Appendix E

Technical Memo - Hydrogeologic Evaluation Proposed Effluent Disposal Facilities, 223 Beach Road, Town of Orleans, Massachusetts

(June 2016)

FINAL

HYDROGEOLOGIC EVALUATION
PROPOSED EFFLUENT DISPOSAL FACILITIES
223 BEACH ROAD
TOWN OF ORLEANS, MASSACHUSETTS

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TABLE OF CONTENTS

TABLE OF CONTENTS ____ *i*
LIST OF FIGURES ____ *iii*
LIST OF TABLES ____ *iii*
1.0 INTRODUCTION AND BACKGROUND ____ *1*
1.1 Introduction and Purpose ____ **1**
1.2 Consensus Plan Description ____ **1**
1.3 Initial Process of Site Identification ____ **3**
1.4 Hybrid Plan Site Identification Criteria Used During OWQAP Process ____ **5**
1.5 Site Review and Shortlisted Sites ____ **6**
2.0 PROPOSED COLLECTION, TREATMENT AND DISCHARGE FACILITIES ____ *7*
2.1 Collection Area and WWTF ____ **7**
2.2 Effluent Disposal – Primary and Secondary Discharge Area ____ **7**
3.0 HYDROGEOLOGIC INVESTIGATION ____ *11*
3.1 Previous Subsurface Investigations ____ **11**
3.2 Test Pit Excavation and Percolation Tests ____ **11**
3.3 Soil Boring and Monitoring Well Installation ____ **12**
3.4 Grain-Size Analysis ____ **12**
3.5 Slug Testing ____ **12**
4.0 HYDROGEOLOGIC CONDITIONS AND DATA ANALYSIS ____ *15*
4.1 Geology, Groundwater Flow and Boundary Conditions ____ **15**
4.2 Calculated Aquifer Values ____ **19**
4.3 Groundwater ____ **22**
4.4 Surface Water ____ **22**
5.0 GROUNDWATER MODELING EVALUATION ____ *25*
5.1 Modeling Method ____ **25**
5.2 Conceptual Model of the Aquifer System ____ **25**
5.3 Model Design and Updates ____ **26**
5.4 Model Calibration ____ **33**
5.5 Predictive Simulations ____ **33**
6.0 WATER QUALITY ____ *45*
7.0 POTENTIAL IMPACTS ____ *47*
7.1 Potential Groundwater Mounding Impacts ____ **47**
7.2 Potential Water Quality Impacts ____ **47**
8.0 GROUNDWATER MONITORING PLAN ____ *49*
8.1 Proposed Monitoring Locations ____ **49**

8.2 Baseline Water Quality 49
8.3 Compliance Monitoring 49
8.4 Replacement Monitoring Well Installation 51
9.0 ESTIMATED COSTS OF GROUNDWATER DISPOSAL FACILITIES 53
9.1 Subsurface Groundwater Discharge – Estimated Costs 53
9.2 Wick Discharge – Estimated Costs 53
10.0 REFERENCES 57

LIST OF FIGURES

1 Locus
2 Conceptual Approach to Meet Orleans Water Quality Goals
3 Meetinghouse Pond Area Collection System
4 Site Plan
5 Proposed Groundwater Discharge Area
6 Lines of Geologic Cross Section
7 Geologic Cross Section A-A'
8 Geologic Cross Section B-B'
9 Static Groundwater Contours
10 Model Grid and Location of General Head Boundaries and Drain Nodes
11 Recharge Distribution
12 Hydraulic Conductivity Values
13 Model Results - Steady State Contours & Calibration Targets
14 Simulation A – 25,000 gpd
15 Simulation B – 50,000 gpd
16 Simulation C – 100,000 gpd
17 Simulation D – 150,000 gpd
18 Simulation E – 200,000 gpd
19 Simulation F – 300,000 gpd
20 Simulation G – 400,000 gpd
21 Simulation H – 500,000 gpd
22 Location of Private Water Supply Wells
20 Locations of Proposed Monitoring Wells

LIST OF TABLES

1 Observation Well Construction and Water Level Summary
2 Summary of Aquifer Characteristics – Grain Size Analysis
3 Summary of Aquifer Characteristics – Slug Test Analysis
4 Comparison of Mass Balance
5 Comparison of High Water Table Conditions
6 Summary of Laboratory Water Quality Results
7 Subsurface Groundwater Discharge – Estimated Costs

LIST OF APPENDICES

A. Non Traditional Technology – Technical Memorandum
B. Watershed Ranking Spreadsheets
C. MassDEP Correspondence
D. Previous Investigations
E. Test Pit Data and Soil Evaluator Forms
F. Soil Boring Logs
G. Laboratory Reports - Grain Size Analysis
H. Hydraulic Conductivity Approximation Report
I. Laboratory Reports – Water Quality

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1.0 INTRODUCTION AND BACKGROUND

1.1 Introduction and Purpose

The Hydrogeologic Evaluation Technical Memorandum documents the approach used to evaluate 223 Beach Road (Figure 1) for a groundwater discharge from the proposed Meetinghouse Pond Area wastewater treatment facility (WWTF). This Memorandum includes the following:

- Description of the initial process that was employed to develop the Orleans Consensus Plan and selected potential groundwater discharge sites;
- Description of the initial steps taken in the process of evaluating groundwater discharge sites;
- Summary of existing data that is available to help evaluate the 223 Beach Road site;
- Summary of field investigations conducted at 223 Beach Road site;
- Evaluation of field investigations and other available data;
- Results of groundwater flow modeling and groundwater mounding analysis; and
- Recommended maximum discharge capacity for the 223 Beach Road Site.

The purpose of this document is to provide a transparent and objective assessment of the 223 Beach Road Site for the discharge of WWTF effluent. The Hydrogeologic Evaluation will be submitted to the Massachusetts Department of Environmental Protection (MassDEP) as part of the Groundwater Discharge Permit (GWDP) application process.

1.2 Consensus Plan Description

The Orleans Water Quality Advisory Panel (OWQAP) was convened to achieve consensus and build widespread community support for a customized, affordable water quality management plan for the Town of Orleans. The panel consisted of stakeholder representatives (Orleans Selectmen and representatives of engaged citizen constituencies), and liaisons from key town boards and commissions, organizations, neighboring towns, and regional, state, and federal partners. The OWQAP met for twelve half-day meetings starting in July 2014, all of which were open to public attendance and comment.

Potential alternative planning scenarios, designed to meet Massachusetts Estuaries Project (MEP) water quality standards, were developed for the OWQAP and presented at meetings and workshops. Initially, a Hybrid Plan was developed that included specific sites for aquaculture and coastal habitat restoration (CHR), as well as permeable reactive barriers (PRB) and floating constructed wetlands (FCW). The number of acres of shellfish growing area, as well as linear feet of PRBs and square footage for FCW were quantified to achieve specific nitrogen-removal targets for numerous sub-estuaries surrounding the Town of Orleans. These specific locations became the basis for potential demonstration site locations for aquaculture, CHR, FCWs and PRBs.


ASPINET ROAD
OCEAN ROAD
SURF BOAT LANE
NAUSET HEIGHTS ROAD
NAUSET KNOLLS LANE
PENDLETON DRIVE
SURF PATH
BEACH ROAD
SMITH NECK ROAD
Beach Road Site
Proposed Groundwater Discharge
DUCK FARM LANE
HIGH VIEW LANE
FIGURE 1
TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING
LOCUS MAP
0 150 300
Feet
AECOM
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The OWQAP vetted Hybrid Plan during several meetings, including a day-long workshop. This iterative process resulted in a draft Consensus Plan that included a combination of non-traditional and traditional technologies. Once the feasibility of using shellfish and other non-traditional technologies as part of the Town's nutrient management strategy was established, the OWQAP decided that the final Consensus Plan would not specify exact growing locations, but instead focus on overall area of shellfish and other alternative technologies needed to remove the appropriate mass of nitrogen at the watershed level.

The resulting map (Figure 2), entitled Conceptual Approach to Meet Orleans Water Quality Goals (March 2015) shows the agreed upon water quality management plan and includes 5.5 acres of shellfish in the Nauset Harbor watershed and 9 acres of shellfish in Pleasant Bay. Neither coastal habitat restoration nor aquaculture is part of the plan for the Rock Harbor watershed. This map also specifies acreages for FCW and linear feet of PRBs.

1.3 Initial Process of Site Identification

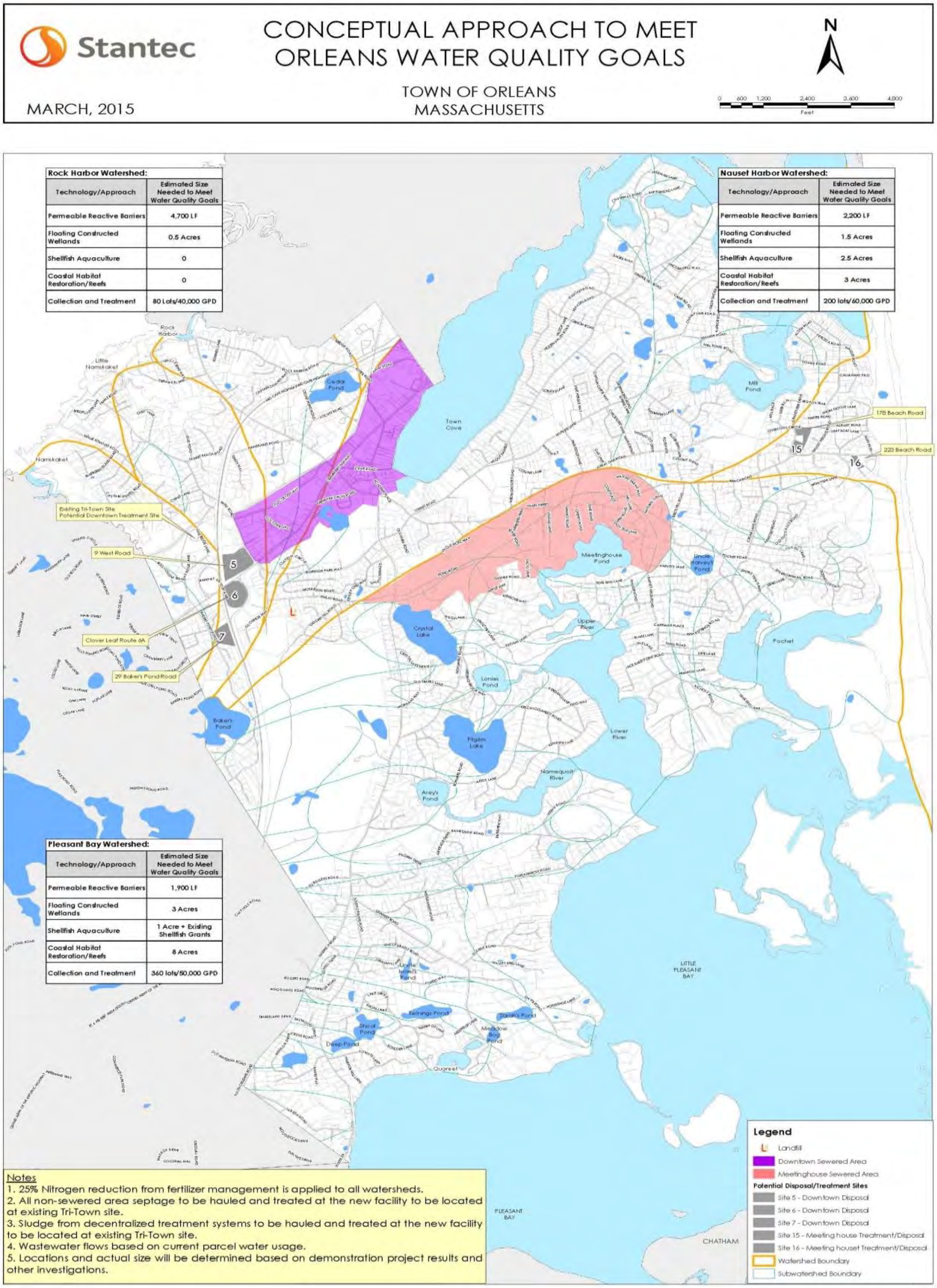
As part of updating the 208 Plan, The Cape Cod Commission (CCC) created Traditional and Non-Traditional Scenarios that would meet the regulatory requirements for nitrogen, formalized as Total Maximum Daily Loads (TMDLs) for Orleans' impaired water bodies. The Traditional Scenario for Orleans used centralized sewers exclusively. The Non-Traditional Scenario met nitrogen-removal goals through a subset of the many alternatives that are described in the 208 Plan's Technology Matrix. The subset of technologies in the CCC's Non-Traditional Scenario included PRBs, FCWs, CHR, shellfish aquaculture, fertigation, composting and urine-diverting toilets and innovative/alternative septic systems. In order to ensure consistency with this established regulatory framework, the Non-Traditional Scenario developed by the CCC became the starting point for the OWQAP and consensus-building process.

This planning and design process for tailoring a non-traditional scenario for Orleans included studying the information prepared by the CCC, and collecting and analyzing a significant amount of additional local data that was not reviewed as part of the regional planning process undertaken by the CCC. Local data from satellite images, geographic information system (GIS) maps, groundwater maps, and coastal pond bathymetry data was reviewed. Paper records on the history of local aquaculture, and Town shellfish propagation were aggregated into a database for trending and other analyses. Site visits both by land and by water were conducted to validate locations for shellfish aquaculture and CHR. Interviews with the Orleans Shellfish Constable, the former Shellfish Constable, and local shell fishers were also conducted to verify initial findings.

This local data was used to:

- Evaluate depth to groundwater and aquifer thickness for PRB installations;
- Assess roads and neighborhoods for PRB installations;
- Classify water bodies in terms of suitability for aquaculture and/or CHR based on water quality data contained in Massachusetts Estuaries Project (MEP) Reports and data synthesis from the Pleasant Bay Alliance;
- Inventory potential and existing use conflicts (boating, moorings, aesthetic preferences);
- Identify specific areas for shellfish growing within waterbody; and
- Recommend different species for specific areas, including quahogs, oysters, and mussels.

Figure 2 - Conceptual Approach to Meet Orleans Water Quality Goals



This local data collection and evaluation allowed the Non-Traditional scenario for Orleans to be based on key validated site parameters, ensuring that the non-traditional technologies were feasible in their planned locations. In addition, a Technical Memorandum on Non-Traditional Technologies (Appendix A) was prepared and submitted to the OWQAP. This Technical Memorandum detailed initial performance expectations, as well as key site and permitting considerations that should be used to verify the usefulness of these technologies for specific subwatersheds in Orleans.

The results of this detailed analysis and resulting initial locations for non-traditional technologies were presented and thoroughly discussed during the October 8, 2014 OWQAP Stakeholder meeting. Based on this technical review, as well as direction from the OWQAP, specific non-traditional technologies were then selected to be used to create a “Hybrid Plan” that included both non-traditional as well as traditional technologies for Orleans. The Hybrid Plan showed both technologies in specific locations in order to verify that appropriate nutrient loads could be removed.

1.4 Hybrid Plan Site Identification Criteria Used During OWQAP Process

During a day-long OWQAP public workshop on December 17, 2014, the Hybrid Plan was presented, screened, and evaluated. This plan described a combination of traditional and non-traditional technologies that meet the MEP load-reduction targets for nitrogen in each impaired waterbody. The OWQAP then formed three subgroups to discuss, evaluate and revise the Hybrid Plan. To assist in this process, the OWQAP received a Technology Evaluation Decision Support Tool that allowed risks and benefits of each technology to be evaluated by subwatershed. Preliminary comparative costs were also presented on a relative dollars/kilogram of nitrogen removed basis. Spreadsheets with ranking for each subwatershed are included in Appendix B.

Ranked categories include:

- Nutrient removal certainty: nitrogen (saltwater), phosphorus (freshwater);
- Implementation certainty;
- Other benefits: ecosystems, economic, social;
- Adaptability to uncertainty in nutrient-reduction goals and build-out; and
- Contaminants of emerging concern (CEC) removal.
- Overall cost

Based on these criteria, two areas were identified for wastewater collection, treatment and discharge. These areas were identified as the Downtown and Meetinghouse Sewered Areas (Figure 2). The following WWTF effluent discharge sites were identified as part of the process of defining the Consensus Plan:

- 9 West Road;
- Cloverleaf Route 6A;
- 29 Baker Pond Road;

- 178 Beach Road; and
- 223 Beach Road.

1.5 Site Review and Shortlisted Sites

The initial groundwater discharge sites, taken from the Hybrid Plan developed during the OWQAP process, were further evaluated by the Town. Two locations were initially shortlisted for hydrogeologic evaluation; Cloverleaf Route 6A and 223 Beach Road. These sites met the goals and objectives of the OWQAP's Consensus Plan.

The Town of Orleans did not own the parcel within the southeast cloverleaf of the Route 6 Interchange (Exit 12) with Route 6A. In the fall of 2015, the Town approached MassDOT for permission to access the Cloverleaf site to perform a hydrogeologic investigation. When a site access agreement could not be obtained, the Cloverleaf Site was removed from consideration in mid-January, 2016. Alternative groundwater discharge sites are being considered.

The 223 Beach Road site is located in east Orleans near Nauset Beach. The parcel is owned by the Town. On November 30, 2015, a proposed scope of work to conduct a Hydrogeologic Site Evaluation was submitted to MassDEP for review and comment. The notification of the proposed scope of work was published in the December 23, 2015 Environmental Monitor and open to public comment. The Proposed Hydrogeologic Site Evaluation was approved by MassDEP on January 19, 2016 after receiving no public comments. Copies of the proposed Hydrogeologic Evaluation scope of work, Environmental Monitor Notification and MassDEP approval letter are provided in Appendix C. The following Technical Memorandum reports on the scope of work, methodology, findings, conclusions, and recommendations of the 223 Beach Road Hydrogeologic Evaluation.

2.0 PROPOSED COLLECTION, TREATMENT AND DISCHARGE FACILITIES

2.1 Collection Area and WWTF

MEP estimates that 100 percent of the nitrate load from existing and future septic systems will need to be removed from the Meetinghouse Pond Watershed to meet the nutrient load reduction target for Meetinghouse Pond. The OWQAP evaluated traditional and non-traditional nutrient reduction technologies for nitrate removal within the watershed. Due to the high percentage of nitrate removal and the limited potential for use of non-traditional technologies within the Meetinghouse Pond Watershed, the OWQAP proposed to manage a majority of the nitrate load through the construction of wastewater collection, treatment, and disposal facilities in the Consensus Plan. Flow from the collection area will be primarily residential and commercial. Flows are estimated at 110,000 gallons per day (gpd). The proposed collection area is shown on Figure 3. The method of treatment is also being evaluated although a membrane bioreactor (MBR) facility is considered likely. The location of the proposed discharge site, 223 Beach Road, is shown on Figure 4.

2.2 Effluent Disposal – Primary and Secondary Discharge Area

The Beach Road site was considered for two primary reasons. First, the site is owned by the Town; second, the site is located outside the Meetinghouse Pond Watershed and discharges to the Atlantic Ocean and not to an estuary where the nitrate in the effluent could be a potential issue (Figure 4). The Town also plans to use the site for Nauset Beach parking. Installation of a subsurface discharge at the site would not interfere with these plans.

Based on the soils investigations performed by AECOM, the primary and reserve discharge leaching facilities will be designed using a percolation rate less than 2 minutes per inch. This percolation rate has been verified by percolation tests conducted on February 18, 2016. Some of the finer soils located near the surface would likely be removed and replaced with Title 5 sand for the installation of a subsurface leaching trench discharge. Removal of the sands would not be required for a wick discharge. At the time of this report, the Town of Orleans is considering leaching trenches for a groundwater discharge. As required in the MassDEP's "Guidelines for the Design, Construction, Operation, and Maintenance of Small Sewage Treatment Facilities with Land Disposal", this percolation rate combined with leaching trenches provides an allowable loading rate of 3 gallons per day per square foot (gpd/ft^2) of effective leaching surface area.

The potential discharge area at 223 Beach Road is shown on Figure 5. The potential discharge area is approximately 140,000 square feet (sq.ft.). At this time the location of the primary and reserve discharge areas within the highlighted area has not been determined. Approximately 350,000 to 500,000 gpd could be discharged at the Beach Road site, depending on the discharge method and location of the reserve discharge area.

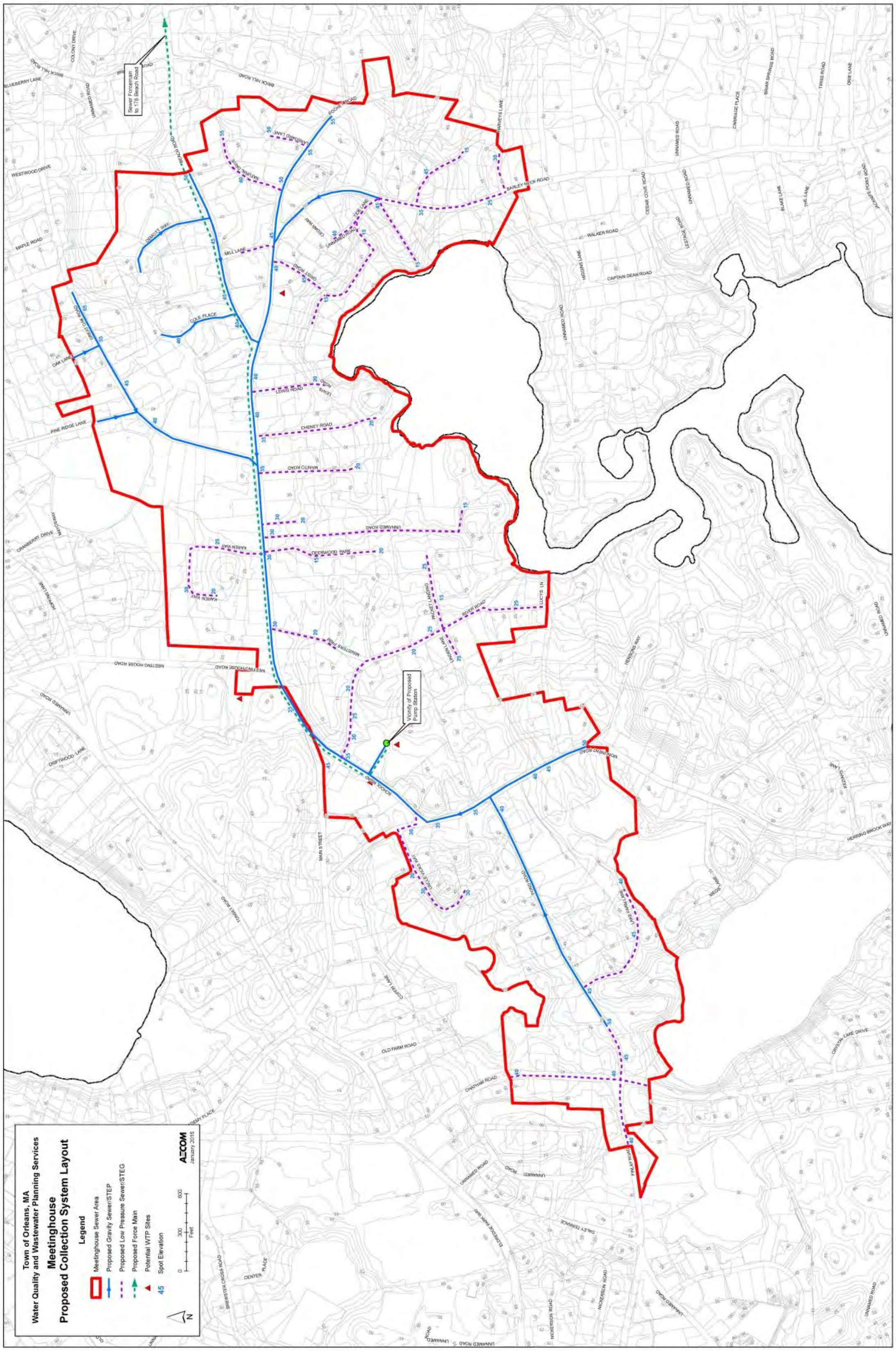


Figure 3 – Meetinghouse Pond Area Collection System

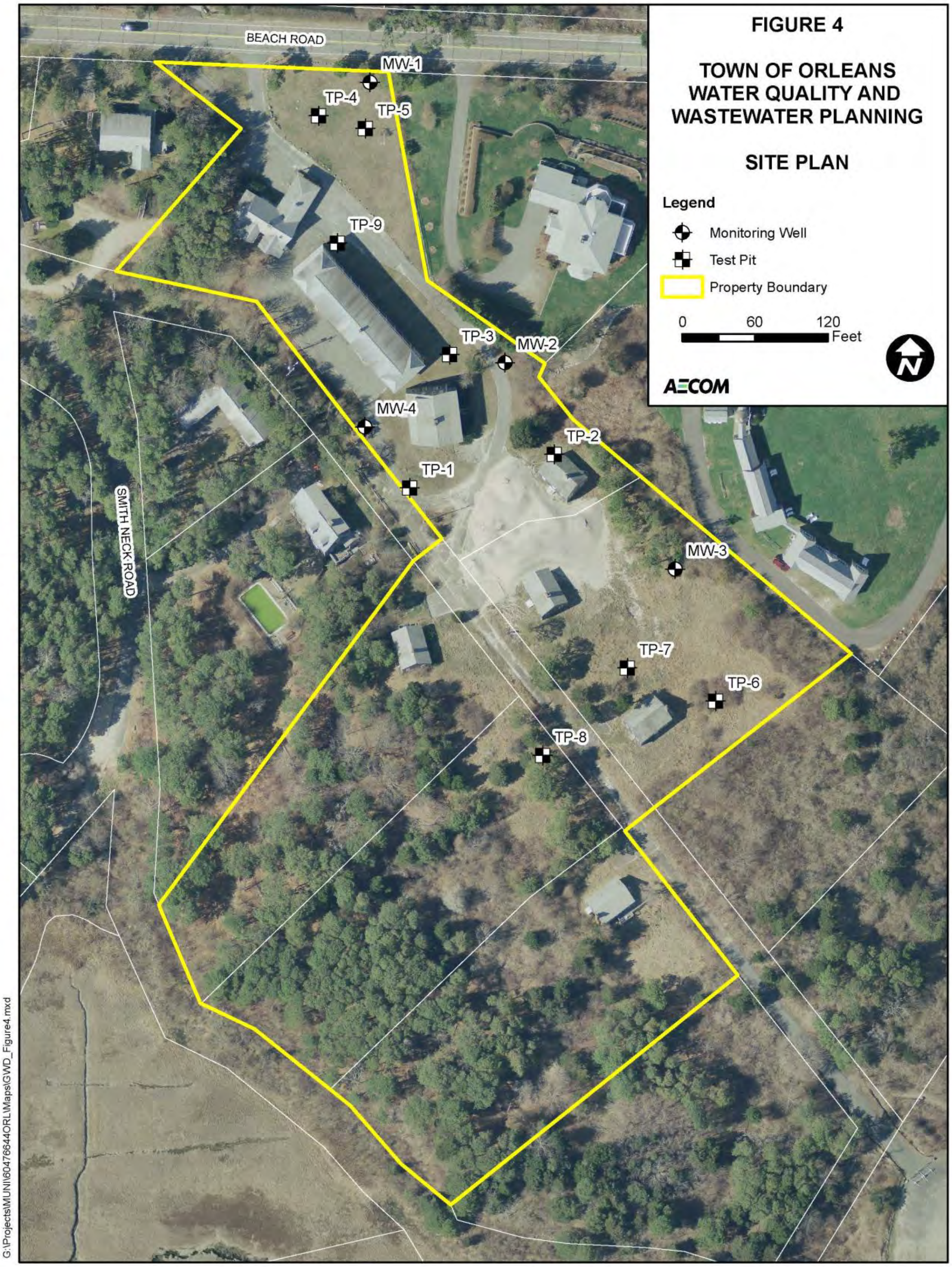


FIGURE 4
TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING
SITE PLAN
Legend
Monitoring Well
Test Pit
Property Boundary
0
60
120
Feet
AECOM
BEACH ROAD
SMITH NECK ROAD
MW-1
MW-2
MW-3
MW-4
TP-1
TP-2
TP-3
TP-4
TP-5
TP-6
TP-7
TP-8
TP-9
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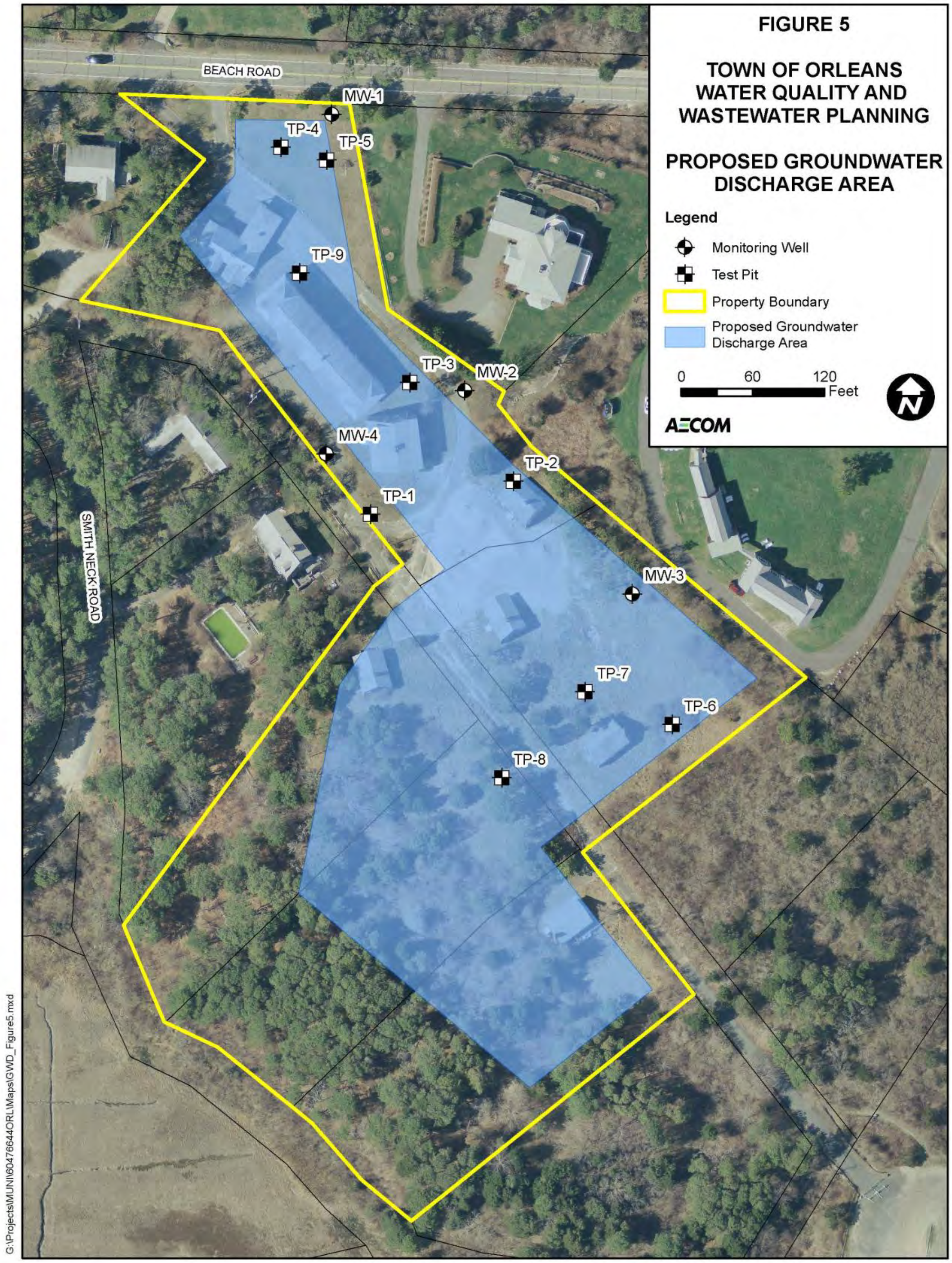
FIGURE 5
TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING
PROPOSED GROUNDWATER
DISCHARGE AREA
Legend
Monitoring Well
Test Pit
Property Boundary
Proposed Groundwater
Discharge Area
0
60
120
Feet
AECOM
BEACH ROAD
SMITH NECK ROAD
MW-1
MW-2
MW-3
MW-4
TP-1
TP-2
TP-3
TP-4
TP-5
TP-6
TP-7
TP-8
TP-9
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3.0 HYDROGEOLOGIC INVESTIGATION

Results of the hydrogeologic investigation are included in the following sections. AECOM's investigations included the excavation of test pits, performing Title 5 percolation tests, the installation of soil borings and monitoring wells, grain-size analysis of soil samples, and the performance of slug tests. The data obtained were used to evaluate subsurface conditions, estimate the groundwater flow direction and calculate aquifer characteristics. Results of the field investigations and data analysis were incorporated into a numerical groundwater flow model to simulate groundwater flow across the site and estimate groundwater mounding under various discharge scenarios. A summary of these investigations follows.

3.1 Previous Subsurface Investigations

In the early 1990, the CCC investigated soils, water level and water quality data across the Town of Orleans. The CCC gathered existing soil boring and water level data from numerous previous investigations. The CCC also had numerous additional soil borings and monitoring wells installed to evaluate soil and groundwater elevations across the Town of Orleans. Once collected, data was summarized in a report titled "Orleans Water Table Mapping Project, Orleans Massachusetts", dated May 1995. Soil boring logs, water level and groundwater elevation data, well location maps, geologic cross-sections and groundwater contour maps are included in the report. A copy of the report including soil boring logs, well construction diagrams, geologic cross sections, is provided in Appendix D.

In December 2015, Bennett Environmental .Associates, Inc. (BEA) began a site investigation at the Beach Road site. The investigations focused on evaluating potential impacts from several underground storage tanks (USTs) used at the site. Prior to the Town purchasing the property in 2010, the site was operated as a motel with several cottages/outbuildings. Several of the buildings had USTs used for the storage of heating oil. Once the USTs had been removed and most of the facilities razed, BEA conducted investigations to evaluate soils for petroleum products.

Petroleum contaminated soils were found and removed from the site as part of the investigations. On February 26, 2016 BEA submitted a Limited Removals Action Completion Statement to the Town of Orleans. The report summarizes the investigations, soil sampling, laboratory results, and removal of approximately 100 cubic yards of petroleum contaminated soils. A copy of the report is provided in Appendix D.

3.2 Test Pit Excavation and Percolation Tests

On February 18, 2016 a total of 7 test pits and 1 percolation test were conducted by AECOM at the proposed discharge site (Figure 5). The test pits were performed to evaluate the overall suitability of the subsurface soils for the proposed discharge. The test pits were excavated to depths of between 150 and 204 inches (12.5 and 17.0 feet).

Test pits TP-1 through TP-6, were witnessed by MassDEP and the Town of Orleans Health Department. All test pits and percolation test were excavated under the direction of a Massachusetts licensed soil evaluator John Schnaible of Coastal Engineering Company of Orleans, CEC # C18470.00. Mr. Brian Dudley of MassDEP SERO was present during the excavations. Copies of the test pit data and Soil Evaluator Forms, including the percolation test results, are contained in Appendix E.

3.3 Soil Boring and Monitoring Well Installation

A total of four soil borings and four monitoring wells were installed by AECOM December 28th and 29th, 2015. Soil borings were installed with a Geoprobe 6600 direct push rig, and soil core samples were collected for soil type characterization. Monitoring wells were constructed with 2-inch Schedule 40 PVC casings and 10 foot screens (Schedule 40 PVC .010" 10 slot well screen). The soil borings were advanced at locations MW-1, MW-2, MW-3, and MW-4. Continuous sampling was conducted from the ground surface to depths of between 60 and 80 feet at locations MW-1, MW-3, and MW-4 (Figure 5).

Locations where continuous soil samples were collected were drilled using 2-inch diameter drill casing. Samples were collected using 60-inch long, one-inch diameter clear liners. Once soil collection was completed, 3-inch diameter drill casing was advanced in the same borehole to allow for the installation of a 2-inch diameter monitoring well. Once the borehole drilling was completed, a single 2-inch diameter monitoring well was installed at each location.

Each monitoring well consisted of ten-foot sections of schedule 40 PVC riser pipe attached to 10-foot sections of 10-slot well screen. An artificial sand pack was installed between the well and the formation from the base of the well to approximately 2 feet above the well screen. The sand pack was then capped by approximately 2 feet of bentonite pellets and allowed to hydrate. Grout was then installed to a depth of 5 to 10 feet below the ground surface.

The monitoring wells were used to determine the water table elevation and to perform slug tests. All wells were surveyed for location and elevation relative to National Geodetic Vertical Datum. Water-table elevations were used to estimate groundwater flow patterns (Section 4.0). Copies of the boring logs with monitoring well details are provided in Appendix F. A summary of the well construction details is provided in Table 1.

3.4 Grain-Size Analysis

Soil samples were collected during the installation of the soil borings. Select samples were submitted to a laboratory for grain size analysis. Copies of the grain-size analysis reports are provided in Appendix G. Results of the soils analysis are discussed in Section 4.2.

3.5 Slug Testing

Slug tests consist of measuring the recovery of water levels in a monitoring well after a near-instantaneous change in head. AECOM performed pneumatic slug tests by using air pressure to depress the water table “slug” in the well. A submersible pressure transducer and data logger was used to record the water level response over time. Data was recorded using a pressure transducer with Aqu4Plus (2016) software by Northwest Instrumentation Inc.

The rising head slug tests were performed by rapidly releasing the air pressure in the well allowing the water level in the well to rise, simulating removing a slug of water out of the well. In wells where the static water level was within the screened interval (MW-1), the pneumatic slug test could not be performed. The pneumatic slug tests were conducted at monitoring wells MW-2, MW-3, and MW-4. The analysis methodology and results are discussed in Section 4.2.

Table 1

OBSERVATION WELL CONSTRUCTION AND WATER-LEVEL SUMMARY
GROUNDWATER DISCHARGE, BEACH ROAD SITE
ORLEANS, MASSACHUSETTS

Observation Well	Diameter (inches)	Borehole Depth	Depth of Screened Interval	Ground Elevation	Northing	Easting	Top of PVC Elevation (ft msl)	Depth to Water Table (3 31 16)	Groundwater Elevation (ft msl)
MW-1	**2.0**	**65**	**44 - 54**	43.3	2751878.494	1081768.949	43.03	40.12	2.91
MW-2	**2.0**	**55**	**44 - 54**	44.7	2751647.290	1081880.269	44.42	41.78	2.64
MW-3	**2.0**	**55**	**44 - 54**	45.1	2751476.907	1082020.569	44.66	42.09	2.57
MW-4	**2.0**	**60**	**47 - 57**	42.3	2751594.281	1081764.428	42.00	39.20	2.80
					Lat Long (NAD 27)				
OSW-22	**2.0**	**52**	**52**	39	41°47'26"	69°58'16"	39.10	34.38	4.72
BMW-21	**2.0**	**25**	**25**	36	41°45'18"	70°02'03"	36.92	9.04	27.88
BMW-22	**1.5**	**52**	**49 - 52**	50	41°46'30"	70°01'49"	50.45	29.30	21.15

Notes
All depths in feet below ground level (bgl)
All elevations in feet mean sea level (msl)
ft = feet

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4.0 HYDROGEOLOGIC CONDITIONS AND DATA ANALYSIS

4.1 Geology, Groundwater Flow and Boundary Conditions

Orleans is underlain by glacially derived sediments deposited 15,000 or so years ago during the waning stages of continental glaciation. The sediments consist of outwash deposited from the melting of the Cape Cod Bay and South Channel Lobes of the glacier (Wordsworth and Wigglesworth, 1934). The Harwich Outwash Plain deposits were derived from the Cape Cod Bay Lobe, while the Nauset Heights and Eastham plain deposits were derived from the South Channel Lobe (Oldale et.al., 1971).

According to Koteff and Cotton (1962) coarse sand and gravel deposits (Harwich Outwash Plain Deposits) are underlain by coarse sands to clayey silts followed by compact basal till directly overlying bedrock. The relatively thin layer of basal till indicates that the soils were deposited as the result of a single glaciation. Previous seismic investigations in the Orleans beach area indicate the bedrock surface at about 400 feet below sea level (Oldale and Tuttle, 1964).

The Beach Road parcel is underlain by Nauset Heights deposits, as mapped by Oldale et.al (1971). According to Oldale, these deposits consist primarily of sand and gravel. Due east of the site, Dune (windblown sands from Beach deposits) and Beach Deposits (wave deposited sands and coarser-grained deposits from stratified drift) are mapped (Oldale et.al., 1971). In general, these deposits are fairly well sorted and very permeable.

