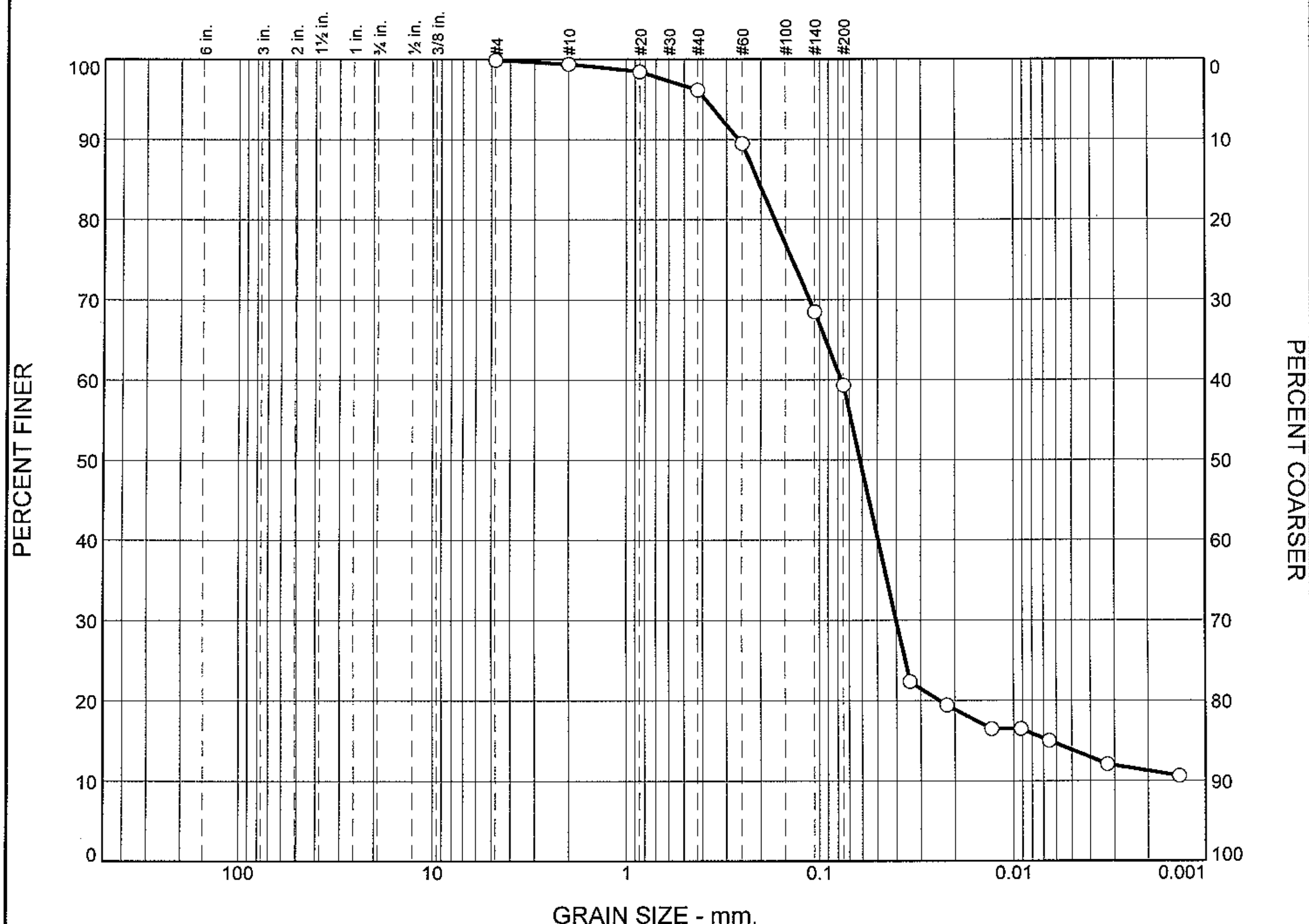
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
				0.7	3.6	20.8	25.1	44.8	27.5	72.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
			0.0068	0.0371	0.0509	0.1307	0.1951	0.3055	0.6739

Fineness Modulus
0.43

Alpha Analytical

Particle Size Distribution Report



	% Cobbles	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				0.5	3.3	36.8	45.4	13.9

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2082	0.0770	0.0615	0.0402	0.0065			

Material Description	USCS	AASHTO
○		

Project No. L0914033 **Client:** Woods Hole Group
Project: Brushneck Cove

○ **Source of Sample:** C **Sample Number:** L0914033-04

Remarks:

Alpha Analytical

Mansfield, MA

Figure

GRAIN SIZE DISTRIBUTION TEST DATA

10/26/2009

Client: Woods Hole Group
Project: Brushneck Cove
Project Number: L0914033
Location: C
Sample Number: L0914033-04
Sieve opening list: BS Bulk Sieve

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 32.18
Tare Wt. = 4.62
Minus #200 from wash = 57.5%

Dry Sample and Tare (grams)	Tare (grams)	Sieve Opening Size	Weight Retained (grams)	Sieve Weight (grams)	Percent Finer	Percent Retained
64.85	0.00	#4	521.78	521.72	99.9	0.1
		#10	485.06	484.72	99.4	0.6
		#20	406.04	405.44	98.5	1.5
		#40	363.14	361.64	96.1	3.9
		#60	370.81	366.49	89.5	10.5
		#140	356.56	342.93	68.5	31.5
		#200	351.16	345.21	59.3	40.7

Hydrometer Test Data

Hydrometer test uses material passing #200
Percent passing #200 based upon complete sample = 59.3
Weight of hydrometer sample =64.85
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -0.04
Meniscus correction only = -3.0
Specific gravity of solids = 2.65
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 - 0.2645 x Rm

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer	Percent Retained
2.00	22.0	1.0150	1.0152	0.0133	12.0	13.1	0.0341	22.3	77.7
5.00	22.0	1.0130	1.0132	0.0133	10.0	13.6	0.0220	19.4	80.6
15.00	22.0	1.0110	1.0112	0.0133	8.0	14.2	0.0129	16.5	83.5
30.00	22.0	1.0110	1.0112	0.0133	8.0	14.2	0.0092	16.5	83.5
60.00	22.0	1.0100	1.0102	0.0133	7.0	14.4	0.0065	15.0	85.0
250.00	22.0	1.0080	1.0082	0.0133	5.0	15.0	0.0033	12.1	87.9
1440.00	22.0	1.0070	1.0072	0.0133	4.0	15.2	0.0014	10.6	89.4

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
				0.5	3.3	36.8	40.6	45.4	13.9	59.3

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0065	0.0241	0.0402	0.0615	0.0770	0.1697	0.2082	0.2605	0.3880

Fineness Modulus
0.36

Certificate/Approval Program Summary

Last revised June 17, 2009 – Mansfield Facility

The following list includes only those analytes/methods for which certification/approval is currently held.
For a complete listing of analytes for the referenced methods, please contact your Alpha Customer Service Representative.