Geologic conditions found at the Beach Road site through AECOM’s field investigations are consistent with the deposits described above. Test Pit excavations revealed silty and fine sands (loamy sand) at the surface, extending to depths between 2.5 to 17 feet below the ground surface. These silty sands would not limit the These silty sands were underlain by a loose medium, medium to coarse, or medium to fine sand at all test pit locations with the exception of TP-6 where finer soils were excavated to total depth of the pit (17 feet). A percolation test was performed in the underlying medium sand at TP-1. After saturation, the percolation rate was less than 2 minutes per inch indicating that the underlying medium sands are suitable for a groundwater discharge system. Copies of the soil evaluator forms are provided in Appendix E. Copies of soil boring logs are in Appendix F.

Monitoring Well MW-1, installed in December 2015, was drilled to a depth of 80 feet below the ground surface. Soils encountered at MW-1 were a tan to light brown fine-to-medium sand with silt from a depth of 5 to approximately 10 feet. A tan to light brown fine-to-coarse sand (predominantly medium sand), was encountered 10 to approximately 75 ft. below ground surface (bgs). At MW-2, light-brown fine-to-coarse sand was encountered from 5 feet to a depth of 60 feet. At MW-3, a tan to light-brown, fine-to-coarse sand was found to a depth of 60 feet below ground. The soils at each boring location were similar and consistent with those encountered at the test pit excavations. A predominantly medium sand with varying amounts of fine and coarse sand and only trace amounts of gravel and silt. There was no refusal at any of the locations due to cobbles or boulders.

Groundwater was not encountered in any of the test pits, but was measured in the monitoring wells at a depth of approximately 40 feet below ground surface. Based on soil boring logs drilled within 500 feet of the site by the USGS, the saturated thickness of the aquifer underlying is in excess of 100 feet below mean sea level (msl).

The lines of geologic cross-section are shown on Figure 6. The geologic cross-sections A-A’ and B-B’ (Figures 7 and 8, respectively) graphically depict geologic conditions locally and regionally. Well logs used to construct the geologic cross-section are in Appendix F.


FIGURE 6
TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING
LINES OF GEOLOGIC
CROSS-SECTION
Legend
Monitoring Well
Test Pit
Cross-Sections
Property Boundary
Proposed Groundwater
Discharge Area
0
250
500
Feet
AECOM
DOANE ROAD
CALLANANS PASS
NAUSET ROAD
RED FOX TRAIL
SNOW GOOSE LANE
DEER RUN
GRANDVIEW DRIVE
HARRIS ROAD
OVERLOOK CIRCLE
OCEAN ROAD
ASPINET ROAD
SURF BOAT LANE
NAUSET HEIGHTS ROAD
SURF PATH
B
P-1
A
CCC-17
BEACH ROAD
CCC-29
TP-5
MW-1
A'
MW-2
MW-4
MW-3
TP-2
HIGH VIEW LANE
WINDSWEPT LANE
OWS-30
B'
USGS, MassGIS
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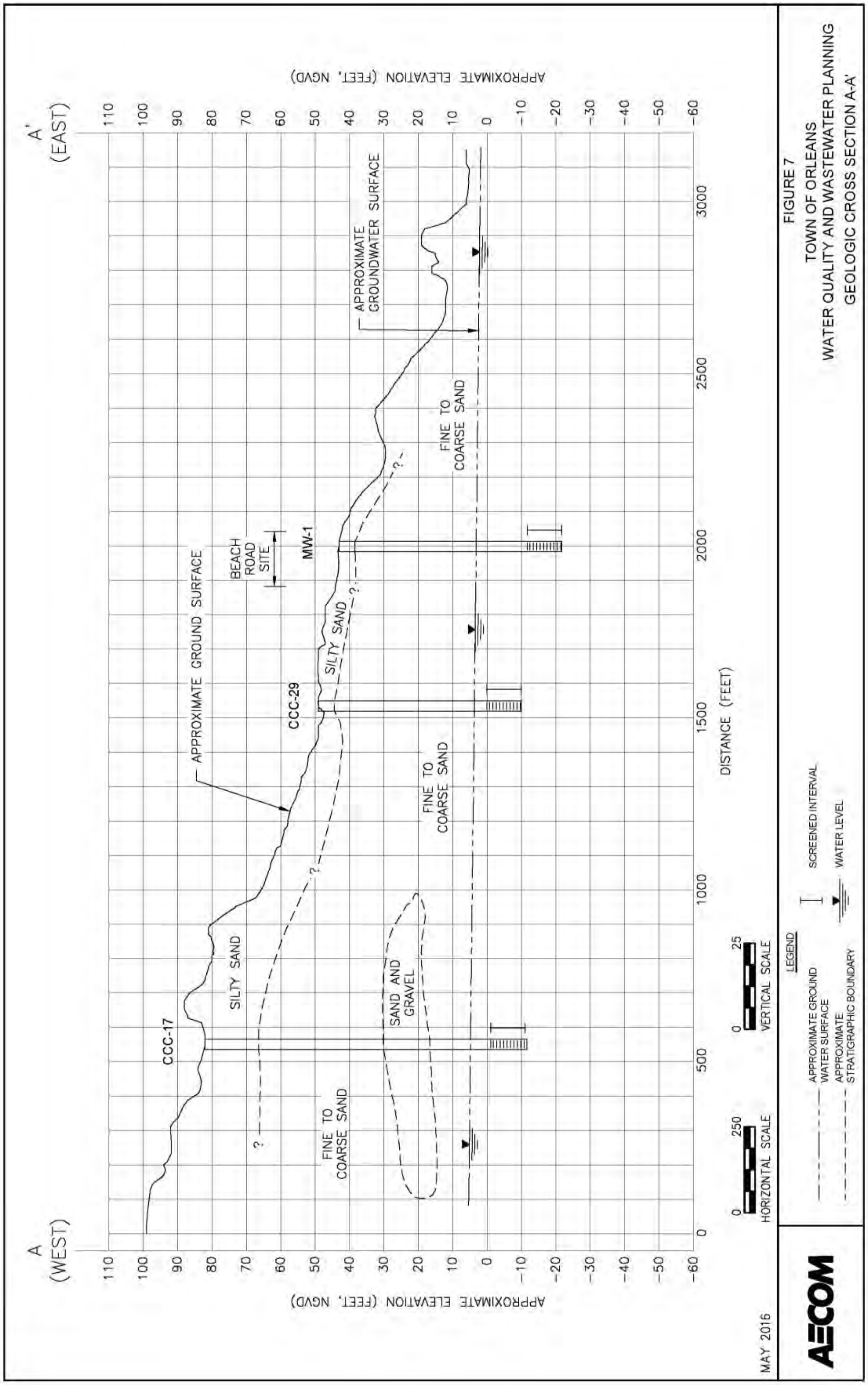
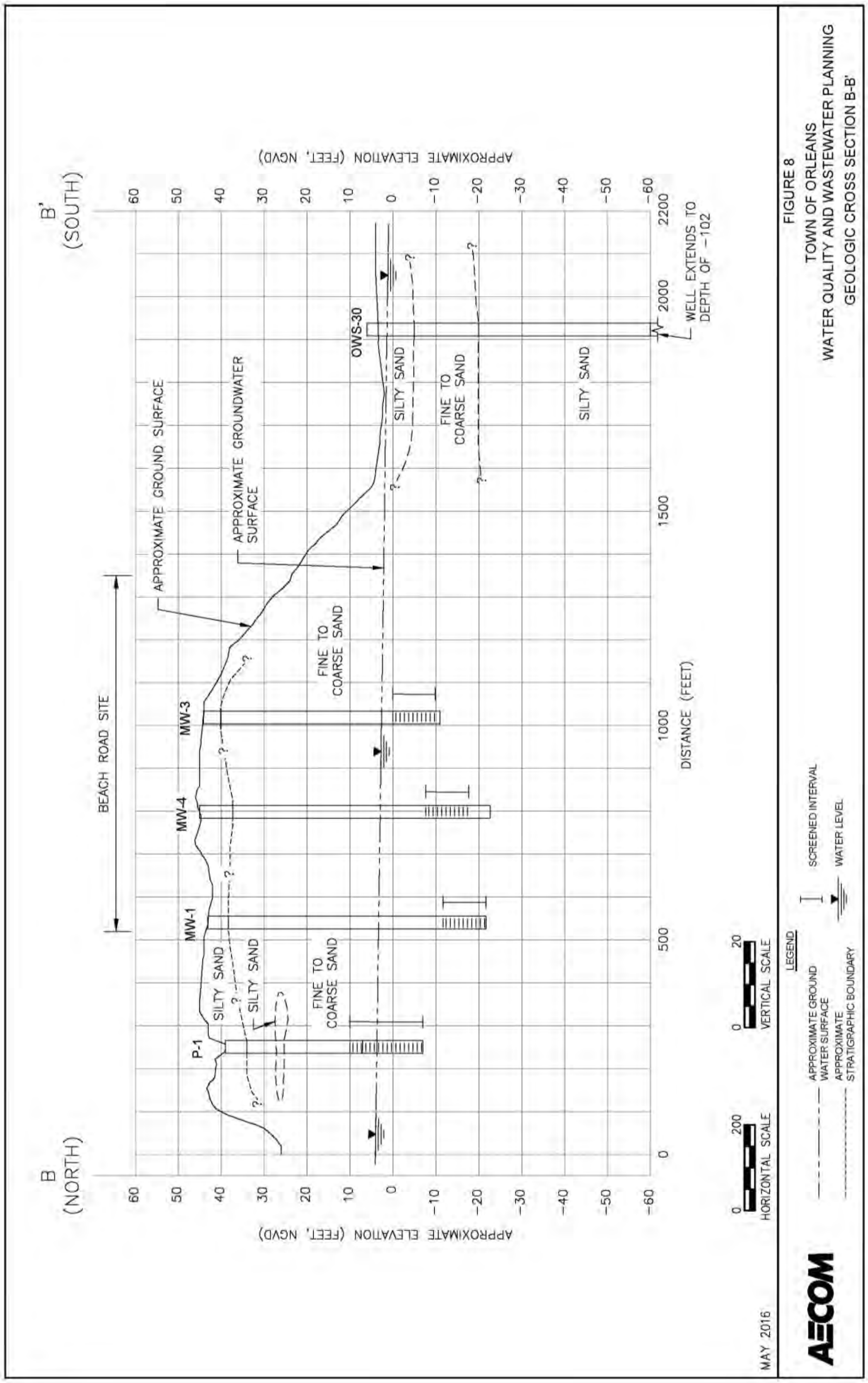


FIGURE 7
TOWN OF ORLEANS
WATER QUALITY AND WASTEWATER PLANNING
GEOLOGIC CROSS SECTION A-A'


B
(NORTH)
B'
(SOUTH)
APPROXIMATE ELEVATION (FEET, NGVD)
DISTANCE (FEET)
BEACH ROAD SITE
APPROXIMATE GROUND SURFACE
APPROXIMATE GROUNDWATER SURFACE
P-1
MW-1
MW-4
MW-3
OWS-30
SILTY SAND
FINE TO COARSE SAND
WELL EXTENDS TO DEPTH OF -102
HORIZONTAL SCALE
VERTICAL SCALE
LEGEND
APPROXIMATE GROUND WATER SURFACE
APPROXIMATE STRATIGRAPHIC BOUNDARY
SCREENED INTERVAL
WATER LEVEL
MAY 2016
AECOM
FIGURE 8
TOWN OF ORLEANS
WATER QUALITY AND WASTEWATER PLANNING
GEOLOGIC CROSS SECTION B-B'

According to USGS and CCC water table maps, groundwater flows easterly across the site toward the Atlantic Ocean (USGS, 2005). The drainage divide to Pochet Neck, a sub-estuary of Pleasant Bay, is located approximately 400 feet south, southwest of the site.

4.2 Calculated Aquifer Values

Aquifer characteristic were estimated through laboratory grain-size analysis and analysis of slug test data. A description of each method follows.

4.2.1 Soils Testing and Data Analysis

Samples collected from selected soil boring and test pit excavations were submitted to a laboratory for grain-size analysis. In total, 12 soil samples were submitted for grain-size analysis, four samples each from soil borings at MW-1, MW-3 and MW-4.

Hydraulic conductivity (K) and porosity (n) values for each of the 12 samples were estimated using several numerical methods including Kozeny-Carman (Carman, 1937), Shepards (1989), Hazen (1892), and Slitcher (1992).

Average calculated hydraulic conductivity values from the grain-size analysis ranged from 117 feet per day (ft./day) to 678 ft./day for sand and gravel samples, and 62 ft./day to and 517 ft./day for the sandy soils underlying the site. Conductivity of the few isolated, noncontiguous lenses of fine sand and silt ranged from approximately 1 to 85 ft./day. Including the results of the finer soils, the calculated averages at MW-1, MW-3, and MW-4, were 199, 216, and 154 ft./day, respectively. Averaging the results from all of the samples at all locations, results in a conductivity of 189 ft./day. The calculated hydraulic conductivity values estimated from the grain-size analysis are summarized in Table 2. The hydraulic conductivity approximation reports are provided in Appendix H. Laboratory reports for the soils analysis are provided in Appendix G.

4.2.2 Slug Testing and Data Analysis

Analysis of the slug test data was performed with the aid of AQTESOLV (2015) using the Bouwer and Rice (1967) method. The results of the slug test analysis indicate hydraulic conductivity values ranging from 148 ft./day to 363 ft./day for the medium-to-coarse saturated sands underlying the site. The average conductivity of the slug tests performed was 236 ft./day.

A summary of the estimated aquifer characteristics obtained from the slug test data is provided in Table 3. Copies of the hydraulic conductivity approximation reports are contained in Appendix H.

TABLE 2
SUMMARY OF AQUIFER CHARACTERISTICS - GRAIN SIZE ANALYSIS
TOWN OF ORLEANS
WATER QUALITY AND WASTEWATER PLANNING

Soil Sample Location	Depth (ft)	D10 (mm)	D50 (mm)	D60 (mm)	U (d60/d10)	n (porosity)	Classification	Fines (%)	Hydraulic Conductivity (ft/day): Kozeny-Carman	Sheperds	Hazen	Slitcher	Sample Average	Well Average	Site Average
MW-1	22-23	0.2524	0.4796	0.5567	2.21	0.42	poorly graded SAND	0.0	336	139	279	105	215	199	189
MW-1	27-28	0.3145	0.6194	0.7043	2.24	0.42	poorly graded SAND	0.0	517	212	432	162	331		
MW-1*	58.5		0.018	0.0337			poorly graded SAND	0.8							
MW-1*	63.4	0.1204	0.2064	0.2283	1.9	0.43	poorly graded SAND	0.0	85	35	66	26	53		
MW-3	20-22	0.2196	0.5455	0.6324	2.88	0.40	poorly graded SAND	1.6	206	172	196	68	160	216	
MW-3	35-37	0.3251	0.9937	1.2414	3.82	0.38	poorly graded SAND	1.6	347	462	387	122	329		
MW-3*	38-40	0.1932	0.375	0.4263	2.21	0.42	poorly graded SAND	0.0	197	93	164	62	129		
MW-3	43-44	0.2685	0.5267	0.5885	2.19	0.42	poorly graded SAND	0.0	383	162	317	119	245		
MW-4	18-20	0.3466	1.2536	1.6287	4.7	0.36	poorly graded SAND with gravel	3.0	319	678	402	117	379	154	
MW-4	30-32	0.2582	0.5505	0.6139	2.38	0.42	poorly graded SAND	2.3	333	174	286	106	225		
MW-4*	48-49	0.0224	0.1251	0.1457	6.49	0.33	poorly graded SAND	0.3	0.9	15.1	1.4	0.4	5.5		
MW-4*	52-53	0.0229	0.1497	0.1758	7.68	0.32	poorly graded SAND	0.2	0.8	20.3	1.4	0.3	7.2		

* Thin layers (<1 foot thick) of finer soils that appear to be discontinuous across the site.

TABLE 3
SUMMARY OF AQUIFER CHARACTERISTICS - SLUG TEST ANALYSIS
TOWN OF ORLEANS
WATER QUALITY AND WASTEWATER PLANNING

			Hydraulic Conductivity (ft/day)		
Monitoring Well	Run ID	Displacement (ft)	Run	Well Average	Site Average
MW-2	A	1.00	143	148	237
	B	1.17	143		
	C	1.65	152		
	D	1.73	154		
MW-3	A	1.07	217	198	
	B	1.19	203		
	C	1.72	186		
	D	1.61	186		
MW-4	D	0.79	308	365	
	E	0.66	408		
	F	0.99	372		
	G	0.85	372		

4.3 Groundwater

The study area is located in a watershed that discharges directly to the Atlantic Ocean. Locally, groundwater flows eastward towards the Atlantic Ocean. Water levels measured on March 31, 2016, from 4 observation wells were used to estimate the groundwater flow direction across the study area. Each well was surveyed relative to NAVD 1988. Using the survey data, the water levels obtained at each location were converted to elevation in feet msl. A summary of groundwater elevation data is provided in Table 1.

The static groundwater elevations were plotted on a map and approximated contours of the potentiometric surface were drawn. The resulting contours are shown on Figure 9. Contours were inferred between monitoring well locations. Based on the contours, groundwater flow across the site is approximately due east. The hydraulic gradient between the 4.2 foot and 4.5 foot contour was calculated at 0.0016 ft./ft. Between the 4.1 and 4.2 foot contour, the hydraulic gradient was slightly steeper and calculated at 0.0005 ft./ft. The groundwater contours are shown on Figure 9.

The probably high groundwater levels were estimated for the site. To evaluate whether the groundwater mound resulting from the discharge would cause the water table to rise to within four feet of the bottom of the discharge beds or ground surface at the site. High groundwater levels were estimated by comparing water levels collected at the Beach Road site with water level data at a USGS reference well on the same day. The long-term reference well selected was OSW-22. Reference Well OSW-22 is a USGS well located approximately 8,700 feet west of the Beach Road site in Orleans, which has been monitored since 1967, and is screened in a similar formation and hydrogeologic setting as the Beach Road Site.

Water Levels were collected at the Beach Road site and the reference well site on the same day: March 31, 2016. The observed groundwater level at OSW-22 was the compared to the historic high water level for that site. The high water level on record was 1.54 feet higher than observed on March 31, 2016. Using the method developed by Frimpter, the 1.54 feet difference was added to the Beach Road water table elevations measured on the same date, adjusting the Beach Road site water table elevations to simulate high water level conditions (Frimpter, 1980). Water levels were also collected at two other long-term reference sites; BMW-21 and BMW-22. Similar differences between water levels measured on March 31, 2016 and high water level conditions were also observed at these two reference wells.

4.4 Surface Water

The nearest surface water bodies are the Atlantic Ocean and the upper reaches of Pochet Neck, a subwatershed of the Pleasant Bay Watershed. The Atlantic Ocean is located between 900 and 1,200 feet east of the proposed discharge area. The marshes and tidal area of Pochet Neck are located approximately 400 feet to the south and southwest of the closest area of the discharge (Figure 4). Despite the proximity of Pochet Neck to the discharge area, groundwater flows towards the Atlantic Ocean. Simulated changes in the groundwater flow direction resulting from the proposed discharge are discussed in Section 5.7.

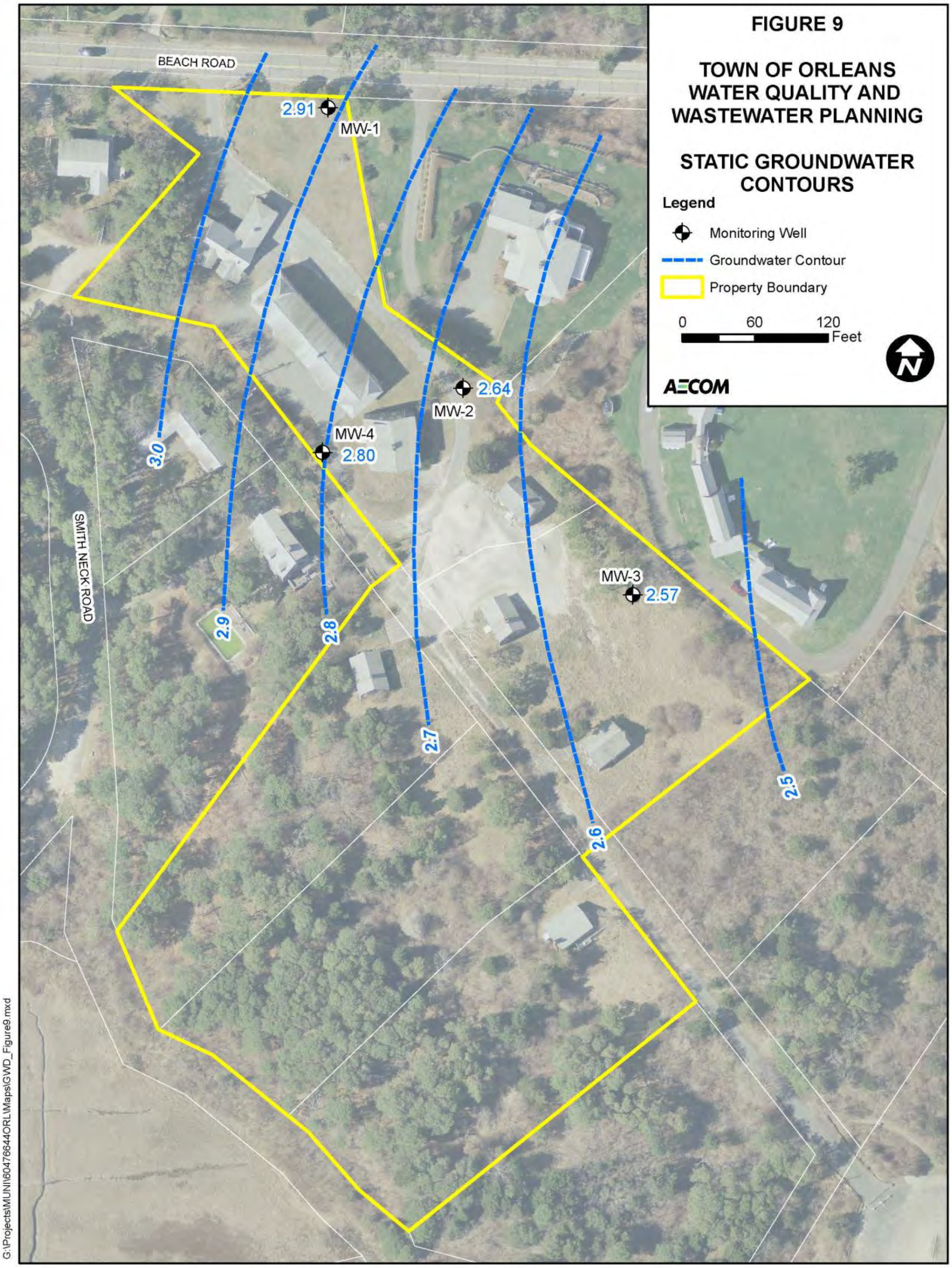


FIGURE 9
TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING
STATIC GROUNDWATER
CONTOURS
Legend
Monitoring Well
Groundwater Contour
Property Boundary
0
60
120
Feet
AECOM
BEACH ROAD
SMITH NECK ROAD
2.91
MW-1
2.64
MW-2
MW-4
2.80
MW-3
2.57
3.0
2.9
2.8
2.7
2.6
2.5
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5.0 GROUNDWATER MODELING EVALUATION

Groundwater modeling was performed by AECOM as a part of the evaluation of disposal options to provide feedback on potential designs; this feedback can then be used to help make design decisions. Specifically for this project, numerical groundwater modeling was used by AECOM to predict changes in groundwater elevations and flow directions based on the volume of discharge.

More specifically, the purpose of the groundwater modeling was to: 1) evaluate the potential impacts of the groundwater discharge on ambient groundwater flow and water levels, and 2) to evaluate the ultimate discharge of groundwater originating from the discharge at Beach Road.

5.1 Modeling Method

A regional three-dimensional groundwater flow model of the Monomoy Lens was developed by the USGS as a tool for understanding the groundwater flow system and water budget (USGS, 2004). This regional groundwater flow model formed the basis of the model modified by AECOM for the purpose of performing groundwater discharge simulations.

MODFLOW was used by AECOM for this analysis (MacDonald and Harbaugh, 1988). The three-dimensional groundwater flow model was coupled with a particle tracking model called MODPATH (Pollack, 2004) in order to illustrate the potential movement of groundwater over time. Both of these models were used on the GMS platform, Version 10.0.

5.2 Conceptual Model of the Aquifer System

A conceptual site model (CSM) of a groundwater flow system is a representation of how an aquifer functions based on available data. Geologic maps and cross-sections, groundwater flow maps, and the generalized water balance (the volume of water entering and leaving the aquifer) are common elements of a conceptual aquifer model. AECOM's understanding of how the Town of Orleans groundwater flow system functions is based on the geological and hydrological data presented in Sections 3.0 and 4.0; additionally the CSM is based on the work done and reported on by the USGS (2004).

The CSM for hydrogeology and groundwater flow in the Monomoy Lens is well documented in the USGS (2004) report. Overall, the CSM documented in the USGS (2004) report is the same as is used for AECOM's modeling effort. However, AECOM's investigation of the Beach Road site completed in December 2015-January 2016 was used to verify the USGS's CSM. AECOM's work included new wells and hydraulic testing of the aquifer (to estimate K). These results of the investigation and data analysis are discussed in Sections 3.0 and 4.0 of this document.

In general, the aquifer in the Town of Orleans is a relatively simple water table aquifer composed of relatively homogeneous deposits of sand with trace amounts of gravel and silt. The bottom of the aquifer is assumed to coincide with the bottom of the numerical model, around -350 feet elevation below sea level.

According to the USGS's CSM, water enters the aquifer system primarily in the form of rainfall recharge. Rainfall recharge is expected to be around 29 inches per year except in wetlands, lakes, oceans where it may be low or zero. Groundwater then leaves the aquifer system through surface water features, such as lakes, streams, wetlands, marshes and the ocean.

5.3 Model Design and Updates

The numerical groundwater flow modeling was completed using the USGS numerical groundwater flow model of the Monomoy Lens as a basis. This model is documented in "Simulated Water Sources and Effects of Pumping on Surface and Ground Water, Sagamore and Monomoy Flow Lenses, Cape Cod, Massachusetts" (USGS, 2005). Modeling files were received from the USGS and were imported into the GMS 10.0 platform. GMS is a pre- and post-processor for MODFLOW-2000 that facilitates data input, and depiction and interpretation of output.

5.3.1 Model design

The model prepared by the USGS, and modified by AECOM, is structured as follows:

- The USGS model runs as a steady-state model, which incorporates long-term average conditions and does not include short-term (i.e., transient) changes in storage.
- The USGS model domain included the entire Monomoy Lens; a map of this domain is included in Figure 1-1A, Appendix 1 (USGS, 2004). The model domain updated by AECOM is shown in Figure 10 and is bounded primarily by surface water features (streams, marshes, inlets, estuaries, and ocean). The southwestern limit of the model domain was adjusted from the full regional model; a no flow boundary was assigned there to coincide with the groundwater divide.
- The original USGS model and AECOM modified model are both 20 layers. In this area of the Monomoy Lens, the groundwater table is low enough such that many of the upper layers go dry. The first fully wet layer is layer 8. The bottom updated model domain ranges from approximately -300 to -400 feet elevation below sea level. With the exception of the lowest model layer, the model layers are uniform thickness across the model domain, see Figure 1-1B, Appendix 1 (USGS, 2004).
- USGS assigned rainfall recharge using a variable array for the model domain. The rainfall recharge rate ranges from 0 ft./day to 0.00723 ft./day (0 to 31.67 in/year). Most of the model area includes rainfall recharge around 29 inches per year. Lesser rates or zero rainfall recharge rates were assigned to wetlands, open water, and/or oceans. Figure 11 shows rainfall recharge distribution across the model domain.
- USGS simulated surface water features in a variety of ways:
    - Streams, wetlands, marshes, estuaries and other drainages were simulated using the drain (DRN) package.
    - The Atlantic Ocean and Cape Cod Bay were simulated with a general head boundary (GHB).
    - Lakes were simulated with horizontal flow boundaries (HFB) and high hydraulic conductivity.
    - The original model included using the stream (STR) package for some surface water drainages, but when the model domain was made smaller, those features were excluded. Therefore, the updated model does not use the stream package.

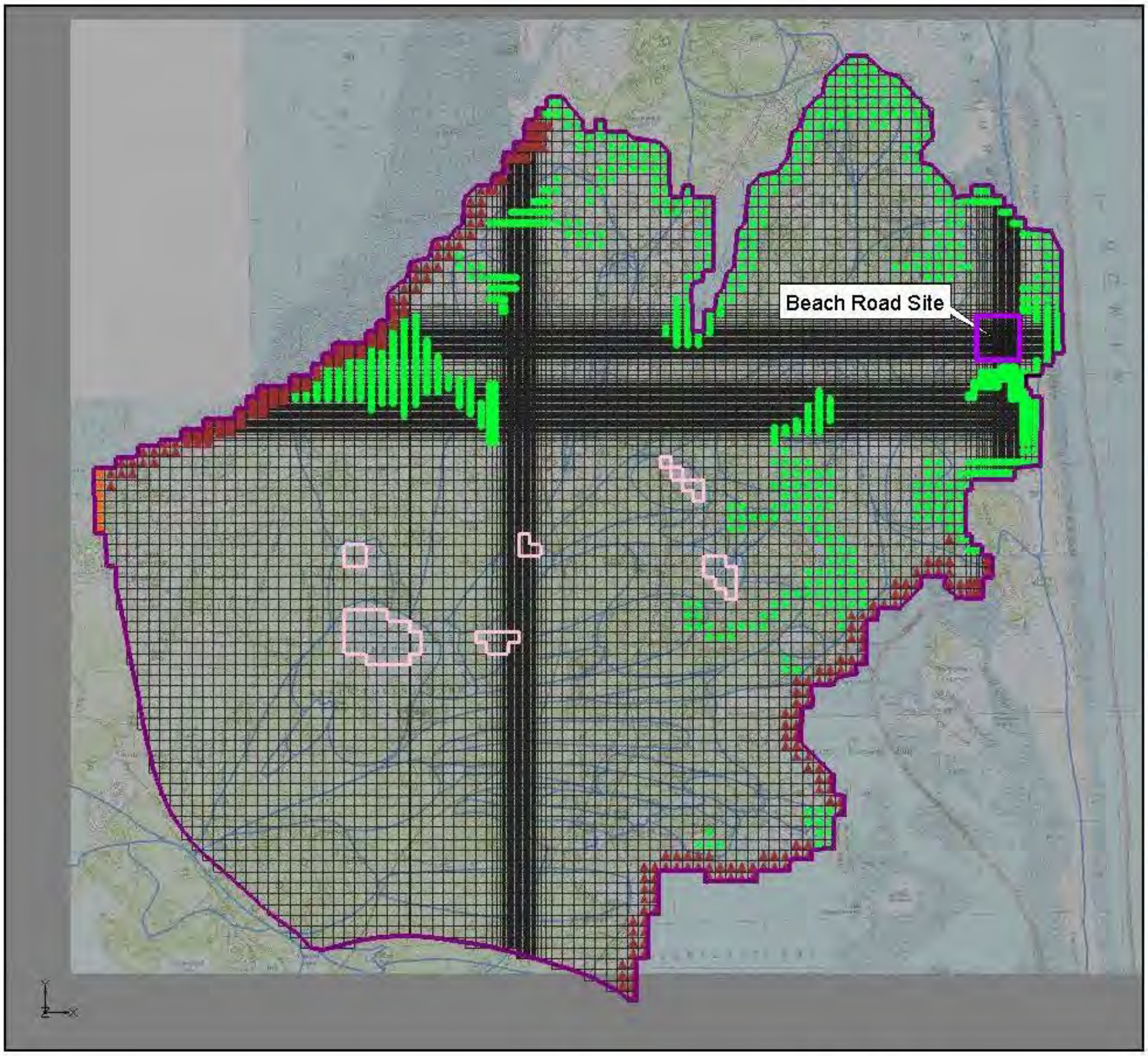

FIGURE 10

TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING

MODEL GRID AND LOCATION OF GENERAL HEAD BOUNDARIES AND DRAIN NODES

Legend

- Constant Head Boundary
- Model Drain Nodes
- General Head Boundary
- Boundary of Model Domain
- Horizontal Barrier

AECOM

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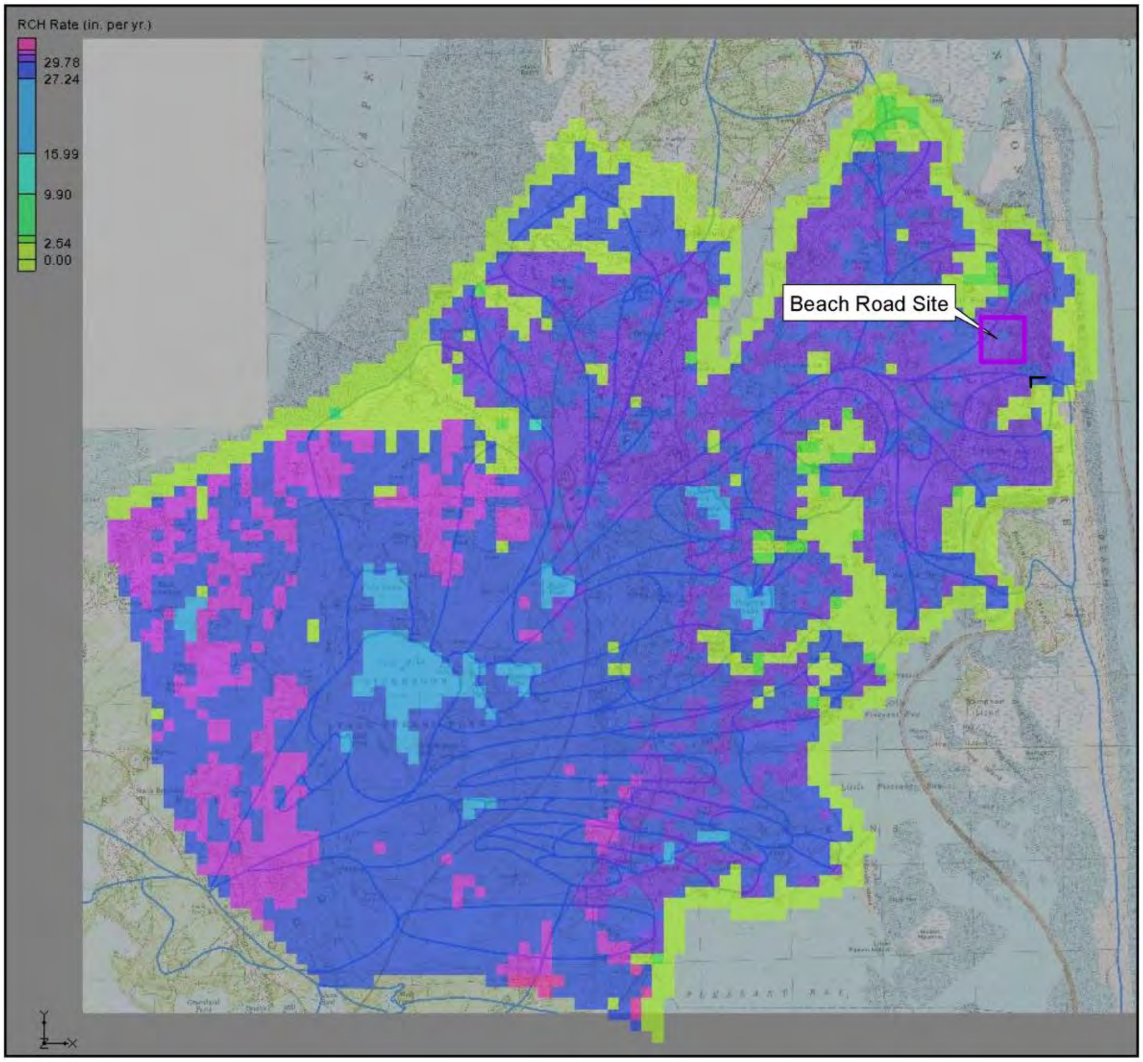

FIGURE 11

**TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING**

RECHARGE DISTRIBUTION

Legend

CH Rate (in. per yr.)

0
2.54
3.62
9.9
15.99
27.24
29.78
30.88
31.61

AECOM

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- Hydraulic conductivity values used in the USGS model ranged from 10 ft./day for sandy silts to 300 ft./day for sand and gravel deposits. The distributions of hydraulic conductivity values for layer 8 (the layer representing the water table aquifer) are shown in Figure 12. The hydraulic conductivity values for layers 7 and 8 are identical in the area of the proposed discharge. High hydraulic conductivities (50,000 ft./day) were used for lakes. AECOM's recent site investigations completed at the Beach Road Site indicated that the soils were fine- to coarse-grained sediments, resulting in hydraulic conductivity values ranging from 62 to 678 ft./day for the sand, and sand and gravel soils underlying the site. These values were consistent with the USGS model for these areas; therefore no changes to horizontal or vertical hydraulic conductivity in the updated AECOM model.

- The original USGS model included groundwater extraction consistent with water usage using the well (WEL) package. Extraction rates are summarized in Table 1-3 of Appendix 1 of the USGS (2004) report. AECOM made no changes to the well rates for the updated model domain. AECOM used the WEL package to simulate the groundwater discharge at the Beach Road site. This is discussed in the Simulations section, below.

5.3.2 AECOM Model Updates

AECOM made a number of changes to the model by to meet model objectives. They are as follows:

- AECOM converted the solver package to the PCG2 package from the LMG package based on a recommendation from the USGS in the model documentation that accompanied the model files ("…due to licensing restrictions, the USGS is no longer able to publicly distribute the Algebraic Multi-Grid (AMG) solver, on which the Link-AMG (LMG) Package relies. There are two possible solutions: 1) use a standard solver publicly available from USGS, such as SIP or PCG2 or 2) obtain the AMG/LMG solver from Fraunhofer-Institute for Algorithms and Scientific Computing (SCAI).").

- AECOM refined the grid around the Beach Road site. The USGS model used a grid size of 400 feet by 400 feet over the entire model domain. AECOM adjusted the grid to range from 50 feet by 50 feet to 400 feet by 400 feet, with the most refined portions of the model grid located in the areas of interest. This was completed to provide better resolution on the model inputs (i.e., discharge areas) and outputs.

- In refining the grid, AECOM made some model features were updated:

  - Drain cell conductances were adjusted to reflect the geometry of the grid cells.

  - General head boundary conductances were adjusted to reflect the geometry of the grid cells.

  - Horizontal flow barrier segments were added as needed to encompass the ponds/lakes in the model domain.