Connecticut Department of Public Health Certificate/Lab ID: PH-0141.

Wastewater/Non-Potable Water (Inorganic Parameters: pH, Turbidity, Conductivity, Alkalinity, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Thallium, Tin, Vanadium, Zinc, Total Residue (Solids), Total Suspended Solids (non-filterable), Total Cyanide. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Acid Extractables, Benzidines, Phthalate Esters, Nitrosamines, Nitroaromatics & Isophorone, PAHs, Haloethers, Chlorinated Hydrocarbons, Volatile Organics.)

Solid Waste/Soil (Inorganic Parameters: pH, Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Vanadium, Zinc, Total Organic Carbon, Total Cyanide, Corrosivity, TCLP 1311. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Volatile Organics, Acid Extractables, Benzidines, Phthalates, Nitrosamines, Nitroaromatics & Cyclic Ketones, PAHs, Haloethers, Chlorinated Hydrocarbons.)

Florida Department of Health Certificate/Lab ID: E87814. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters: SM2320B, 4500NH3-F, EPA 120.1, SM2510B, 2340B, EPA 245.1, EPA 150.1, EPA 160.2, SM2540D, EPA 335.2, 420.1, SM2540G, EPA 180.1. Organic Parameters: EPA 625, 608.)

Solid & Chemical Materials (Inorganic Parameters: 6020, 7470, 7471, 9045, 9014. Organic Parameters: EPA 8260, 8270, 8082, 8081.)

Air & Emissions (EPA TO-15.)

Louisiana Department of Environmental Quality Certificate/Lab ID: 03090. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters: EPA 120.1, 150.1, 160.2, 180.1, 200.8, 245.1, 310.1, 335.2, 608, 625, 1631, 3010, 3015, 3020, 6020, 9010, 9014, 9040, SM2320B, 2510B, 2540D, 2540G, 4500CN-E, 4500H-B, Organic Parameters: EPA 3510, 3580, 3630, 3640, 3660, 3665, 5030, 8015 (mod), 3570, 8081, 8082, 8260, 8270,)

Solid & Chemical Materials (Inorganic Parameters: 6020, 7196, 7470, 7471, 7474, 9010, 9014, 9040, 9045, 9060. Organic Parameters: EPA 8015 (mod), EPA 3570, 1311, 3050, 3051, 3060, 3580, 3630, 3640, 3660, 3665, 5035, 8081, 8082, 8260, 8270.)

Biological Tissue (Inorganic Parameters: EPA 6020. Organic Parameters: EPA 3570, 3510, 3610, 3630, 3640, 8270.)

Maine Department of Human Services Certificate/Lab ID: MA0030.

Wastewater (Inorganic Parameters: EPA 120.1, 300.0, SM 2320, 2510B, 2540C, 2540D, EPA 245.1. Organic Parameters: 608, 624.)

Massachusetts Department of Environmental Protection Certificate/Lab ID: M-MA030.

Non-Potable Water (Inorganic Parameters: SM4500H+B. Organic Parameters: EPA 624.)

New Hampshire Department of Environmental Services Certificate/Lab ID: 2206. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters: EPA 200.8, 245.1, 1631E, 120.1, 150.1, 180.1, 310.1, 335.2, 160.2, SM2540D, 2540G, 4500CN-E, 4500H+B, 2320B, 2510B. Organic Parameters: EPA 625, 608.)

New Jersey Department of Environmental Protection Certificate/Lab ID: MA015. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters: SW-846 1312, 3010, 3020A, 3015, 6020, SM2320B, EPA 200.8, SM2540C, 2540D, 2540G, EPA 120.1, SM2510B, EPA 180.1, 245.1, 1631E, SW-846 9040B, 6020, 9010B, 9014 Organic Parameters: EPA 608, 625, SW-846 3510C, 3580A, 5030B, 3035L, 5035H, 3630C, 3640A, 3660B, 3665A, 8081A, 8082 8260B, 8270C)

Solid & Chemical Materials (Inorganic Parameters: SW-846 6020, 9010B, 9014, 1311, 1312, 3050B, 3051, 3060A, 7196A, 7470A, 7471A, 9045C, 9060. Organic Parameters: SW-846 3580A, 5030B, 3035L, 5035H, 3630C, 3640A, 3660B, 3665A, 8081A, 8082, 8260B, 8270C, 3570, 8015B.)

Atmospheric Organic Parameters (EPA TO-15)

Biological Tissue (Inorganic Parameters: SW-846 6020 Organic Parameters: SW-846 8270C, 3510C, 3570, 3610B, 3630C, 3640A)

New York Department of Health Certificate/Lab ID: 11627. ***NELAP Accredited.***

Non-Potable Water (Inorganic Parameters: EPA 310.1, SM2320B, EPA 365.2, 160.1, EPA 160.2, SM2540D, EPA 200.8, 6020, 1631E, 245.1, 335.2, 9014, 150.1, 9040B, 120.1, SM2510B, EPA 376.2, 180.1, 9010B. Organic Parameters: EPA 624, 8260B, 8270C, 608, 8081A, 625, 8082, 3510C, 3511, 5030B.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 9040B, 9045C, SW-846 Ch7 Sec 7.3, EPA 6020, 7196A, 7471A, 7474, 9014, 9040B, 9045C, 9010B. Organic Parameters: EPA 8260B, 8270C, 8081A, DRO 8015B, 8082, 1311, 3050B, 3580, 3050B, 3035, 3570, 3051, 5035, 5030B.)

Air & Emissions (EPA TO-15.)

Pennsylvania Department of Environmental Protection Certificate/Lab ID: 68-02089. ***NELAP Accredited.***

Non-Potable Water (Organic Parameters: EPA 5030B, EPA 8260)

Rhode Island Department of Health Certificate/Lab ID: LAO00299. ***NELAP Accredited via LA-DEQ.***

Refer to MA-DEP Certificate for Non-Potable Water.

Refer to LA-DEQ Certificate for Non-Potable Water.

Texas Commission of Environmental Quality Certificate/Lab ID: T104704419-08-TX. ***NELAP Accredited.***

Solid & Chemical Materials (Inorganic Parameters: EPA 6020, 7471. Organic Parameters: EPA 8015, 8270.)

U.S. Army Corps of Engineers

Certificate/Approval Program Summary

Last revised October 22, 2009 - Westboro Facility

The following list includes only those analytes/methods for which certification/approval is currently held.
For a complete listing of analytes for the referenced methods, please contact your Alpha Customer Service Representative.

Connecticut Department of Public Health Certificate/Lab ID: PH-0574. ***NELAP Accredited Solid Waste/Soil.***

Drinking Water (Inorganic Parameters: Color, pH, Turbidity, Conductivity, Alkalinity, Chloride, Free Residual Chlorine, Fluoride, Calcium Hardness, Sulfate, Nitrate, Nitrite, Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Vanadium, Zinc, Total Dissolved Solids, Total Organic Carbon, Total Cyanide, Perchlorate. Organic Parameters: Haloacetic Acids, Volatile Organics 524.2, Total Trihalomethanes 524.2, 1,2-Dibromo-3-chloropropane (DBCP), Ethylene Dibromide (EDB).)
Wastewater/Non-Potable Water (Inorganic Parameters: Color, pH, Conductivity, Acidity, Alkalinity, Chloride, Total Residual Chlorine, Fluoride, Total Hardness, Calcium Hardness, Silica, Sulfate, Sulfide, Ammonia, Kjeldahl Nitrogen, Nitrate, Nitrite, O-Phosphate, Total Phosphorus, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Thallium, Tin, Titanium, Vanadium, Zinc, Total Residue (Solids), Total Dissolved Solids, Total Suspended Solids (non-filterable), BOD, CBOD, COD, TOC, Total Cyanide, Phenolics, Foaming Agents (MBAS), Bromide, Oil and Grease. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, 2,4-D, 2,4,5-T, 2,4,5-TP(Silvex), Acid Extractables (Phenols), Benzidines, Phthalate Esters, Nitrosamines, Nitroaromatics & Isophorone, Polynuclear Aromatic Hydrocarbons, Haloethers, Chlorinated Hydrocarbons, Volatile Organics, Extractable Petroleum Hydrocarbons (ETPH), MA-EPH, MA-VPH.)
Solid Waste/Soil (Inorganic Parameters: Lead in Paint, pH, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Tin, Vanadium, Zinc, Total Cyanide, Ignitability, Phenolics, Corrosivity, TCLP Leach (1311), Reactivity. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Extractable Petroleum Hydrocarbons (ETPH), MA-EPH, MA-VPH, Dicamba, 2,4-D, 2,4,5-T, 2,4,5-TP(Silvex), Volatile Organics, Acid Extractables (Phenols), 3.3'-Dichlorobenzidine, Phthalates, Nitrosamines, Nitroaromatics & Cyclic Ketones, PAHs, Haloethers, Chlorinated Hydrocarbons.)

Maine Department of Human Services Certificate/Lab ID: 2009024.
Drinking Water (Inorganic Parameters: SM9215B, 9221E, 9222B, 9222D, 9223B, EPA 180.1, 300.0, 353.2, SM2130B, 2320B, 4500Cl-D, 4500CN-C, 4500CN-E, 4500F-C, 4500H+B,4500NO3-F, EPA 200.7, EPA 200.8, 245.1. Organic Parameters: 504.1, 524.2, SM 6251B.)
Wastewater/Non-Potable Water (Inorganic Parameters: EPA 120.1, 1664A, 350.1, 351.1, 353.2, 410.4, 420.1, Lachat 10-107-06-1-B, SM2320B, 2340B, 2510B, 2540C, 2540D, 426C, 4500Cl-D, 4500Cl-E, 4500CN-C, 4500CN-E, 4500F-B, 4500F-C, 4500H+B, 4500Norg-B, 4500Norg-C, 4500NH3-B, 4500NH3-G, 4500NH3-H, 4500NO3-F, 4500P-B.5, 4500P-E, 5210B, 5220D, 5310C, EPA 200.7, 200.8, 245.1. Organic Parameters: 608, 624.)

Massachusetts Department of Environmental Protection Certificate/Lab ID: M-MA086.
Drinking Water
Inorganic Parameters: (EPA 200.8 for: Sb,As,Ba,Be,Cd,Cr,Cu,Pb,Ni,Se,Tl)
(EPA 200.7 for: Ba,Be,Ca,Cd,Cr,Cu,Na,Ni) 245.1, (300.0 for: Nitrate-N, Fluoride, Sulfate)
353.2 for: Nitrate-N, Nitrite-N; SM4500NO3-F, 4500F-C, 4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, 2320B, SM2540C, SM4500H-B.
Organic Parameters: (EPA 524.2 for: Trihalomethanes, Volatile Organics)
(504.1 for: 1,2-Dibromoethane, 1,2-Dibromo-3-Chloropropane), 314.0, 332.
Microbiology Parameters: SM9215B; MF-SM9222B; ENZ. SUB. SM9223; EC-SM9221E; MF-SM9222D
Non-Potable Water
Inorganic Parameters:, (EPA 200.8 for: Al,Sb,As,Be,Cd,Cr,Cu,Pb,Mn,Ni,Se,Ag,Tl,Zn)
(EPA 200.7 for: Al,Sb,As,Be,Cd,Cr,Co,Cu,Fe,Pb,Mn,Mo,Ni,Se,Ag,Sr,Tl,Ti,V,Zn,Ca,Mg,Na,K)
245.1, SM4500H,B, EPA 120.1, SM2510B, 2540C, 2540B, 2340B, 2320B, 4500CL-E, 4500F-BC, 426C, SM4500NH3-BH, (EPA 350.1 for: Ammonia-N), LACHAT 10-107-06-1-B for Ammonia-N, SM4500NO3-F, 353.2 for Nitrate-N, SM4500NH3-B,C-Titr, SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, 4500P-B,E, 5220D, EPA 410.4, SM 5210B, 5310C, 4500CN-CE, 2540D, 4500CL-D, EPA 1664, SM14 510AC, EPA 420.1
Organic Parameters: (EPA 624 for Volatile Halocarbons, Volatile Aromatics)
(608 for: Chlordane, Aldrin, Dieldrin, DDD, DDE, DDT, Heptachlor, Heptachlor Epoxide, PCBs-Water), EPA 625 for SVOC Acid Extractables and SVOC Base/Neutral Extractables, 600/4-81-045-PCB-Oil