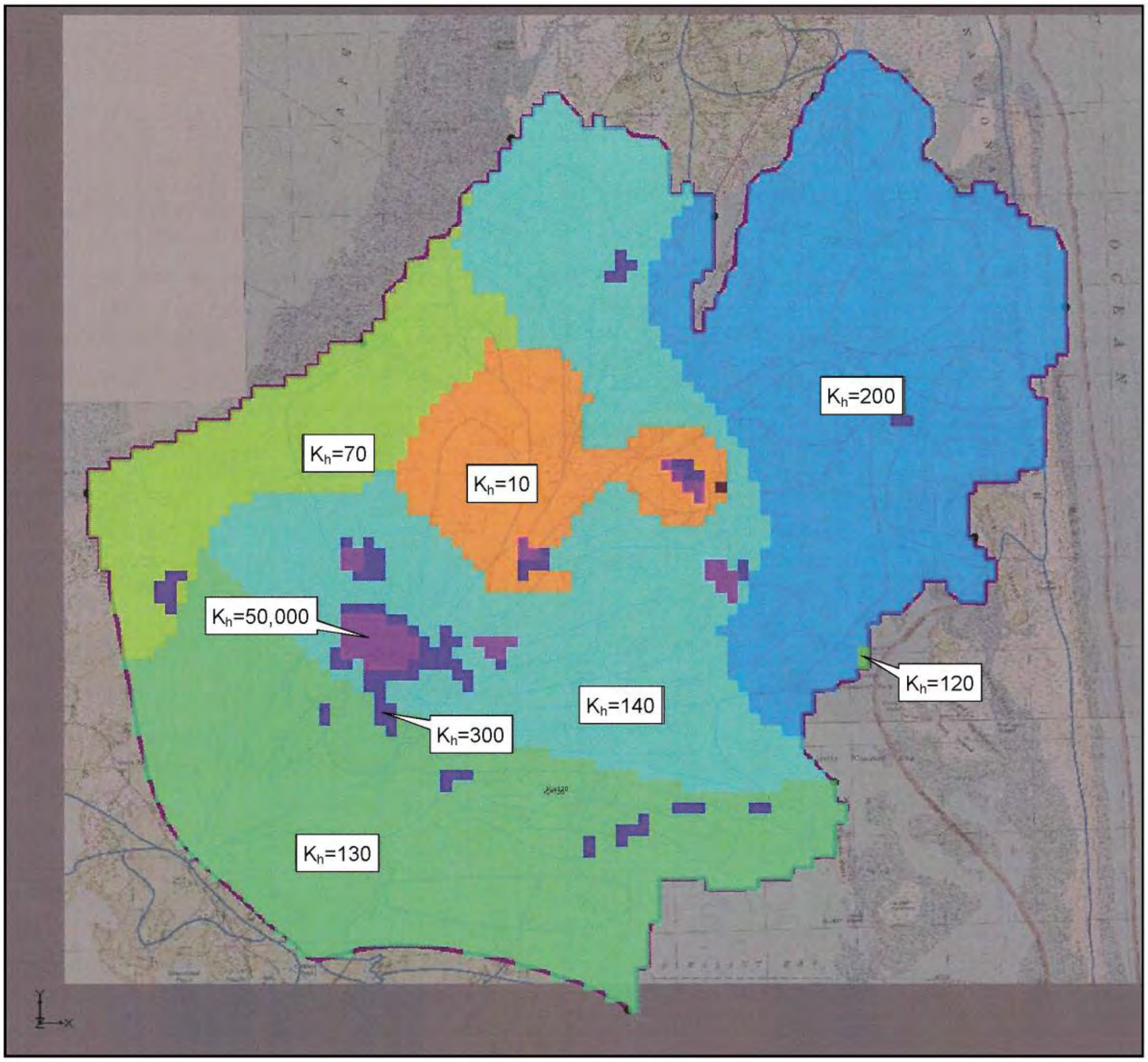

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FIGURE 12

**TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING**

HYDRAULIC CONDUCTIVITY VALUES (FT/DAY), K_h, IN MODEL LAYER 8

Legend

Boundary of Model Domain

AECOM

Figure 10 shows AECOM's updated model grid, general head boundaries and drain nodes. The distribution of recharge is shown in Figure 11. The hydraulic conductivity values used by the USGS and AECOM are shown in Figure 12.

After AECOM made the changes above, the model was verified to be an adequate representation of the original USGS model in the following ways:

- A comparison of predicted groundwater elevations was made in select cells/areas to demonstrate that AECOM's new version of the model predicted groundwater elevations similar to that predicted by the USGS model. Generally, the differences were less than 0.5 feet and lower in many instances. There are a handful of cells where AECOM model predictions are greater than 1 foot, but these are far from the areas of interest and so should not impact model predictions.

- A comparison of groundwater flow directions as demonstrated with particle tracking. Particles were seeded in select areas to verify that groundwater flow paths and divides are similar as those mapped by the USGS. Generally speaking the AECOM version of the model was the same or similar to the particle tracking under ambient conditions from the USGS version of the model.

- AECOM made a comparison of mass balance generated by the two models. More specifically, recharge, well, general head boundary, drain boundary volumes were compared to verify that the water balances were the same or similar to the USGS model. Table 4 summarizes the comparison. The percent differences on the water budget components are very small; most differences can be attributed, in part, to the regridding and resulting changes to conductances of the drain and general head boundaries.

- On March 31, 2016, groundwater levels were measured at the Beach Road monitoring wells (MW-1 through MW-4) and at three USGS wells in Orleans. An estimate of high groundwater levels at Beach Road was made based on the differences observed between high and current groundwater levels at OSW-22. These high groundwater level estimates compared favorably to the groundwater levels predicted by the model (summarized below) indicating that the model is simulating high groundwater levels. Table 5 summarizes the comparison between the calculated high water level conditions and the model simulated groundwater levels, and

- The change in model solver (from LMG to PCG2), which results in a slightly different solution.

In summary, AECOM made a number of changes to the original USGS model domain and structure to better meet the project objectives. Despite the changes, the AECOM model replicated the USGS output adequately; differences can be explained and are not expected to impact model predictions. Overall, AECOM considers this model a good tool to complete a preliminary evaluation of effluent disposal scenarios.

TABLE 4 - COMPARISON OF MASS BALANCE

	SUBSET OF REGIONAL[1]	UPDATED MODEL[2]	DIFFERENCE	% DIFFERENCE FROM ORIGINAL
IN (ft^3/day):				
CONSTANT HEAD	0.00	0.00		
WELLS	0.00	0.00		
DRAINS	0.00	0.00		
GENERAL HEAD	0.00	0.00		
RECHARGE	3,899,661.85	3,906,112.50	-6,450.64	-0.17%
STREAM LEAKAGE	0.00	NA		
OUT (ft^3/day):				
CONSTANT HEAD	0.00	0.00		
WELLS	239,703.00	239,703.00	0.00	
DRAINS	2,137,289.64	2,152,853.94	-15,564.31	-0.73%
GENERAL HEAD	1,472,953.97	1,513,555.55	-40,601.58	-2.76%
RECHARGE	0.00	0.00		
STREAM LEAKAGE	0.00	NA		

Notes:
1 - Using Zonebudget, calculated based on approximate same domain as the Updated Model
2 - Using Zonebudget.

TABLE 5 - COMPARISON OF HIGH WATER TABLE CONDITIONS

Observation Well	Groundwater Elevation (feet msl) March 31, 2016	Estimated High Water Table Elevation (feet msl)[1]	Estimated High Water Table Elevation (feet msl)[2]	Simulated Water Table Elevation (feet msl)
MW-1	2.91	4.45	4.75	4.60
MW-2	2.64	4.18	4.48	4.53
MW-3	2.57	4.11	4.41	4.42
MW-4	2.80	4.34	4.64	4.62

Notes
1. Based on the difference (1.54) between current (Mar 31, 2016) measured and historical high at OSW-22.
2. Based on the average difference (1.84) between current (Mar 31, 2016) measured and historical high at OSW-22 and BMW-21.

5.4 Model Calibration

USGS calibrated the full Monomoy Lens model and this process is described in Appendix 1 of the USGS report (2004). In accordance with our scope, AECOM verified that the calibration was maintained after the domain and grid were updated as discussed above. In summary:

- Simulated groundwater elevations from the USGS model compared favorably to the simulated groundwater elevations generated in the AECOM model.
- Simulated groundwater flow paths from the USGS model compared favorably to the simulated groundwater flow paths generated in the AECOM model.
- The water budget of the USGS model (for the area of interest) compared favorably with the water budget for the AECOM model.
- Simulated groundwater elevations compared favorably to estimates for high groundwater elevation conditions.

Overall AECOM's updated model was able to reproduce the results from the original USGS model very closely. Therefore AECOM's model was considered a good tool for conducting simulations. The results of the calibrated steady-state model output (water table levels) are shown in Figure 13. These are the simulated water levels in Layer 8 of the model.

5.5 Predictive Simulations

AECOM's calibrated groundwater flow model was used to simulate eight proposed discharge scenarios to predict groundwater mounding and the flow of mounded groundwater from the discharge sites. The Beach Road Site is proposed to be the primary discharge area for the groundwater discharge. The entire discharge from the WWTF is proposed to be discharged at this area. The reserve area would be used only if necessary.

Eight separate discharge simulations (Simulations A through H) were modeled simulated using the groundwater flow model. Each simulation scenarios assumes a different discharge rate (between 25,000 and 500,000 gpd) through subsurface leaching trenches at the site under the average ambient water-table conditions described above. The simulation results are illustrated in Figures 13 through 21.

Simulations A through H are eight scenarios simulating groundwater discharges between 25,000 and 500,000 gpd through the subsurface discharge area at the Beach Road Site.

- Simulation A – 25,000 gpd - Figure 14 shows the simulated paths of groundwater flow as determined by the particle-tracking module. The ultimate discharge points of groundwater are shown by the particle track endpoints.

  The modeling indicates that all of the groundwater will flow discharge east and discharge into the Atlantic Ocean. Based on particle tracking travel times (averaged), the model predicts that groundwater discharge will reach the Atlantic in approximately 4,600 days (range: 3,400 to 6,900 days) at the discharge rate of 25,000 gpd. Compared to the baseline conditions, the flow path distribution is slightly wider; however there are no particles that cross the watershed divide (mapped by the USGS) to the south (Figure 14). The baseline groundwater elevation near the center of the discharge area is 4.65 feet; with discharge, the groundwater elevation at the same location is 4.83 feet, indicating 0.18 feet of mound.

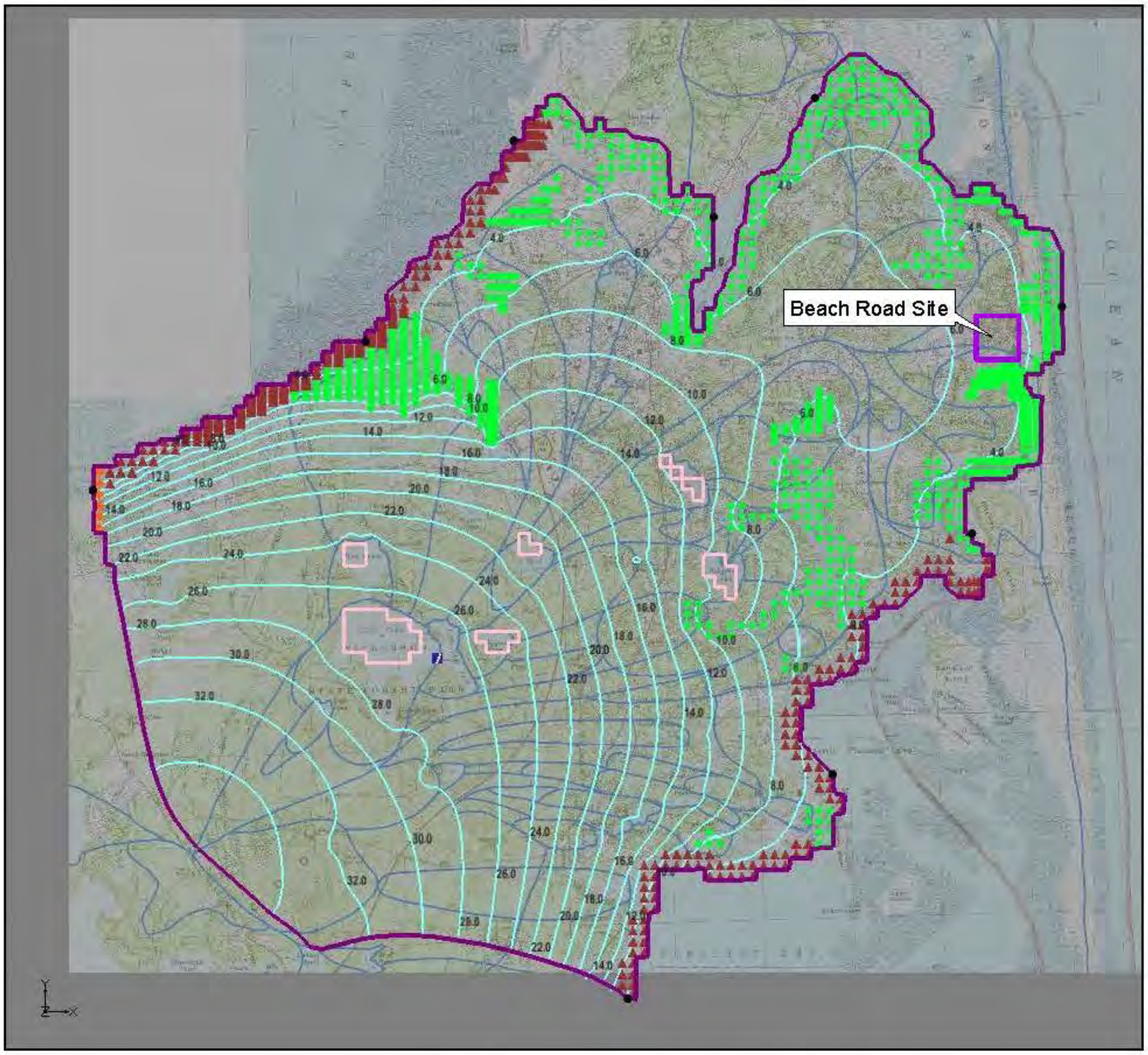

FIGURE 13

**TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING**

**MODEL RESULTS - STEADY STATE
CONTOURS AND CALIBRATION TARGETS**

Legend

- Constant Head Boundary
- Model Drain Nodes
- General Head Boundary
- Model Domain
- Watershed Boundary
- Simulated Groundwater Elevation Contours
- Horizontal Barrier

AECOM

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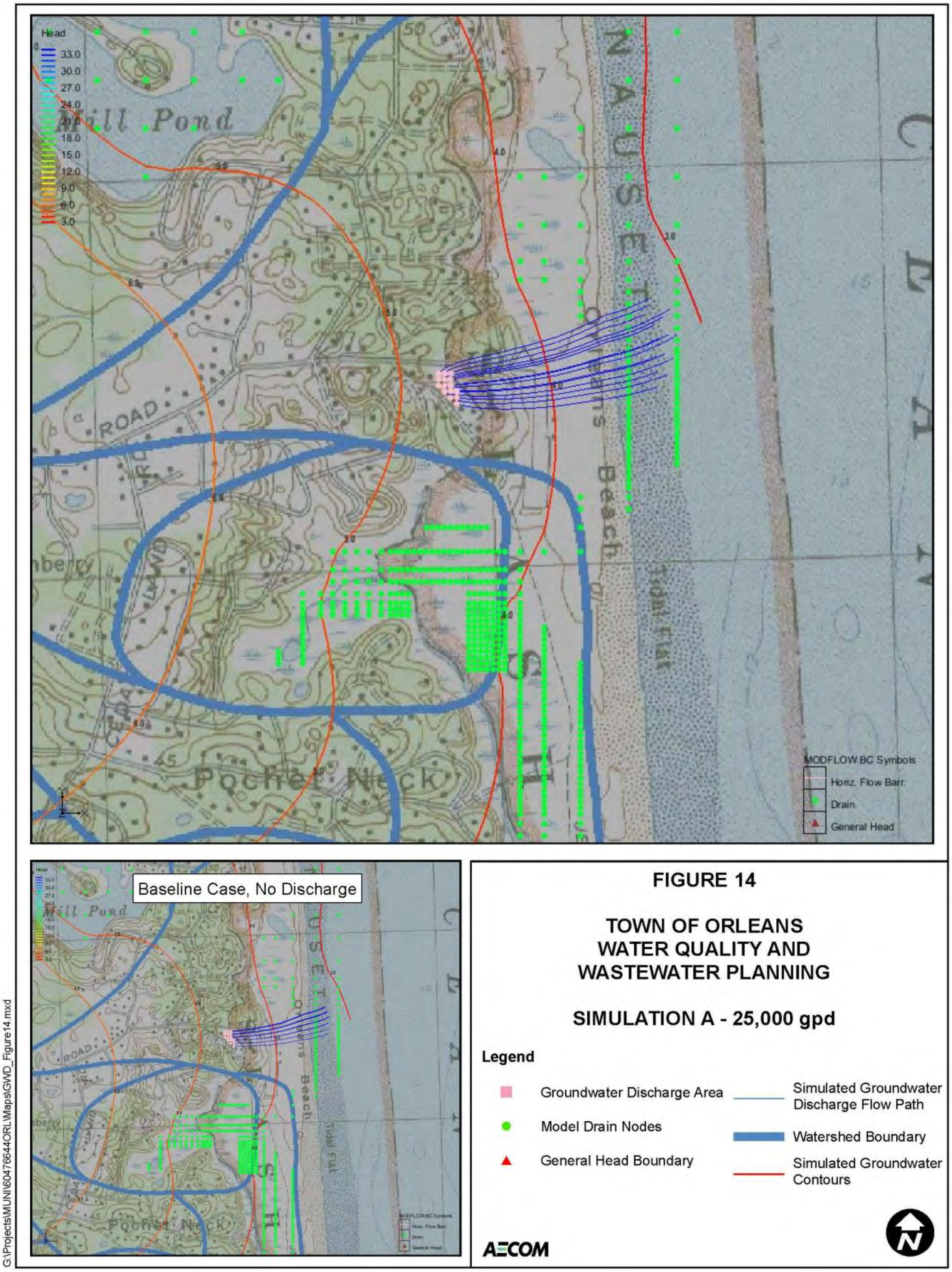


FIGURE 14

TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING

SIMULATION A - 25,000 gpd

Legend

Groundwater Discharge Area
Model Drain Nodes
General Head Boundary
Simulated Groundwater Discharge Flow Path
Watershed Boundary
Simulated Groundwater Contours

AECOM

- Simulation B – 50,000 gpd - Figure 15 shows the results of Simulation B, treated effluent discharge at a rate of 50,000 gpd. The maximum mound elevation is predicted to be approximately 5.01 feet indicating 0.36 feet of mounding above the ambient groundwater levels. The top of the mound would approximately 39 feet below ground surface.

- Simulation C – 100,000 gpd - Simulation C (Figure 16) shows the simulated paths of groundwater flow as estimated by the groundwater model. At 100,000 gpd, the model predicts that all of the groundwater will discharge along the coast east of the site into the Atlantic Ocean. The model predicts the groundwater elevation at the top of the mound to be 5.36 feet, or 0.71 feet of mounding. The estimated high groundwater condition would bring the mound less than a foot closer to the ground surface compared to high water table conditions. The overall distribution of applied groundwater spread of the discharge continues to widen (as seen by the particle path lines) when compared to the no discharge simulation as well as at lower discharge rates (Figure 16). However, the model indicates that discharge will be to the ocean. Groundwater continues to flow to the Atlantic Ocean.

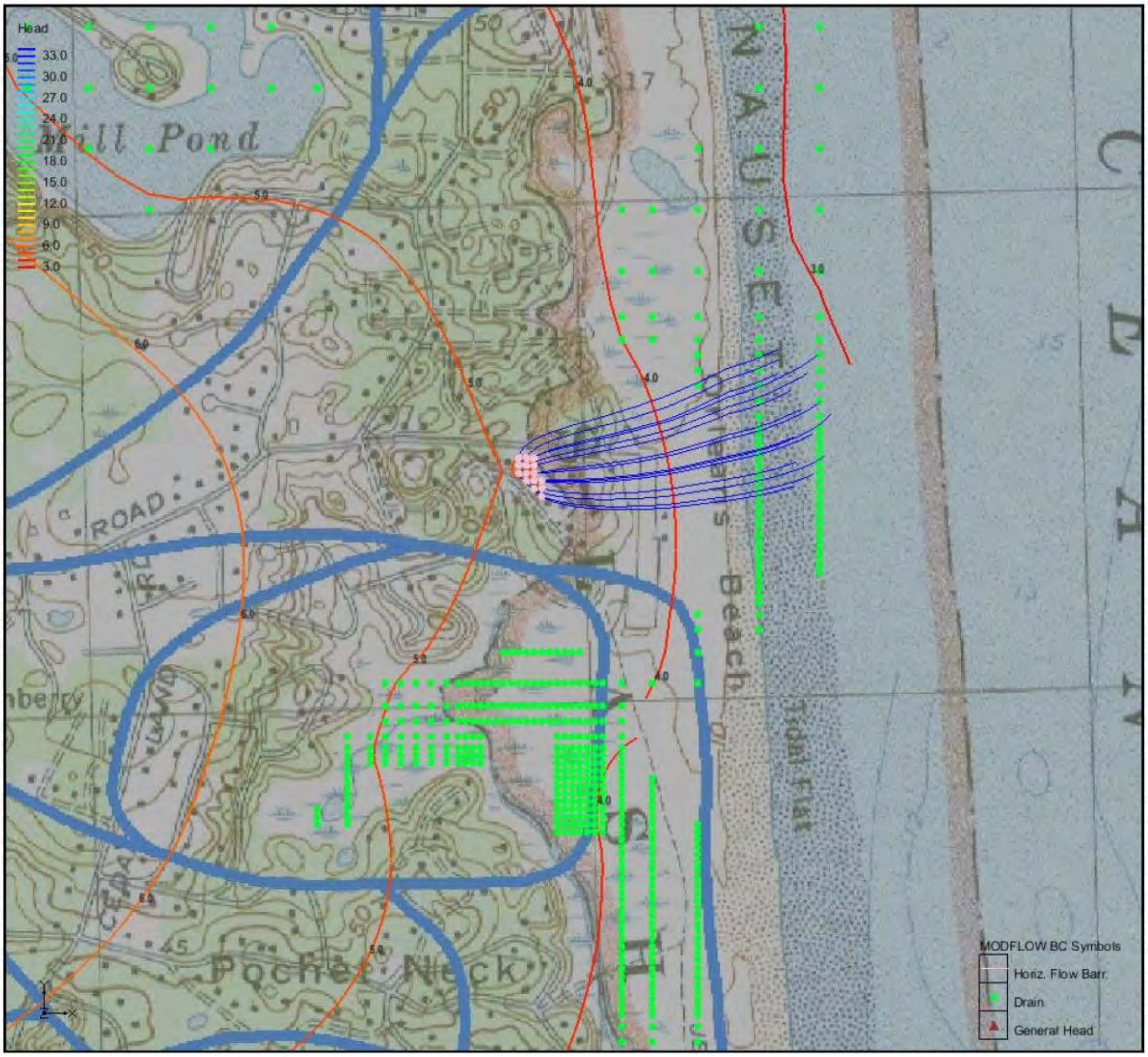
- Simulation D – 150,000 gpd - Figure 17 also shows the simulated paths of groundwater flow as determined by the particle-tracking module for a discharge rate of 150,000 gpd. The model results indicate that most of the groundwater will discharge to the Atlantic Ocean. The overall distribution of applied groundwater continues to widen (as seen by the particle path lines) when compared to the no-discharge simulation as well as at lower discharge rates (Figure 17). The groundwater elevation is 5.71 feet indicating 1.06 feet of mounding. By comparison to the 25,000 gpd discharge, the overall spread widens, but does not intersect with the divide to the south (Figure 17).

- Simulation E – 200,000 gpd - Model Simulation E, simulates a groundwater discharge of 200,000 gpd. Figure 18 shows the model results of Scenario Simulation E. The maximum mound height, directly below the discharge, is predicted to be approximately 1.41 feet above the ambient groundwater levels. This is approximately 38 feet below ground surface. MassDEP requires a four-foot separation between the bottom of the infiltration beds and the high water table.

- Simulation F – 300,000 gpd – In this simulation, a groundwater discharge of 300,000 gpd was modeled. Figure 19 shows the model results of Simulation F. The maximum mound height, directly below the discharge, is approximately 2.1 feet above the ambient groundwater levels. This is approximately 37 feet below ground surface.

- Simulation G – 400,000 gpd - In this simulation, a groundwater discharge of 400,000 gpd was modeled. Figure 20 shows the model results of Simulation G. The maximum mound height, directly below the discharge, is approximately 2.8 feet above the ambient groundwater levels. This is approximately 36.5 feet below ground surface.

- Simulation H – 500,000 gpd - In this simulation, a groundwater discharge of 500,000 gpd was modeled. Figure 21 shows the model results of Simulation H. The maximum mound height, directly below the discharge, is approximately 3.5 feet above the ambient groundwater levels. This is approximately 36 feet below ground surface.



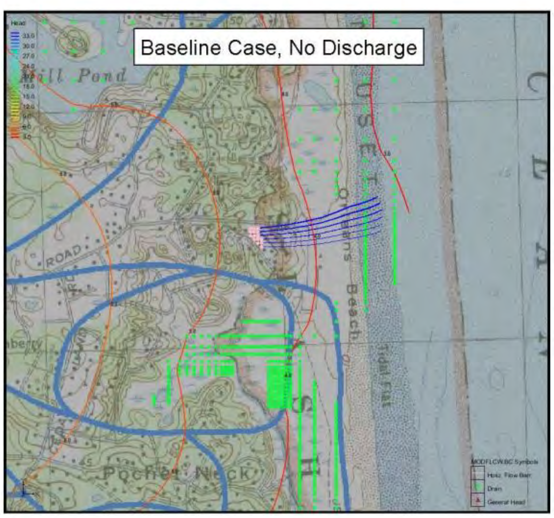


FIGURE 15

**TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING**

SIMULATION B - 50,000 gpd

Legend

- Groundwater Discharge Area
- Model Drain Nodes
- General Head Boundary
- Simulated Groundwater Discharge Flow Path
- Watershed Boundary
- Simulated Groundwater Contours

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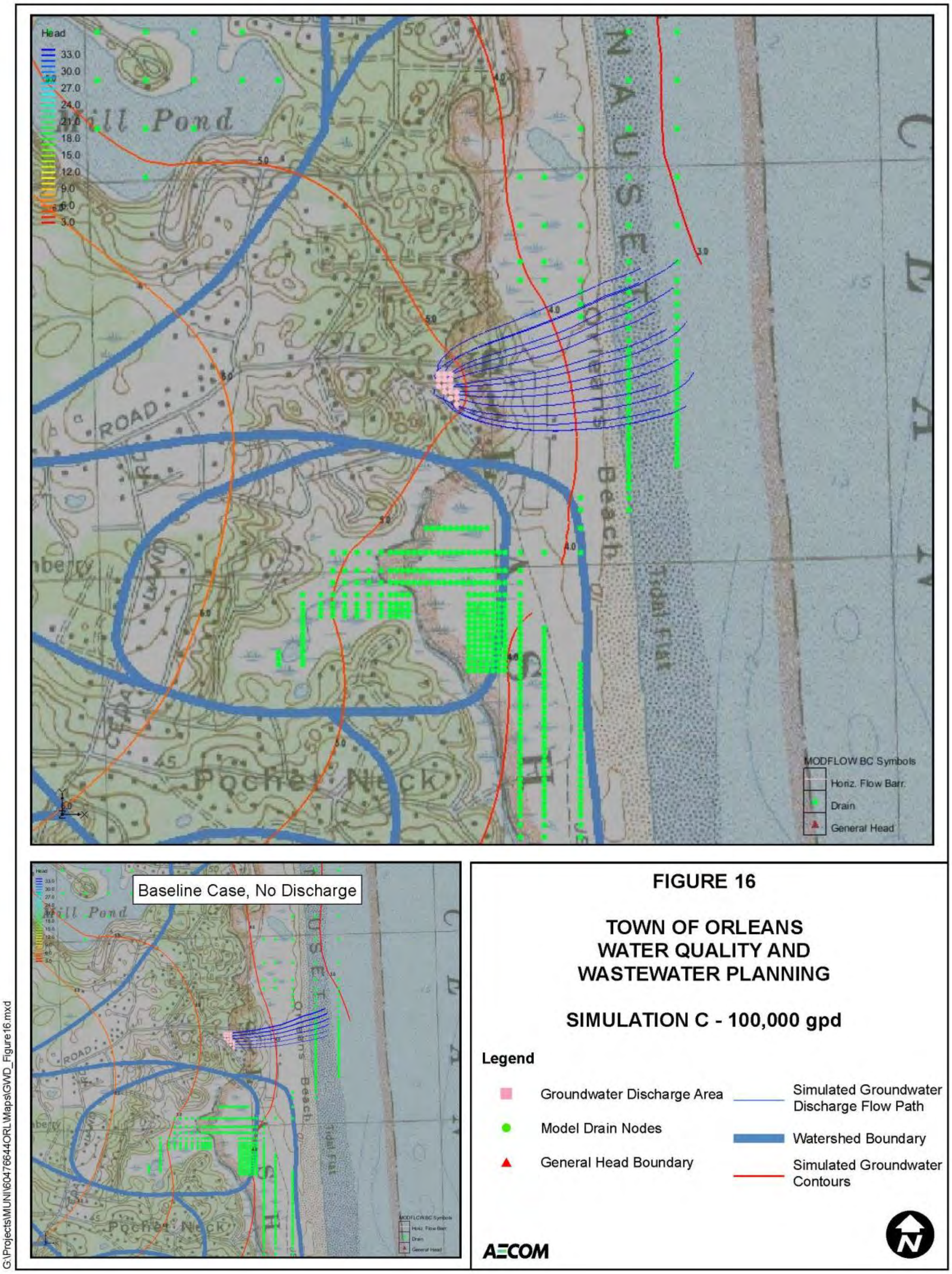

FIGURE 16

TOWN OF ORLEANS WATER QUALITY AND WASTEWATER PLANNING

SIMULATION C - 100,000 gpd

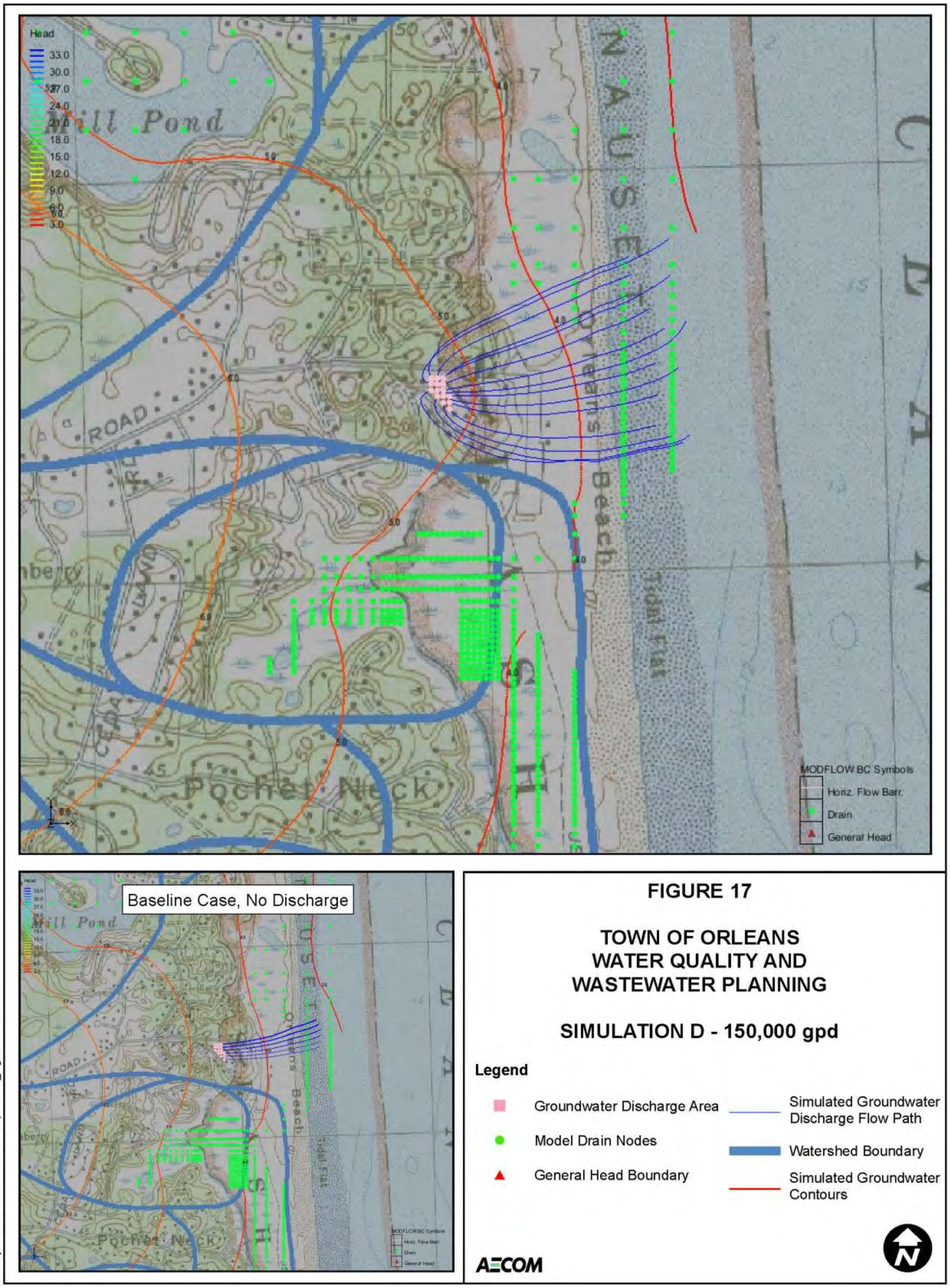

FIGURE 17

TOWN OF ORLEANS WATER QUALITY AND WASTEWATER PLANNING

SIMULATION D - 150,000 gpd

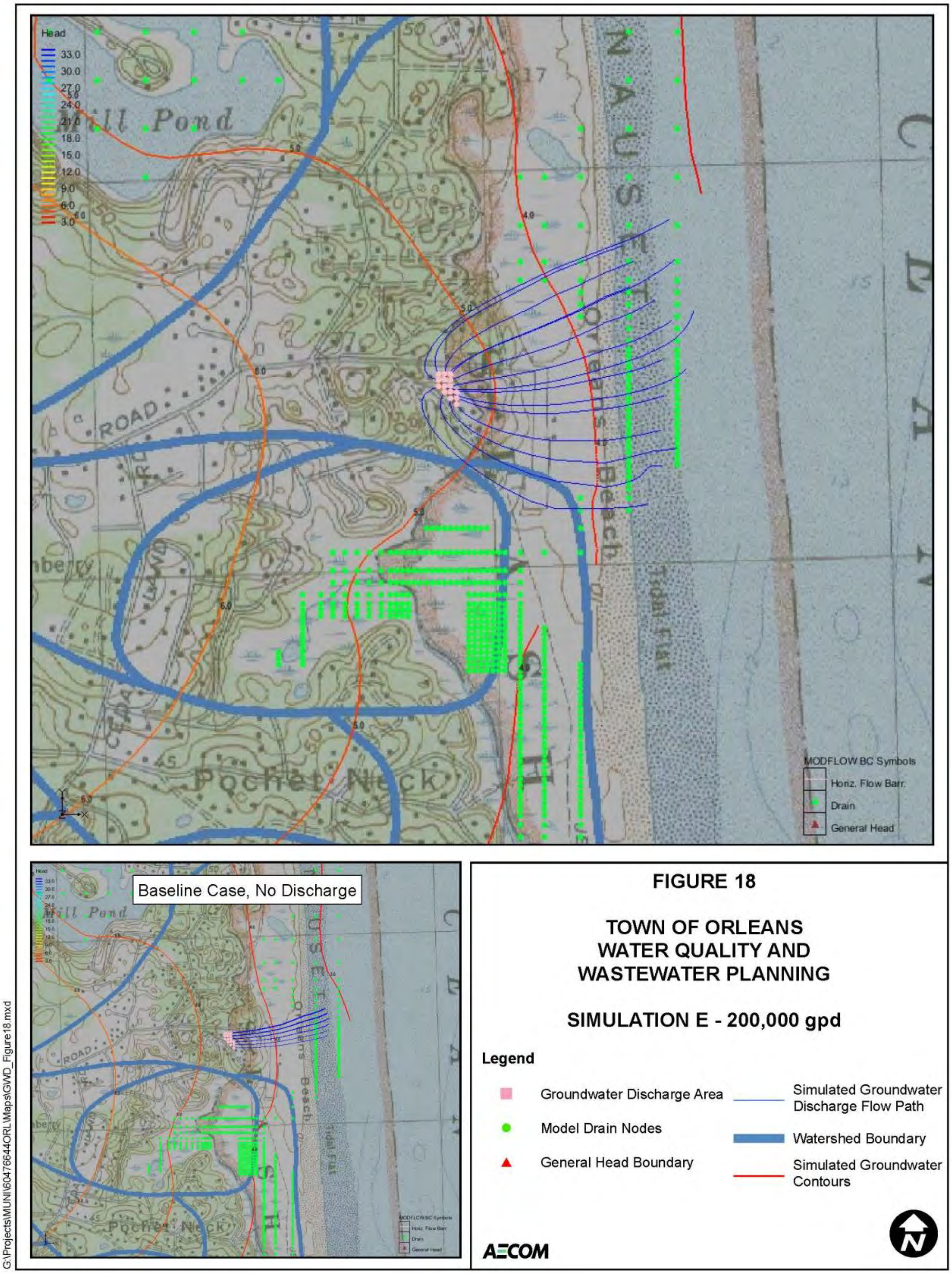

FIGURE 18

TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING

SIMULATION E - 200,000 gpd

Legend

Groundwater Discharge Area
Model Drain Nodes
General Head Boundary
Simulated Groundwater Discharge Flow Path
Watershed Boundary
Simulated Groundwater Contours

AECOM

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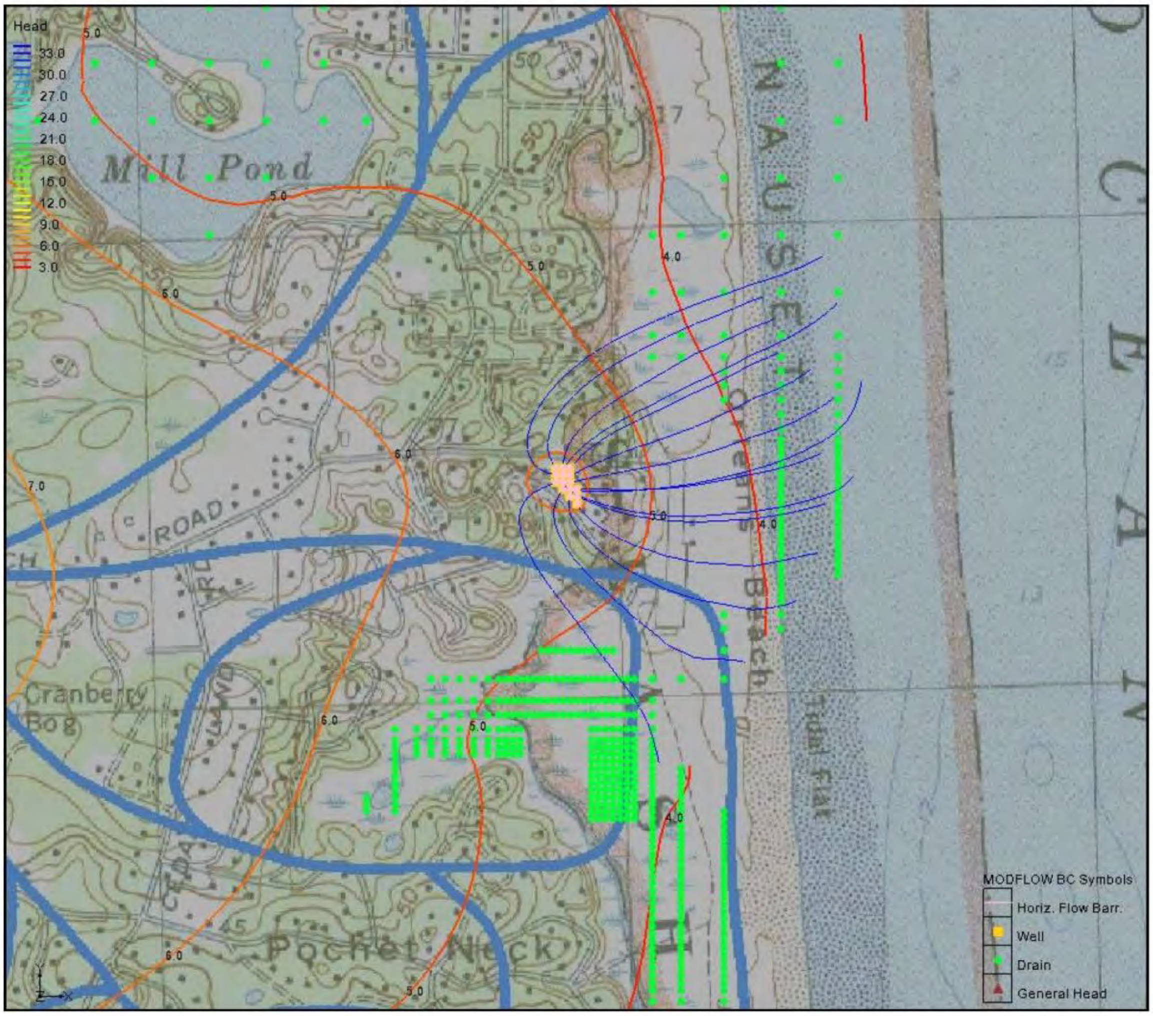