New Hampshire Department of Environmental Services Certificate/Lab ID: 200307. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM6215B, 9222B, 9223B Colilert, EPA 200.7, 200.8, 245.2, 120.1, 300.0, 314.0, SM4500CN-E, 4500H+B, 4500NO3-F, 2320B, 2510B, 2540C, 4500F-C, 5310C, 2120B, EPA 331.0. Organic Parameters: 504.1, 524.2, SM6251B.)
Non-Potable Water (Inorganic Parameters: SM9222D, 9221B, 9222B, 9221E-EC, EPA 200.7, 200.8, 245.1, 245.2, SW-846 6010B, 6020, 7196A, 7470A, SM3500-CR-D, EPA 120.1, 300.0, 350.1, 351.1, 353.2, 420.1, 1664A, SW-846 9010, 9030, 9040B, SM426C, SM2310B, 2540B, 2540D, 4500H+B, 4500NH3-H, 4500NH3-E, 4500NO2-B, 4500P-E, 4500-S2-D, 5210B, 2320B, 2540C, 4500F-C, 5310C, 5540C, LACHAT 10-117-07-1-B, LACHAT 10-107-06-1-B, LACHAT 10-107-04-1-C, LACHAT 10-107-04-1-J, LACHAT 10-117-07-1-A, SM4500CL-E, LACHAT 10-204-00-1-A, LACHAT 10-107-06-2-D. Organic Parameters: SW-846 3005A, 3015A, 3510C, 5030B, 8021B, 8260B, 8270C, 8330, EPA 624, 625, 608, SW-846 8082, 8081A.)
Solid & Chemical Materials (Inorganic Parameters: SW-846 6010B, 7196A, 7471A, 7.3.3.2, 7.3.4.2, 1010, 1030, 9010, 9012A, 9014, 9030B, 9040, 9045C, 9050C, 1311, 3005A, 3050B, 3051A. Organic Parameters: SW-846 3540C, 3545, 3580A, 5030B, 5035, 8021B, 8260B, 8270C, 8330, 8151A, 8082, 8081A.)

New Jersey Department of Environmental Protection Certificate/Lab ID: MA935. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9222B, 9221E, 9223B, 9215B, 4500NO3-F, 4500F-C, EPA 300.0, 200.7, 2540C, 2320B, 314.0, SM2120B, 2510B, 5310C, SM4500H-B, EPA 200.8, 245.2. Organic Parameters: 504.1, SM6251B, 524.2.)
Non-Potable Water (Inorganic Parameters: SM5210B, EPA 410.4, SM5220D, 4500Cl-D, EPA 300.0, SM2120B, SM4500F-BC, EPA 200.7, 351.1, LACHAT 10-107-06-2-D, EPA 353.2, SM4500NO3-F, 4500NO2-B, EPA 1664A, SM5310B, C or D, 4500-PE, EPA 420.1, SM4500P-B5+E, 2540B, 2540C, 2540D, EPA 120.1, SM2510B, SM15 426C, SM9221CE, 9222D, 9221B, 9222B, 9215B, 2310B, 2320B, 4500NH3-H, 4500-S D, EPA 350.1, SM5210B, SW-846 3015, 6020, 7470A, 5540C, 4500H-B, EPA 200.8, SM3500Cr-D, EPA 245.1, 245.2, SW-846 9040B, 3005A, EPA 6010B, 7196A, SW-846 9010B, 9030B. Organic Parameters: SW-846 8260B, 8270C, 3510C, EPA 608, 624, 625, SW-846 5030B, 8021B, 8081A, 8082, 8151A, 8330, NJ OQA-QAM-025 Rev.7.)
Solid & Chemical Materials (Inorganic Parameters: SW-846 9040B, 3005A, 6010B, 7196A, 5030B, 9010B, 9030B, 1030, 1311, 3050B, 3051, 7471A, 9014, 9012A, 9045C, 9050A, 9065. Organic Parameters: SW-846 8021B, 8081A, 8082, 8151A, 8330, 8260B, 8270C, 1311, 1312, 3540C, 3545, 3550B, 3580A, 5035L, 5035H, NJ OQA-QAM-025 Rev.7.)

New York Department of Health Certificate/Lab ID: 11148. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9223B, 9222B, 9215B, EPA 200.8, 200.7, 245.2, SM5310C, EPA 314.0, 332.0, SM2320B, EPA 300.0, SM2120B, 4500CN-E, 4500F-C, 4500H-B, 4500NO3-F, 2540C, EPA 120.1, SM 2510B. Organic Parameters: EPA 524.2, 504.1.)
Non-Potable Water (Inorganic Parameters: SM9221E, 9222D, 9221B, 9222B, 9215B, 5210B, EPA 410.4, SM5220D, 2310B-4a, 2320B, EPA 200.7, 300.0, LACHAT 10-117-07-1A or B, SM4500Cl-E, 4500F-C, SM15 426C, EPA 350.1, LACHAT 10-107-06-1-B, SM4500NH3-H, EPA 351.1, LACHAT 10-107-06-2, EPA 353.2, LACHAT 10-107-041-C, SM4500-NO3-F, 4500-NO2-B, 4500P-E, 2540C, 2540B, 2540D, EPA 200.8, EPA 6010B, 6020, EPA 7196A, S\M3500Cr-D, EPA 245.1, 245.2, 7470A, SM2120B, SM4500-CN-E LACHAT 10-204-00-1-A, EPA 9040B, SM4500-HB, EPA 1664A, SM5310C, EPA 420.1, SM14 510C, EPA 120.1, SM2510B, SM4500S-D, SM5540C, EPA 3005A, 3015. Organic Parameters: EPA 624, 8260B, 8270C, 625, 608, 8081A, 8151A, 8330, 8082, EPA 3510C, 5030B, 9010B, 9030B.)
Solid & Hazardous Waste (Inorganic Parameters: 1010, 1030, SW-846 Ch 7 Sec 7.3, EPA 6010B, 7196A, 7471A, 9012A, 9014, 9040B, 9045C, 9065, 9050, EPA 1311, 1312, 3005A, 3050B, 9010B, 9030B. Organic Parameters: EPA 8260B, 8270C, 8081A, 8151A, 8330, 8082, 3540C, 3545, 3546, 3580, 5030B, 5035.)

North Carolina Department of the Environment and Natural Resources Certificate/Lab ID : 666. Organic Parameters: MA-EPH, MA-VPH.

Pennsylvania Department of Environmental Protection Certificate/Lab ID : 68-03671. ***NELAP Accredited.***
Non-Potable Water (Organic Parameters: EPA 3510C, 5030B, 625, 624. 608, 8081A, 8082, 8151A, 8260B, 8270C, 8330)
Solid & Hazardous Waste (Inorganic Parameters: EPA 1010, 1030, 1311, 3050B, 3051, 6010B, EPA 7.3.3.2, EPA 7.3.4.2, 7196A, 7471A, 9010B, 9012A, 9014, 9040B, 9045C, 9050, 9065. Organic Parameters: 3540C, 3545, 3580A, 5035, 8021B, 8081A, 8082, 8151A, 8260B, 8270C, 8330)

Rhode Island Department of Health Certificate/Lab ID: LAO00065. ***NELAP Accredited via NY-DOH.***
Refer to MA-DEP Certificate for Potable and Non-Potable Water.
Refer to NY-DOH Certificate for Potable and Non-Potable Water.

Utah Department of Health Certificate/Lab ID: AAMA. ***NELAP Accredited.***
Non-Potable Water (Inorganic Parameters: Chloride EPA 300.0)

Analytes Not Accredited by NELAP

Certification is not available by NELAP for the following analytes: **EPA 8260B:** Freon-113, 1,2,4,5-Tetramethylbenzene. **EPA 8330A:** PETN, Picric Acid, Nitroglycerine, 2,6-DANT, 2,4-DANT. **EPA 8270C:** Methyl naphthalene, Dimethyl naphthalene, Total Methylnapthalenes, Total Dimethylnaphthalenes. **EPA 625:** 4-Chloroaniline. **EPA 350.1** for Ammonia in a Soil matrix.

11020917:03

ALPHA ANALYTICAL

WESTBORO, MA
TEL: 508-898-9220
FAX: 508-898-9193

MANSFIELD, MA
TEL: 508-822-9300
FAX: 508-822-3288

CHAIN OF CUSTODY

PAGE 1 OF 2

Date Rec'd in Lab:

ALPHA Job #: L0914033

Client Information

Client: Woods Hole Group
Address: 81 Technology Park Dr
E. Falmouth, MA 02536
Phone: 508-540-8080
Fax: 508-540-1001
Email: mbuck@whgrp.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: Brushneck Cove
Project Location: Brushneck Cove, RI
Project #: TO-8816
Project Manager: Lee Weishar
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due: Time:

Report Information - Data Deliverables

☐ FAX ☒ EMAIL
☒ ADEx ☐ Add'l Deliverables

Billing Information

☒ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTOCOLS

☐ Yes ☐ No Are MCP Analytical Methods Required?
☐ Yes ☐ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

ANALYSIS

SAMPLE HANDLING
Filtration
☐ Done
☐ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	Grain Size	TOC	Ammonia/Nitrate/TKN/P	Sample Specific Comments	TOTAL # BOTTLES
-1	A - TOC	10/1/09	1750	S	MAB		X			1
↓	A - Nutrient	10/1/09	1750	S	MAB			X		1
↓	A - Grain	10/1/09	1750	S	MAB	X				1
-2	A DUP-TOC	10/1/09	1806	S	MAB		X			1
↓	A DUP - Nutrient	10/1/09	1806	S	MAB			X		1
↓	A DUP - Grain	10/1/09	1806	S	MAB	X				1
-3	B - TOC	10/1/09	1818	S	MAB		X			1
↓	B - Nutrient	10/1/09	1818	S	MAB			X		1
↓	B - Grain	10/1/09	1818	S	MAB	X				1
-4	C - TOC	10/1/09	1840	S	MAB		X			1
					Container Type	O	G	G		
					Preservative	A	A	A		

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP or CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
Mitchell Buck	10/2/09 10:10	Paul Gilbert	10/2/09 10:10
Paul Gilbert	10/2/09 16:00	[illegible]	10/2/09 1600

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Payment Terms. See reverse side.

FORM NO: 01-01 (rev. 30-JUL-07)

11020917:03

CHAIN OF CUSTODY

PAGE 2 OF 2

ALPHA ANALYTICAL

WESTBORO, MA
TEL: 508-898-9220
FAX: 508-898-9193

MANSFIELD, MA
TEL: 508-822-9300
FAX: 508-822-3288

Date Rec'd in Lab:

ALPHA Job #: L0914033

Client Information

Client: Woods Hole Group
Address: 81 Technology Park Dr
E. Falmouth, MA 02536
Phone: 508-540-8080
Fax: 508-540-1001
Email: mbuck@whgrp.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: Brushneck Cove
Project Location: Brushneck Cove, RI
Project #: TO-2016
Project Manager: Lee Weishar
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due: Time:

Report Information - Data Deliverables

☐ FAX ☒ EMAIL
☒ ADEx ☐ Add'l Deliverables

Billing Information

☒ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program Criteria

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTOCOLS

☐ Yes ☐ No Are MCP Analytical Methods Required?
☐ Yes ☐ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

ANALYSIS

SAMPLE HANDLING
Filtration
☐ Done
☐ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	Grain Size	Ammonia/Nitrate/TKN/P	Sample Specific Comments	TOTAL # BOTTLES
-4	C-Nutrient	10/1/09	1840	S	MAB		X		1
↓	C-Grain	10/1/09	1840	S	MAB	X			1
Container Type						O	G		
Preservative						A	A		

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP *or* CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
Mitchell Buck	10/2/09-10:10	Paul Gilbert	10/2/09 10:10
Paul Gilbert	10/2/09 16:00	[illegible signature]	10/2/09 1600

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Payment Terms. See reverse side.

FORM NO: 01-01 (rev. 30-JUL-07)

CHAIN OF COUSTODY

PAGE 1 OF 2

Date Rec'd in Lab:

ALPHA Job #: L0914033

ALPHA ANALYTICAL

WESTBORO, MA TEL: 508-898-9220 FAX: 508-898-9193

MANSFIELD, MA TEL: 508-822-9300 FAX: 508-822-3288

Client Information

Client: Woods Hole Group

Address: 81 Technology Park Dr

E. Falmouth, MA 02536

Phone: 508-540-8080

Fax: 508-540-1001

Email: mbuck@whgrp.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: Brushneck Cove

Project Location: Brushneck Cove, RI

Project #: TO-0016

Project Manager: Lee Weishar

ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due: Time:

Report Information - Data Deliverables

☐ FAX ☒ EMAIL

☒ ADEx ☐ Add'l Deliverables

Billing Information

☒ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

MA MCP PRESUMPTIVE CERTAINTY — CT REASONABLE CONFIDENCE PROTOCOLS

☐ Yes ☐ No Are MCP Analytical Methods Required?