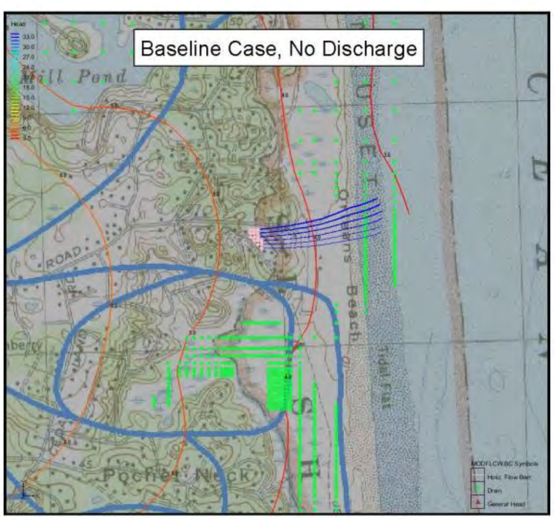

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FIGURE 19

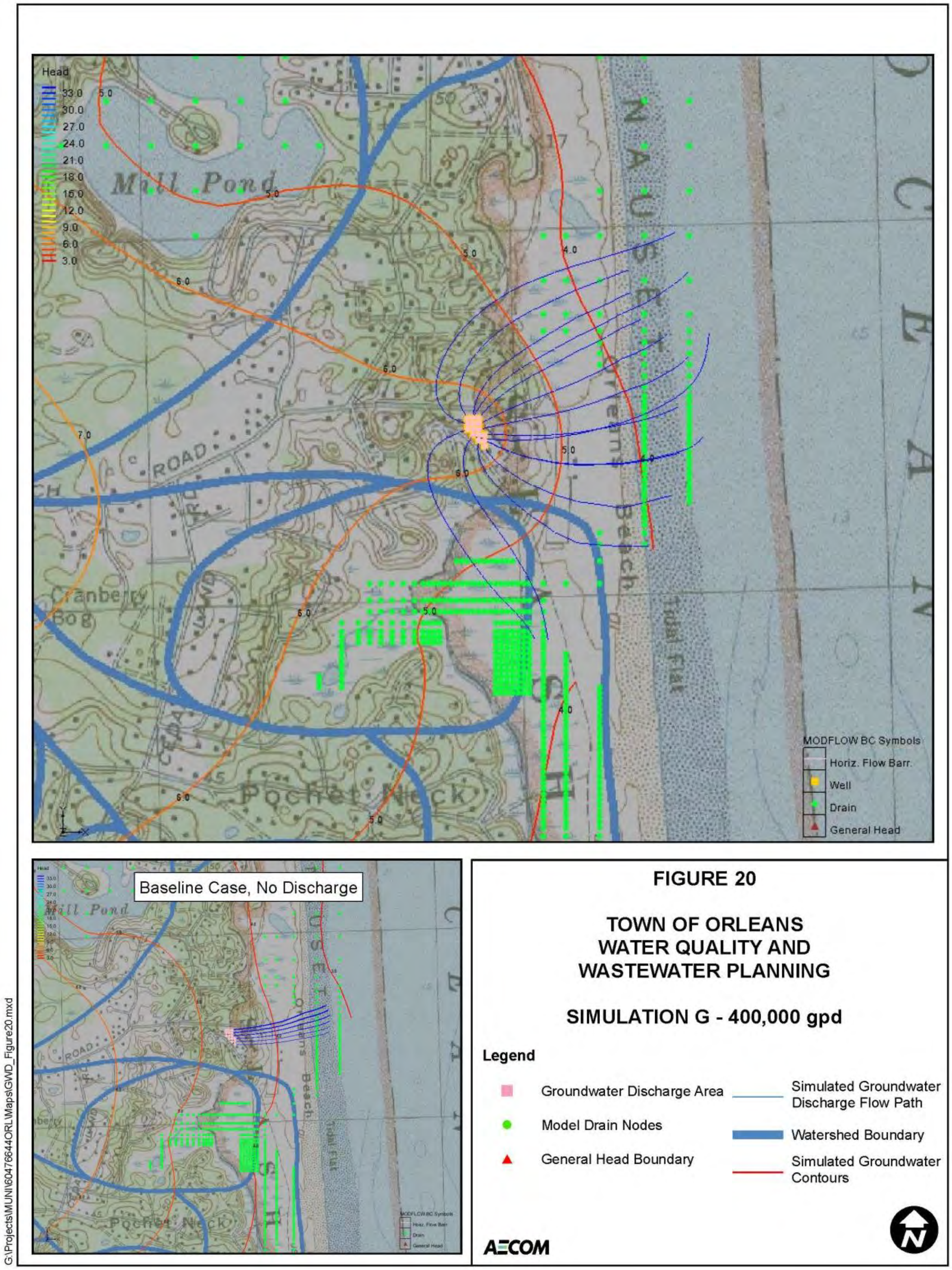
TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING

SIMULATION F - 300,000 gpd

Legend

- Groundwater Discharge Area
- Model Drain Nodes
- General Head Boundary
- Simulated Groundwater Discharge Flow Path
- Watershed Boundary
- Simulated Groundwater Contours

AECOM


Head
33.0
30.0
27.0
24.0
21.0
18.0
15.0
12.0
9.0
6.0
3.0
Mill Pond
ROAD
Cranberry Bog
Pochet Neck
NAUSET
Orleans Beach
Tidal Flat
MODFLOW BC Symbols
Horiz. Flow Barr.
Well
Drain
General Head
Baseline Case, No Discharge
FIGURE 20
TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING
SIMULATION G - 400,000 gpd
Legend
Groundwater Discharge Area
Model Drain Nodes
General Head Boundary
Simulated Groundwater Discharge Flow Path
Watershed Boundary
Simulated Groundwater Contours
AECOM
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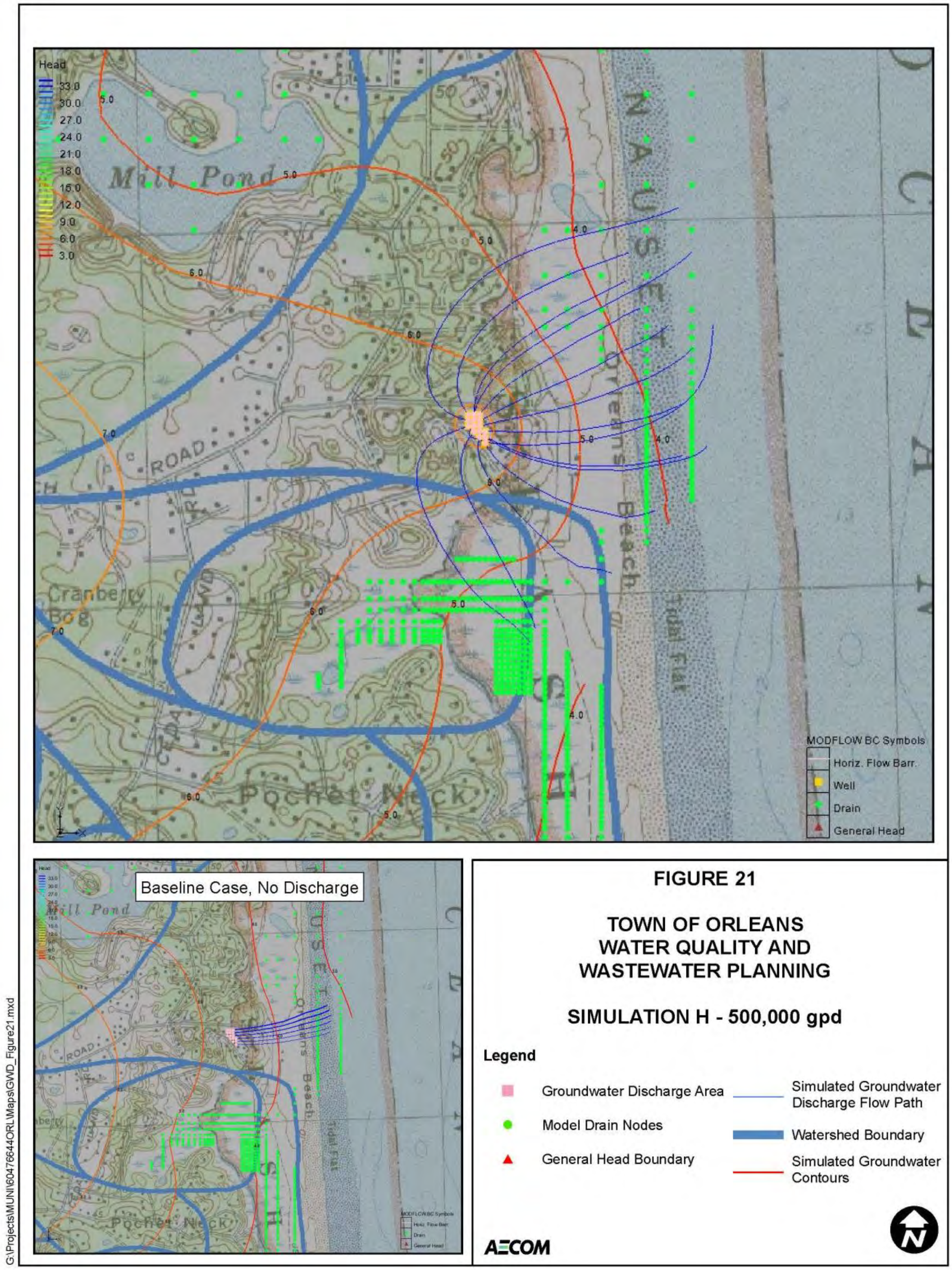

FIGURE 21

TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING

SIMULATION H - 500,000 gpd

A higher rate of discharge was not simulated. At rates of 200,000 gpd and greater, the model predicts particle tracks crossing into the Pochet Neck, a sub-estuary Pleasant Bay. Although the model indicates the discharge flow would travel under the tidal marsh and discharge to the Atlantic Ocean. However, there remains the possibility that a small portion of the discharge could end up in the nitrate sensitive estuary triggering a high level of treatment at the WWTF.

6.0 WATER QUALITY

On February 2, 2016, baseline water quality sampling was performed at the Beach Road site. Groundwater samples were collected from one up gradient (MW-4) and three (MW-1, MW-2, and MW-3) downgradient monitoring wells. The samples were submitted to a Massachusetts certified analytical laboratory for inorganic and organic analyses. In addition, in-situ water quality sampling was performed in the field using an YSI water quality meter. In general, the water quality results indicate that the groundwater quality results meet Massachusetts's drinking water quality standards. Nitrate and phosphorous levels are relatively low. Chloride levels in groundwater from Monitoring Well 1, located next to Beach Road, are slightly elevated compared to Monitoring Wells MW-2, MW-3 and MW-4. Results of the field and laboratory testing are summarized in Table 6. Copies of the laboratory reports are provided in Appendix I.

TABLE 6
SUMMARY OF LABORATORY WATER-QUALITY RESULTS

Parameter	Units	MRL	Drinking Water Standard[1]	Monitoring Well 1	Monitoring Well 2	Monitoring Well 3	Monitoring Well 4
Sample Date:				2/2/16	2/2/16	2/2/16	2/2/16
<u>Field Results:</u>							
pH	S.U.	NA	6.5-8.5[2]	5.42	5.22	6.88	5.06
Specific Conductance	µmho/cm	0	NE	532	306	298	208
Turbidity	NTU	0.25	NE	30.1	2.88	37.5	169
Temperature	^{0}C	0.01	15[2]	12.61	12.17	11.19	11.54
ORP	mV	0.1	3[2]	95.8	154.5	64.7	173.9
Dissolved Oxygen	mg/L	2.50	20[3]	10.31	10.74	8.77	11.31
<u>Laboratory Results:</u>							
Sodium	mg/L	2.50	NE	95.0	44.1	35.8	30.9
Chloride	mg/L	3.0	250[2]	140	74.4	53.1	50.5
Nitrate-N	mg/L	0.110	10	1.90	1.56	1.66	0.683
Nitrite-N	mg/L	0.010	1	ND	ND	ND	ND
Total Nitrogen	mg/L	0.30	10	1.90	1.56	1.66	0.68
Total Phosphorus as P	mg/L	0.10	NE	ND	ND	ND	ND
Ortho Phosphorus as P	mg/L	0.10	NE	ND	ND	ND	ND
VOCs	µg/L	1.0	Various	ND	ND	ND	ND

NA = not applicable	[1]Mass. Maximum Contaminant Level
ND = not detected	[2]Mass. Secondary Maximum Contaminant Level
NE = not established	[3]Mass. DEP Office Research and Standards Goal
NTU = Nephelometeric turbidity units	mg/L = milligram per liter
TON = threshold odor number	µg/L = microgram per liter
TDS = total dissolved solids	µmho/cm = micromho per centimeter
S.U. = standard units	chl. = chloroform
MRL = Minimum Reporting Limit	VOCs = Volatile Organic Compounds

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7.0 POTENTIAL IMPACTS

The potential impacts resulting from the proposed groundwater discharge fall into two general categories: 1) potential water quality impacts and 2) potential groundwater mounding impacts. Although the discharge will be treated to high levels, the discharge may contain slightly higher levels of nutrients and other constituents compared to the ambient groundwater. Potential mounding impacts include: one, the discharge of groundwater in areas where groundwater does not presently discharge, and second the rise of water levels on surrounding properties.

7.1 Potential Groundwater Mounding Impacts

The primary site of proposed discharge is at 223 Beach Road in Orleans. Based on AECOM's groundwater model simulations, groundwater mounding would not impact any structures at the Beach Road site, or any nearby properties. In general, the average or high water level elevations from groundwater mounding is insignificant compared to the surrounding ground elevations.

7.2 Potential Water Quality Impacts

Discharge from the WWTF is expected to be within water quality standards set by the state. There are no known sensitive receptors directly downgradient of the discharge with the exception of a potential private water supply well. According to Town records, the property at 9 Hubler Lane (Map 38, Parcel 16-6) has a private well on its property (Figure 22). If the well is a drinking water or irrigation supply, the Town should consider connecting the property to the public water supply as the private well may be located with the influence of the proposed discharge.

Based on the groundwater mounding analysis outlined in Chapter 5, discharges from the WWTF will generally flow east and discharge directly to the Atlantic Ocean, a waterbody with no TMDL for Nitrate. At flows between 200,000 and 300,000 gpd, the model indicates that a portion of the discharge may discharge to Pochet Neck, a sub-estuary of Pleasant Bay which has a TMDL for Nitrate. If the discharge at the Beach Road site were to exceed 200,000 gpd, mitigation measures to reduce or offset the nitrate load entering Pleasant Bay would need to be considered.


ALDEN ROAD
NAUSET HEIGHTS ROAD
NAUSET ROAD
DOANE ROAD
CALLANANS PASS
RED FOX TRAIL
MILL RACE
DEER RUN
GRANDVIEW DRIVE
HARRIS ROAD
OCEAN ROAD
ASPINET ROAD
SURF BOAT LANE
SURF PATH
BEACH ROAD
HIGH VIEW LANE
BREEZY WAY
CEDAR LAND ROAD
SAMOSET ROAD
LOVELL LANE
POCHET ROAD
SPARROWHAWK ROAD
SIBSIE LANE
SHORE VIEW DRIVE
FELLS LANE
FIGURE 22
TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING
LOCATIONS OF PRIVATE
WATER SUPPLY WELLS
Legend
Parcel with Potential Private Well
Other Parcels
Proposed Discharge Area
0
500
1,000
Feet
AECOM
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8.0 GROUNDWATER MONITORING PLAN

A groundwater monitoring plan will be implemented to assess both baseline and compliance groundwater quality in the vicinity of the proposed primary discharge. The location of the proposed monitoring wells, baseline water quality parameters and compliance water quality parameters are discussed in the following sections.

8.1 Proposed Monitoring Locations

To date, four monitoring wells (MW-1, MW-2, MW-3, and MW-4) have been installed and sampled as part of the hydrogeologic investigation. The location of the proposed discharge and monitoring wells are shown on Figure 23. Three additional monitoring wells are being proposed for compliance monitoring. The wells will be installed and sampled for baseline water quality before the WWTF becomes operational. The well locations are shown on Figure 23 and labeled as MW-5, MW-6, and MW-7. If any of these existing wells is destroyed during construction of the discharge, a new monitoring well will be installed. Details of the monitoring well installation, groundwater sampling and laboratory analysis are discussed in the following sections. The replacement monitoring well will be installed as outlined in Section 8.4.

8.2 Baseline Water Quality

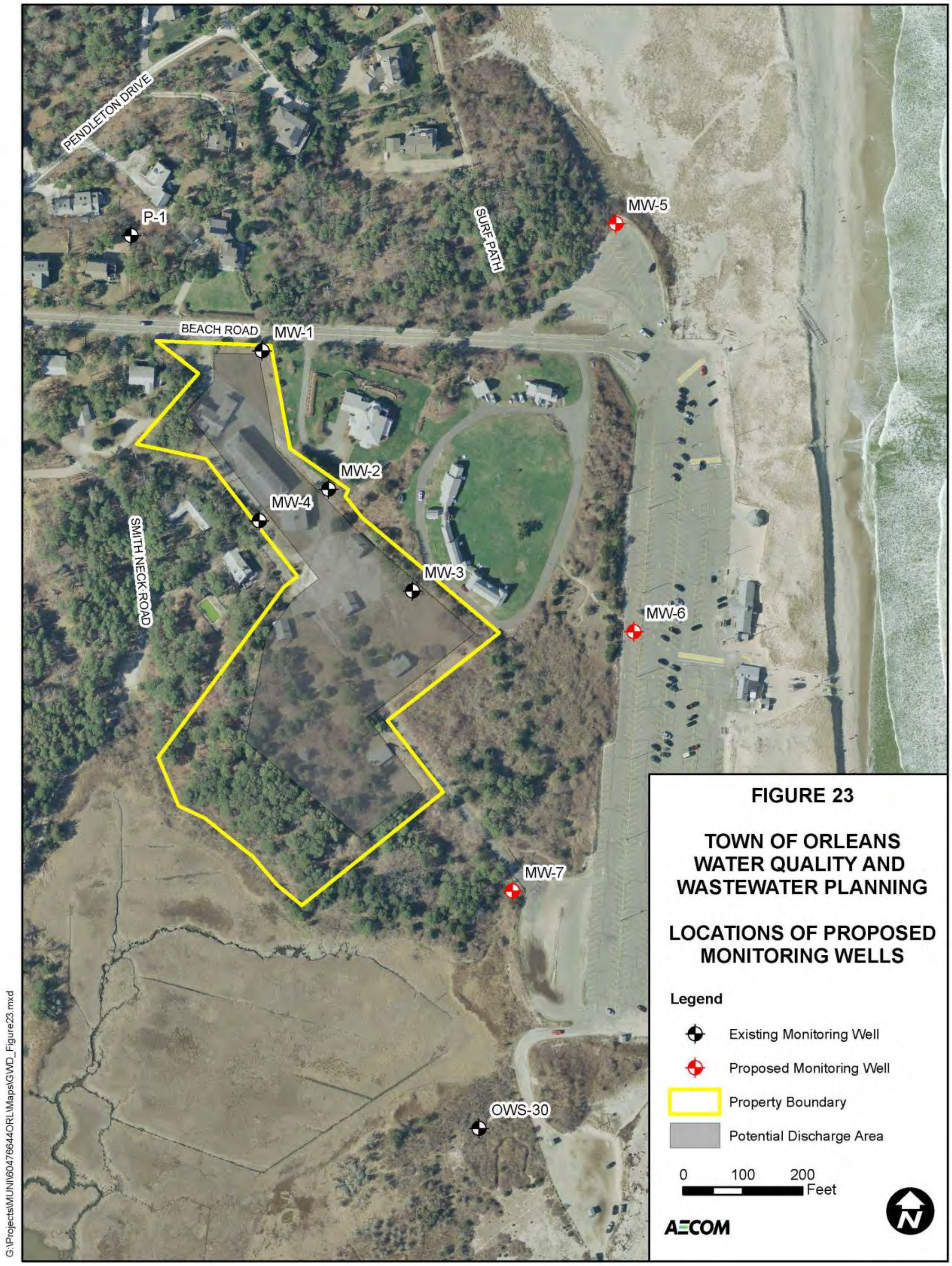
An initial round of water level data and groundwater samples was collected from the proposed monitoring wells in January of 2016. A summary of the field and laboratory results is provided in Section 4.0. Prior to discharging effluent (Figure 23) two rounds of groundwater samples will be collected at monitoring well locations MW-1, MW-2, MW-3, and MW-4 and sent to a laboratory for analysis. Water samples will be analyzed in the field for temperature, pH and specific conductance. Groundwater samples collected from each of the monitoring wells will also be sent to a MassDEP certified laboratory for analysis. At a minimum, laboratory analysis will include nitrate-nitrogen, total nitrogen, total phosphorus, sodium, and volatile organic compounds (VOCs). Groundwater sampling will be conducted in accordance with MassDEP's "Standard References for Monitoring Wells". A round of water levels will also be collected at the time of sampling. The water level data and water quality results will be summarized and submitted to the MassDEP for review.

8.3 Compliance Monitoring

Once the WWTF is operational, groundwater samples will be collected and analyzed to demonstrate that the groundwater quality meets the standards set by MassDEP. Groundwater monitoring will be performed at the six monitoring well locations (MW-1, MW-2, MW-3, MW-4, MW-5, MW-6 AND MW-7) outlined above. The proposed sampling frequency and parameters are as follows:

- Monthly Sampling – Water quality analysis for pH and conductivity will be analyzed on a monthly basis. In addition, a round of water levels will be collected and recorded.

- Quarterly Sampling – In addition to the monthly sampling, total nitrogen, total phosphorus, nitrate-nitrogen, sodium and fecal coliform will be sampled and analyzed quarterly.


PENDLETON DRIVE
P-1
SURF PATH
MW-5
BEACH ROAD
MW-1
MW-2
MW-4
SMITH NECK ROAD
MW-3
MW-6
MW-7
OWS-30
FIGURE 23
TOWN OF ORLEANS
WATER QUALITY AND
WASTEWATER PLANNING
LOCATIONS OF PROPOSED
MONITORING WELLS
Legend
Existing Monitoring Well
Proposed Monitoring Well
Property Boundary
Potential Discharge Area
0 100 200
Feet
AECOM
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- Twice Annual Sampling. In addition to the monthly and quarterly sampling, VOCs will be sampled and analyzed twice annually.

- Groundwater samples collected during each round will be sent to a MassDEP certified laboratory for analysis. Groundwater sampling will be conducted in accordance with MassDEP's "Standard References for Monitoring Wells". After each round of sampling, the water level data and water quality results will be summarized and submitted to the MassDEP for review.

8.4 Replacement Monitoring Well Installation

Should any of the monitoring wells become damaged or need to be replaced, the MassDEP will be notified prior to replacing the well. The installation of the replacement well(s) will be as follows.

For each replacement well, one soil boring will be drilled to a depth of approximately 10 to 15 feet below the water table. At a minimum, split spoon samples will be collected every five feet to the total depth of the boring. The soil borings will be drilled in accordance with MassDEP's "Standard References for Monitoring Wells".

Once the soil boring is completed, a single monitoring well with ten feet of 10-slot well screen will be installed. The bottom of the well screen will be installed approximately 15 feet below the water table. The two-inch diameter PVC monitoring wells will be installed and developed in accordance with MassDEP's "Standard References for Monitoring Wells".

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9.0 ESTIMATED COSTS OF GROUNDWATER DISPOSAL FACILITIES

Estimated costs for groundwater discharge facilities are provided in the following section. Two discharge methods were considered. Both subsurface and wick discharges were evaluated. Open bed discharge was not considered as this method of discharge would not be in line with the Town's plans to develop the site as area parking for Nauset Beach area. A summary of the discharge methods and estimated costs to permit, install and operate is discussed in the following sections.

9.1 Subsurface Groundwater Discharge – Estimated Costs

At a discharge rate of 100,000 gpd, approximately 35,000 to 50,000 square feet of discharge area would be required based on the design of the subsurface discharge. Based on the hydrogeologic investigation at the site, it is expected that 5 to 15 feet of the finer soils near the surface would need to be remove and replaced with Title 5 Sand. An alternative would be to discharge at a lower rate over a larger footprint.

Estimated costs for 35,000 to 50,000 square feet of subsurface leaching trenches are in the range of $700,000 to $1,000,000. These costs only include installation of the subsurface leaching trenches. Refer to able 7. Design of the discharge facilities, demolition of existing buildings, design and installation of the force main from the WWTF to the Beach Road Site, Title 5 sand, construction oversight, and contingencies are not included.

9.2 Wick Discharge – Estimated Costs

A wick is a vertical subsurface structure constructed for the purpose of transporting highly treated effluent to groundwater. A wick is basically a large diameter borehole filled with pea stone or gravel. The highly treated effluent is discharged into the wick just below the ground surface, allowing the treated effluent to flow over the stone to the underlying groundwater. Typically, a minimum depth of 20 to 30 feet to the water table is required.

The concept of a wick is similar to conventional effluent disposal systems where the wick applies the discharge vertically instead of horizontally. The component that is common to both is the receiving groundwater system, which must be capable of receiving and transporting the effluent that is applied to it. The wick is merely the means of transporting the highly treated effluent from the surface and dispersing it into the groundwater.

A wick is installed in much the same way as a well. A borehole is excavated and casing is installed to the entire depth of the proposed wick. Once the total depth of the wick has been excavated, the borehole is backfilled with pea stone. The casing is then pulled back to expose the stone to the surrounding formation. When completed, effluent is piped to the top of the wick for gravity discharge into the wick. The entire top of the wick is to be enclosed in a precast concrete structure to protect it from the elements. At this time, it is anticipated that a total of three to five wicks would be installed within the primary discharge area at the site.

Wicks similar to the ones that would be proposed for the Beach Road site have been installed, tested, and used at Linden Ponds Retirement Community in Hingham, Massachusetts. These wicks have been in use for approximately 12 years, have performed well and remain in use today. In general, as with conventional subsurface disposal systems, wick applications require certain favorable hydrogeologic conditions relative to subsurface conditions and depths to water tables; as described herein, the Beach Road site provides such favorable conditions.

To demonstrate that a wick is a viable discharge option, a test wick will need to be installed and tested on the Beach Road Site within the proposed primary discharge area. Wick loading test results, analysis and conclusions would need to be submitted as part of the Hydrogeologic Evaluation submitted to MassDEP. The wick installation and loading test is required for all proposed wick installations.

The Beach Road site provides sufficient area for the reserve discharge for the wicks. The reserve discharge area would be located adjacent to the wicks and within the discharge area identified in Figure 4. The proposed method of discharge in the reserve areas would be through subsurface groundwater discharge leaching trenches.

Costs for the installation of a wick discharge range from $625,000 to $800,000 for three to four wicks. The estimated costs include performing the detailed hydrogeologic evaluation required by MassDEP for wick discharges, but do not include the design of the discharge facilities, demolition of existing buildings, design and installation of the force main from the WWTF to the Beach Road Site, construction oversight, and contingencies are not included.

Advantages of the wick discharge over subsurface leaching trenches are: one, the finer surficial soils would not have to be removed and replaced with Title 5 sands, and second the existing buildings could remain.

Table 7 - Subsurface Groundwater Discharge – Estimated Costs

Town of Orleans, MA
FY 2016 Water Quality and Wastewater Planning
Estimated Capital Costs
Effluent Disposal - Meetinghouse Pond (223 Beach Road)

Components	Quantity	Unit	Unit Cost	Extended Total	Remarks/Notes
Mobilization and Demobilization	1	LS	$ 27,500	$ 27,500	5% of Other Items
Effluent Disposal - Subsuface	1	L.S.	$ 550,000	$ 550,000	Based on Fruit Street WWTF As-Bid Costs
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
Subtotal				$ 577,500	
Overhead and Profit			22.0%	$ 127,100	
Subtotal				$ 704,600	
Contingency			25.0%	$ 176,200	
Construction Total				$ 880,800	
Town Administration and Engineering					
Town Administration			5.0%	$ 44,000	
Engineering - Planning/Consultation			5.0%	$ 44,000	
Engineering - Design			10.0%	$ 88,100	
Engineering - Construction			15.0%	$ 132,100	
Total Estimated Project Cost				**$ 1,189,000**	Engineering News Record (ENR) = 10182 (Feb. 2016)

Town of Orleans, MA
FY 2016 Water Quality and Wastewater Planning
Estimated Annual Operation and Maintenance Costs
Effluent Disposal - Meetinghouse Pond (223 Beach Road)

Components	Quantity	Unit	Unit Cost	Extended Total	Remarks/Notes
Allowance for Miscellaneous Maintenance	1	Allow.	$ 10,000	$ 10,000	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
Subtotal				$ 10,000	
Contingency			10.0%	$ 1,000	
Subtotal				$ 11,000	
Town Administration and Engineering					
Town Administration			3.0%	$ 300	
Engineering - Planning/Consultation			0.0%	$ -	
Engineering - Design			0.0%	$ -	
Engineering - Construction			0.0%	$ -	
Total Estimated Annual Operation and Maintenance Costs				**$ 11,300**	Engineering News Record (ENR) = 10182 (Feb. 2016)

Town of Orleans, MA
FY 2016 Water Quality and Wastewater Planning
Estimated Replacement Costs
Effluent Disposal - Meetinghouse Pond (223 Beach Road)

Components	Quantity	Unit	Unit Cost	Extended Total	Remarks/Notes
Mobilization and Demobilization	1	LS	$ -	$ -	5% of Other Items
	-		$ -	$ -	No replacement costs over 20 year planning period
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
Subtotal				$ -	
Overhead and Profit			22.0%	$ -	
Subtotal				$ -	
Contingency			25.0%	$ -	
Construction Total				$ -	
Town Administration and Engineering					
Town Administration			3.0%	$ -	
Engineering - Planning/Consultation			0.0%	$ -	
Engineering - Design			10.0%	$ -	
Engineering - Construction			15.0%	$ -	
Total Estimated Replacement Cost				**$ -**	Engineering News Record (ENR) = 10182 (Feb. 2016)

Town of Orleans, MA
FY 2016 Water Quality and Wastewater Planning
Estimated Annual Monitoring Costs
Effluent Disposal - Meetinghouse Pond (223 Beach Road)

Components	Quantity	Unit	Unit Cost	Extended Total	Remarks/Notes
Sampling per GWDP - Quarterly (6 wells)	12	Hrs.	$ 65	$ 800	
Analysis per GWDP - Quarterly (6 wells)	24	Ea.	$ 200	$ 4,800	Static Water Level; Specific Conductance: pH; Total Nitrogen (NO2+NO3+TKN); Nitrate Nitrogen; Total Phosphorous; and Orthophosphate
Sampling per GWDP - Annually (6 wells)	4	Hrs.	$ 65	$ 300	
Analysis per GWDP - Annually (6 wells)	6	Ea.	$ 100	$ 600	Volatile Organic Compounds
Miscellaneous Coordination, Calibration, etc.	40	Hrs.	$ 65	$ 2,600	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
	-		$ -	$ -	
Subtotal				$ 9,100	
Contingency			10.0%	$ 900	
Subtotal				$ 10,000	
Town Administration and Engineering					
Town Administration			5.0%	$ 500	
Engineering - Planning/Consultation			3.0%	$ 300	
Engineering - Design			0.0%	$ -	
Engineering - Construction			0.0%	$ -	
Total Estimated Annual Monitoring Costs				**$ 10,800**	Engineering News Record (ENR) = 10182 (Feb. 2016)

10.0 REFERENCES

Anderson, M.P. and W.W. Woessner, 1992, Applied Groundwater Modeling, Academic Press, Inc., San Diego, California.

Carman, 1937, "Fluid flow through granular beds." Transactions, Institution of Chemical Engineers, London, 15: 150-166,.

Carman, 1956. "Flow of gases through porous media." Butterworths, London.

Frimpter, M.H., 1980, “Probable High Ground-Water Levels in Massachusetts,” U.S. Geological Survey Water Resource Investigations 80-1205.

Guswa, J.H., and LeBlanc, D.R., 1985, Digital models of ground-water flow in the Cape Cod aquifer system, Massachusetts: U.S. Geological Survey Water-Supply Paper 2209, 112 p

Hazen, A., 1892, Experiments upon the Purification of Sewage and Water at the Lawrence Experiment Station, Massachusetts State Board of Health 23rd Annual Report.

Koteff, C., and Cotton, J.E., 1962, Preliminary Results of Recent Deep Drilling on Cape Cod Massachusetts, Science, v. 137, no. 2523, p. 34.

Kozeny, J., 1927, "Ueber kapillare Leitung des Wassers im Boden." Sitzungsber Akad. Wiss., Wien, 136(2a): 271-306.

McDonald, M.G. and A.W. Harbaugh, 1988, "A Modular Three-Dimensional Finite Difference Groundwater Flow Model", Techniques of Water Resources Investigations 06-Al, USGS.

Oldale, R. N., Carl Koteff, and J. H. Hartshorn, 1971, Geologic Map of the Orleans Quadrangle, Barnstable County, Cape Cod, Massachusetts”, GQ-931, U. S. Geological Survey.

Odong, Justine, 2007, Evaluation of Empirical Formulae for Determination of Hydraulic Conductivity based on Grain-Size Analysis, Journal of American Science, 3(3).

Poeter, E.P and M.C. Hill, 1998, “Documentation of UCODE, A Computer Code for Universal Inverse Modeling,” U.S. Geological Survey Water Resources Investigations Report 98-4080.

Pollock, D.W., 1994, User's Guide for MODPATH/MODPATH-PLOT, Version 3: A particle tracking post-processing package for MODFLOW, the U.S. Geological Survey finite-difference ground-water flow model: U.S. Geological Survey Open-File Report 94-464, 234 p.

Randall, A.D., 1996, “Mean Annual Runoff, Precipitation and Evapotranspiration in the Glaciated Northeastern United States, 1951-1980,” U.S. Geological Survey, Open File Report, OFR 96-395.

Shepherd, R.G. 1989, Correlations of permeability and grain size. Ground Water 27 (5), 633-638.

Salarashayeri, A. F., and Siosemarde, M., 2012, Prediction of Soil Hydraulic Conductivity for Particle-Size Distribution”, International Journal of Environmental, Chemical, Ecological, Geological and Geophysical Engineering, Vol. 6, No. 1.

Wang, T., Huang, Y. Chen, X., and Chen, X., February 2015, Using Grainsize Distribution Methods for Estimation of Air Permeability, Groundwater, NGWA Press, 1 – 12 p.

Woodworth, J. B. and Wigglesworth, Edward, 1934, Geography and Geology of the Region including Cape Cod, the Elizabeth Islands, Nantucket, Martha's Vineyard, No Mans Land, and Block Island: Harvard Coll. Mus. Comp. Zoology Mem. v.52, 322 p.

Appendix A

Non Traditional Technology – Technical Memorandum

General Comments or Notes from Chatham Shellfish Propagation and AECOM Shellfish Team Responses (in red) provided below.

Thank you for providing your comments and suggestions to the Technical Memorandum, we appreciate your input to this process.

GENERAL RESPONSE: Please also read our response to the comments from Cape Cod Cooperative Extension. Here, we explain in greater detail why the specifics of a demonstration project design are going to be the subject of the next Technical Memorandum, entitled “Preliminary Engineering and Design Work Plan”. We will also note in the Purpose section of the Final Site Characterization and Evaluation Technical Memorandum that preliminary engineering and design are addressed in a subsequent Technical Memorandum.

1. After reading the general AECOM memo for the Orleans Water Project here are a few comments or notes that came to light from the standpoint of Shellfish Propagation in a neighboring town. At no point in the memo was quantity or numbers discussed which makes use of gear and feasibility hard to judge as a realistic project. Growing 30,000 shellfish is very different and often requires different methods than growing 3,000,000.

   RESPONSE: The purpose of this Tech Memo is to characterize the sites for demonstration projects. This is not the design and monitoring plan for a demonstration, which is the subject of the next Tech Memo.

2. Setting that aside one of the major discussions missing from the memo was any discussion of predators or disease with the exception of a mention of oyster drills in Town Cove. Other predators and disease exist in these systems and water bodies and their absence or presence often dictates the methods used for growth. Predators such as, green crabs, blue crabs, starfish, moon snails to name a few are all present in these bodies of water and protection methods are needed in order to produce viable shellfish. Disease has also been known to be present and Best Management Practices are needed in order to minimize the chance of disease or spread.

   RESPONSE: We agree with your comment and the site engineering and the monitoring plans will include in detail the need for baseline studies and monitoring of disease and predation

3. The use of floating gear for oyster aquaculture has been a game changer for many growers and resource mangers. However, there are often draw backs with floating gear. The use of floating gear increases the size of the area (footprint) that it takes to grow your animals and also increases conflicts with boaters and moorings. Utilizing floating gear in a small pond with many moorings like Arey’s Pond is not always a good options as the hazards to navigation caused to boaters can be detrimental to the project. Utilizing floating gear can be labor intensive for large scale operations. In Massachusetts and most northern areas floating gear can not remain floating in the winter time due to the hazards from ice and winter storms. The gear must be sheltered enough that I doesn’t get affected by large wind events in the summer. A large pond area with no boating activity is ideal. Although there are not any specific discussions about methods to be utilized, the memo mentions putting Remote Set in floating bags multiple times. Floating remote set, although possible would not be a feasible option for most operations.

   RESPONSE: We agree with your comment that gear is both a game-changer and a challenge to site. The site engineering and the monitoring plans will include an assessment of the feasibility of gear-based systems in the specific locations where gear is recommended.

4. One of the targets listed for growing oysters was the necessity for having a hard bottom. If growing these animals on the bottom sediment this is needed, however this report mainly discusses growing seed oysters in floating gear and then transferring to a secondary broadcast area. The initial area can be located regardless of bottom conditions, and then the broadcast area can be anywhere. From an enforcement standpoint, broadcasting sub-legal oysters makes for additional labor enforcing these newly planted oyster beds. From recreational harvesters taking seed to grant holders transferring seed to their grants for final grow out, often restoration oyster beds are too good to resist for poaching.

   RESPONSE: We agree with your comment, and are focusing on areas that are visible and easily patrolled. And, additional staffing hours will be required to maintain adequate patrol.

5. This memo is a general site characterization, but more detail on the methods and quantity of shellfish are needed to truly evaluate the project from a propagation standpoint. Some of the water quality data is over 13 years old and some of the sites were almost ½ mile from the proposed sites. Water data and conditions change year to year and more fine scale information should be collected and reviewed.

   RESPONSE: Because the purpose of this Tech Memo is to characterize the sites for demonstration projects with the specifics of the design as well as monitoring plan as subject of the next Tech Memo, many details are not included. Baseline monitoring at the demonstration sites are an important first step in implementation.

We very much appreciate your comments and questions!

Comments from Ed Daly (in black) and AECOM Shellfish Team Responses (in red) provided below.

Comments on:

- Letter Report 12-1-15 Memorandum from AECOM
- Phase 1 Shellfish Tech Memorandum dated June 2015

GENERAL RESPONSE: Thank you for taking the time to review and comment on the Site Characteristics and Evaluation for Aquaculture/Shellfish Propagation Technical Memorandum (Tech Memo). Below are specific responses to your comments.

Summary

1. The reports are focused mostly on Pleasant Bay. Town Cove seems to be dismissed by comparison. Town Cove is far more in need of remediation than Pleasant Bay based on the nitrogen levels shown in Cadmus Report of June 2015 and current nitrogen monitoring data in Town Cove. So the plan is unbalanced. How will it become balanced?

2. Mussels are a historical feature of our Orleans shellfish culture. Again mussels in Town Cove dismissed in the report. Decision was not made with local input .

   RESPONSE: We believe that a key purpose of a shellfish demonstration project is to evaluate the impacts of shellfish propagation or/and aquaculture system on the water quality. For this reason, we are focusing on the areas that are likely to result in high shellfish survival, in order to maximize the potential for quantifying impacts. While we do not want to preclude opportunities to further scientific understandings related to various species propagation, we feel that it is important to focus on already proven approaches for growing shellfish species. We want this first demonstration to work well, so that the ongoing shellfish efforts can build on this success.

   We reviewed the idea of growing blue mussels (Mytillus edulis) in response to your comments and have the following observations:

   - We agree that mussels are an important species to include as part of the mix of shellfish used for nitrogen-removal.
   - We believe that shallow-water propagation of mussels reliably is still at the research stage, making it a higher risk for this project than demonstrating oysters or quahogs.
   - It is our understanding that the mussel bed propagation is difficult in shallow water due to severe predation from sea/bay ducks.
   - Siting can also be an issue, but this is the case with all gear-based aquaculture.
   - Deep-water mussel projects are not applicable to Nauset Harbor because these estuaries are too shallow to prevent ducks from diving to feed on them.
   - Presently, there are no seed mussels available from hatcheries for a demonstration project.
   - Relocating mussels from natural set may not be a reliable/sustainable, long term source for ongoing growth of mussel beds as part of a demonstration.
   - There is limited data on nutrient-removal from mussels, and no data for Cape Cod.

- There is one small mussel grant in Orleans, which we see as an opportunity for future efforts.