☐ Yes ☐ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

ANALYSIS: Grain Size; TOC; Ammonia/Nitrate/TKN/P

SAMPLE HANDLING

Filtration ☐ Done ☐ Not needed ☐ Lab to do

Preservation ☐ Lab to do (Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	Grain Size	TOC	Ammonia/Nitrate/TKN/P	Sample Specific Comments	TOTAL # BOTTLES
-1	A - TOC	10/1/09	1750	S	MAB		X			1
↓	A - Nutrient	10/1/09	1750	S	MAB			X		1
↓	A - Grain	10/1/09	1750	S	MAB	X				1
-2	A DUP-TOC	10/1/09	1806	S	MAB		X			1
↓	A DUP - Nutrient	10/1/09	1806	S	MAB			X		1
↓	A DUP - Grain	10/1/09	1806	S	MAB	X				1
-3	B - TOC	10/1/09	1818	S	MAB		X			1
↓	B - Nutrient	10/1/09	1818	S	MAB			X		1
↓	B - Grain	10/1/09	1818	S	MAB	X				1
-4	C - TOC	10/1/09	1840	S	MAB		X			1
					Container Type	O	G	G		
					Preservative	A	A	A		

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP or CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
Mitchell Buck	10/2/09 1010	Paul Dilliat	10/2/09 1010
Paul Dilliat	10/2/09 1600	[signature]	10/2/09 1600
[signature]	10/5/09 1300	[signature]	10/5/09 1300
[signature]	10/5/09 1835	[signature]	10/5/09 1835

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Payment Terms. See reverse side.

FORM NO: 01-01 (rev. 30-JUL-07)

ALPHA ANALYTICAL

WESTBORO, MA
TEL: 508-898-9220
FAX: 508-898-9193

MANSFIELD, MA
TEL: 508-822-9300
FAX: 508-822-3288

CHAIN OF CUSTODY

PAGE 2 OF 2

Date Rec'd in Lab:

ALPHA Job #: L0914033

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Address: 81 Technology Park Dr
E. Falmouth, MA 02536
Phone: 508-540-8080
Fax: 508-540-1001
Email: mbuck@whgrp.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: Brushneck Cove
Project Location: Brushneck Cove, RI
Project #: TO-0016
Project Manager: Lee Weishar
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH (only confirmed if pre-approved!)

Date Due: Time:

Report Information - Data Deliverables

☐ FAX ☒ EMAIL
☒ ADEx ☐ Add'l Deliverables

Billing Information

☒ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program | Criteria

MA MCP PRESUMPTIVE CERTAINTY --- CT REASONABLE CONFIDENCE PROTOCOLS

☐ Yes ☐ No Are MCP Analytical Methods Required?
☐ Yes ☐ No Are CT RCP (Reasonable Confidence Protocols) Required?

Other Project Specific Requirements/Comments/Detection Limits:

SAMPLE HANDLING
Filtration
☐ Done
☐ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	ANALYSIS: SPLP 572	Ammonia/Nitrate/TKN/P	Sample Specific Comments	TOTAL # BOTTLES
-4	C-Nutrient	10/1/09	1840	S	MAB		X		1
4	C-Grain	10/1/09	1840	S	MAB	X			1

Container Type	O	G
Preservative	A	A

PLEASE ANSWER QUESTIONS ABOVE!

IS YOUR PROJECT MA MCP or CT RCP?

Relinquished By:	Date/Time	Received By:	Date/Time
Mitchell Buck	10/2/09-10:10	Paul Gillent	10/2/09 10:10
Paul Gillent	10/2/09 16:00	[illegible]	10/2/09 1600
[illegible]	10/5/09 1300	[illegible]	10/5/09 1300
[illegible]	10/5/09 1835	[illegible]	10/5/09 1835

FORM NO: 01-01 (rev. 30-JUL-07)

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Payment Terms. See reverse side.

Appendix B

Benthic Invertebrate Data

Assessment of marine and estuarine habitats in Rhode Island: benthic organisms from Brush Neck Cove, Warwick, RI.

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July 28, 2006

Background

The Department of the Army, NE District, Corps of Engineers is carrying out studies to aid in restoration of Brush Neck Cove and Buttonwoods Cove, Warwick RI. The coves share an entrance on the north side of Greenwich Bay. They extend north, 1 mile and northwest, 0.75 miles, respectively. A bar built by long shore sediment transport narrows the entrance to the Bay.

Benthic invertebrates are important components of shallow estuarine systems and will respond to changes in salinity, oxygen concentration, water depth, sediment grain size, and sediment organic matter concentration. The benthos includes fisheries resource species and indicators of habitat quality.

Corps of Engineers personnel obtained seven samples in the Brush Neck Cove area on August 30 2005. The samples were preserved in 10% formaldehyde solution and delivered to the University of Rhode Island, Graduate School of Oceanography in 2006. Location and elevation of stations were not provided.

Procedure
At the Graduate School of Oceanography the preserved samples were prepared for removal of organisms by washing through 2.0mm and 0.5mm sieves. In each size fraction low-density materials (polychaetes, crustaceans, algae) were separated from high-density materials (sand, shell, mollusks) by suspension and decantation in a tall pitcher. Coarse high-density particles were examined in trays without magnification. All remaining material was examined under low-power dissecting microscopes. Most individuals were identified to the species level. Counts of organisms were entered on computer spreadsheets (MS Excel). Organisms were preserved in 70% alcohol and archived. The volume and constituents of sieve residues were recorded.

Results

Sieve residue

Sand and shell hash (greater than 0.5mm) was retained in samples 4 and 7. Mya and Ilyanassa shells were major constituents in samples 2,3,5, and 6. Organic detritus was the most abundant constituent in sample 1. Ulva fragments were relatively abundant in samples 1 and 2. Unoccupied tubes of ampeliscid amphipods were found in sample 2.

Organisms
Counts of invertebrate organisms recovered from Brush Neck Cove samples are given in Table 1. A total of 32 taxa were identified in seven samples. Each major group (mollusks, annelids and crustaceans) was represented by similar numbers of taxa. The number of individuals varied greatly between major groups, however. There were 937 mollusks, 155 annelids and 58 crustaceans in all samples combined.

Numbers of species and individuals per sample were not correlated. Low numbers of species (3-5) were found in samples 1, 2, 3 and 5. More species (12-16) were found in samples 4, 6, and 7. Large numbers of individuals were found in samples 1, 4, 6, and 7 (132-175), while few individuals were found in samples 2 and 3 (3, 4).

Mollusks: The soft shell clam, *Mya arenaria*, was the most abundant organism collected, with 456 juvenile individuals found in sample 4. Single clams were found in samples 2 and 5. Two living clams and the siphons of 77 dead clams were found in sample 6.

Mature mud snails (*Ilyanassa obsoleta*) were found in high densities in samples with both low and high-diversity faunal assemblages. The slipper limpet (Cripidula fornicata) and the gem clam, *Gemma gemma* was found in samples 4, 6, and 7 with sandy sediments and relatively diverse fauna. *Mya*, *Crepidula* and *Gemma* are suspension feeders. *Ilyanassa* is a deposit feeder and scavenger.

Annelids: Only a few annelid taxa were found in Samples 1-5. *Capitella capitata* was relatively abundant in samples 4 and 5. A greater number of annelid taxa were found in samples 6 and 7. *Heteromastus filliformis*, *Neanthes* spp., *Soclelepis squamata*, *Streblospio benedicti,* and *oligochaetes* were relatively abundant in the samples. The taxa include selective and unselective deposit feeders and predators.

Crustaceans: Only three crustaceans were found in significant densities in this study: the amphipod *Elasmopus levis*, a mud crab, *Eurypanopeus depressus*, and a hermit crab *Pagurus longicarpus*. Empty tubes of the amphipod, *Ampelisca abdita,* were found in sample 3.

Discussion

Distribution of benthos within Brush Neck Cove: Oviatt et al (1975) sampled infauna (300 cm^2 box cores, 0.5mm mesh sieve) and clams ($1m^2$ quadrats, 2.54 cm mesh screen) along the length of Brush Neck Cove. Dominant fauna at the head of the cove included species that in this region are restricted to low salinity environments (*Hobsonia florida, Cyathura polita*, and *Macoma balthica*). Other species were important throughout the length of the cove (*Heteromastus filliformis, Capitella capitata, Polydora cornuta*, and *Streblospio benedicti*). The most diverse fauna was found in the cove mouth (18 and 21species).

The samples obtained in the present study include most of the species that were found near the cove mouth in 1975. The present study did not sample the brackish water species found at the cove head. The densities of *C. capitata, P. cornuta*, and *S. benedicti* found in 2005 are lower by an order of magnitude than those obtained in 1975. These species are indicators of organically enriched habitats and a decrease in their numbers could indicate improved water quality over time. The generally low numbers of individuals and species richness in 2005 samples could also be the result of some other deleterious effect such as overgrowth by sea lettuce (*Ulva lact*uca). Pratt and Seavey (1981) found reduced numbers organisms under *Ulva* in nearby Apponaug Cove. They noted that the mud snail *I. obsoleta* was one of the few benthic species found where *Ulva* was abundant.

Mortality of *Mya arenaria*: A very high density of *Mya* was found in a single sample. There is evidence that *Mya* recruited throughout the study area in June or July and suffered mortality at many locations before samples were taken in late August. The large number of *Mya* found in sample 4 was all young-of-the year with a median shell length of 12.5 mm. *Mya* siphons in sample 6 indicate that mortality had taken place a short time before sampling. Shells of *Mya* found in the sieve residues of five other samples indicate that mortality had also taken place earlier in the summer (most shells in sample 2 were between 1.5 and 2.1mm long; the largest was 5mm lon).

In this region recruitment of high densities of *Mya* are frequently followed by high mortalities throughout their first year. Predation, high or low temperatures, and unsuitable sediment types are possible causes of mortality. Negative effects of dense *Ulva* on *Mya* was observed by Pratt (Applied Bio-Systems,1997) in Stillhouse Cove, RI. In the present study small particles of *Ulva* were recorded in the residues from sample 1 and 2.

Table 1. Benthic organisms from Brush Neck Cove, August 30 2005

529 cm^2 sample, 0.5mm sieve

SAMPLE	**1**	**2**	**3**	**4**	**5**	**6**	**7**
PLATYHELMINTHES							
platyhelminthes unk						1	
MOLLUSCA							
GASTROPODA							
Crepidula fornicata				22		24	9
Ilyanassa obsoleta	102		1	114	9	40	31
Odostomia trifida	28					1	
Nassarius trivittatus				1		4	
BIVALVIA							
Gemma gemma				3		18	67
Mercenaria mercenaria		1					
Mulinea lateralis		1					
Mya arenaria		1		456	1	2	
ANNELIDA							
POLYCHAETA							
Capitella capitata			2	23	23	2	2
Glycera dibranchiata							2
Heteroeteone heteropoda						1	3
Heteromastus filliformis						22	3
Leitoscoloplos fragilis							6
Neanthes arenacedonta							11
Neanthes succinea						1	
Polydora cornuta			1	1			
Scolelepis squamata						1	15
Streblospio benedicti						2	10
Tharyx acutus							3
OLIGOCHAETA							
oligochaete unk.						12	9
CRUSTACEA							
OSTACODA							
Ostracoda sp	1						
HARPACTICOIDA							
harpacticoid unk.				1			
CUMACEA							
Oxyurostylis						1	
ISOPODA							
Edotea triloba							2
AMPHIPODA							
Corophium unk.				1	1		
Elsasmopus levis				2	2	14	

Table 1 continued. Benthic organisms from Brush Neck Cove, August 30 2005

529 cm^2 sample, 0.5mm sieve

SAMPLE	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Microdeutopus gryllotalpa							1
Microprotopus raneyi							1
Mucrogammarus mucronatus						1	
DECAPODA							
Eurypanopeus depressus	1			2		4	
Pagurus longicarpus				21		2	
Total Number of Individuals	132	3	4	647	36	153	175
Total Number of Species	4	3	3	12	5	19	16
Mya arenaria siphons						77	
Sieve Residue (vol cc)	400	400	150	40	10	100	300
Constituents	org detritu	Mya sh.	Mya sh.	sand	Ilyanassa.	Mya sh.	sand
	Mya sh.	Pectinaria	org detrit	shell hash	Mya sh.	sand	shell hash
	Ulva	Ulva	Amp tubes		org detrit		Mya sh.

References

Hoff, J.G. and S. Moss 1978. Apponaug Cove – Greenwich Bay Environmental Survey. Report to New England Division, Corps of Engineers, Waltham MA, Southeastern Massachusetts University, North Dartmouth MA. 43 pp.

Oviatt**,** C.A,. S. Nixon, E. Evans, and B.Wicklow 1975. Environmental assessment of a plan for improving boating and boating facilities at Brush Neck Cove, Greenwich Bay, RI. Report to Gordon R. Archibald, Providence RI, 59 pp

Pratt, S.D.and G. Seavey 1981. The environment of Apponaug Inner Cove and the impact of development on the Cove. Report to Robinson Green Beretta Corp. Providence RI. University of Rhode Island, Kingston RI. 61 pp.

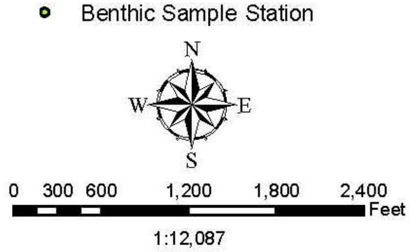
Applied Bio-Systems 1996. Environmental assessment of the Stillhouse Cove dredge project for the Rhode Island Yacht Club…. Prepared by Applied Bio-Systems, 42 North Rd, South Kingstown RI 10 pp.