- As part of working with growers, mussel aquaculture in Town Cove and Mill Pond should be explored.

- We are not aware of any shallow-water mussel propagation or restoration efforts in New England (which is different from aquaculture efforts), nor published literature that describes a successful methodology for artificially propagating blue mussels on Cape Cod or similar areas. We have spoken to MBL about their efforts near Martha's Vineyard (both blue and ribbed mussels) but we think the blue mussel deep-water aquaculture project is not comparable to the sites in Orleans.

The EXCEL spread sheet with binary scores for all parameters for site selection does not show a thoughtful or correct analysis.

Engineering trade -off decision making relies on expert input to weigh the **importance** of each parameter. The Excel Spreadsheet analysis incorrectly treats every parameter with equal weight. The Excel spreadsheet must be redone correctly by weight assignment to each parameter. Outcomes may change for site selection.

RESPONSE: The shellfish team specifically discussed whether we felt that one factor was more important than another and we all agreed that the factors had equal weight. We believe that our analysis, based on available data for all parameters evaluated was thoughtful and correct. However, we recognized during our analysis that the Town may choose to assigned additional weight to one or more factors.

3. Reference is made to an "Shellfishermen Association directive" that eliminates oysters from consideration in Town Cove. Where is the reference documentation and analysis supporting this decision? Who made it? There are successful oyster grants in Nauset Harbor / Town Cove.

   RESPONSE: This information was presented by Cape Cod Cooperative Extension to the Massachusetts Shellfish Officers Association. The shellfish team confirmed this recommendation with Diane Murphy and Josh Reitsma, and included it in our report.

4. The planned demo by AECOM for Pleasant Bay is poorly explained in the reports. We need more technical detail to assess its efficacy. The Google earth site photo in Pochet is barely legible. What is the purpose, goal and cost of the demo? Please correctly explain what is planned in much greater detail including water flow paths , sampling station locations , monitoring plan and rationale for using commercial shellfish grants as a resource.

   RESPONSE: The purpose of this Tech Memo is to characterize demonstration sites. This is not the engineering plan for a demonstration, which will be the subject of the next Technical Memorandum entitled "Preliminary Engineering Design and Work Plan". Please read our response to the comments received by the Cape Cod Cooperative Extension. In our response, we explained in greater detail why the specifics of a demonstration design will be the subject of this next Tech Memo.

5. How will measured changes in nitrogen be made? Pochet shows a bioactive nitrogen level at one station to be very low and within DEP spec. If nitrogen levels are so low how will it be possible to measure small changes meaningfully? Please consult the 2015 Cadmus Report when considering your answer. Please show similar levels measurements in Wellfleet, Boston or Falmouth or anywhere else in the United States.

   RESPONSE: Shellfish uptake phytoplankton, which can be estimated using empirically-derived chlorophyll-a concentrations. Phytoplankton-derived nitrogen is also contained in the particulate organic nitrogen (PON) fraction of the total nitrogen (TN) measured as part of water quality evaluations. In the datasets for Pleasant Bay, the PON fraction is approximately 25% of the TN. Moreover, a monitoring program for the demonstration locations will be designed to specifically measure localized (in situ) changes in water clarity, pigments (chlorophyll a), and particulate organic nitrogen (PON) as well as total nitrogen. This involves sampling with high temporal and spatial resolution. For example, the Little Pond Demonstration Project in Falmouth measured changes in PON effectively using this approach; as well as in the Wellfleet oyster restoration project. Measuring nitrogen changes where absolute concentrations are below 1 mg/L is not a problem because laboratory equipment is sensitive enough to measure to the μg/L level.

6. What is the estimated cost of removing a kilogram of nitrogen using oysters and quahogs ? We need capital and O&M costs for a full scale deployment ---exclude R&D demo costs. We have seen no backup to support any estimate. We need to compare these cost numbers to Sewering. Are there are nationwide sources and estimates from other Cape towns that provide cost numbers that can be used to help compare estimates of a cost for Orleans. What is the Orleans cost for the demos? **Cost will decide how the citizens support acquaculture remediation.**

   Response: This is an important question but is outside the scope of this Tech Memo. These types of questions will be addressed in the next Tech Memo.

7. The recommended Hybrid Plan is based on obsolete requirements for nitrogen removal that are over a decade old. Nitrogen Levels in Town Cove are 50% higher now than then. **The current Hybrid system design will not restore water quality in Town Cove.** When will the correct design requirements be used so that a correct acquaculture deployment can be designed?

   Response: This is an important question but is outside the scope of this Tech Memo. As part of Adaptive Management, A Technical Memorandum evaluating baseline conditions has been prepared and is currently under review by SMAST.

8. I am disappointed with the lack of accomplishment on the aquaculture project. Tasks scheduled for late 2016 and 2017 should have been already been completed. The Pleasant Bay plan using existing grants and shellfishermen is not scientifically supported in the report. The plan is not quantitative. I am not sure the community will support such a long non specific , fuzzy and expensive plan. Two years pass and not one oyster planted!

   RESPONSE: The purpose of this Tech Memo is only about characterizing the sites. This is not the engineering plan for a demonstration, which will be the subject of the next Tech Memo, once the demonstration locations are selected. Please read our response to the comments from Cape Cod Cooperative Extension. In this response, we explain in greater detail why the specifics of a demonstration design are the subject of the next Tech Memo.

9. Has the Hybrid Plan been revised to reflect the decisions you made for elimination of oysters in Town Cove? What are the new remediation techniques now in the Plan? Do the recent WQAP costs presented reflect the revised techniques?

Response: Oysters have not been eliminated from Town Cove. Town Cove is simply not the preferred location for the first (of likely several) demonstration projects in Orleans. Quahogs are also an important species for Town Cove in the Hybrid Plan.

One excellent suggestion that has come from this review is to evaluate the potential for additional shellfish leases in Town Cove. In this way, oysters could be grown in Town Cove in gear-based systems, thus avoiding the bottom-planting that leads to increased drill populations.

10. Does the DEP agree with the proposed Orleans plan?

    Response: This is an important question but this Tech Memo is not the Orleans plan.

11. We know that oysters grow in Town Cove and Pleasant Bay. We know approximately how much nitrogen each oyster removes. Is there a more efficient and cost effective way to calibrate and assess how much nitrogen will be removed by a calculated quantity of oysters at a particular location? For example : 1)by extracting a known small quantity of oysters and water from a location then moving both to a laboratory location and 2) accurately measuring the nitrogen reduction over a predetermined length of time use the data to estimate from that location to estimate nitrogen from that location. I would be happy to discuss this approach further.

    Response: Field studies and comprehensive monitoring are critical to evaluating shellfish impacts to water quality because ecosystems are comprised of dynamic and interdependent variables. It is important to remember that shellfish filter water and in the process feed on the organic particles therein. These filtered particles include phytoplankton, suspended silt and clay, and detritus. Most of the particles that oysters ingest are microalgae (phytoplankton), but other particles are also metabolized. The nitrogen bound in organic particles may also be removed by this filtering process. Oysters do not directly remove inorganic nitrogen (nitrate and nitrite).

    In addition to removing the fraction of the total nitrogen in the water column that is in organic particles, water clarity and phytoplankton filtration are top-down controls on eutrophication. Therefore, monitoring these parameters in-situ is the best way to understand the value of shellfish for nitrogen-removal uptake, as well as water clarity improvement.

We very much appreciate your comments and questions!

Comments from Dave Slack (in black) and AECOM Shellfish Team Responses (in red) provided below

Thank you for taking the time to review the Site Characterization Technical Memorandum. We appreciate your comments.

1. I'm pessimistic about oyster reef viabiliy in either Nauset or P. Bay. Oysters in our waters love to die under the best of husbandry but particularly when left untended on the bottom. Natural set or recruitment would likely be negligible. To achieve significant N reduction with aquaculture would require thousands of pieces of equipment and hundreds of hours of maintenance. Quahogs doing poorly in much of P. Bay. Few growers currently are even buying Mm seed.

   RESPONSE: We agree that aquaculture is equipment and labor-intensive. Any solution to nitrogen-remediation is going to require a significant effort. We believe that the ecosystems services and economic as well as local food production benefits of shellfish warrant further analysis. In particular, we may find that the filtering of phytoplankton as a top-down control of eutrophication starts to improve water quality immediately. This ecosystems service may reduce the total nitrogen-removal required to achieve water quality.

2. Diane Murphy has studied disease and predation in P. Bay for years. It's brutal.

   RESPONSE: We agree that predation is going to be a major factor in determining how we grow shellfish in Pleasant Bay, and bottom-planting feasibility.

3. Diminished tide flow is disrupting oyster aquaculture in Town Cove. Unlikely that an oyster Demo Project would succeed there.

   RESPONSE: We have not recommended an oyster demonstration in Town Cove. We have heard from growers in Eastham that they have good success with oyster aquaculture, although fouling requires constant cleaning of gear.

4. What is the proposed interaction between existing growers and the Demonstration Project in P. Bay. Successful growers are already maxed out in terms of bottom and time.

   RESPONSE: The proposed interaction is to begin a dialogue to help build an understanding of the practical extent to which shellfish aquaculture can contribute to the town's water quality goals. Working with growers will also help define the needs of this group relative to the town's goals for shellfish.

5. What impact will Demonstration Project have on our already stressed public landings particularly Paw Wah where summer parking and access are already problematic.

   RESPONSE: We agree that access is a key factor in selecting a demonstration location. Your concern about public landings, and not increasing pressure on the limited parking is very important. We will make sure to keep this in mind as we plan the day-to-day logistics of installing and operating a demonstration project. Paw Wah is not being considered because it is currently an area closed to shellfishing.

We appreciate these thoughtful insights.

Comments from Sandy MacFarlane (in black) and AECOM Shellfish Team Responses (in red) provided below:

To: Sia Karplus
From: Sandy Macfarlane, Coastal Resource Specialists
Re: Review of the Technical Memorandum on Draft for Site Characteristics and Evaluation for Aquaculture/Shellfish Propagation
Date: March 4, 2016

You asked me to review and comment on the Technical Memorandum on Draft for Site Characteristics and Evaluation for Aquaculture/Shellfish Propagation.

In order to review this document, I also included earlier communiques including materials sent prior to the Shellfish Forum held in June, Orleans Shellfish Operations and Program Expansion Plan, the Orleans Water Quality Advisory Panel Consensus document and the spreadsheet matrix used to evaluate potential sites.

My comments include ones of both general and specific nature.

Thank you for providing your comments and suggestions to the Technical Memorandum, we appreciate your input to this process.

GENERAL RESPONSE: Please also read our response to the comments from Cape Cod Cooperative Extension. Here, we explain in greater detail why the specifics of a demonstration project design are going to be the subject of the next Technical Memorandum, entitled "Preliminary Engineering and Design Work Plan". We will also note in the Purpose section of the Site Characterization and Evaluation Technical Memorandum that preliminary engineering and design are addressed in a subsequent Technical Memorandum.

General:

1. I was surprised to see that Lonnie's Pond was not considered. At the shellfish forum, terminal ponds were identified as areas in greatest need of nitrogen remediation to meet TMDL's. A plan to address the needs of Meeting House Pond (the most severely degraded waterbody) exists but I have not seen a similar plan for Lonnie's Pond. Lonnie's was mentioned several times as potentially appropriate for certain types of shellfish propagation.

   RESPONSE: Lonnie's is under review for a PRB by the EPA. In addition, Lonnie's was identified in both the Hybrid Plan as well as by the Floating Constructed Wetlands (FCW) team as a preferred location for a FCW. Planning for a FCW demonstration project is proceeding at this site. Therefore, it was not included in the shellfish demonstration site selection. Shellfish could be part of full scale CWMP implementation at Lonnies, even though a first-round demonstration is not planned for this site.

2. The closest site to Lonnie's is the Lower River site at Kent's Point that was rejected (more on that later). With that rejection, Lonnie's is not covered at all from a remediation standpoint. While these are demonstration projects and a full-scale program may emanate from them, choosing sites that may have the most remediative qualities would seem to be appropriate.

   RESPONSE: Please see the Purpose section of this Technical Memorandum (Tech Memo) as well as comments to Cape Cod Cooperative Extension regarding the purpose of this Tech Memo. This is not the overall plan for remediation project. The reasons why Kent's Pond was not selected are based on important considerations.

3. In the pre-forum materials, approximately 17 acres were suggested for shellfish/restoration; in the current document, 13 acres are suggested (5.5 acres in Nauset and 9 in Pleasant Bay). The discrepancy is not explained anywhere that I can find. The memorandum does not contain the final tally of acres or amount of shellfish needed to achieve the stated goal at each site. It is not known if the estimate presented to forum panelists is the same as the amount presented to the advisory panel. Therefore, I cannot comment on the feasibility of the amount of shellfish to be raised. The amount and size of shellfish to be cultured will dictate the type and amount of gear to be used, especially if oysters are considered.

   RESPONSE: Please see the Purpose section of this Technical Memorandum (Tech Memo) as well as comments to Cape Cod Cooperative Extension regarding the specific purpose of this Tech Memo. This is not the overall plan for full-scale nitrogen removal in either Pleasant Bay or Nauset Harbor. The purpose of the current effort is to implement a demonstration project to test different aspects of shellfish propagation or aquaculture at a given location. Quantitative recommendations will be developed through an Adaptive Management process based on the findings of the demonstration projects.

4. Whereas identifying specific sites was rejected in favor of generalized areas, evaluation of specific grow-out methods is not feasible since actual site conditions can vary considerably. (See Macfarlane). Macfarlane, Sandra L., 1998. The evolution of a municipal quahaug (Hard Clam) Mercenaria mercenaria management program: a twenty year history - 1975-1995. Journal of Shellfish Research, Vol. 17(4):1015-1036.

   RESPONSE: The purpose of this Tech Memo is to characterize the sites for demonstration projects. This is not the design and monitoring plan for a demonstration, which is the subject of the next Tech Memo. Please see our comments to Cooperative Extension that explains in detail the process we have been using.

5. The amount of area to be used for each separate demonstration project was listed in the original materials but is not listed in the memorandum. I do not know if they remain the same.

   RESPONSE: The purpose of this Tech Memo is to characterize the sites for demonstration projects. This is not the design and monitoring plan for a demonstration, which is the subject of the next Tech Memo. Please see our comments to Cooperative Extension that explains in detail the process we have been using.

6. The only predator noted in the memorandum is the oyster drill. Both Nauset and Pleasant Bay have far more predators than just one.

   RESPONSE: We agree with your comment, the site characterizations were based on the available data; however, the site engineering and the monitoring plans will include in detail the need for baseline studies and monitoring of disease and predation.

7. Fouling was only mentioned for Nauset. Pleasant Bay would not be immune to fouling at the demonstration sites. The issue of fouling, especially as it relates to gear handling, length of time the gear is deployed, labor needed to address fouling, and eventual cost as a result is not examined to any degree in any of the documentation I have seen.

   RESPONSE: We agree with your comment, but the purpose of this Tech Memo is to characterize the sites. This is not the operation and maintenance plan for a demonstration project, which will be the subject of the next Tech Memo.

8. I cannot find any evaluation of removal of contaminants of emerging concern. They are mentioned once as a potential issue/threat but addressing them is not discussed.

   RESPONSE: Thank you for your comment. This Tech Memo did not address this issue. CECs will be considered for inclusion in the demonstration monitoring plan.

9. I am unsure of how the inventory of potential and existing conflicting uses was executed and the time of year the inventory was conducted.

   RESPONSE: This was accomplished by interviewing the Harbormaster and Shellfish Constable

10. I assume low DO measurements were usually bottom water (although not always specified in words) but the time of year the sampling was conducted is not mentioned. I also assume it was summer measurements when DO should be at their lowest level. If that is the case, shellfish would probably not be grown in the deepest part of the water body where low DO would be most problematic. If that is not the case, DO needs further exploration as a parameter.

    RESPONSE: Your assumptions are correct, DO was bottom water sampled during the summer. Quanset does not have low bottom-water DO. DO assessments will be part of the monitoring plan for each demonstration project.

11. It is unclear on whether eelgrass cover was based on existing maps or was ground-truthed to current conditions. If it was ground-truthed, there is no mention of when that was accomplished.

    RESPONSE: The published eelgrass maps have a degree of ground-truthing already. When we visited the sites by boat and on foot when near the shoreline, we performed visual verification of general presence/absence of eelgrass.

12. How the type and location of current uses of the waterways were determined is not fully explained.

    RESPONSE: This was accomplished by interviewing the Harbormaster and Shellfish Constable

13. How the relative importance of other uses in the numerical scale was determined is not explained. No factor has greater weight and I understand that, but if there were thresholds to get to a positive, neutral or negative scoring, those thresholds were not defined. (See Pleasant Bay Resource Management Plan and Macfarlane et al.).

    Macfarlane, S.L., J. Early, T. Henson, T. Balog, and A. McClennen, 2000. A resource-based methodology to assess dock and pier impacts on Pleasant Bay, Ma. Journal of Shellfish Research, Vol.19, No. 1, 455-464.

    "To apply this tool to each potential shellfish demonstration site, the Shellfish Technical Team held a day-long working session. At this session, the Team first reviewed and discussed all of the available information for each site: water quality data from the MEP Reports, Pleasant Bay Alliance data and reports, shellfish suitability and other GIS maps from the DMF, preliminary grain size maps from Center for Coastal Studies and notes from site visits with the harbormaster and shellfish constable. The Team then evaluated each demonstration site and ranked the criteria for each site based on this available information."

    Based on the above paragraph, there is no indication of how the separate pieces of the shellfish suitability index, for example, were fitted together to determine the eventual score at each site. The same is true for the other uses of the area that could be conflicting, especially boating.

    RESPONSE: For the purpose of this project, this was accomplished by using the developed Site Evaluation Matrix tool that is attached to this email response.

14. The memorandum states directly that "neighbors are not likely to object to a well-designed demonstration location near them." The origin and veracity of that statement is not explained; who was contacted, what were those people asked, how was the project described, etc.

    RESPONSE: We did not directly contact neighbors. This statement is based on the team's experience implementing other demonstrations and the scale and location being proposed for this demonstration project. As potential demonstration sites move forward, neighbors will be contacted. Part of what a demonstration shows is how people feel about the project. A demo is ideal because it allows for reactions to be based on a real project, and allows for the demo to be discontinued if not acceptable. It is probably more accurate to say that "Neighbors are less likely to object to a well-designed demonstration". We will edit the Tech Memo accordingly.

15. Only two areas are noted for education and outreach and I find that curious, since many of the locations have some attributes for those activities.

    RESPONSE: During our site visits, the areas mentioned seemed to have exceptional attributes for education and outreach and that is why they were called out. We agree that all the sites could have educational and outreach activities.

16. There is no mention of the size of the upweller system that would be needed nor is there any discussion of seed acquisition.

    RESPONSE: This Tech Memo is only about characterizing sites. This is not the operation and maintenance plan for a demonstration. This is the subject of the next Tech Memo

17. Of great important is the follow-up after the demonstration project runs its course. If shellfish are to be utilized as part of a wastewater management plan, it would be an annual expenditure to grow the amount of shellfish needed to offset the nutrient loading, especially if the source of the nutrients is not addressed. Establishing natural shellfish productivity through propagation is possible but it is definitely not a guaranteed success. The numbers needed, despite the prolific nature of shellfish to reproduce, is high; a very small number survive to reproduce in natural conditions (for coastal habitat restoration as envisioned in the memorandum). For planning purposes, shellfish cultivation would have to be a long-term annual commitment. Seed availability and upweller operation annually would be crucial elements as well. Additionally, these are live animals that live in a complex environment where small perturbations, that can easily go unnoticed, can have severe deleterious effects.

    RESPONSE: We completely agree with this statement and budgeting and planning will take these factors into account.

Specific areas:

1. Town Cove is a big body of water shared with Eastham. The map provided with the pre-forum materials showed three demonstration locations near the middle of the Cove. It is unclear where those sites actually are relative to the channel and therefore water depths and sediment types, at those sites are unknown. It is unclear why quahaugs are not considered for an upweller nursery. If I am not mistaken, an area near the Yacht Club is closed to shellfishing during part of the year but is open for family permit holders during the remainder of the year. The matrix spreadsheet does not downgrade the Town Cove because of it being a popular recreational destination. It is a busy place yet without knowing the area under consideration, it is impossible to say whether other uses would conflict (see #13 above).

   RESPONSE: All of Town Cove was considered in the selection process. Because of severe predation for oyster bottom-planting (per Shellfish Constable) and without a population study of existing quahogs, a demonstration here was not recommended as the first step for Orleans. The next Tech Memo will provide recommendations on design and engineering for demonstration projects and will include recommendations for both a quahog population study, and a study of the potential for expanding aquaculture in Town Cove.

2. The reason for rejecting mussels "due to the difficulty of growing this species at this time." The prolific nature of mussels, feeding habits and nature of gregarious setting would seem to be worth some sort of demonstration project.

   RESPONSE: We believe that a key purpose of a shellfish demonstration project is to evaluate the impacts of shellfish propagation or/and aquaculture system on the water quality. For this reason, we are focusing on the areas that are likely to result in high shellfish survival, in order to maximize the potential for quantifying impacts. While we do not want to preclude opportunities to further scientific understandings related to various species propagation, we feel that it is important to focus on already proven approaches for growing shellfish species. We want this first demonstration to work well, so that the ongoing shellfish efforts can build on this success.

   We reviewed the idea of growing blue mussels (Mytillus edulis) in response to your comments and have the following observations:

   - We agree that mussels are an important species to include as part of the mix of shellfish used for nitrogen-removal
   - We believe that shallow-water propagation of mussels reliably is still at the research stage, making it a higher risk for this project than demonstrating oysters or quahogs
   - It is our understanding that the mussel bed propagation is difficult in shallow water due to severe predation from sea/bay ducks
   - Siting can also be an issue, but this is the case with all gear-based aquaculture
   - Deep-water mussel projects are not applicable to Nauset Harbor because these estuaries are too shallow to prevent ducks from diving to feed on them
   - Presently, there are no seed mussels available from hatcheries for a demonstration project
   - Relocating mussels from natural set may not be a reliable/sustainable, long term source for ongoing growth of mussel beds as part of a demonstration
   - There is limited data on nutrient-removal from mussels, and no data for Cape Cod
   - There is one small mussel grant in Orleans, which we see as an opportunity for future efforts

- As part of working with growers, mussel aquaculture in Town Cove and Mill Pond should be explored

- We are not aware of any shallow-water mussel propagation or restoration efforts in New England (which is different from aquaculture efforts), nor published literature that describes a successful methodology for artificially propagating blue mussels on Cape Cod or similar areas. We have spoken to MBL about their efforts near Martha's Vineyard (both blue and ribbed mussels) but we think the blue mussel deep-water aquaculture project is not comparable to the sites in Orleans.

If you are aware of successful efforts, please let us know.

3. Mill Pond is a propagation site. Oysters in bags in oyster condos for the last three years have not been bothered by oyster drills but once they are bottom planted, they are heavily preyed upon. While it may take extra diligence, rejecting Mill Pond because of the drills may not be advisable. Mill Pond and Robert's Cove have, in the past, been high mussel producing areas, a species also preyed upon by drills. A combination of all three species in that area could be beneficial. Moreover, the semi-enclosed nature of the Mill Pond makes it a reasonable candidate to measure the nitrogen reduction capability of the shellfish.

   RESPONSE: We agree that oysters that are bottom planted will be heavily preyed-upon. We also support the polyculture paradigm. For the reasons stated above, we do not believe there is a reliable source of mussels for a demonstration, and are concerned that the sea and harbor ducks would eradicate any mussels before the drills got to them. We do support the implementation of remediation efforts in Mill Pond using gear-based systems. The use of gear-based aquaculture is a well-established practice, and we feel that a demonstration of this technique is not necessary. Instead, we recommend a program that explores working with growers already using gear-based systems. Based on comments, growers in Town Cove will be included in this exploration.

   In terms of finding locations with good potential for monitoring success, shellfish uptake phytoplankton, which can be estimated using empirically-derived chlorophyll-a concentrations. Phytoplankton-derived nitrogen is also contained in the particulate organic nitrogen (PON) fraction of the total nitrogen (TN) measured as part of water quality evaluations. In the datasets for Pleasant Bay, the PON fraction is approximately 40% of the TN, and is about 25% in Mill Pond. A monitoring program for the demonstration locations will be designed to specifically measure localized (in situ) changes in water clarity, pigments (chlorophyll a), and particulate organic nitrogen (PON) as well as total nitrogen. This involves sampling with high temporal and spatial resolution. For example, the Little Pond Demonstration Project in Falmouth measured changes in PON effectively using this approach; as well as in the Wellfleet oyster restoration project.

4. Little Pleasant Bay was set aside as a grant site because of its lack of natural productivity and because it is not in an area of as high in boating activity as other areas. Working with grant-holders for a demonstration project is laudable. However, reliance on private aquaculture to provide a public service of nutrient remediation should be fully examined.

   RESPONSE: We agree that a full examination is necessary, and in the next Tech Memo will detail a program for a full evaluation of this option.

5. Arey's Pond is another terminal pond where remediation is most needed. The accumulation of fine silt and heavy organic mud precludes the pond of being bottom planted as stated. Moreover, the number of boats in the pond limits the amount of floating gear that could be deployed. The area may require further scrutiny. It is not clear why aesthetic considerations are -1 but conflicting use is 0 at this site. The land around the pond is developed but there is a section of undeveloped land and the boating use is very high (again, see #13 above).

   RESPONSE: Ongoing use of floating bags are not considered as a vista-neutral approach, thus the -1 rating. The demo envisioned would be small and outside the boating area, with no real conflict with boating. The replicability is low and the operation and maintenance much more difficult.

6. Pochet is an interesting area to consider. According to the map, the site chosen is in the river heading to the broader area north of Pochet Island. Any part of the broader area has limited use as a demonstration site due to sediment conditions. If the demonstration project is where it is suggested, on the Pochet Island side of the river at the south eastern part of Barley Neck, it would be more or less out of the way but as stated, it would not be easily accessible.

   RESPONSE: Access is tough and requires permission from a private landowener and the National Seashore. With private aquaculture nearby, the team thought that this would make monitoring even more complex.

7. The analysis of Little River is difficult to understand. There is nothing stated to preclude its use for a demonstration project except that it is a popular recreational destination and for that, it has been excluded. It is not clear why aesthetics or user conflicts are determined to be higher at this site than elsewhere. There are more similarities between this site and others than differences.

   RESPONSE: Our understanding from field visits is that this area is very popular for water skiing and outside a ribbon of sand, most of the bottom is muck, which precludes bottom planting. It is these two factors together that ranked it lower than Quanset.

8. Quanset is also difficult to evaluate. All the information provided deals with the pond but the actual site for the work is not clear. If a reef is established in a shallow area of the pond that expands to the very narrow shallow channel, the reef will decrease the depth even more with sharp-shelled oysters. The pond is also a highly-used mooring area. If the reef is on the outside of the pond, as the original map indicates, that is a different situation entirely and it is not clear if a reef does eventually get established, whether it will expand to the shallower parts of this area.

   RESPONSE: This Tech Memo is only about characterizing sites. This is not the operation and maintenance plan for a demonstration. This is the subject of the next Tech Memo.

I hope these comments are useful as Orleans continues to evaluate the possibility of shellfish as part of a wastewater management program. However, shellfish at the end of the effluent trail does nothing to correct the root of the problem—the one that starts with the backyard septic system. Shellfish added to the ecosystem will help but they can't do it all and they are not a panacea.

We very much appreciate your comments and questions!

Sandy requested that these three comments came in via email on March 6, 2016:

First, as a person who no longer lives in the area, I am honored to have been asked to comment.

Second, while not the primary objective, the number of demonstration projects and the diversity of sites will present a positive impression to put shellfish front and center as a resource that provides many benefits. Residents and tourists alike will understand what it takes to get shellfish from the water to the table as well as the ecosystem services they provide. They will also hopefully understand the challenges involved in a long-term project designed to maintain shellfish populations and to establish new populations of certain species. My earlier review points to some of those challenges.

Third, I appreciate the introduction of the matrix approach as a tool to sort through a range of criteria. A little tweaking to define those might be helpful.

We appreciate these thoughtful insights.

Appendix B

Watershed Ranking Spreadsheets

ORLEANS, MA

Potential Disposal/Treatment Sites for Modified Traditional Bookend

General Site Information								Initial Site Screening				Further Site Investigation						
Site ID	**Map/ Parcel**	**Street Address**	**Owner**	**Name**	**Total Acres**	**Development Status**	**Residential/ Commercial**	**Watershed**	**Sub-watershed**	**Within the following: Flood Zone, ACEC, Water Supply Zone II, NHESP,Conservation Land**	**Investigate Further?**	**Ownership**	**Topography**	**Distance to Wetlands**	**Soil Conditions**	**Depth to Groundwater**	**Private wells near-by**	**Max Disposal Flow (gpd)**
1	39 - 6	29 Oak Ridge Lane	Town of Orleans	Tri-Town	26.4	Dev--utility	Commercial	Namskaket Creek	Namskatet Main	NHESP Priority Habitat of Rare Species, ACEC, 100 yr Flood zone	No - due to Namskaket watershed and within sensitive areas							
2		Route 6A	MassDOT	exit 12 cloverleaf	5.5	Hwy ROW	Commercial	Namskaket Creek		No	No - due to Namskaket watershed							
3	46 - 16	17 Nell Way	Joseph Carter	U'ground Mall	3.7	Dev--comm	Commercial	Namskatet Creek / Little Namskaket Creek	Namskaket Stream / Little Namskaket	No	No - due to Namskaket watershed							
4	53 - 1	40 Baker's Pond Road	Seth Wilkinson	Wilkinson	8.5	Dev--res/ag.	Commercial	Namskatet Creek / Little Namskaket Creek	Namskatet Stream / Little Namskaket	No	No - due to Namskaket watershed							
5	40 - 7	9 West Road	TRT Orleans LLC	Skaket Corner	12.1	Dev--comm	Commercial	Little Namskaket Creek	Little Namskaket	No	Yes	Private	Flat	> 500 ft.	Carver-Hinesburg loamy coarse sands, undulating & rolling, Plymouth loamy coarse sand, 3 to 8 percent, very stony, Eastchop loamy fine sand, 0 to 3 percent slopes		No	225,000
6		Route 6A	MassDOT	exit 12 cloverleaf	5.5	Hwy ROW	Commercial	Little Namskaket Creek		No	Yes	Public	Very Hilly	>500 ft.	Carver-Hinesburg loamy coarse sands, Carver-Hinesburg loamy coarse sands, undulating		No	480,000
7	46 - 20	29 Baker's Pond Road	NSTAR Electric Co.	Nstar--I	6.2	Dev--utility	Commercial	Little Namskaket Creek/Namskaket	Little Namskaket	No	Yes	Private	Flat	> 500 ft.	Carver coarse sands, undulating and 8 to15 percent slopes		No	225,000
8	40 - 84	9 Lots Hollow Road	NSTAR Electric Co.	Nstar--II	2.5	Dev--utility	Commercial	Nauset	Rock Harbor Main / Cedar Pond	No	No - due to Rock Harbor watershed							
9	33 - 57	140 Route 6A	Orleans Marketplace LLC	O' Mrktpplace	9.4	Dev--comm	Commercial	Rock Harbor	Cedar Pond	No	No - due to Rock Harbor watershed							
10	40 - 65	46 Eldredge Park Way	Town of Orleans	Elem School	23.8	School	Commercial	Nauset	Boland Pond	No	Not for site disposal. Look into for water reuse potential for irrigation							
11	34 - 85	70 So. Orleans Road	Eastham-Orleans-Wellfleet	Middle School	27.9	School	Commercial	Nauset	Town Cove	No	Not for site disposal. Look into for water reuse potential for irrigation							

General Site Information								Initial Site Screening				Further Site Investigation						
Site ID	**Map/ Parcel**	**Street Address**	**Owner**	**Name**	**Total Acres**	**Development Status**	**Residential/ Commercial**	**Watershed**	**Sub-watershed**	**Within the following: Flood Zone, ACEC, Water Supply Zone II, NHESP,Conservation Land**	**Investigate Further?**	**Ownership**	**Topography**	**Distance to Wetlands**	**Soil Conditions**	**Depth to Groundwater**	**Private wells near-by**	**Max Disposal Flow (gpd)**
12	35 - 120	139 Main Street	Town of Orleans	Am. Legion	2.2	Parking	Commercial	Pleasant Bay	Town Cove	No	No - due to Town Cove watershed							
13	27 - 60	54 Hopkins Lane	Town of Orleans	Comm. Gardens	11.0	Gardens	Commercial	Nauset	Town Cove	No	No - due to Town Cove watershed							
14	29 - 3	100 Dunlukin Lane	Nancy Johnson	Nstar--II	24.5	Dev--res.	Commercial	Nauset	Mill Pond	Flood zone, conservation land, wetlands throughout the site	No - due to flood zone and wetlands on site							
15	29 - 83	178 Beach Road	Walter Mayo	Mayo	6.7	Dev--res.	Residential	Atlantic Ocean		No	Yes	Private	Steep slopes throughout site	> 500 ft.	Mapunit Name Nantucket sandy loam, 3 to 15 percent slopes, Carver-Hinesburg loamy coarse sands, undulating		No	150,000
16	38-16 et al	223 Beach Road	Town of Orleans	Hubler motel	5.6	Dev-comm	Commercial	Atlantic Ocean		Near 100 yr flood zone, ACEC on portion of site	Yes	Public	Flat	Wetlands located in adjacent parcel. A number of lots to provide 100 ft. buffer	Mapunit Name Ipswich, Pawcatuck, and Matunuck peats, 0 to 1 percent slopes, Carver coarse sand, 8 to 15 percent slopes,Carver-Hinesburg loamy coarse sands, undulating		No	50,000
17	36 - 140	7 Barley Neck Road	Philip Deschamps	Nauset Marine	1.5	Parking	Commercial	Pleasant Bay	Meetinghouse Pond LT 10	Near 100 yr flood zone, ACEC	No - due to Meetinghouse Pond watershed							
18	64 - 14	59 Fernwood	Richard Walton	Walton	9.1	Dev--res.	Residential	Pleasant Bay	Pleasant Bay LT 10	Along shore line, ACEC	No - due to along shoreline and ACEC							
19	68 - 8	353 So. Orleans Road	Kenrick Sparrow	Sparrow--I	6.6	Dev--res.	Residential	Pleasant Bay	Arey's Pond LT 10	ACEC, within zone II public water supply	No - due to ACEC,within zone II public water supply							
20	69-75	35 Namequoit Road	Town of Orleans		19.4	Conservation land		Pleasant Bay	Namequoit River LT 10	Conservation land, within zone II public water supply	No - due to ACEC, within zone II public water supply							
21	69 - 75-1	61 Namequoit Road	Kenrick Sparrow	Sparrow--II	2.0	Vacant	Residential	Pleasant Bay	Namequoit River LT 10	No	Yes	Private	Gradual site slope	250 ft.	Carver coarse sand, 3 to 15 percent slopes		no	60,000
22	62 - 67	44 Arey's Lane	Anthony Davis	AP Boatyard	4.5	Dev--res.	Commercial	Pleasant Bay	Pilgrim Lake LT 10	Conservation restriction on 2 acre portion of site, portion of site ACEC	No - due to conservation restriction and ACEC							
23	63 - 10	95 Arey's Lane	Louise Thayer	Thayre Lane	6.8	Vacant--recr.	Residential	Pleasant Bay	Namequoit River LT 10	ACEC	No - entire site within ACEC							

General Site Information								Initial Site Screening				Further Site Investigation						
Site ID	Map/ Parcel	Street Address	Owner	Name	Total Acres	Development Status	Residential/ Commercial	Watershed	Sub-watershed	Within the following: Flood Zone, ACEC, Water Supply Zone II, NHESP,Conservation Land	Investigate Further?	Ownership	Topography	Distance to Wetlands	Soil Conditions	Depth to Groundwater	Private wells near-by	Max Disposal Flow (gpd)
24	70 - 31	75 Viking Road	Thomas J. Russell	Viking Pt.	1.9	Vacant	Residential	Pleasant Bay	Lower River LT 10	Along shore line, ACEC, 100 yr flood zone, NHESP	No - due to along shore line, ACEC, flood zone and NHESP							
25	91 - 14	46 Tar Kiln Road	Jeffrey Norgeot	Norgeot	8.2	Dev--res/ag.	Commercial	Pleasant Bay	Tar Kiln Stream LT 10 / Pleasant Bay LT 10	Portion within ACEC	Yes	Private	Gradual site slope	On Site	Carver coarse sand, 3 to 35 percent slopes		No	75,000
26	91 - 14	48 Tar Kiln Road	San Giovanni Rebecca Ann		2.1	Dev--res/ag.	Commercial	Pleasant Bay	Tar Kiln Stream LT 10 / Pleasant Bay LT 10	Within 100 yr. flood zone, ACEC	No - due to entire site within flood zone, ACEC							
27	13 - 19	33 Snow Shore Road	George Thompson, II	Seal lane	9.2	Dev--res.	Residential	Nauset	Nauset Marsh	Along shoreline, 100 yr. flood zone, conservation	No - due to along shoreline, flood zone and conservation							
28	30-64	237 Beach Road	Benz Corporation		3.9	Dev-comm	Commercial	Atlantic Ocean		National Park	No - due to National Park							

Appendix C

MassDEP Correspondence

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Southeast Regional Office • 20 Riverside Drive, Lakeville MA 02347 • 508-946-2700

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Matthew A. Beaton
Secretary

Martin Suuberg
Commissioner

January 19, 2016

Mark Owen
AECOM Technical Services, Inc.
9 Jonathan Bourne Drive
Pocasset, Massachusetts 02559

RE: ORLEANS – Meetinghouse Pond Area, Approval of Hydrogeologic Scope of Work

Dear Mr. Owen:

The Massachusetts Department of Environmental Protection (MassDEP) has completed its review of the hydrogeologic scope of work prepared and submitted by your office to support a future groundwater discharge application for the proposed wastewater treatment facility to serve the Meeting House Area in Orleans, Massachusetts. The document is dated November 30, 2015 and outlines the tasks that will be completed to assess the soil and groundwater conditions at the proposed discharge location. The information gathered during this investigation will be used to determine the suitability of the site for the discharge of 50,000 gallons per day (gpd) of treated sanitary effluent.

A public notice announcing the preparation of the scope of work and its submission to MassDEP was published in *Environmental Monitor* on December 23, 2015. As of this date, MassDEP has not received any public comments regarding the submitted scope of work.

MassDEP has determined that the AECOM Technical Services, Inc. (AECOM) submission is complete and hereby approves its scope of work subject to the following comments and recommendations:

- Upon the completion of the activities outlined in the approved scope of work, AECOM shall prepare and submit a hydrogeologic evaluation report to MassDEP. A MassDEP Transmittal Form and a complete BRPWP 83 application shall accompany the report. The report shall comply with the requirements outlined in the Hydrogeologic Evaluation Report Guidance that accompanies the BRPWP 83 application packet. HWG shall contact MassDEP to discuss hydrogeologic report requirements that may not be applicable to this project.

- AECOM shall identify the downgradient sensitive receptors that may be impacted by the proposed discharge and assess the current groundwater quality downgradient of the proposed discharge. Additionally, AECOM shall discuss any anticipated impacts to these downgradient receptors and to overall downgradient groundwater quality.

- The hydrogeological evaluation report documenting the results of the proposed investigation shall be expanded to include the following:

    - A surveyed site plan prepared and stamped by a professional engineer. At a minimum the surveyed site plan will identify and document;

        - The locations/footprints of the primary and reserve disposal areas,

        - The locations of all test pits and percolation tests conducted as part of the hydrogeological investigation,

        - The locations and top-of-casing/top-of-PVC elevations of all borings/monitoring wells installed as part of the investigation and of all existing, on-site monitoring wells used in the investigation, and

        - The proposed locations of monitoring wells to be installed as part of the approved groundwater monitoring plan.

      This surveyed site plan, along with an approved maximum daily discharge volume, will be referenced in MassDEP's Site Approval Letter.

    - A groundwater monitoring well plan capable of identifying and assessing any impacts to groundwater flow and quality resulting from a discharge of effluent at the approved location. Monitoring wells installed as part of the site investigation may be utilized provided they are appropriately located and constructed in accordance with MassDEP's *Standard References for Monitoring Wells.* Additional well locations shall be proposed if needed to monitor impacts to nearby sensitive receptors.

- AECOM shall notify the Southeast Regional Office at least one week prior to conducting any of the significant, on-site field work proposed in the approved scope of work so that a MassDEP representative may be present if necessary.

If you have questions regarding the comments and conditions of this approval, please contact Kermit Studley of this office at 508-946-2803.

Sincerely,

Brian Dudley
Bureau of Water Resources

D/KS

Ecc: Christos Dimisioris, MassDEP-BWR: cdimisioris@state.ma.us
Robert J. Canning, Orleans Health Department: health@town.orleans.ma.us
George Meservey, Orleans Planning Department: gmeservey@town.orleans.ma.us
Michael Domenica, Orleans Program Manager: mdomenica@threebayswater.com

Orleans – Meetinghouse Pond Area WWTF Discharge – Hydrogeologic SOW.doc

Appendix D

Previous Investigations

BENNETT ENVIRONMENTAL ASSOCIATES, INC.
LICENSED SITE PROFESSIONALS · ENVIRONMENTAL SCIENTISTS · GEOLOGISTS · ENGINEERS
1573 Main Street - P.O. Box 1743, Brewster, MA 02631 · 508-896-1706 · Fax 508-896-5109 · www.bennett-ea.com

BEA15-10815

February 25, 2016

Mr. Ron Collins
Town of Orleans Building & Facilities Manager
19 Main Street
Orleans, MA 02653

RE: LIMITED REMOVAL ACTIONS COMPLETION STATEMENT
N/F Nauset Beach Side Motel/Hubler Property
223 Beach Road, 15 Hubler Ln., 26 Hubler Ln., 31 Hubler Ln.
Orleans, MA

Dear Mr. Collins,

Pursuant to our agreement dated December 1, 2015 (rev. January 5, 2016), BENNETT ENVIRONMENTAL ASSOCIATES, INC. (BEA) has prepared the following narrative as Limited Removal Actions Completion Statement for four distinct areas of petroleum impacted soils, noted as having separate sources and being spatially divided. As such, the following narrative and supporting documentation describe the conditions at the property and the measures taken in response to absolve significant impacts, in accordance with 310 CMR 40.0318, which included environmental assessment and remedial response performance for the excavation and proper disposal of a total of 161.38 tons (~100 cubic yards) of petroleum contaminated soils.

BACKGROUND/ENVIRONMENTAL ASSESSMENT

The Town of Orleans purchased the subject property in 2010 from the Hubler family. The subject property had been in use as a motel prior to the purchase of the property by the Town. Orleans Fire Department personnel inspected the property in May 2010, prior to the sale, and found multiple fuel oil ASTs servicing the subject buildings. Only one of the tanks was properly permitted and some were noted in poor condition. Orleans Fire Department personnel recommended maintaining minimum levels of oil in the tanks until the business was closed, and the property winterized. In October 2010, Orleans Fire Department personnel took an inventory of the oil remaining in the tanks. Six of the tanks were documented to be between 3/8 and ½ full, while the gauge on the remaining tank was noted as unreadable.

The property has since been sitting unused for the past five years until the Town of Orleans decided to move forward with the redevelopment of the property for additional overflow parking for Nauset Beach. In order to absolve potential environmental impact as a liability associated with the historic storage of fuel oil, the Town of Orleans engaged Tank Removal Services (TRS) to properly clean and remove the tanks. The Town also engaged BEA to inspect each of the fuel tanks upon removal from the buildings and to conduct soil sampling and field screening, with laboratory analysis as needed, to qualify environmental impact.

As such, on December 15, 2015 BEA personnel were at the site with TRS personnel to oversee the removal of the abandoned ASTs. Due to the location of two of the tanks, as within the crawlspaces beneath Office/Unit 1 and 2, and Unit 3 and 4, they were left in place to be removed subsequent to the demolition of the buildings. The other 275-gallon ASTs were removed on this day.

BEA personnel performed four hand borings beneath or adjacent to the fuel oil ASTs. Soil samples were placed in 8-ounce glass jars sealed with aluminum septa. The samples were then agitated to develop organic vapors and subsequently screened with a photoionization detector (PID) [MiniRAE 3000] by "jar headspace" method consistent with the MA DEP BWSC Interim Soils Policy (WSC-94-400). Field screening reported headspace concentrations between background (Non-Detect) and 152 ppmv, with distinct fuel oil odor and staining present in three of the four locations (HB-1, HB-2 and HB-4). Soil samples from each of the borings (HB-1, HB-2, HB-3, and HB-4) were sent to R.I. Analytical for EPH analysis.

BEA personnel returned to the Site on December 23, 2015 and performed two additional hand borings at Unit 9 to investigate potential environmental impact from bulk fuel oil storage at this location. PID readings from soil samples at these locations reported concentrations of organic vapors between background (ND) and 29.4 ppmv. Soil samples from HB-5 and HB-6 were again sent to R.I. Analytical for EPH analysis.

Results of the soil analysis, received December 21 and 30, 2015, reported concentrations of 2-Methylnaphthalene in the HB-1:0-4' sample and fractional C9-C18 EPH in HB-2:2-4' above their respective RCS-1 Reportable Concentrations. Based on these results 120-day Reportable Conditions were apparent at the HB-1 and HB-2 locations.

Table 1: Soil Analytical Results Compared to Applicable RCS-1 Reporting Concentrations
N/F Nauset Beach Side Motel/Hubler Property

Sample Identification: Sample Date:	HB-1: 0-4' 1/22/2015	HB-2: 2-4' 1/22/2015	HB-3:0-4' 1/22/2015	HB-4: 0-3' 1/22/2015	HB-5: 0-4' 12/23/2015	HB-6:0-4' 12/23/2015	MA RCS-1
PARAMETER							
EPH/PAH (mg/kg)							
C9-C18 Aliphatics	720	**1900**	<21	740	<21	740	1000
C19-C36 Aliphatics	100	310	<21	290	<21	160	3000
Adj. C11-C22 Aromatics	430	340	<21	290	<21	720	1000
Naphthalene	1.9	<0.4	<0.4	<0.4	<0.4	<0.4	4
2-Methylnaphthalene	**12**	<0.4	<0.4	<0.4	<0.4	0.63	0.7
Acenaphthene	0.56	<0.4	<0.4	<0.4	<0.4	0.61	4
Phenanthrene	2.7	<0.4	<0.4	0.4	<0.4	2.8	10

Bold numbers indicate concentrations of analytes reported above the applicable RCS-1 concentrations

REMEDIAL RESPONSE

Subsequent to the demolition of the various on-site buildings, BEA returned to the subject property on February 1, 2016 to direct contaminated soil removal activities performed by the Town of Orleans DPW personnel. Soil removal activities were performed using a rubber-wheeled backhoe direct-loading into a 20-yard roll off container. Impacted soils were also stockpiled at the site when the roll-off container was en-route to the recycling facility. The impacted soils were transported to Aggregate Industries asphalt batching plant in South Dennis for recycling, under an approved Bill of Lading.

Based on the analytical results of soil samples collected, soil from the area of HB-1 and HB-2 required removal pursuant to 310 CMR 40.000. As such, soil removal activities began at the former Office/Unit 1 and Unit 2 building in the vicinity of HB-1 (Zone A). In this area, soils were removed in an approximate 12-22' x 6-15' area to approximately 6' deep. Once field screening results reported concentrations of organic vapors/TPH below reference threshold concentrations, soil samples were collected from the extent of excavation for subsequent laboratory analysis, in review of remedial response performance and risk characterization.

Remedial response activities were then shifted to focus on the former Unit 3A,B/Unit 4 A,B building, in the area of HB-2 (Zone B). Soils from this location were removed on February 1 and 2, 2016. Extent of final dimensions of the excavation were noted as approximately 30' x 16-22' x approximately 9' deep. Soil samples were again collected at the extent of excavation for subsequent laboratory analysis.

Subsequent to the removal of impacted soils from the HB-1 and HB-2 locations, BEA personnel performed additional soil removal from the areas around HB-4 and HB-6. While the analytical results from the limited assessment activities conducted did not necessitate a remedial response, it was evident that fuel oil impacted soils in these areas should to be removed from the site. Therefore, these soils were removed from around HB-4 (Zone C) in a 13' x 8' area to approximately 9' deep, and from around HB-6 (Zone D) in a 12' x 12' area approximately 5' deep. Samples from the extent of soil removal at each of these locations were also collected for laboratory analysis.

The soil samples collected were submitted to R. I. Analytical for Extractable Petroleum Hydrocarbon (EPH) analysis with target Polycyclic Aromatic Hydrocarbons (PAHs). All concentrations of fractional EPH and target PAHs were reported as Non-Detect in the samples collected from Zone A. A summary of results is provided below in Table 2.

Table 2: Soil Analytical Results Compared to Applicable RCS-1 Reporting Concentrations
N/F Nauset Beach Side Motel/Hubler Property
Zone A - Former Office/Units 1 & 2

	Zone A	Zone A	Zone A	Zone A	Zone A	Zone A	Standards
Sample Identification:	**SW-N: 5-6'**	**SW-S: 0-6' X2**	**SW-E: 0-6' X2**	**SW-W: 0-6'**	**BOH @ 6'**	**CLEAN OB**	**MA**
Sample Date:	**2/1/2016**	**2/1/2016**	**2/1/2016**	**2/1/2016**	**2/1/2016**	**2/2/2016**	**RCS-1**
Parameter							
EPH/PAH (mg/kg dry)							
C9-C18 Aliphatics	<21	<24	<24	<24	<21	<21	1000
C19-C36 Aliphatics	<21	<24	<24	<24	<21	<21	3000
Adj. C11-C22 Aromatics	<21	<24	<24	<24	<21	<21	1000
Target PAH Analytes							
Naphthalene	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	4
2-Methylnaphthalene	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.7
Acenaphthene	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	4
Phenanthrene	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	10

Low concentrations of fractional EPH were reported in a single sidewall sample (Zone B SW-NE: 0-9') and a bottom of hole sample (BOH-S@9') from the soil samples collected from Zone B. Each of these concentrations was reported below the applicable RCS-1 Reporting Concentrations. A summary of results is provided below in Table 3.

Table 3: Soil Analytical Results Compared to Applicable RCS-1 Reporting Concentrations
N/F Nauset Beach Side Motel/Hubler Property
Zone B - Former Units 3A/B & 4A/B

	ZONE B	ZONE B	ZONE B	ZONE B	ZONE B	ZONE B	ZONE B	ZONE B	ZONE B	ZONE B	ZONE B CLEAN OB	Standards
Sample Identification:	**SW-NE: 0-9'**	**SW-EN: 0-9'**	**SW-ES: 0-9'**	**SW-SE: 0-9'**	**SW-NW: 0-9'**	**SW-WN: 0-9'**	**SW-WS: 0-9'**	**SW-SW: 0-9'**	**BOH-S @ 9'**	**BOH-N @ 9'**	**STOCKPILE**	**MA**
Sample Date:	**2/2/2016**	**2/2/2016**	**2/2/2016**	**2/2/2016**	**2/2/2016**	**2/2/2016**	**2/2/2016**	**2/2/2016**	**2/2/2016**	**2/2/2016**	**2/2/2016**	**RCS-1**
Parameter												
EPH/PAH (mg/kg dry)												
C9-C18 Aliphatics	23	<21	<21	<21	<22	<22	<21	<21	110	<21	<22	1000
C19-C36 Aliphatics	<22	<21	<21	<21	<22	<22	<21	<21	24	<21	<22	3000
Adj. C11-C22 Aromatics	<22	<21	<21	<21	<22	<22	<21	<21	56	<21	<22	1000
Target PAH Analytes												
Naphthalene	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	4
2-Methylnaphthalene	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.7
Acenaphthene	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	4
Phenanthrene	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	10

All concentrations of fractional EPH and target PAHs were reported as Non-Detect in the samples collected from Zone C. A summary of results is provided below in Table 4.

Table 4: Soil Analytical Results Compared to Applicable RCS-1 Reporting
N/F Nauset Beach Side Motel/Hubler Property
Zone C - Former Unit 7

	ZONE C	ZONE C	ZONE C	ZONE C	ZONE C	Standards
Sample Identification:	SW-N: 0-9'	SW-S: 0-9'	SW-E: 0-9'	SW-W: 0-9'	BOH @ 9'	MA
Sample Date:	2/2/2016	2/2/2016	2/2/2016	2/2/2016	2/2/2016	RCS-1
Parameter						
EPH/PAH (mg/kg dry)						
C9-C18 Aliphatics	<21	<21	<21	<21	<21	1000
C19-C36 Aliphatics	<21	<21	<21	<21	<21	3000
Adj. C11-C22 Aromatics	<21	<21	<21	<21	<21	1000
Target PAH Analytes						
Naphthalene	<0.4	<0.4	<0.4	<0.4	<0.4	4
2-Methylnaphthalene	<0.4	<0.4	<0.4	<0.4	<0.4	0.7
Acenaphthene	<0.4	<0.4	<0.4	<0.4	<0.4	4
Phenanthrene	<0.4	<0.4	<0.4	<0.4	<0.4	10

All concentrations of fractional EPH and target PAHs were reported as Non-Detect in the samples collected from Zone D. A summary of results is provided below in Table 5.

Table 5: Soil Analytical Results Compared to Applicable RCS-1 Reporting
N/F Nauset Beach Side Motel/Hubler Property
Zone D - Former Unit 9

	ZONE D	ZONE D	ZONE D	ZONE D	ZONE D	Standards
Sample Identification:	SW-N: 0-5'	SW-S: 0-5'	SW-E: 0-5'	SW-W: 0-5'	BOH @ 5'	MA
Sample Date:	2/2/2016	2/2/2016	2/2/2016	2/2/2016	2/2/2016	RCS-1
Parameter						
EPH/PAH (mg/kg dry)						
C9-C18 Aliphatics	<25	<21	<21	<21	<21	1000
C19-C36 Aliphatics	<25	<21	<21	<21	<21	3000
Adj. C11-C22 Aromatics	<25	<21	<21	<21	<21	1000
Target PAH Analytes						
Naphthalene	<0.4	<0.4	<0.4	<0.4	<0.4	4
2-Methylnaphthalene	<0.4	<0.4	<0.4	<0.4	<0.4	0.7
Acenaphthene	<0.4	<0.4	<0.4	<0.4	<0.4	4
Phenanthrene	<0.4	<0.4	<0.4	<0.4	<0.4	10

Contaminated soils were transported both days of soil removal activities (February 1st and 2nd), while the remaining stockpile was transported the following day (February 3rd). The completed Bills of Lading are included as an enclosure.

RISK CHARACTERIZATION

The laboratory analytical results reported all EPH/PAH concentrations for all of the end-point soil samples as below the applicable RCS-1 Reportable Concentrations or as Non-Detect (ND) wherein the reporting limits were less than the applicable and strictest RCS-1 Reportable Concentration criteria. The RCS-1 Reportable Concentrations are analogous to the strictest S-1 (GW-1) Method 1 Risk Characterization standards, which are relied upon in review of risk characterization. As such, all significant fuel oil impacts have been removed and there is No Significant Risk associated with the post-excavation soil conditions based on the analyses performed and the results reported.

CONCLUSIONS

Significant petroleum impact in soil was discovered at two locations at the Site, associated with the historic storage of heating fuel oil. Soils were removed from a total of four different locations, with excavation operations resulting in the removal of some 161.38 tons (~100 cubic yards) of petroleum contaminated soils. End-point soil samples collected from the extent of soil removal from each of the four excavations, reported all fractional EPH and target PAH analyte concentrations as below the applicable RCS-1 Reportable Concentrations or as ND, wherein the reporting limits were less than the strictest applicable RCS-1 Reportable Concentrations. As such, based on the contaminated soil removal performed and the laboratory analytical results reported for the end-point samples submitted, it is apparent that there is no significant risk to human health or to the environment associated with the subject release given the testing performed. This data qualifies the efficacy of the LRA Completion Statements, as consistent with the provisions of 310 CMR 40.0318, to support project closure and document regulatory compliance, wherein no Release Notification or Remedial Response liabilities remain under the provisions of 310 CMR 40.0000 as based upon the available data and regulations in effect at the time of this reporting.

The findings of this investigation, as represented herein, document regulatory compliance with governing regulations and set forth the rationale and technical justification for project closure specific to the area of release as identified on the accompanying Site Plan. While these records are archived in your folder at our offices, you are required under the provisions of 310 CMR 40.0318(7) to maintain a copy of this LRA Completion Statement for a minimum period of five (5) years.

If you have any questions or need additional information, please contact me directly at your earliest convenience.

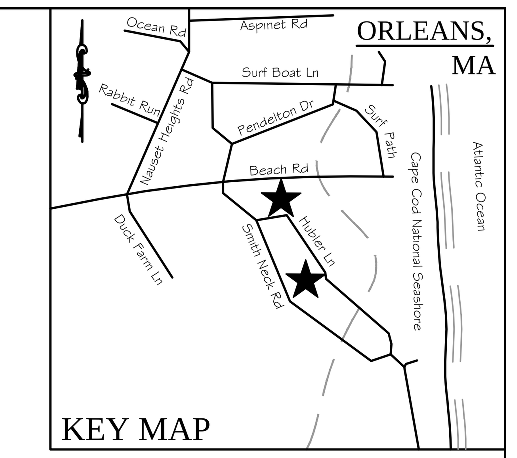
Sincerely,
BENNETT ENVIRONMENTAL ASSOCIATES, INC.

John D. Tadema-Wielandt, Sr. Environmental Scientist
Project Manager

Encl. -Site Plan entitled "Limited Removal Action Completion..." prepared by BENNETT ENVIRONMENTAL ASSOCIATES, INC., dated February 17, 2016.
-Town of Orleans Fire Department Records
-Field Response Log
-Bill of Lading - BWSC-112 (to transport soil to recycling facility)
-Aggregate Industries Soil Recycling Submittal
-Aggregate Industries Cover Letter
-Bill of Lading - BWSC-112, A, B (received at recycling facility)
-Laboratory Analytical Reports, R.I. Analytical (#1512-27329, #1512-28055, #1602-02683)

Cc. Robert Canning, Health Agent - Orleans Health Department
Fire Prevention Officer Gregory Baker - Orleans Fire Department
John Kelly - Orleans Town Administrator
David C. Bennett, LSP [internal]

ENCLOSURES



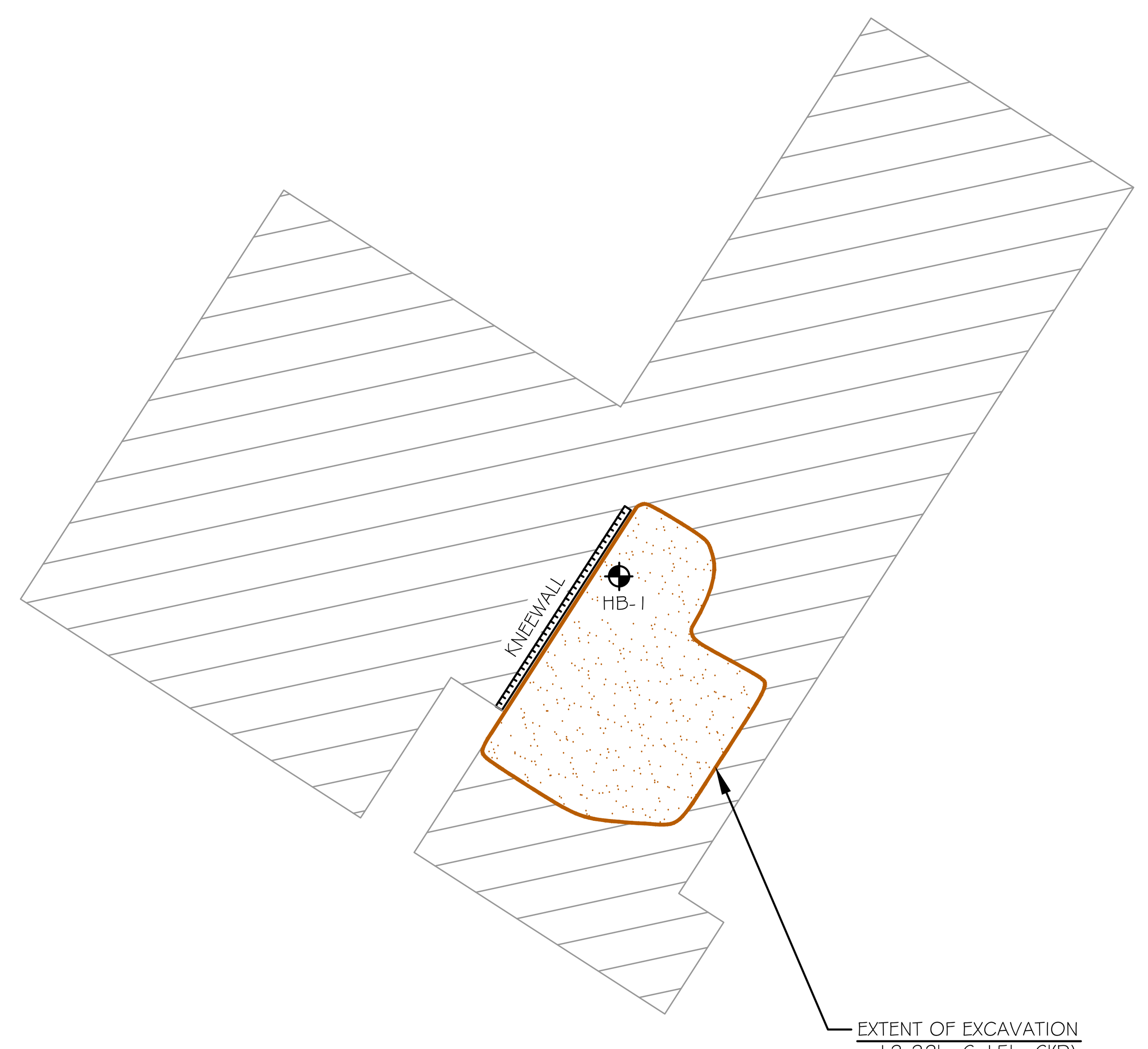
LEGEND

HB HAND BORING

TP TEST PIT

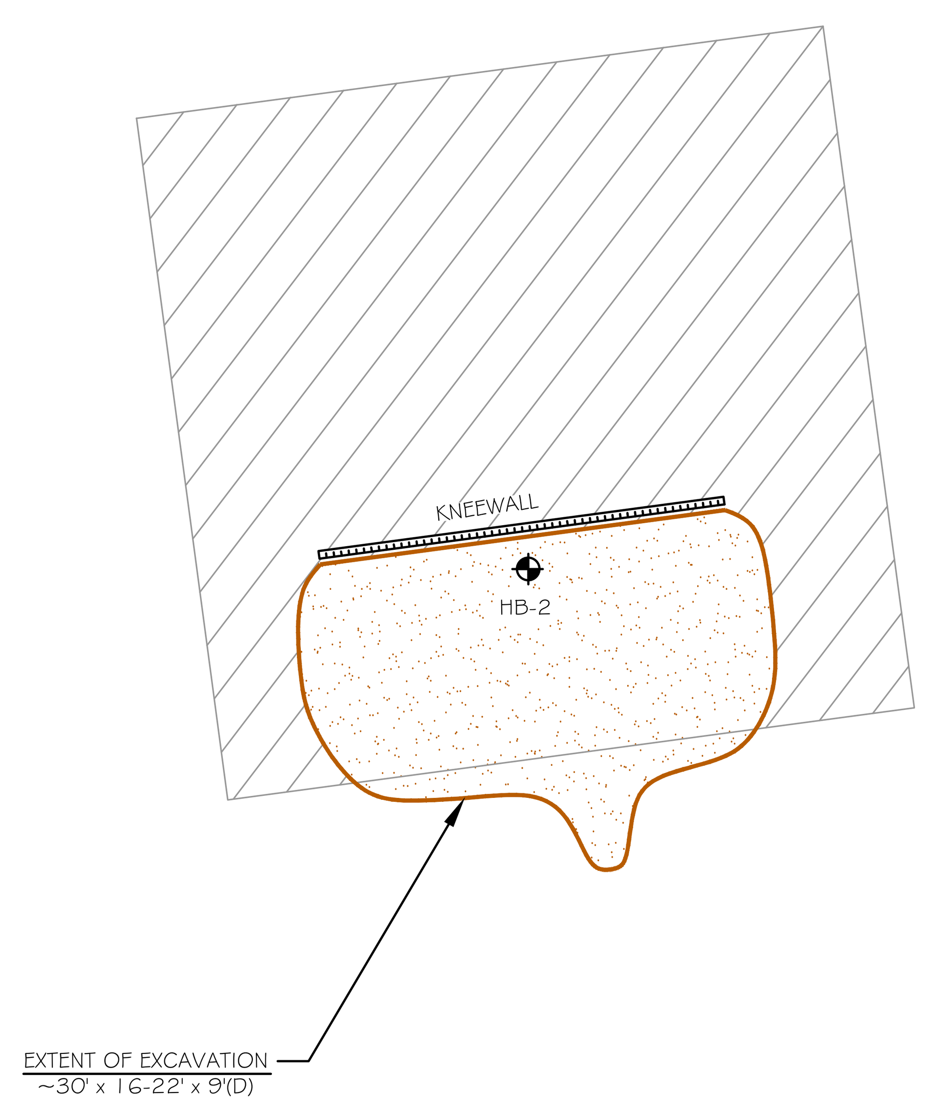
DETAIL A

FORMER OFFICE & UNITS 1 & 2



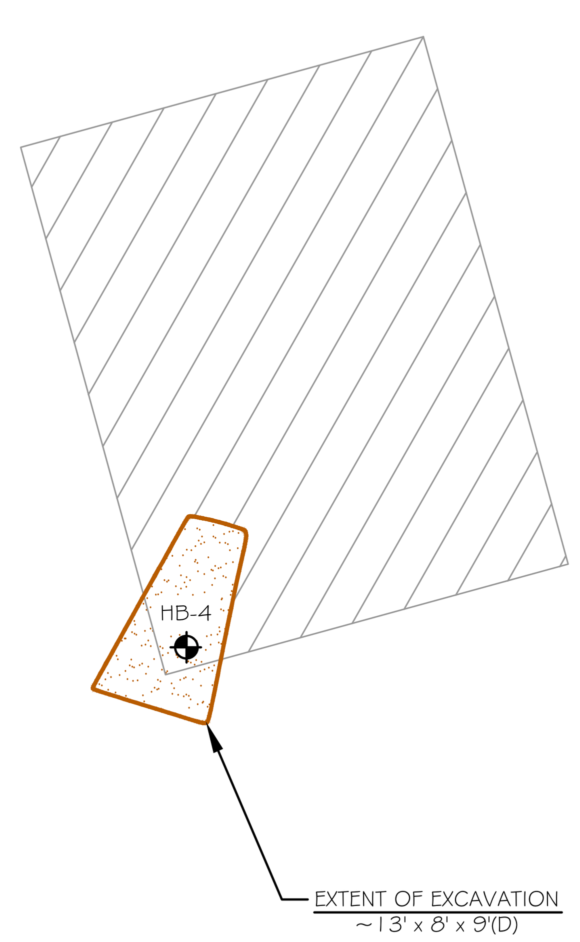
DETAIL B

FORMER UNITS 3A & B
FORMER UNITS 4A & B



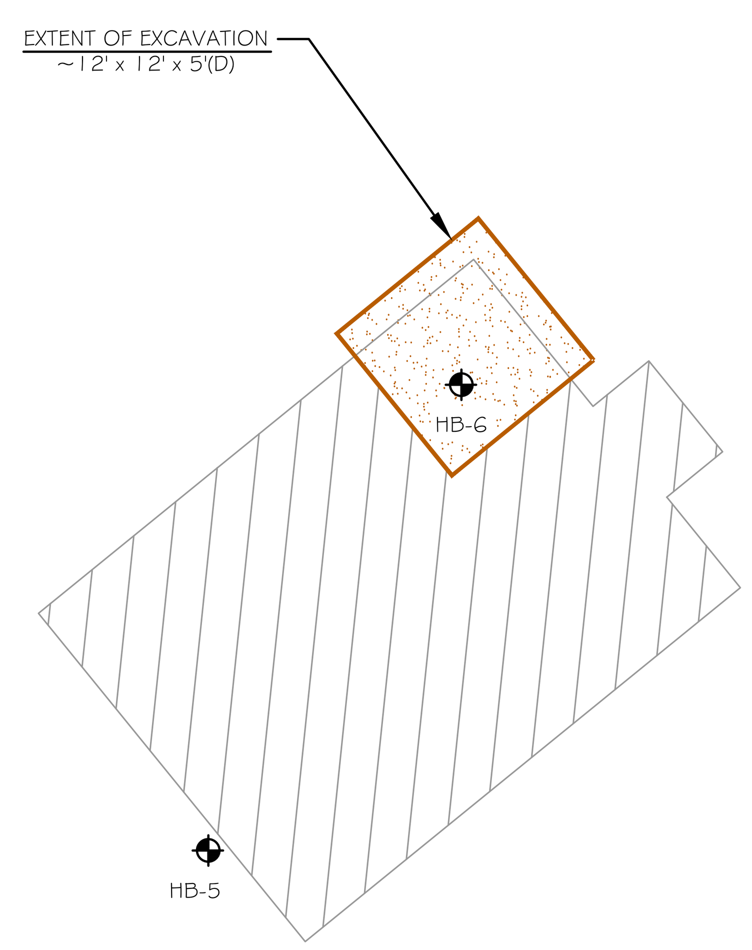
DETAIL C

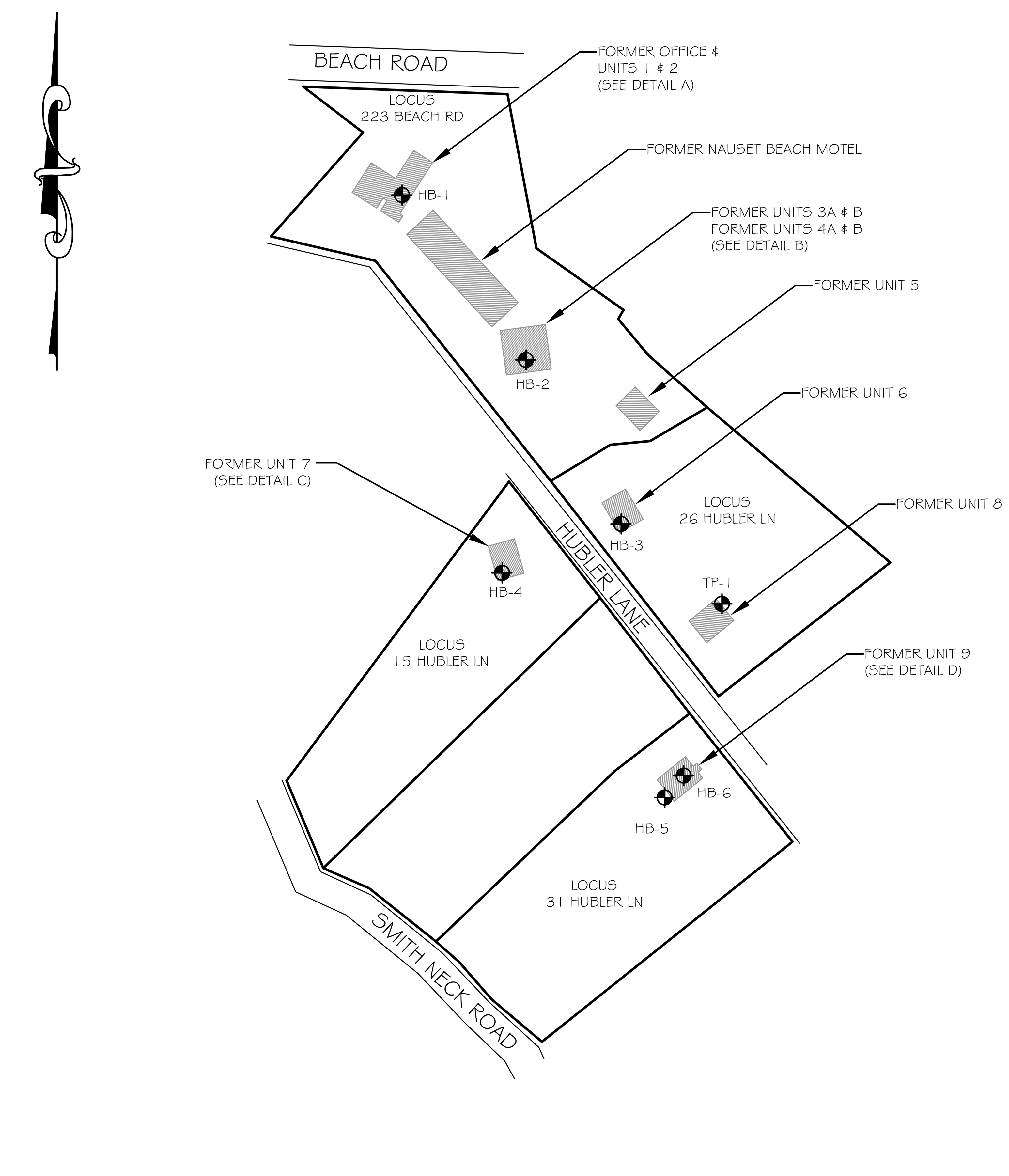
FORMER UNIT 7



DETAIL D

FORMER UNIT 9





KEY MAP

SCALE 1"=100'

DETAILS

0 10 20 30

SCALE 1"=10'

Project: TOWN OF ORLEANS c/o JOHN KELLY, TOWN MANAGER 19 SCHOOL STREET - ORLEANS, MA 02653-3699				
Title: LIMITED REMOVAL ACTIONS N/F NAUSET BEACH MOTEL 223 BEACH ROAD - ORLEANS, MA 02653				
BEA BENNETT ENVIRONMENTAL ASSOCIATES, INC. LICENSED SITE PROFESSIONALS, ENVIRONMENTAL SCIENTISTS, GEOLOGISTS, ENGINEERS 1573 MAIN STREET, P.O. BOX 1743, BREWSTER, MA 02631 PHONE: (508) 896-1706 www.bennett-ea.com FAX: (508) 896-5109				
DATE	SCALE	BY	CHECK	JOB NUMBER
02/17/16	As Noted	SRF	DCB	BEA15-10815

FIELD RESPONSE LOG
Town of Orleans, Limited Removal Actions
BEA15-10815

Potentially Responsible Party: Town of Orleans

Property Location: 223 Beach Road, Orleans
Formerly Nauset Beach Side Motel/Hubler Property
[Map/Parcel ID: 38-16-6]

Background Conditions:

- Municipality purchased property several years ago with above-ground fuel oil storage tanks (ASTs) servicing the existing buildings.
- During the removal of the ASTs, soil sampling indicates fuel oil impact to soils at two locations above RCS-1 Reportable Concentrations.

Environmental Conditions:

- Area serviced by town water. No private potable wells in the area
- Depth to groundwater 50' +/-
- Prior to demolition of buildings, access to release areas was restricted by being within the basement crawlspaces beneath the buildings
- Subsequent to the demolition of the buildings, access was unrestricted with on-site workers and visitors to the property identified as the primary human receptors

Remedial Response:

12/15/15

11:15 am BEA personnel arrive on-site and met by Tank Removal Service (TRS) personnel already on-site. TRS personnel (Rick and Jamie) are in first building (Office), cleaning out tanks in basement.

11:30 am TRS personnel finish cleaning tank. Exit basement and prepare to move on the next building to cut and clean tank(s). Rick indicates that the two tanks in the first building are to be removed when building is demolished. Enter basement and observe 3” +/- water on the floor from last night’s rain. 275

gallon AST is at the bottom of stairs, has been cut and cleaned. Shift this tank out of the way to access second tank in crawlspace to the right. This tank is also cut, has some dirt in bottom; appears to remain connected to the fill and vent pipes. Discolored soils surrounding tank – can't tell if it's oil or water. Faint petro odor to soils near oil filter flange. Decide to collect soil samples for PID screening.

12:30 pm Remove first 6" of soil/stones/concrete. Begin HB-1 at base of tank beneath oil filter flange. Observe grey/black soils to at least 2'. Soil conditions improve with depth with tight silty soils at 2.5-3'. Screen soil samples as follows:

HB-1:	0-2'	152
	2-4'	32

Definitely impacted at this location. Additional assessment or remediation should be conducted after demolition. Pack up and mobilize to next building.

1:30 pm Second building (Units 3 and 4), both tanks have been cut and cleaned. First tank in basement looks good, no staining to concrete floor beneath. Investigate tank in crawl space. Dig out approximately 1' of soil from base to expose fuel filter. No obvious evidence of impact. Perform hand boring at base of tank beneath oil filter, screen with PID as follows:

HB-2:	0-2'	1.0
	2-4'	59

Weathered fuel odor at 2-4'. Additional assessment should be conducted at this location subsequent to building demolition, as well.

Seth Pearson, Town of Orleans, stops by -- indicate impact at first location. He will talk to Ron Collins.

2:05 pm Pack up and mob to the next building (Unit 6).

275 gallon AST has been cut and cleaned, removed from the basement. Tank is in OK shape with some staining on side and bottom. Some incidental impact near filter. Screen with PID as follows:

HB-3:	0-2'	1.0
	2-4'	1.0

No evidence of significant impact at centrally located cottage location.

2:15 pm TRS personnel begin removing AST in basement of cottage opposite the roadway (Unit 7).

2:40 pm Remove tank from basement. Remove wood and concrete blocks from corner. Observe some soil staining in location of former oil filter. Perform HB-4 in area of staining and screen as follows:

HB-4:	0-2’	3.0	
	2-3’	3.0	Refusal x2

3:00 pm Rick and Jamie depart site. Finish screening samples. Some impact at this location although it is not clear from gravelly soils makes hand auguring difficult.

3:35 pm Depart site.

12/21/15

2:45 pm BEA personnel arrive at site to locate ASTs/HBs performed last week, so that these locations can be found subsequent to building demolition.

Enter buildings. Record GPS info:

HB-1:	41* 47.296’ N	69* 56.369’ W (Office)
HB-2:	41* 47.27’ N	69* 56.35’ W (Units 3 and 4)
HB-3:	41* 47.244’ N	69* 56.33’ W (Unit 6)
HB-4:	41* 47.236’ N	69* 56.353’ W (Unit 7)

4:15 pm Depart site.

Receive laboratory results from soil samples from hand borings HB-1 through HB-4:

- Results report concentrations of fractional EPH above RCS-1 Reportable Concentrations in the HB-1: 0-4' sample and the HB-2: 2-4' sample, indicating a 120-Day reporting condition.
- HB-3 reported EPH/PAHs as ND and HB-4 was reported as below RCS-1 Concentrations.

12/23/15

1:15 pm BEA personnel arrive on-site and met by Town of Orleans DPW personnel cleaning up debris from demolished cottage (Unit #8). Mobilize to Unit #9 to inspect area of former exterior 275 gallon AST removed by

TRS personnel (Jamie) on Saturday, 12/19/15.

Locate area of former tank at western gable end of cottage, between chimney and bulkhead. Perform HB-5 in area of former tank. Screen soil samples as follows:

HB-5:	0-2’	0.3
	2-4’	0.3
	4-6’	0.3

No evidence of impact with all PID readings consistent with background. Stake and geo-locate HB-5 location:

HB-5: 41* 47.206’ N 69* 56.313’

2:00 pm Investigate basement of Unit 9. Observe apparent area of staining in area of furnace. Perform HB-6 in area of staining, as follows:

HB-6:	0-2’	3.7
	2-4’	29.4
	4-6’	5.1

Stake and geo-locate HB-6 location:

HB-5: 41* 47.203’ N 69* 56.314’

2:30 pm Some fuel oil apparent at HB-6 location. Pack up and decon equipment.

2:50 pm Depart site.

12/30/15

Receive laboratory results from soil samples from hand borings HB-5 and HB-6. HB-5 reported EPH/PAHs as ND and HB-6 was reported as below RCS-1 Concentrations.

2/1/16

8:05 am BEA personnel arrive on-site and met by Town of Orleans Parks personnel (Frank) and Orleans DPW personnel, Bob (Operator), Steve (Foreman), truck driver, to perform soil removal in four separate locations under Limited Removal Action. Equipment set up at Units 1&2/Office. Backhoe to dig dirt and load into Daniels roll-off/truck.