Benthic Sample Stations.
Stations A-G correspond with the above report Stations 1-7 (A=1, B=2, C=3 etc)

Brush Neck Cove Benthic Samples, July 2006

Legend

Benthic Sample Station



Brush Neck Cove - Benthic Grab Locations			
Station	LAT	Long	Water Depth (ft)
A	41.69861	71.41615	1.5
B	41.69738	71.41338	1.5
C	41.69619	71.41060	2
D	41.68705	71.40351	3.5
E	41.68577	71.40251	4.5
F	41.68469	71.40384	1
G	41.68316	71.39987	2

Appendix C

Historic and Archaeological Resources

(Summaries from websites)

A Brief History of Warwick, Rhode Island

Warwick was founded in 1642 by Samuel Gorton when Narragansett Indian Chief Sachem Miantonomi agreed to accept 144 fathoms of *Wampumpeague* for what was known as “The Shawhomett Purchase.” This included the present day towns of Coventry and West Warwick.

In 1648, Gorton was granted a Charter by Robert Rich, *Earl of Warwicke and Governour in Chiefe for the Colonies*. Because of this, the name of the settlement was changed from Shawomett to Warwick.

In 1772, Warwick was the scene for the first violent act against the Crown when local patriots boarded the British revenue cutter *HMS Gaspee*. It was here that the first English blood of the American Revolution was spilled when the commanding officer of the Gaspee, Lt. Duddingston, was shot with a musket ball while resisting the taking of his ship. The patriots then stripped the Gaspee of all cannon and arms before setting her afire.

During the Revolution, Warwick Militiamen participated in the battles of Montreal, Quebec, Saratoga, Monmouth, Trenton, Rhode Island, and were present for the surrender at Yorktown.

After the war, Warwick and the rest of Rhode Island voted against ratification of the Constitution as it lacked a "Bill of Rights" as was found in Rhode Island's State Constitution. Thus, when the newly inaugurated President George Washington left New York City to travel to Boston, he was required to detour around "The State of Rhode Island and Providence Plantations" as it was an "Independent and Sovereign Republic".

Abundant supplies of water power enabled Warwick to enter the Industrial Revolution and emerge as a major textile manufacturing center. The "Fruit of the Loom Company" was founded in Warwick at the B.B. & R. Knight Mill on the Pawtuxet River.

By the close of the 19th century, Warwick was one of the wealthiest communities in the State. Warwick's 39 miles of coastline are graced with many beautiful stretches of beachfront. This magnificent shore lured many of America's wealthiest citizens into spending their summers in Conimicut, Warwick Neck, Oakland Beach, and Buttonwoods. Before the Great Depression and the Great New England Hurricane of 1938, more millionaires called Warwick their summer home than any other location in the country.

In 1929, the State of Rhode Island began construction of Hillsgrove State Airport in the center of Warwick. When it was completed, it was called "The Most Modern Airport in the Nation". Now known as Theodore Francis Green State Airport, the airport has recently undergone major renovations and is now a work of art to be seen.

Since the original purchase of land from Miantonomi, Warwick increased in size twice and was reduced in size twice and yet remains the second largest city in the State.

In 1654, the Potowomut peninsula was purchased from Taxxomann for grazing of the settlers livestock. In 1696, the settlement in Pawtuxet was added to the town.

By 1741, the residents of the western portion of the town felt that communications with those in the east made efficient government nearly impossible and formed the Town of Coventry.

In 1913, the bulk of the town's population was centered around the textile mills on the west side of the Pawtuxet River. Local politicians seeking to secure their power created the movement to create the new town of West Warwick leaving the eastern portion of the town to the farmers living there.

Warwick was incorporated as a City in 1931 and elected its first Mayor, Pierce Brereton, in 1932.

By the 1950's the textile industry had left New England and the post-war housing boom was underway. Warwick farms became subdivisions as people left cities for life in the suburbs.

Today, Warwick is "the Crossroads of Southern New England" with a major airport and a modern interstate highway and rail system poised to lead the way into the 21st century.

[From: http://www.warwickri.gov/heritage/generalhistory.htm, accessed on December 21, 2007.]

Buttonwoods, Warwick, Rhode Island

Located in the West Bay area of Warwick, the Old Buttonwoods section was founded as a summer colony in 1871 by Rev. Moses Bixby of Providence's Cranston Street Baptist Church who was looking for a serene vacation retreat for his congregation.

He envisioned a community that would be similar to Oak Bluffs on Martha's Vineyard where the Methodists established a summer campground in 1835. Today, this coastal community on Greenwich Bay is home to people of many different religious backgrounds.

This residential neighborhood is small, about 170 homes, and most of the houses are historic, with many Victorian cottages and larger shingled bungalows in the Arts and Crafts style. The waterfront along Promenade Avenue has many mature trees on their streets.

There is a neighborhood group, the Buttonwoods Beach Association, that organizes activities and celebrations for residents, many held at an association-owned building called the Casino. The Casino has a stage and two bowling alleys. Tennis courts and a playground are also nearby. Potluck dinners, seasonal parties, and arts and crafts lessons for children take place there. Association members can use the hall for private parties. The Association owns a non-denominational chapel at Ninth Avenue and Janice Road.

Buttonwoods is also home to Warwick City Park which includes three baseball fields, picnic areas and shelters, three miles of paved bicycle paths and tennis courts among other amenities.

[From http://en.wikipedia.org/wiki/Buttonwoods; accessed on Dec. 10, 2007 and dated May 2007]

Oakland Beach, Warwick, Rhode Island

Oakland Beach is a neighborhood located in the south central area of Warwick on Greenwich Bay, a tributary of Narragansett Bay. This densely populated community of small cottages was developed after World War I as a summer colony, largely for nearby Providence's middle class Irish and Italian communities. Oakland Beach reached its heyday in the 1930's when it boasted a bathing beach, boat docks and restaurants, as well as a Ferris Wheel, and rail service to Providence and other nearby summer colonies.

The New England Hurricane of 1938, however, destroyed most of Oakland Beach. The area never fully recovered and Hurricane Carol in 1954 sent the neighborhood in further decline. By the late 1960's and into the 1970's the area had fallen into decline and became notorious for street fights, drug dealing, and house break-ins. Today, Oakland Beach shows some signs of revitalization as several upscale homes have been built near the shore to take advantage of the panorama of Greenwich Bay and Narragansett Bay. In the summer, hundreds of people flock to Oakland Beach restaurants like Iggy's for clam cakes and chowder, a Rhode Island favorite.

[From http://en.wikipedia.org/wiki/Oakland_Beach_Rhode_Island; last modified on Nov. 21, 2007 and accessed on Dec. 10, 2007]