8:15 am	Begin removing soil from area of HB-1 (see location of borehole). Grey stained soils with strong petroleum odor observed 6" below basement soils. Instruct operator to dig approximately 6' bgs area to remove visually impacted soils. Ron Collins arrives on-site.
8:30 am	Continue removing soils from excavation #1. Driver indicates the 20-yard container will hold 10 yards +/- soil. Layers of brown and grey clay also observed in excavation.
9:00 am	Truck departs site to Aggregate. Ask operator to clean up hole and collect soils samples on pavement, until truck returns. Screen soil samples with PID (MinieRAE) as follows:

SW-N:	5-6'	1.3 (kneewall)
SW-S:	0-6'	160
SW-E:	0-6'	95
SW-W:	0-6'	27 → Dexsil: 201
BOH	@6'	14.2 → Dexsil:195

Instruct operator to remove additional material from South and East sidewalls. Run Dexsil PetroFlag tests on SW-S and SW-E samples and screen with PID:

SW-Sx1:	0-6'	40
SW-Ex1:	0-6'	59

Remove additional soils and recollect samples:

SW-Sx2:	0-6'	ND
SW-Ex2:	0-6'	0.1

11:00 am	Soil samples at extent of excavation indicate significant impact has been removed. Dimensions approximately 12-22' x 6-15' x 6' D. Move on to next location.
11:05 am	Begin excavation in area of HB-2 at Units #3&4. Instruct operator to dig hole to 4' bgs in HB-2 location. Odor in hole at 4' – ask operator to dig a hole to 6'; collect BOH sample and screen as follows:

Zone B-BOH	@6'	19.4 → Dexsil: 317

Instruct operator to continue digging out hole laterally to 6'. Receive call from Dave; let him know what is going on.

12:00 pm DPW personnel break for lunch.

1:00 pm DPW personnel return to site. Instruct operator to dig deeper to try to find the bottom of impact. Collect sidewall samples and screen as follows:

Zone B

SW-S:	0-7’	45
SW-E:	0-7’	90
SW-W:	0-7’	51.5
BOH	@7’	7.5

1:30 pm Instruct operator to remove additional soils in each sidewall to 7’ bgs. Review weight slips from driver with two loads totaling 37 tons so far. Third truck departs site.

2:15 pm Collect samples from extent of excavation and screen as follows:

SW-N:	5-7’	2.5 (below kneewall)
SW-Sx1:	0-7’	1.2
SW-Ex1:	0-7’	29
SW-Wx1:	0-7’	17.8 → Dexsil: 1016

2:30 pm East and West sidewalls remain impacted. Instruct operator to strip off clean over-burden materials and stockpile next to hole in preparation to remove additional soils. DPW personnel fence off open excavation. Tape in dimensions of excavation, 22’ x 16.6’ x 7D’

Make plans to return tomorrow at 7: 30 a.m. to continue soil removal.

3:15 pm Depart site.

2/2/16

7:30 am BEA personnel arrive on-site and met by Town of Orleans personnel already on-site and beginning to load impacted soils from Zone B Eastern sidewall. Continue to load soil from Eastern sidewall and collect samples for screening, as follows:

SW-NE:	0-9’	7.1
SW-SE:	0-9’	0.6
SW-EN:	0-9’	2.5
Clean OB:		4.7
BOH –N @9’		2.6

Mobilize to Western sidewall and begin stripping clean OB to access impacted soils below.

9:00 am Collect SW samples from Western portion of excavation and screen with PID as follows:

SW-WN:	0-9’	8.0
SW-WS:	0-9’	2.3
SW-NW:	0-9’	9.7
SW-SW:	0-9’	ND
BOH-S@9’		18 → Dexsil: 362

9:30 am Mobe to area of Unit 7/HB-4. Instruct operator to remove surface material to approximately 4’ bgs.

10:00 am Collect a composite sidewall and BOH sample in Zone C. Screen with PID as follows:

SW-Comp:	0-4’	23.2
BOH	@4’	10.5

Instruct operator to remove additional soils from sidewall and BOH areas. Collect discrete samples and screen as follows:

SW-N:	0-5’	43.4
SW-S:	0-5’	3.1
SW-E:	0-5’	1.9
SW-W:	0-5’	0.5
BOH	@5’	40.3

Instruct operator to dig test pit in center of excavation; collect sample at depth and screen with PID and Dexsil:

Zone C

BOH	@7-8’	70.2 → Dexsil: EEEE (>2000)

Explain that impact is to at least 7-8’ and we will need to remove soils beyond that depth. DPW personnel prepare site for access to location by ramping down into cellar hole and changing grade of slope for loader access. Remove clean OB surrounding release area.

11:00 am Call DCB regarding 50 yards specified on BOL. Based on weight slips, approximately 53 yards shipped with another truck out for delivery. Dave will contact Bill at facility to advise.

Remove additional soils to approximately 9’ bgs in Zone C.

11:25 am Collect samples from representative sidewall and BOH areas; screen as follows:

Zone C

SW-N:	0-9’	5.0
SW-S:	0-9’	5.1
SW-E:	0-9’	8.3
SW-W:	0-9’	0.5
BOH	@9’	0.8

Final dimensions of Zone C are 8’ x 13’ x 9’D.

11:30 am Discuss Unit 8 with DPW personnel. Steve and Dennis performed demolition. They remember location of chimney and furnace next to chimney in central portion of basement. They did not see a tank at Unit 8 but remember fuel line running west. Instruct operator to perform two test pits at Western wall of former cottage Unit 8 for evidence of impact to soils.

12:00 pm Break for lunch.

1:00 pm Return from lunch. Perform test pit at Unit 8: clean sands observed in test pit. Instruct operator to move forward and continue. Concrete block and wood debris observed in test pit, underlain by clean sands. No evidence of impact from former tank observed in test pit.

1:10 pm Move to Unit #9 area of HB-6. Scrape down area of staining – smell old fuel oil fumes. Dig into layer of clay beneath, to collect discrete sidewall and BOH soil samples. Screen with PID as follows:

SW-N:	0-4’	16.3
SW-S:	0-4’	20.7
SW-E:	0-4’	44.6
SW-W:	0-4’	4.3
BOH	@4’	13.2

Request DPW personnel remove additional material from sidewall and BOH areas. Operator removes banking above the Eastern and Southern sidewalls to avoid collapsing into the hole.

2:00 pm Remove additional material from sidewall and BOH areas.

2:30 pm Collect representative soils samples from sidewall and BOH areas as follows:

Zone D

SW-N:	0-5’	0.7
SW-S:	0-5’	0.4
SW-E:	0-5’	ND
SW-W:	0-5’	0.1
BOH	@5’	0.5

Dimensions of excavation are 12’ x 12’ x 5’D.

Based on field screening results, soil removal is complete.

2:45 pm Pack up equipment.

3:05 pm Depart site.

2/8/16

Receive results of end point soil sampling results. Results report concentrations of EPH/PAHs below RCS-1 Concentrations in all samples from all locations. Notify client.

Submitted by:
BENNETT ENVIRONMENTAL ASSOCIATES, INC.
This Field Response Log is a compilation of field observations, interviews with individuals familiar with the project and a review of public record. As such, it is intended to be an accurate and complete record of pertinent information. However, based on the reliance on third party and hearsay information included, no guarantee or warranties of the accuracy and completeness of that information is expressed or implied.

Orleans Fire Department - Fire Prevention Office

58 Eldredge Park Way – Orleans, Massachusetts – 02653

Robert E. Felt Sr.
Capt Fire Inspector
email – rfelt@orleansfd.com
Phone 508-255-0050
Fax line 508-240-0855

October 20, 2010

To: Mr. Paul Fulcher
From: Captain Robert Felt
Re: 223 Beach Road

Mr. Fulcher,

As we noted yesterday the Heating Oil Tanks at the new property were not drained prior to closing. The amounts found are as follows:

Unit #6 was unreadable due to age / fogging of the gauge
Unit #7 is ¼ full
Unit # 8 is ½ full and has new non-compliant single walled tank
Unit # 9 is 3/8 full
The "Four Unit" building is ½ full (has the water leak been resolved?)
"Main unit" is ½ full
"Office building" is 3/8 full. This building also has 2nd tank which has large hole cut into one end and remains piped to outside fill and vent.

I have informed Chief Quinn of the status of these tanks and he has instructed me to Placard the fill fitting after these tanks are drained. This will prevent these tanks being inadvertently filled. Please keep in mind that there are state regulations that will not allow tanks to be abandoned in place. Therefore, a decision on the disposition of these tanks is required. Chief Quinn recommends that if any of these systems are to be used, an inspection and all necessary repairs and service be performed by a licensed technician prior to use.

Please inform me of the decision so that I may assist as needed.

Respectfully,

Captain Robert Felt, Fire Inspector
Orleans Fire Department

2235 Bldg. h

Orleans Fire and Rescue Department

58 Eldredge Park Way – Orleans, Massachusetts – 02653

William P. Quinn Jr
Fire Chief

email – wquinn@orleansfd.com

Phone 508-255-0050
Fax line 508-240-0855

To: Town of Orleans
From Chief Quinn
Re: Hubler Property

October 19, 2010

To whom it may concern,

As part of the sale of the Hubler property I was able to negotiate the pumping out of all of the oil tanks so that no leaks could occur during the uncertain future of the buildings. All of this came about as only one of the 7 oil tanks on the property had a permit taken out and that one could not be passed as it was only single walled.

Before any consideration is given to the future everyone must be aware that the tanks and oil burners are condemned. If we wanted to use this type of heating again the tanks must be replaced with double wall tanks and all of the burners must be serviced and blessed by a licensed oil burner technician. This could be a costly procedure.

My recommendation is to investigate with National Grid installing new equipment gas heating appliances in the buildings. There are programs that provide the appliances at cost in return for purchasing the gas from them.

Respectfully,

William P. Quinn Jr.
Orleans Fire Chief

Cc to files

The Commonwealth of Massachusetts
Department of Public Safety
527 CMR 4.00
Form 1

Application for Permit, Permit, and Certificate of Completion for the Installation or Alteration of Fuel Oil Burning Equipment and the Storage of Fuel Oil

ORLEANS (City or Town) 7/15/10 (Date)

Permit #'s: FD 2308 Elec.______ FDID #: 01224 Fee Paid: $ 25-

Brian 253-3348

Owner/Occupant Name: NAUSET BEACHSIDE MOTEL Tel.#: 508-237-8047

Installation Address: COTTAGE #8 Serviced Floor or Unit #:______

☐ Heating Unit ☐ Domestic Water Heater ☐ Power Vent ☐ Other______

Burner: ☐ New ☑ Existing ☐ Location:______

Trade Name:______ Mfg:______

Type:______ Model# or Size:______ Nozzle Size:______

☐ Fuel Oil ☐ Kerosene ☐ Waste Oil

Storage Tank: ☑ New ☐ Existing Location: OUTSIDE

Type: STEEL OVAL Capacity: 275 gallons No. of Tanks: 1

Special requirements (or additional safety devices)______

☐ OSV Valve ☒ Oil Line Protected ☐ Sheet Rock ☐ Sprinkler AFUE: ☐ yes ☐ no (Furnace and Boilers) EF: ☐ yes ☐ no (Water heater)

Co. Name: MOLDSTAD HEATING SERVICE Tel.# 508 896 6183

Address: P.O. 51 City: BREWSTER Zip: 02631

Completion Date:______

Combustion Test: Gross Stack Temp.:______ Net Stack Temp:______

CO_2 Test______ Breech Draft:______

Smoke:______ Overfire Draft:______ Efficiency Rating %:______

I, the undersigned certify that the installation of fuel burning equipment has been made in accordance with M.G.L. c. 148 and 527 CMR 4:00 currently in effect. Furthermore, this installation has been tested in accordance with such requirements, is now in proper operating condition and complete instructions as to its use and maintenance have been furnished to the person for whom the installation (or alteration) was made.

Installer: CHARLES A. MOLDSTAD (Print Name) 24868 (Cert of Comp. #) [signature] Signature (no stamp)

Address: P.O. 51 City: BREWSTER

Once signed by the fire department, this is a PERMIT for the storage and use of oil burning equipment.

Approved by:______ Date:______

REFER TO CHECKLIST ON REVERSE SIDE

Form Distribution: White: Fire Dept. (Application) Yellow: Installation (Permit To Store) Pink: Installer (Permit To Install)

This form approved by the State Fire Marshal and provided courtesy of the Mass. Oil Heat Council. Form design in NCR by Cotuit and COMM Fire Depts. July 1, 1996

Orleans Fire and Rescue Department

58 Eldredge Park Way – Orleans, Massachusetts – 02653

William P. Quinn Jr
Fire Chief

email – wquinn@orleansfd.com

Phone 508-255-0050
Fax line 508-240-0855

May 17, 2010

To: John Kelly
From: Chief Quinn
Re: 223 Beach Rd.

Dear Mr. Kelly,

I have inspected 223 Beach Rd as requested. Almost every building at the location has an active 275 gallon oil burner supply tank. There is one cottage that has an abandoned tank that is no longer in use due to rust and support legs missing. It is in a place that is not easily removed.

Without definite plans for the Town or its agent to operate this facility in the future I would recommend we ask the present owner/operator to maintain minimum levels in the oil tanks during this last season and until the closing. After the closing and the property should be placed in a winterized mode with regard to all plumbing. Unless we plan to sand and paint the remaining tanks we should have them drained and removed from the property. They are not in good repair and I see them causing the Town problems in the next few years. If we consider using the property again we could place a gas service into the complex and convert the burners.

For your consideration, we could find the best of the tanks and have it repaired so it could be used safely in the future. This tank could be installed in one of the cottages well into the complex and rented at a low cost to someone that could be responsible to be a caretaker to the property. Despite our Police's best efforts I can see the property becoming vandalized without someone traveling through the property every day.

Respectfully,

William P. Quinn Jr.
Orleans Fire Chief

Cc to files

ORLEANS FIRE DEPARTMENT / PUBLIC & COMMERCIAL FIRE PREVENTION INSPECTION
PHONE 255-0050

BUSINESS NAME Nauset Beach Side Motel DATE 5-26-99

BUSINESS ADDRESS 223 Beach Rd TEL NO 255-3348

OCCUPANT

BUILDING OWNERS NAME Betty Hubler TEL NO 255-1406

ADDRESS

Concrete walls on between all rooms

SD'S in All Apts 110 - Photo

HOUSEKEEPING GENERAL
1. Basement
2. 1st floor
3. 2nd floor
4. Attic or overhead
5. Shipping Area
6. Receiving Area
7. Trash Storage
8. Exterior of Buildings

EXITS
10. Unobstructed
11. Lighted
12. Exit Signs

STORAGE FACILITIES
13. Combustibles
14. Flammables
15. Chlorine
16. Cleaning Supplies

KITCHEN
17. Ductwork & Filters
18. Hoods
19. Fusible Links
20. Automatic extinguishing System

EXTINGUISHERS
21. Adequate
22. Proper Type
23. Current Inspection

SPRINKLER SYSTEM
24. Main valve open
25. Area accessable
26. Spare heads
27. Material stored away from heads
28. Siamese accessable

ELECTRICITY
29. Panel accessable & closed
30. Properly fused
31. Excessive extension cords
32. Emergency lighting
33. Outlets

LABEL ALL CIRCUIT BREAKERS

HEATING
34. General condition
35. Recent maintenance
36. Area free of flammable material & trash
37. Area accessable
38. Chimneys

LAYOUT
39. Proper aisle width
40. Adequate exits

EDUCATION
41. Emergency FD numbers posted
42. Employees trained in use of fire extinguishers
43. No smoking signs
44. Designated smoking areas

REINSPECTION DATE:

COMMENTS:
(1) Smoke Detector within 12" of wall 4-12" or on ceiling - Changed OK
(2) Abandoned oil Tank - Remove or obtain Cleaner - Have F.D. check when done
(3) Plugs in bathroom + kitchen should be GFI.
(4) Put directions in rooms to summon 911 - for Police - Fire + Rescue -
(5) Mount Fire Extinguishers on wall in kitchenette Apts / not under sinks
(6) Flammable, combustible cleaning supplies etc. store in metal cabinet away from Rooms
(7) Rooms 10-16 Front Concrete Patio - concrete is falling + breaking - Needs Repair
(8) Heater Room - Connector of [illegible] Pipe (TAPE) into Chimney Flue - 2" Cap 90 Straps to hold + replace Pipe to H.W. Heater -

SIGNATURE (operator/manager/owner) [signature]

INSPECTOR [signature] DATE: 5-26-99

B2

ORLEANS FIRE DEPARTMENT / PUBLIC & COMMERCIAL FIRE PREVENTION INSPECTION
PHONE 255-0050

BUSINESS NAME Nauset Beachside Motel DATE 5-26-99

BUSINESS ADDRESS ____ TEL NO ____

OCCUPANT ____

BUILDING OWNERS NAME ____ TEL NO ____

ADDRESS ____

HOUSEKEEPING GENERAL — Good to Excellent
1. Basement
2. 1st floor
3. 2nd floor
4. Attic or overhead
5. Shipping Area
6. Receiving Area
7. Trash Storage
8. Exterior of Buildings

EXITS — Good
10. Unobstructed
11. Lighted
12. Exit Signs

STORAGE FACILITIES — Store in metal cabinet away from motel room
13. Combustibles
14. Flammables
15. Chlorine
16. Cleaning Supplies

KITCHEN
17. Ductwork & Filters
18. Hoods
19. Fusible Links
20. Automatic extinguishing System

EXTINGUISHERS — OK in all kitchenettes
21. Adequate
22. Proper Type
23. Current Inspection

SPRINKLER SYSTEM — None
24. Main valve open
25. Area accessable
26. Spare heads
27. Material stored away from heads
28. Siamese accessable

ELECTRICITY
29. Panel accessable & closed
30. Properly fused
31. Excessive extension cords
32. Emergency lighting
33. Outlets

HEATING
34. General condition
35. Recent maintenance
36. Area free of flammable material & trash
37. Area accessable
38. Chimneys

LAYOUT
39. Proper aisle width
40. Adequate exits

EDUCATION
41. Emergency FD numbers posted
42. Employees trained in use of fire extinguishers
43. No smoking signs
44. Designated smoking areas

REINSPECTION DATE: ____

COMMENTS: (9) Move Rubbish Containers away from side of Motel
(10) Secure oil line / or put on a delayed oil valve –
(11) Move oil Burner E Switch to 1st Floor in Cottage # 3/4 – Winter Spring –
(12) Put # on cottage at door 3A, 3B etc – 5 - 6
(13) Raise 2nd Flr Cottage 3, A, 3B – Railing or replace – not stable –

SIGNATURE (operator/manager/owner) [illegible]

INSPECTOR [illegible] DATE: 5/26/99

The Commonwealth of Massachusetts
Department of Public Safety
527 CMR 4.00
Form 1

Application for Permit, Permit, and Certificate of Completion for the Installation or Alteration of Fuel Oil Burning Equipment and the Storage of Fuel Oil.

ORLEANS (City or Town) 11/17 (Date)

Permit #'s: FD 190 Elec.______ FDID #: 01224 Fee Paid: $______

Owner/Occupant Name: Nauset Beachside Motel Tel.#:______

Installation Address: 227 Beach Rd Serviced Floor or Unit #: 1

☐ Heating Unit ☐ Domestic Water Heater ☐ Power Vent ☐ Other______

Burner: ☐ New ☒ Existing ☐ Location:______

Trade Name:______ Mfg:______

Type:______ Model# or Size:______ Location:______

☒ Fuel Oil ☐ Kerosene ☐ Waste Oil

Storage Tank: ☒ New ☐ Existing Location: Outside

Type: Steel Capacity: 330 gallons No. of Tanks: 1

Special requirements (or additional safety devices)______

☐ OSV Valve ☒ Oil Line Protected ☐ Sheet Rock ☐ Sprinkler AFUE: ☐ yes ☐ no

Combustion Test Nozzle Size:______ Gross Stack Temp.:______

Net Stack Temp.: CO_2 Test______ Breech Draft:______

Smoke:______ Overfire Draft:______ Efficiency Rating %:______

I, the undersigned certify that the installation of fuel burning equipment has been made in accordance with M.G.L. c. 148 and 527 CMR 4:00 current in effect. Furthermore, this installation has been tested in accordance with such requirements, is now in proper operating condition and complete instructions as to its use and maintenances have been furnished to the person for whom the installation (or alteration) was made.

Co. Name: Benco Heating Service Phone 896-2972 Lic.# 02946

Address: 7 Pequot Ct. City: Brewster Zip: 02631

Installer: Steve Bengston Phone: Same [signature]
Print Name Signature (no stamp)

Once signed by the fire department, this is a PERMIT for the storage and use of oil burning equipment.

Inspected by: [signature] Date: 11/20/98

REFER TO CHECKLIST ON REVERSE SIDE

Form Distribution: White: Fire Dept. (Application) Yellow: Installation (Permit To Store) Pink: Installer (Permit To Install)

Form design in NCR format courtesy of Cotuit and COMM Fire Depts.

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC112

BILL OF LADING **(pursuant to 310 CMR 40.0030)**

Release Tracking Number
[ ] - LRA

A. LOCATION OF SITE OR DISPOSAL SITE WHERE REMEDIATION WASTE WAS GENERATED:

1. Release Name/Location Aid: **N/F Nauset Beach Motel**
2. Street Address: **223 Beach Rd.**
3. City/Town: **Orleans** 4. Zip Code: **02653-0000**

☐ 5. Check her if a Tier Classification Submittal has been provided to DEP for this disposal site:

☐ a. Tier 1A ☐ b. Tier 1B ☐ b. Tier 1C ☐ d. Tier II

6. If applicable provide the Permit Number:

B. THIS FORM IS BEING USED TO: (check one: B1-B4):

☑ 1. Submit a **Bill of Lading (BOL)** to transport Remediation Waste to Temporary Storage or a Receiving Facility. Response Actions associated with this BOL (check all that apply):

☐ a. Immediate Response Action (IRA)
☐ b. Release Abatement Measure (RAM)
☐ c. Downgradient Property Status (DPS)
☐ d. Utility Release Abatement Measure (URAM)
☐ e. Comprehensive Response Actions
☑ f.. Limited Removal Action (LRA): (must be retained pursuant to 310 CMR 40.0034(6); can't be submitted via eDEP)
☐ g. Other

☐ 2. Submit an Attestation of Completion of **Shipment to Temporary Storage** (Sections C, F and J are not required):

☐ 3. Submit an Attestation of Completion of **Shipment to a Receiving Facility** (Sections C, F and J are not required):

☐ 4. Certify that Remediation Waste Was **Not Shipped, and the Bill of Lading is Void.** (Sections C, D, E, and F are not required)

5. Date Bill of Lading submitted to the Department: (mm/dd/yyyy) b. eDEP Transaction ID:

SB 1/21/16

6. Period of Generation Associated with this Bill of Lading **12/23/2015** (mm/dd/yyyy) to **02/28/2016** (mm/dd/yyyy)

(All sections of this transmittal form must be filled out unless otherwise noted)
The Bill of Lading is not considered complete until the Attestation of Completion of Shipment is received by the Department.

C. DESCRIPTION OF WASTE AND WASTE SOURCE:

1. Contaminated Media /Debris (check all that apply):

☑ a. Soil ☐ b. Groundwater ☐ c. Surface Water ☐ d. Sediment ☐ e. Vegetation or Organic Debris

☐ f. Demolition/Construction Waste ☐ g. Inorganic Absorbent Materials ☐ h. Other:

2. Uncontainerized Waste (check all that apply):

☐ a. Inorganic Absorbent Materials ☐ b. Other:

C. DESCRIPTION OF WASTE AND WASTE SOURCE (cont.):

3. Containerized Waste (check all that apply):

☐ a. Tank Bottoms/Sludges ☐ b. Containers ☐ c. Drums ☐ d. Engineered Impoundments

☐ e. Other:

4. Estimated Quantity: 50.00 ☑ Tons ☐ Cu. Yds. ☐ Gallons

5. Contaminant Source (check one):

☐ a. Transportation Accident ☐ b. Underground Storage Tank ☐ c. Brownfields Redevelopment

☑ d. Other: ASTs

6. Type of Contaminant (check all that apply):

☐ a. Gasoline ☐ b. Diesel Fuel ☑ c. #2 Fuel Oil ☐ d. #4 Fuel Oil ☐ e. #6 Fuel Oil ☐ f. Jet Fuel

☐ g. Waste Oil ☐ h. Kerosene ☐ i. Chlorinated Solvents ☐ j. Urban Fill ☐ k. Other:

7. Constituents of Concern (check all that apply):

☐ a. As ☐ b. Cd ☐ c. Cr ☐ d. Pb ☐ e. Hg ☑ f. EPH/TPH ☐ g. VPH

☐ h. PCBs ☐ i. VOCs ☐ j. SVOCs ☐ k. Other:

8. If applicable, check the box for the Reportable Concentration Category of the site:

☑ a. RCS-1 ☐ b. RCS-2 ☐ c. RCGW-1 ☐ d. RCGW-2

9. Remediation Waste Characterization Documentation (check at least one):

☑ a. Site History Information ☑ b. Sampling Analytical Methods and Procedures ☑ c. Laboratory Data

☑ d. Field Screening Data ☐ e. Characterization Documentation previously submitted to the Department

i. Date submitted: (mm/dd/yyyy) ii. Type of Documentation:

D. TRANSPORTER OR COMMON CARRIER INFORMATION:

1. Transporter/Common Carrier Name: Town of Orleans - DPW
2. Contact First Name: Tom 3. Last Name: Daley
4. Street: 139 Main Street 5. Title: Director
6. City/Town: Orleans 7. State: MA 8. Zip Code: 02653-0000
9. Telephone: (508) 240-3700 10. Ext: 363 11. Fax:

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC112

BILL OF LADING (pursuant to 310 CMR 40.0030)

Release Tracking Number

[ ] - LRA

A. LOCATION OF SITE OR DISPOSAL SITE WHERE REMEDIATION WASTE WAS GENERATED:

1. Release Name/Location Aid: **N/F Nauset Beach Motel**

2. Street Address: **223 Beach Rd.**

3. City/Town: **Orleans** 4. Zip Code: **02653-0000**

☐ 5. Check her if a Tier Classification Submittal has been provided to DEP for this disposal site:

☐ a. Tier 1A ☐ b. Tier 1B ☐ b. Tier 1C ☐ d. Tier II

6. If applicable provide the Permit Number:

B. THIS FORM IS BEING USED TO: (check one: B1-B4):

☑ 1. Submit a **Bill of Lading (BOL)** to transport Remediation Waste to Temporary Storage or a Receiving Facility. Response Actions associated with this BOL (check all that apply):

☐ a. Immediate Response Action (IRA)
☐ b. Release Abatement Measure (RAM)
☐ c. Downgradient Property Status (DPS)
☐ d. Utility Release Abatement Measure (URAM)
☐ e. Comprehensive Response Actions
☑ f.. Limited Removal Action (LRA): (must be retained pursuant to 310 CMR 40.0034(6); can't be submitted via eDEP)
☐ g. Other

☐ 2. Submit an Attestation of Completion of **Shipment to Temporary Storage** (Sections C, F and J are not required):

☐ 3. Submit an Attestation of Completion of **Shipment to a Receiving Facility** (Sections C, F and J are not required):

☐ 4. Certify that Remediation Waste Was **Not Shipped, and the Bill of Lading is Void.** (Sections C, D, E, and F are not required)

5. Date Bill of Lading submitted to the Department: ____ (mm/dd/yyyy) b. eDEP Transaction ID: ____

6. Period of Generation Associated with this Bill of Lading **12/23/2015** (mm/dd/yyyy) to **01/30/2015** (mm/dd/yyyy)

(All sections of this transmittal form must be filled out unless otherwise noted)
The Bill of Lading is not considered complete until the Attestation of Completion of Shipment is received by the Department.

C. DESCRIPTION OF WASTE AND WASTE SOURCE:

1. Contaminated Media /Debris (check all that apply):

☑ a. Soil ☐ b. Groundwater ☐ c. Surface Water ☐ d. Sediment ☐ e. Vegetation or Organic Debris

☐ f. Demolition/Construction Waste ☐ g. Inorganic Absorbent Materials ☐ h. Other:

2. Uncontainerized Waste (check all that apply):

☐ a. Inorganic Absorbent Materials ☐ b. Other:

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BILL OF LADING (pursuant to 310 CMR 40.0030)

BWSC112

Release Tracking Number

☐ - LRA

C. DESCRIPTION OF WASTE AND WASTE SOURCE (cont.):

3. Containerized Waste (check all that apply):

☐ a. Tank Bottoms/Sludges ☐ b. Containers ☐ c. Drums ☐ d. Engineered Impoundments

☐ e. Other:

DB 2/2/2016

4. Estimated Quantity: ~~50.00~~ 100 ~~☑ Tons~~ ☑ Cu. Yds. ☐ Gallons

5. Contaminant Source (check one):

☐ a. Transportation Accident ☐ b. Underground Storage Tank ☐ c. Brownfields Redevelopment

☑ d. Other: ASTs

6. Type of Contaminant (check all that apply):

☐ a. Gasoline ☐ b. Diesel Fuel ☑ c. #2 Fuel Oil ☐ d. #4 Fuel Oil ☐ e. #6 Fuel Oil ☐ f. Jet Fuel

☐ g. Waste Oil ☐ h. Kerosene ☐ i. Chlorinated Solvents ☐ j. Urban Fill ☐ k. Other:

7. Constituents of Concern (check all that apply):

☐ a. As ☐ b. Cd ☐ c. Cr ☐ d. Pb ☐ e. Hg ☑ f. EPH/TPH ☐ g. VPH

☐ h. PCBs ☐ i. VOCs ☐ j. SVOCs ☐ k. Other:

8. If applicable, check the box for the Reportable Concentration Category of the site:

☑ a. RCS-1 ☐ b. RCS-2 ☐ c. RCGW-1 ☐ d. RCGW-2

9. Remediation Waste Characterization Documentation (check at least one):

☑ a. Site History Information ☑ b. Sampling Analytical Methods and Procedures ☑ c. Laboratory Data

☑ d. Field Screening Data ☐ e. Characterization Documentation previously submitted to the Department

i. Date submitted: (mm/dd/yyyy) ii. Type of Documentation:

D. TRANSPORTER OR COMMON CARRIER INFORMATION:

1. Transporter/Common Carrier Name: Town of Orleans - DPW

2. Contact First Name: Tom 3. Last Name: Daley

4. Street: 139 Main Street 5. Title: Director

6. City/Town: Orleans 7. State: MA 8. Zip Code: 02653-0000

9. Telephone: (508) 240-3700 10. Ext: 363 11. Fax:

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC112

BILL OF LADING (pursuant to 310 CMR 40.0030)

Release Tracking Number
[ ] - LRA

E. RECEIVING FACILITY/TEMPORARY STORAGE LOCATION:

1. Operator/Facility Name: Aggregate Industries
2. Contact First Name: William 3. Last Name: Reinhardt
4. Street: 230 Great Western Road 5. Title: GM of Environmental Safety
6. City/Town: South Dennis 7. State: MA 8. Zip Code: 02660-0000
9. Telephone: (781) 341-5500 10. Ext: 11. Fax:
12. Type of Facility: (Check one)
   a. Temporary Storage i. Period of Temporary Storage: ______ to ______ (mm/dd/yyyy) (mm/dd/yyyy)
   ii. Reason for Temporary Storage:
   [✓] b. Asphalt Batch/Hot Mix [ ] c. Landfill/Disposal [ ] d. Landfill/Structural Fill [ ] e. Landfill/Daily Cover
   [✓] f. Asphalt Batch/Cold Mix [ ] g. Thermal Processing [ ] h. Incinerator [ ] i. Other:
13. Division of Hazardous Waste/Class A Permit Number: S-01-027
14. Division of Solid Waste Permit Number:
15. EPA Identification Number: MAD985286384

F. LSP SIGNATURE AND STAMP:

I attest under the pains and penalties of perjury that I have personally examined and am familiar with this submittal form, including any and all documents accompanying this submittal. In my professional opinion and judgment based upon application of (i) the standard of care in 309 CMR 4.02(1), (ii) the applicable provisions of 309 CMR 4.02(2) and (3), and 309 CMR 4.03(2), and (iii) the provisions of 309 CMR 4.03(3), to the best of my knowledge, information and belief, the assessment action(s) undertaken to characterize the Remediation Waste which is (are) the subject of this submittal for acceptance at the facility identified in this submittal comply with applicable provisions of 310 CMR 40.0000, and such facility is permitted to accept Remediation Waste having the characteristics described in this submittal.

I am aware that significant penalties may result, including, but not limited to, possible fines and imprisonment, if I submit information which I know to be false, inaccurate or materially incomplete.

1. LSP #: 4303
2. First Name: David 3. Last Name: Bennett
4. Telephone: (508) 896-1706 5. Ext. 104
6. FAX: (508) 896-5109
7. Signature:
8. Date: 01/07/2016 (mm/dd/yyyy)
9. LSP Stamp: COMMONWEALTH OF MASSACHUSETTS DAVID C. BENNETT No. 4303 REGISTERED LICENSED SITE PROFESSIONAL

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC112

BILL OF LADING (pursuant to 310 CMR 40.0030)

Release Tracking Number

[ ] - LEA

G. PERSON SUBMITTING BILL OF LADING:

1. Check all that apply: [ ] a. change in contact name [ ] b. Change of address [ ] c. change in person undertaking response actions
2. Name of Organization: Town of Orleans
3. Contact First Name: Ron 4. Last Name: Collins
5. Street: 19 School Street 6. Title: Facilities Manager
7. City/Town: Orleans 8. State: MA 9. Zip Code: 02653-0000
10. Telephone: (508) 240-3700 11. Ext: 354 12. Fax:

H. RELATIONSHIP TO SITE OF PERSON SUBMITTING BILL OF LADING: [ ] Check here to change relationship

[✓] 1. RP or PRP: [✓] a. Owner [ ] b. Operator [ ] c. Generator [ ] d. Transporter

[ ] e. Other RP or PRP Specify:

[ ] 2. Fiduciary, Secured Lender or Municipality with Exempt Status (as defined by M.G.L. c.21E, s.2):

[ ] 3. Agency or Public Utility on a Right of Way (as defined by M.G.L. c.21E, s.5(j))

[ ] 4. Any Other person Undertaking Response Actions: Specify Relationship:

I. REQUIRED ATTACHMENTS AND SUBMITTALS :

[ ] 1. Check here if the Response Action(s) on which this opinion is based, if any, are (were) subject to any order(s), permit(s) and/or approvals issued by DEP or EPA. If the box is checked, you must attach a statement identifying the applicable provisions thereof.

[ ] 2. Check here if any non-updatable information provided on this form is incorrect, e. g. property address. Send corrections to BWSC.eDEP@state.ma.us

[✓] 3. Check here to certify that the LSP Opinion containing the material facts, data, and other information is attached.

J. CERTIFICATION OF PERSON SUBMITTING BILL OF LADING :

1. I, Ronald Collins, attest under the pains and penalties or perjury (i) that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this transmittal form, (ii) that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained in this submittal is, to the best of my knowledge and belief, true, accurate and complete, and (iii) that I am fully authorized to make this attestation on behalf of the entity legally responsible for this submittal. I/the person or entity on whose behalf this submittal is made am/is aware that there are significant penalties, including, but not limited to, possible fines and imprisonment for willfully submitting false, inaccurate, or incomplete information.

2. By: [signature] 3. Title: Facilities Director

4. For: Town of Orleans 5. Date: 01/07/2016

(Name of person or entity recorded in Section H) (mm/dd/yyyy)

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC112

BILL OF LADING **(pursuant to 310 CMR 40.0030)**

Release Tracking Number
[ ] - LRA

J. CERTIFICATION OF PERSON SUBMITTING BILL OF LADING (cont.) :

☐ 6. Check here if the address of the person providing certification is different from address recorded in Section H.

7. Street:

8. City/Town: 9. State: 10. Zip Code:

11. Telephone: 12. Ext: 13. Fax:

YOU ARE SUBJECT TO AN ANNUAL COMPLIANCE ASSURANCE FEE OF UP TO $10,000 PER BILLABLE YEAR FOR THIS DISPOSAL SITE. YOU MUST LEGIBLY COMPLETE ALL RELEVANT SECTIONS OF THIS FORM OR DEP MAY RETURN THE DOCUMENT AS INCOMPLETE. IF YOU SUBMIT AN INCOMPLETE FORM, YOU MAY BE PENALIZED FOR MISSING A REQUIRED DEADLINE.

Date Stamp (MassDEP USE ONLY):

SOIL RECYCLING SUBMITTAL
Revised 3/12/99

AGGREGATE INDUSTRIES

Environmental Services

1101 Turnpike Street, Stoughton, MA 02072 Tel: (781) 341-5500 Fax: (781) 341-2440

Site Information:

NAME	N/F Nauset Beach Motel	CONTACT	Ron Collins
STREET	223 Beach Road	PHONE	508-240-3700 ext.354
CITY / TOWN	Orleans	STATE / ZIP	MA 02653

Generator Information:

NAME	Town of Orleans	CONTACT	Ron Collins
STREET	19 School Road	PHONE	508-240-3700 ext.354
CITY / TOWN	Orleans	STATE / ZIP	MA 02653-3699

Consultant Information:

NAME	Bennett Environmental Associates, Inc.	CONTACT	David Bennett
STREET	1573 Main St. / P.O. Box 1743	PHONE	508-896-1706
CITY / TOWN	Brewster	STATE / ZIP	MA 02631

Estimated Soil Quantity:

TONS	50	CUBIC YARDS	30

Soil Contaminants (gasoline, diesel fuel, motor oil, etc.)

Virgin #2 fuel oil

Analyses Performed (check all that apply)

- [ ] TPH
- [ ] As
- [ ] pH
- [ ] Reactivity (S,CN)
- [ ] PCBs
- [ ] Flash
- [ ] Cr
- [ ] Pb
- [ ] VOCs
- [ ] Cd
- [ ] Hg
- [ ] TCLP (metals) if required based on total levels
- [x] other EPH w/4PAHs

- [ ] All the above tests were performed
- [x] Laboratory analytical data attached
- [x] Screening Data Attached

- [x] Instrument Used and Constituents Found 152 ppm on ThermoEnvironmental 580B OVM Photoionization detector.

Description / Source of Release:

UST	DATE OF RELEASE Historic
OTHER, DESCRIBE Leaks from AST fuel tanks at property	

Soil Description

PHYSICAL DESCRIPTION (SAND, GRAVEL, SILT, ETC.) Sand, silty sand
CLASSIFICATION METHOD USCS

Check if the following materials are present (check all that apply)

- [ ] CLAY
- [ ] CONSTRUCTION DEBRIS
- [ ] OTHER DELETERIOUS MATERIALS (PLEASE LIST)
- [ ] COAL
- [ ] VEGITATIVE MATTER
- [ ] ASH

Soil Characterization Methodology

Sampling Method

- [x] GRAB
- [ ] COMPOSITE
- [ ] BIASED SAMPLES (E.G. HEADSPACE SCREENED, VISUALLY CONTAMINATED)

CONSTITUTES OF CONCERN Petroleum, No.2 Fuel oil

Site History

- [ ] CHECK IF EXTRA SHEETS ATTACHED

CURRENT USE Vacant

PAST USE Motel

I, the generator, having used due diligence determined that there is no reason to suspect or believe that the petroleum contaminated soil has been impacted by any releases of oil or hazardous materials other than that of the known source or I have identified the additional oil and hazardous materials that are suspected or known to be present in the soil, in addition to those associated with the known release, including any anthropogenic contaminants.

I, the generator, realize that due diligence shall consisit of a search of information and records reasonably available to the generator of the contaminated soil and sufficient to make the determination. Such records and information may include, but are not limmited to, those of the generator, location of generation (i.e. facility if not the generator), the Department's Bureau of Waste Site Cleanup and the municipality (i.e. Board of Health, Fire Department) within which the site is located. **All samples for VOC analysis were collected according to DEP policy #99-415.**

SIGNATURE OF GENERATOR [signature]	DATE 1-7-16
GENERATOR - PRINTED NAME Ronald W. Collins	

A site diagram is required indicating any major structures or roads, excavation areas and stockpile locations. All sampling locations must be noted.

☑ CHECK IF DIAGRAM ATTACHED

Site Diagram

NAME OF INDIVIDUAL PREPARING DIAGRAM:

AGGREGATE INDUSTRIES

Aggregate Industries
Northeast Region
1101 Turnpike Street
Stoughton, Massachusetts 02072

Phone 781-344-1100
Fax 781-341-5523
www.aggregate-us.com

RECEIVED FEB 2 3 2016

February 10, 2016
R. Collins
Town of Orleans
19 School Rd
Orleans ,Ma 02653

Re: Soil,

Nauset Beach Motel
Beach Rd
Orleans, Ma

Release Tracking # **LRA**

Recyclable soil from the above referenced project was last received at our facility February 3 ,2016. A total of **161.38 tons** has been received from the project. I have since been advised that shipment is complete. I have attached a copy of the BOL, along with e-dep forms 112A & 112B to close the BOL.

Thank you for recycling with Aggregate Industries.

Regards,

W. Reinhardt

William R. Reinhardt
Manager

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC112

BILL OF LADING **(pursuant to 310 CMR 40.0030)**

Release Tracking Number

☐ - ☐

A. LOCATION OF SITE OR DISPOSAL SITE WHERE REMEDIATION WASTE WAS GENERATED:

1. Release Name/Location Aid: **N/F Nauset Beach Motel**
2. Street Address: **223 Beach Rd.**
3. City/Town: **Orleans** 4. Zip Code: **02653-0000**

☐ 5. Check her if a Tier Classification Submittal has been provided to DEP for this disposal site:

☐ a. Tier 1A ☐ b. Tier 1B ☐ b. Tier 1C ☐ d. Tier II

6. If applicable provide the Permit Number:

B. THIS FORM IS BEING USED TO: (check one: B1-B4):

☐ 1. Submit a **Bill of Lading (BOL)** to transport Remediation Waste to Temporary Storage or a Receiving Facility. Response Actions associated with this BOL (check all that apply):

☐ a. Immediate Response Action (IRA)
☐ b. Release Abatement Measure (RAM)
☐ c. Downgradient Property Status (DPS)
☐ d. Utility Release Abatement Measure (URAM)
☐ e. Comprehensive Response Actions
☐ f.. Limited Removal Action (LRA): (must be retained pursuant to 310 CMR 40.0034(6); can't be submitted via eDEP)
☐ g. Other

☐ 2. Submit an Attestation of Completion of **Shipment to Temporary Storage** (Sections C, F and J are not required):

☑ 3. Submit an Attestation of Completion of **Shipment to a Receiving Facility** (Sections C, F and J are not required):

☐ 4. Certify that Remediation Waste Was **Not Shipped, and the Bill of Lading is Void.** (Sections C, D, E, and F are not required)

5. Date Bill of Lading submitted to the Department: (mm/dd/yyyy) b. eDEP Transaction ID:

6. Period of Generation Associated with this Bill of Lading **12/23/2015** (mm/dd/yyyy) to **01/30/2015** (mm/dd/yyyy)

(All sections of this transmittal form must be filled out unless otherwise noted)

The Bill of Lading is not considered complete until the Attestation of Completion of Shipment is received by the Department.

C. DESCRIPTION OF WASTE AND WASTE SOURCE:

1. Contaminated Media /Debris (check all that apply):

☐ a. Soil ☐ b. Groundwater ☐ c. Surface Water ☐ d. Sediment ☐ e. Vegetation or Organic Debris

☐ f. Demolition/Construction Waste ☐ g. Inorganic Absorbent Materials ☐ h. Other:

2. Uncontainerized Waste (check all that apply):

☐ a. Inorganic Absorbent Materials ☐ b. Other:

C. DESCRIPTION OF WASTE AND WASTE SOURCE (cont.):

3. Containerized Waste (check all that apply):

☐ a. Tank Bottoms/Sludges ☐ b. Containers ☐ c. Drums ☐ d. Engineered Impoundments

☐ e. Other:

4. Estimated Quantity: ☐ Tons ☐ Cu. Yds. ☐ Gallons

5. Contaminant Source (check one):

☐ a. Transportation Accident ☐ b. Underground Storage Tank ☐ c. Brownfields Redevelopment

☐ d. Other:

6. Type of Contaminant (check all that apply):

☐ a. Gasoline ☐ b. Diesel Fuel ☐ c. #2 Fuel Oil ☐ d. #4 Fuel Oil ☐ e. #6 Fuel Oil ☐ f. Jet Fuel

☐ g. Waste Oil ☐ h. Kerosene ☐ i. Chlorinated Solvents ☐ j. Urban Fill ☐ k. Other:

7. Constituents of Concern (check all that apply):

☐ a. As ☐ b. Cd ☐ c. Cr ☐ d. Pb ☐ e. Hg ☑ f. EPH/TPH ☐ g. VPH

☐ h. PCBs ☐ i. VOCs ☐ j. SVOCs ☐ k. Other:

8. If applicable, check the box for the Reportable Concentration Category of the site:

☐ a. RCS-1 ☐ b. RCS-2 ☐ c. RCGW-1 ☐ d. RCGW-2

9. Remediation Waste Characterization Documentation (check at least one):

☐ a. Site History Information ☐ b. Sampling Analytical Methods and Procedures ☐ c. Laboratory Data

☐ d. Field Screening Data ☐ e. Characterization Documentation previously submitted to the Department

i. Date submitted: (mm/dd/yyyy) ii. Type of Documentation:

D. TRANSPORTER OR COMMON CARRIER INFORMATION:

1. Transporter/Common Carrier Name: **Town of Orleans - DPW**
2. Contact First Name: **Tom** 3. Last Name: **Daley**
4. Street: **139 Main Street** 5. Title: **Director**
6. City/Town: **Orleans** 7. State: **MA** 8. Zip Code: **02653-0000**
9. Telephone: **(508) 240-3700** 10. Ext: **363** 11. Fax:

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC112

Release Tracking Number

[ ] - [ ]

BILL OF LADING (pursuant to 310 CMR 40.0030)

E. RECEIVING FACILITY/TEMPORARY STORAGE LOCATION:

1. Operator/Facility Name: **Aggregate Industries**
2. Contact First Name: **William** 3. Last Name: **Reinhardt**
4. Street: **230 Great Western Road** 5. Title: **GM of Environmental Safety**
6. City/Town: **South Dennis** 7. State: **MA** 8. Zip Code: **02660-0000**
9. Telephone: **(781) 341-5500** 10. Ext: 11. Fax:
12. Type of Facility: (Check one)
   a. Temporary Storage i. Period of Temporary Storage: ________ to ________ (mm/dd/yyyy) (mm/dd/yyyy)
   ii. Reason for Temporary Storage:
   - [x] b. Asphalt Batch/Hot Mix
   - [ ] c. Landfill/Disposal
   - [ ] d. Landfill/Structural Fill
   - [ ] e. Landfill/Daily Cover
   - [x] f. Asphalt Batch/Cold Mix
   - [ ] g. Thermal Processing
   - [ ] h. Incinerator
   - [ ] i. Other:
13. Division of Hazardous Waste/Class A Permit Number: **S-01-027**
14. Division of Solid Waste Permit Number:
15. EPA Identification Number: **MAD985286384**

F. LSP SIGNATURE AND STAMP:

I attest under the pains and penalties of perjury that I have personally examined and am familiar with this submittal form, including any and all documents accompanying this submittal. In my professional opinion and judgment based upon application of (i) the standard of care in 309 CMR 4.02(1), (ii) the applicable provisions of 309 CMR 4.02(2) and (3), and 309 CMR 4.03(2), and (iii) the provisions of 309 CMR 4.03(3), to the best of my knowledge, information and belief, the assessment action(s) undertaken to characterize the Remediation Waste which is (are) the subject of this submittal for acceptance at the facility identified in this submittal comply with applicable provisions of 310 CMR 40.0000, and such facility is permitted to accept Remediation Waste having the characteristics described in this submittal.

I am aware that significant penalties may result, including, but not limited to, possible fines and imprisonment, if I submit information which I know to be false, inaccurate or materially incomplete.

1. LSP #:
2. First Name: 3. Last Name:
4. Telephone: 5. Ext.
6. FAX:
7. Signature: ____________________
8. Date: ________ (mm/dd/yyyy)
9. LSP Stamp:

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC112

BILL OF LADING (pursuant to 310 CMR 40.0030)

Release Tracking Number

☐ - ☐

G. PERSON SUBMITTING BILL OF LADING:

1. Check all that apply: ☐ a. change in contact name ☐ b. Change of address ☐ c. change in person undertaking response actions
2. Name of Organization: Town of Orleans
3. Contact First Name: Ron 4. Last Name: Collins
5. Street: 19 School Street 6. Title: Facilities Manager
7. City/Town: Orleans 8. State: MA 9. Zip Code: 02653-0000
10. Telephone: (508) 240-3700 11. Ext: 354 12. Fax:

H. RELATIONSHIP TO SITE OF PERSON SUBMITTING BILL OF LADING: ☐ Check here to change relationship

☑ 1. RP or PRP: ☑ a. Owner ☐ b. Operator ☐ c. Generator ☐ d. Transporter

☐ e. Other RP or PRP Specify:

☐ 2. Fiduciary, Secured Lender or Municipality with Exempt Status (as defined by M.G.L. c.21E, s.2):

☐ 3. Agency or Public Utility on a Right of Way (as defined by M.G.L. c.21E, s.5(j))

☐ 4. Any Other person Undertaking Response Actions: Specify Relationship:

I. REQUIRED ATTACHMENTS AND SUBMITTALS :

☐ 1. Check here if the Response Action(s) on which this opinion is based, if any, are (were) subject to any order(s), permit(s) and/or approvals issued by DEP or EPA. If the box is checked, you must attach a statement identifying the applicable provisions thereof.

☐ 2. Check here if any non-updatable information provided on this form is incorrect, e. g. property address. Send corrections to BWSC.eDEP@state.ma.us

☑ 3. Check here to certify that the LSP Opinion containing the material facts, data, and other information is attached.

J. CERTIFICATION OF PERSON SUBMITTING BILL OF LADING :

1. I, ______________________, attest under the pains and penalties or perjury (i) that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this transmittal form, (ii) that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained in this submittal is, to the best of my knowledge and belief, true, accurate and complete, and (iii) that I am fully authorized to make this attestation on behalf of the entity legally responsible for this submittal. I/the person or entity on whose behalf this submittal is made am/is aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate, or incomplete information.

2. By: 3. Title:

4. For 5. Date:
(Name of person or entity recorded in Section H) (mm/dd/yyyy)

J. CERTIFICATION OF PERSON SUBMITTING BILL OF LADING (cont.) :

☐ 6. Check here if the address of the person providing certification is different from address recorded in Section H.

7. Street:

8. City/Town: 9. State: 10. Zip Code:

11. Telephone: 12. Ext: 13. Fax:

YOU ARE SUBJECT TO AN ANNUAL COMPLIANCE ASSURANCE FEE OF UP TO $10,000 PER BILLABLE YEAR FOR THIS DISPOSAL SITE. YOU MUST LEGIBLY COMPLETE ALL RELEVANT SECTIONS OF THIS FORM OR DEP MAY RETURN THE DOCUMENT AS INCOMPLETE. IF YOU SUBMIT AN INCOMPLETE FORM, YOU MAY BE PENALIZED FOR MISSING A REQUIRED DEADLINE.

Date Stamp (MassDEP USE ONLY):

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BWSC112A

BILL OF LADING (pursuant to 310 CMR 40.0030)

SUMMARY OF SHIPMENT SHEET 1 **OF** 1

Release Tracking Number
 - LRA

A. SUMMARY OF SHIPMENT (To be filled out by the receiving facility upon receipt of Remediation Waste):

1. Date of Shipment: (mm/dd/yyyy)	2. Date of Receipt: (mm/dd/yyyy)	3. Number of Loads Shipped:	4. Daily Volume Shipped: ☐ yds³ ☑ tons ☐ gals
	2-1-16	3	57.46
	2-2-16	4	82.96
	2-3-16	1	20.96
5. Totals Recorded on this Summary of Shipment Sheet:		8	161.38

B. ☐ Check here if additional BWSC112A BOL Summary Sheets are needed.

Massachusetts Department of Environmental Protection
Bureau of Waste Site Cleanup

BILL OF LADING (pursuant to 310 CMR 40.0030)
SUMMARY SHEET SIGNATURE PAGE

BWSC112B

Release Tracking Number

[ ] - LRA

A. ACKNOWLEDGEMENT OF RECEIPT OF REMEDIATION WASTE AT RECEIVING FACILITY OR TEMPORARY STORAGE:

1. I, William R. Reinhardt, attest under the pains and penalties or perjury (i) that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this transmittal form, (ii) that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained in this submittal is, to the best of my knowledge and belief, true, accurate and complete, and (iii) that I am fully authorized to make this attestation on behalf of the entity legally responsible for this submittal. I/the person or entity on whose behalf this submittal is made am/is aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate, or incomplete information.

2. By: **William R. Reinhardt** 3. Title: **Mngr. Env. Srvcs.**

4. For: **Aggregate Industries** 5. Date: 2-10-16 (mm/dd/yyyy)

6. Date of Final Shipment associated with this Bill of Lading: 2-3-16 (mm/dd/yyyy)

B. ACKNOWLEDGEMENT OF SHIPMENT AND RECEIPT OF REMEDIATION WASTE BY PERSON CONDUCTING RESPONSE ACTIONS ASSOCIATED WITH THIS BILL OF LADING:

1. I, [signature], attest under the pains and penalties or perjury (i) that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this transmittal form, (ii) that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained in this submittal is, to the best of my knowledge and belief, true, accurate and complete, and (iii) that I am fully authorized to make this attestation on behalf of the entity legally responsible for this submittal. I/the person or entity on whose behalf this submittal is made am/is aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate, or incomplete information.

2. By: RONALD W. COLLINS 3. Title: BLDG & FACILITIES MANAGER

4. For: TOWN OF ORLEANS, ORLEANS MA 5. Date: 02/18/2016
(Name of person or entity recorded in Section G) (mm/dd/yyyy)

☐ 6. Check here if the address of the person providing certification is different from address recorded in BWSC112 Section H.

7. Street: ______

8. City/Town: ______ 9. State: ______ 10. Zip Code: ______

11. Telephone: ______ 12. Ext: ______ 13. Email: ______

☐ 14. Check here if attaching optional supporting documentation such as copies of Load Information Summary Sheets

R.I. ANALYTICAL
Specialists in Environmental Services

ß/

CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.
Attn: Mr. David Bennett
1573 Main St.
P.O. Box 1743
Brewster, MA 02631

Date Received: 12/16/15
Date Reported: 12/21/15
P.O. #: BEA15-10815
Work Order #: 1512-27329

DESCRIPTION: PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Subject sample(s) has/have been analyzed by our Warwick, RI laboratory with the attached results.

Reference: All parameters were analyzed by U.S. EPA and Massachusetts Contingency Plan (MCP) approved methodologies where applicable. The specific methodologies are listed in the methods column of the Certificate of Analysis.

Data qualifiers (if present) are explained in full at the end of a given sample's analytical results.

Certification #: RI LAI00033, MA M-RI015, CT PH-0508, ME RI00015
NH 2537, NY 11726

This Certificate represents all data associated with the referenced work order and is paginated for completeness. The complete Certificate includes one attachment; the original Chain of Custody.

If you have any questions regarding this work, or if we may be of further assistance, please contact our customer service department.

Approved by:

Data Reporting

enc: Chain of Custody

Customer Name : Bennett Environmental Assoc.

Work Order #: 1512-27329

MassDEP Analytical Protocol Certification Form

Laboratory Name: R.I. Analytical Laboratories   Work Order #: 1512-27329

Project / Location: PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL   RTN :

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):

1512-27329-001 through 1512-27329-004

Matrices: ☐ Groundwater/Surface Water ☒ Soil / Sediment ☐ Drinking Water ☐ Air ☐ Other

CAM Protocol (check all that apply below):

8260 VOC CAM II A ☐	7470/7471 Hg CAM III B ☐	MassDEP VPH CAM IV A ☐	8081 Pesticides CAM V B ☐	7196 Hex Cr CAM VI B ☐	MassDEP APH CAM IX A ☐
8270 SVOC CAM II B ☐	7010 Metals CAM III C ☐	MassDEP EPH CAM IV B ☒	8151 Herbicides CAM V C ☐	8330 Explosives CAM VIII A ☐	TO-15 VOC CAM IX B ☐
6010 Metals CAM III A ☐	6020 Metals CAM III D ☐	8082 PCB CAM V A ☐	9014 Total Cyanide /PAC CAM VI A ☐	6860 Perchlorate CAM V111 B ☐	

Affirmative responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	☒ Yes ☐ No
B	Were the analytical methods(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	☒ Yes ☐ No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	☒ Yes ☐ No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	☒ Yes ☐ No
E	a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s) ? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	a. ☒ Yes ☐ No b. ☐ Yes ☐ No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	☒ Yes ☐ No

Responses to Questions G,H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	☒ Yes ☐ No[1]

***Data User Note:** Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.*

H	Were all QC performance standards specified in the CAM protocol(s) achieved?	☐ Yes ☒ No[1] [illegible]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	☐ Yes ☒ No[1] [illegible]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, is accurate and complete.

Signature: [signature]   Position: Laboratory Director

Printed Name: Eric H. Jensen   Date: 12/21/15

Case Narrative

Date: 12/21/2015

Bennett Environmental Assoc.
Attn: Mr. David Bennett

1573 Main St.
P.O. Box 1743
Brewster, MA 02631

Project: PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Work Order #: 1512-27329

All QA/QC procedures required by the EPH Method were followed. All performance/acceptance standards for the required QA/QC procedures were achieved or otherwise stated in this case narrative. A fractionation check was performed on the silica gel lot associated with this sample and found to pass the method criteria unless otherwise stated here. The data reported for this sample was not corrected for instrument/solvent baseline effects. No significant modifications were made to the EPH Method.

The following exceptions were noted for this Work Order:

Extractable Petroleum Hydrocarbons

Question H - The recovery of n-Nonane in the LCS was below the MCP limit of 30%. non target analyte w/[illegible] accuracy criteria. Low accuracy and precision consider as potential low bias as meeting [illegible] for initial assessment as PC

Question I - The EPH Method limited PAH list was reported as requested on the Chain of Custody.

There were no additional exceptions or analytical issues to discuss concerning the testing requirements for the project. Know [illegible] source as PC

R.I. Analytical Laboratories, Inc.
CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.

Date Received: 12/16/15

Work Order #: 1512-27329

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 001
SAMPLE DESCRIPTION: HB-1: 0-4'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 12/15/2015 @ 13:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	720	24	mg/kg dry	MADEP EPH-04-1.1	12/18/15	18:43	KS
C19-C36 Aliphatics	100	24	mg/kg dry	MADEP EPH-04-1.1	12/18/15	18:43	KS
Unadj. C11-C22 Aromatics	450	24	mg/kg dry	MADEP EPH-04-1.1	12/18/15	18:43	KS
Adj. C11-C22 Aromatics	430	24	mg/kg dry	MADEP EPH-04-1.1	12/18/15	18:43	KS
Target PAH Analytes							
Naphthalene	1.9	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	18:43	KS
2-Methylnaphthalene	12	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	18:43	KS
Acenaphthene	0.56	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	18:43	KS
Phenanthrene	2.7	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	18:43	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	81		40-140%	MADEP EPH-04-1.1	12/18/15	18:43	KS
Ortho-terphenyl	96		40-140%	MADEP EPH-04-1.1	12/18/15	18:43	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	115		40-140%	MADEP EPH-04-1.1	12/18/15	18:43	KS
2-Bromonaphthalene	98		40-140%	MADEP EPH-04-1.1	12/18/15	18:43	KS
Extraction Date				MADEP EPH-04-1.1	12/18/15	10:20	AK

R.I. Analytical Laboratories, Inc.
CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.

Date Received: 12/16/15

Work Order #: 1512-27329

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 002
SAMPLE DESCRIPTION: HB-2: 2-4'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 12/15/2015 @ 13:45

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	1900	24	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:21	KS
C19-C36 Aliphatics	310	24	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:21	KS
Unadj. C11-C22 Aromatics	350	24	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:21	KS
Adj. C11-C22 Aromatics	340	24	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:21	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:21	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:21	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:21	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:21	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	80		40-140%	MADEP EPH-04-1.1	12/18/15	19:21	KS
Ortho-terphenyl	86		40-140%	MADEP EPH-04-1.1	12/18/15	19:21	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	90		40-140%	MADEP EPH-04-1.1	12/18/15	19:21	KS
2-Bromonaphthalene	97		40-140%	MADEP EPH-04-1.1	12/18/15	19:21	KS
Extraction Date				MADEP EPH-04-1.1	12/18/15	10:20	AK

R.I. Analytical Laboratories, Inc.
CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.

Date Received: 12/16/15

Work Order #: 1512-27329

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 003
SAMPLE DESCRIPTION: HB-3: 0-4'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 12/15/2015 @ 14:15

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:59	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:59	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:59	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:59	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:59	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:59	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:59	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	19:59	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	85		40-140%	MADEP EPH-04-1.1	12/18/15	19:59	KS
Ortho-terphenyl	81		40-140%	MADEP EPH-04-1.1	12/18/15	19:59	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	94		40-140%	MADEP EPH-04-1.1	12/18/15	19:59	KS
2-Bromonaphthalene	99		40-140%	MADEP EPH-04-1.1	12/18/15	19:59	KS
Extraction Date				MADEP EPH-04-1.1	12/18/15	10:20	AK

R.I. Analytical Laboratories, Inc.
CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.

Date Received: 12/16/15

Work Order #: 1512-27329

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 004
SAMPLE DESCRIPTION: HB-4: 0-3'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 12/15/2015 @ 14:45

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	740	23	mg/kg dry	MADEP EPH-04-1.1	12/18/15	20:38	KS
C19-C36 Aliphatics	290	23	mg/kg dry	MADEP EPH-04-1.1	12/18/15	20:38	KS
Unadj. C11-C22 Aromatics	300	23	mg/kg dry	MADEP EPH-04-1.1	12/18/15	20:38	KS
Adj. C11-C22 Aromatics	290	23	mg/kg dry	MADEP EPH-04-1.1	12/18/15	20:38	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	20:38	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	20:38	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	20:38	KS
Phenanthrene	0.40	0.4	mg/kg dry	MADEP EPH-04-1.1	12/18/15	20:38	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	97		40-140%	MADEP EPH-04-1.1	12/18/15	20:38	KS
Ortho-terphenyl	87		40-140%	MADEP EPH-04-1.1	12/18/15	20:38	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	92		40-140%	MADEP EPH-04-1.1	12/18/15	20:38	KS
2-Bromonaphthalene	120		40-140%	MADEP EPH-04-1.1	12/18/15	20:38	KS
Extraction Date				MADEP EPH-04-1.1	12/18/15	10:20	AK

QA/QC Report

Client: Bennett Environmental Assoc.
WO #: 1512-27329
Date: 12/21/2015

-Method Blanks Results-

Parameter	Units	Results	Date Analyzed
Extractable Petroleum Hydrocarbons with PAH			
C9-C18 Aliphatics	mg/kg dry	<20	12/18/2015
C19-C36 Aliphatics	mg/kg dry	<20	12/18/2015
Unadj. C11-C22 Aromatics	mg/kg dry	<20	12/18/2015
Adj. C11-C22 Aromatics	mg/kg dry	<20	12/18/2015
Target PAH Analytes			12/18/2015
Naphthalene	mg/kg dry	<0.4	12/18/2015
2-Methylnaphthalene	mg/kg dry	<0.4	12/18/2015
Acenaphthene	mg/kg dry	<0.4	12/18/2015
Phenanthrene	mg/kg dry	<0.4	12/18/2015
Extraction Surrogates	**RANGE**		12/18/2015
5-alpha-Androstane	40-140%	91	12/18/2015
Ortho-terphenyl	40-140%	85	12/18/2015
Fractionation Surrogates	**RANGE**		12/18/2015
2-Fluorobiphenyl	40-140%	90	12/18/2015
2-Bromonaphthalene	40-140%	84	12/18/2015

-LCS/LCS Duplicate Data Results-

Parameter	CRM Acceptance Limits	Spike Conc	LCS Conc	LCS % Rec	LCS Dup Conc	LCS DUP % Rec	% RPD	Date Analyzed
Extractable Petroleum Hydrocarbons with PAH - Solids								
Target PAH Analytes								
Naphthalene		3.33	2.04	61	1.92	58	6	12/18/2015
2-Methylnaphthalene		3.33	2.19	66	2.04	61	7	12/18/2015
Acenaphthene		3.33	2.35	71	2.14	64	9	12/18/2015
Phenanthrene		3.33	2.73	82	2.42	73	12	12/18/2015
Aliphatic Analytes								
n-Nonane		3.33	0.98	29	1.24	37	23	12/18/2015
n-Decane		3.33	1.49	45	1.81	54	19	12/18/2015
n-Dodecane		3.33	1.91	57	2.26	68	17	12/18/2015
n-Tetradecane		3.33	2.23	67	2.64	79	17	12/18/2015
n-Hexadecane		3.33	2.44	73	2.95	89	19	12/18/2015
n-Octadecane		3.33	2.52	76	3.08	92	20	12/18/2015
n-Nonadecane		3.33	2.44	73	2.94	88	19	12/18/2015
n-Eicosane		3.33	2.41	72	3.15	95	27	12/18/2015
n-Docasane		3.33	2.59	78	3.06	92	17	12/18/2015
n-Tetracosane		3.33	2.60	78	3.05	92	16	12/18/2015
n-Hexacosane		3.33	2.58	77	3.03	91	16	12/18/2015
n-Octacosane		3.33	2.52	76	2.96	89	16	12/18/2015
n-Triacontane		3.33	2.43	73	2.85	86	16	12/18/2015
n-Hexatriacontane		3.33	2.15	65	2.51	75	15	12/18/2015
Extraction Surrogates								
5-alpha-Androstane			83		94			12/18/2015
Ortho-terphenyl			90		83			12/18/2015
Fractionation Surrogates								
2-Fluorobiphenyl			92		94			12/18/2015
2-Bromonaphthalene			84		87			12/18/2015
Breakthrough Analytes								
Naphthalene-			0		0			12/18/2015
2-Methylnaphthalene-			0		0			12/18/2015

R.I. ANALYTICAL
Specialists in Environmental Services

CHAIN OF CUSTODY RECORD

41 Illinois Avenue
Warwick, RI 02888-3007
800-937-2580 • Fax: 401-738-1970

131 Coolidge St., Suite 105
Hudson, MA 01749-1331
800-937-2580 • Fax: 978-568-0078

12-16-15

Date Collected	Time Collected	Field Sample Identification	Grab or Composite	# of Containers & Type C	Preservation Code P	Matrix Code M	EPH with 4PAHs
12/15/15	1:00 pm	HB-1: 0-4'	G	1G	NP	S	X
12/15/15	1:45 pm	HB-2: 2-4'	G	1G	NP	S	X
12/15/15	2:15 pm	HB-3: 0-4'	G	1G	NP	S	X
12/15/15	2:45 pm	HB-4: 0-3'	G	1G	NP	S	X

4

Client Information

Company Name:	Bennett Environmental Associates, Inc.
Address:	1573 Main St. / P.O. Box 1743
City / State / Zip:	Brewster, MA 02631
Telephone:	508-896-1706 Fax: 508-896-5109
Contact Person:	D. Bennett/JT

Project Information

Project Name:	T.O. Orleans – Nauset Beach Motel
P.O. Number:	BEA15-10815 Project Number: BEA15-10815
Report To:	D. Bennett Phone: 508-896-1706 Fax 508-896-5109
Sampled by:	JTW
Quote No:	
Email report to these addresses:	dbennett@bennett-ea.com; jtadema-wielandt@bennett-

Relinquished By Signatures	Date	Time	Received By Signatures	Date	Time
[illegible signature]	12/15/15	4:30pm	BEA sample fridge	12/15/15	4:30pm
[illegible signature]	12/16/15	1205	[illegible signature]	12/16/15	1205
[illegible signature]	12/16/15	1830	[illegible signature]	12/16/15	1830

Turn Around Time

	Normal	EMAIL Report
X	5 Business days. Possible surcharge	
	Rush – Date Due: __/__/__	

Project Comments

Circle if applicable: GW-1, GW-2, GW-3, S-1, S-2, S-3 MCP Data Enhancement QC Package? Yes No

Temp. Upon Receipt 2.4 °C

Lab Use Only

X	Sample Pick Up Only
	RIAL sampled; attach field hours
X	Shipped on ice

Workorder No: 1512-27329

Containers: P=Poly, G=Glass, AG=Amber Glass, V=Vial, St=Sterile Preservatives: A=Ascorbic Acid, NH4=NH_4Cl, H=HCl, M=MeOH, N=HNO_3, NP=None, S=H_2SO_4, SB=$NaHSO_4$, SH=NaOH, T=$Na_2S_2O_3$, Z=ZnOAc
Matrix Codes: GW=Groundwater, SW=Surface Water, WW=Wastewater, DW=Drinking Water, S=Soil, SL=Sludge, A=Air, B=Bulk/Solid, WP=Wipe, O=______

Project: PROJECT# BEA15-10815 T.O. ORLEANS-NAUSET BEACH MOTEL

RI ANALYTICAL Work Order # 1512-27329

	Sample Number:	1	2	3	4	Standards
	Sample Identification:	HB-1: 0-4'	HB-2: 2-4'	HB-3:0-4'	HB-4: 0-3'	MA
	Sample Date:	01/22/2015 @ 09:00AM	01/22/2015 @ 02:30PM	01/22/2015 @ 11:30AM	01/22/2015 @ 12:00PM	S-1/GW-1
PARAMETER						
EPH/PAH (mg/kg)						
C9-C18 Aliphatics		720	**1900**	<21	740	1000
C19-C36 Aliphatics		100	310	<21	290	3000
Adj. C11-C22 Aromatics		430	340	<21	290	1000
Naphthalene		1.9	<0.4	<0.4	<0.4	4
2-Methylnaphthalene		**12**	<0.4	<0.4	<0.4	0.7
Acenaphthene		0.56	<0.4	<0.4	<0.4	4
Phenanthrene		2.7	<0.4	<0.4	0.4	10

R.I. ANALYTICAL
Specialists in Environmental Services

DB/

CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.
Attn: Mr. David Bennett
1573 Main St.
P.O. Box 1743
Brewster, MA 02631

Date Received: 12/28/15
Date Reported: 12/30/15
P.O. #: BEA15-10815
Work Order #: 1512-28055

DESCRIPTION: PROJECT# BEA15-10815 TO ORLEANS - NAUSET BEACH MOTEL

Subject sample(s) has/have been analyzed by our Warwick, RI laboratory with the attached results.

Reference: All parameters were analyzed by U.S. EPA and Massachusetts Contingency Plan (MCP) approved methodologies where applicable. The specific methodologies are listed in the methods column of the Certificate of Analysis.

Data qualifiers (if present) are explained in full at the end of a given sample's analytical results.

Certification #: RI LAI00033, MA M-RI015, CT PH-0508, ME RI00015
NH 2537, NY 11726

This Certificate represents all data associated with the referenced work order and is paginated for completeness. The complete Certificate includes one attachment; the original Chain of Custody.

If you have any questions regarding this work, or if we may be of further assistance, please contact our customer service department.

Approved by:

Data Reporting

enc: Chain of Custody

Customer Name : Bennett Environmental Assoc.

Work Order #: 1512-28055

MassDEP Analytical Protocol Certification Form

Laboratory Name: R.I. Analytical Laboratories   Work Order #: 1512-28055

Project / Location: PROJECT# BEA15-10815 TO ORLEANS - NAUSET BEACH MOTEL   RTN :

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):

1512-28055-001 through 1512-28055-002

Matrices: ☐ Groundwater/Surface Water ☒ Soil / Sediment ☐ Drinking Water ☐ Air ☐ Other

CAM Protocol (check all that apply below):

8260 VOC CAM II A ☐	7470/7471 Hg CAM III B ☐	MassDEP VPH CAM IV A ☐	8081 Pesticides CAM V B ☐	7196 Hex Cr CAM VI B ☐	MassDEP APH CAM IX A ☐
8270 SVOC CAM II B ☐	7010 Metals CAM III C ☐	MassDEP EPH CAM IV B ☒	8151 Herbicides CAM V C ☐	8330 Explosives CAM VIII A ☐	TO-15 VOC CAM IX B ☐
6010 Metals CAM III A ☐	6020 Metals CAM III D ☐	8082 PCB CAM V A ☐	9014 Total Cyanide /PAC CAM VI A ☐	6860 Perchlorate CAM V111 B ☐	

Affirmative responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	☒ Yes ☐ No
B	Were the analytical methods(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	☒ Yes ☐ No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	☒ Yes ☐ No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	☒ Yes ☐ No
E	a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s) ? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	☒ Yes ☐ No ☐ Yes ☐ No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	☒ Yes ☐ No

Responses to Questions G,H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	☒ Yes ☐ No[1]

***Data User Note:** Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.*

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	☒ Yes ☐ No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	☐ Yes ☒ No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, is accurate and complete.

Signature: [signature]   Position: Laboratory Director

Printed Name: Eric H. Jensen   Date: 12-31-15

Case Narrative

Date: 12/30/2015

Bennett Environmental Assoc.
Attn: Mr. David Bennett

1573 Main St.
P.O. Box 1743
Brewster, MA 02631

Project: PROJECT# BEA15-10815 TO ORLEANS - NAUSET BEACH MOTEL

Work Order #: 1512-28055

All QA/QC procedures required by the EPH Method were followed. All performance/acceptance standards for the required QA/QC procedures were achieved or otherwise stated in this case narrative. A fractionation check was performed on the silica gel lot associated with this sample and found to pass the method criteria unless otherwise stated here. The data reported for this sample was not corrected for instrument/solvent baseline effects. No significant modifications were made to the EPH Method.

The following exceptions were noted for this Work Order:

Extractable Petroleum Hydrocarbons

Question I - The EPH Method limited PAH list was reported as requested on the Chain of Custody. PAH's reported are targets for known virgin fuel oil source as meeting RC

There were no additional exceptions or analytical issues to discuss concerning the testing requirements for the project.

R.I. Analytical Laboratories, Inc.
CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.

Date Received: 12/28/15

Work Order #: 1512-28055

PROJECT# BEA15-10815 TO ORLEANS - NAUSET BEACH MOTEL

Sample # 001
SAMPLE DESCRIPTION: HB-5:0-4'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 12/23/2015 @ 13:30

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:08	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:08	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:08	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:08	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:08	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:08	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:08	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:08	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	70		40-140%	MADEP EPH-04-1.1	12/29/15	23:08	KS
Ortho-terphenyl	78		40-140%	MADEP EPH-04-1.1	12/29/15	23:08	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	101		40-140%	MADEP EPH-04-1.1	12/29/15	23:08	KS
2-Bromonaphthalene	104		40-140%	MADEP EPH-04-1.1	12/29/15	23:08	KS
Extraction Date				MADEP EPH-04-1.1	12/29/15	8:25	KS

R.I. Analytical Laboratories, Inc.
CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.

Date Received: 12/28/15

Work Order #: 1512-28055

PROJECT# BEA15-10815 TO ORLEANS - NAUSET BEACH MOTEL

Sample # 002
SAMPLE DESCRIPTION: HB-6:0-4'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 12/23/2015 @ 14:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	740	23	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:46	KS
C19-C36 Aliphatics	160	23	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:46	KS
Unadj. C11-C22 Aromatics	720	23	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:46	KS
Adj. C11-C22 Aromatics	720	23	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:46	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:46	KS
2-Methylnaphthalene	0.63	0.4	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:46	KS
Acenaphthene	0.61	0.4	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:46	KS
Phenanthrene	2.8	0.4	mg/kg dry	MADEP EPH-04-1.1	12/29/15	23:46	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	69		40-140%	MADEP EPH-04-1.1	12/29/15	23:46	KS
Ortho-terphenyl	89		40-140%	MADEP EPH-04-1.1	12/29/15	23:46	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	103		40-140%	MADEP EPH-04-1.1	12/29/15	23:46	KS
2-Bromonaphthalene	107		40-140%	MADEP EPH-04-1.1	12/29/15	23:46	KS
Extraction Date				MADEP EPH-04-1.1	12/29/15	8:25	KS

QA/QC Report

Client: Bennett Environmental Assoc.
WO #: 1512-28055
Date: 12/30/2015

-Method Blanks Results-

Parameter	Units	Results	Date Analyzed
Extractable Petroleum Hydrocarbons with PAH			
C9-C18 Aliphatics	mg/kg dry	<20	12/29/2015
C19-C36 Aliphatics	mg/kg dry	<20	12/29/2015
Unadj. C11-C22 Aromatics	mg/kg dry	<20	12/29/2015
Adj. C11-C22 Aromatics	mg/kg dry	<20	12/29/2015
Target PAH Analytes			12/29/2015
Naphthalene	mg/kg dry	<0.4	12/29/2015
2-Methylnaphthalene	mg/kg dry	<0.4	12/29/2015
Acenaphthene	mg/kg dry	<0.4	12/29/2015
Phenanthrene	mg/kg dry	<0.4	12/29/2015
Extraction Surrogates	**RANGE**		12/29/2015
5-alpha-Androstane	40-140%	83	12/29/2015
Ortho-terphenyl	40-140%	77	12/29/2015
Fractionation Surrogates	**RANGE**		12/29/2015
2-Fluorobiphenyl	40-140%	81	12/29/2015
2-Bromonaphthalene	40-140%	83	12/29/2015

-LCS/LCS Duplicate Data Results-

Parameter	CRM Acceptance Limits	Spike Conc	LCS Conc	LCS % Rec	LCS Dup Conc	LCS DUP % Rec	% RPD	Date Analyzed
Extractable Petroleum Hydrocarbons with PAH - Solids								
Target PAH Analytes								
Naphthalene		3.33	2.11	63	2.15	65	2	12/29/2015
2-Methylnaphthalene		3.33	2.27	68	2.29	69	1	12/29/2015
Acenaphthene		3.33	2.40	72	2.44	73	2	12/29/2015
Phenanthrene		3.33	2.74	82	2.77	83	1	12/29/2015
Aliphatic Analytes								
n-Nonane		3.33	1.31	39	1.50	45	14	12/29/2015
n-Decane		3.33	1.85	56	2.05	62	10	12/29/2015
n-Dodecane		3.33	2.29	69	2.49	75	8	12/29/2015
n-Tetradecane		3.33	2.82	85	3.04	91	8	12/29/2015
n-Hexadecane		3.33	3.08	92	3.25	98	5	12/29/2015
n-Octadecane		3.33	3.07	92	3.21	96	4	12/29/2015
n-Nonadecane		3.33	2.87	86	2.98	89	4	12/29/2015
n-Eicosane		3.33	2.81	84	2.93	88	4	12/29/2015
n-Docasane		3.33	3.11	93	3.22	97	3	12/29/2015
n-Tetracosane		3.33	3.06	92	3.17	95	4	12/29/2015
n-Hexacosane		3.33	2.99	90	3.09	93	3	12/29/2015
n-Octacosane		3.33	2.85	86	2.94	88	3	12/29/2015
n-Triacontane		3.33	2.71	81	2.78	83	3	12/29/2015
n-Hexatriacontane		3.33	2.44	73	2.52	76	3	12/29/2015
Extraction Surrogates								
5-alpha-Androstane			90		92			12/29/2015
Ortho-terphenyl			86		85			12/29/2015
Fractionation Surrogates								
2-Fluorobiphenyl			89		87			12/29/2015
2-Bromonaphthalene			86		87			12/29/2015
Breakthrough Analytes								
Naphthalene-			0		0			12/29/2015
2-Methylnaphthalene-			0		0			12/29/2015

R.I. ANALYTICAL
Specialists in Environmental Services

CHAIN OF CUSTODY RECORD

41 Illinois Avenue
Warwick, RI 02888-3007
800-937-2580 • Fax: 401-738-1970

131 Coolidge St., Suite 105
Hudson, MA 01749-1331
800-937-2580 • Fax: 978-568-0078

12-23-15

Date Collected	Time Collected	Field Sample Identification	Grab or Composite	# of Containers & Type C	Preservation Code P	Matrix Code M	EPH with 4PAHs
12/23/15	1:30 pm	HB-5: 0-4'	G	1G	NP	S	X
12/23/15	2:00 pm	HB-6: 0-4'	G	1G	NP	S	X

Client Information

Company Name:	Bennett Environmental Associates, Inc.
Address:	1573 Main St. / P.O. Box 1743
City / State / Zip:	Brewster, MA 02631
Telephone:	508-896-1706 Fax: 508-896-5109
Contact Person:	D. Bennett/JT

Project Information

Project Name:	T.O. Orleans – Nauset Beach Motel
P.O. Number:	BEA15-10815 Project Number: BEA15-10815
Report To:	D. Bennett Phone: 508-896-1706 Fax 508-896-5109
Sampled by:	JTW
Quote No:	
Email report to these addresses:	dbennett@bennett-ea.com; jtadema-wielandt@bennett-

Relinquished By Signatures	Date	Time	Received By Signatures	Date	Time
[illegible]	12/23/15	4:00pm	BEA sample fridge	12/23/15	4:00pm
Fridge	12-23-15	12cc	[illegible]	12-23-15	12cc
[illegible]	12-28-15	1810		12/28/15	1020

Turn Around Time

	Normal	EMAIL Report
X	5 Business days. Possible surcharge	
	Rush – Date Due: ___/___/___	

Project Comments

Circle if applicable: GW-1, GW-2, GW-3, S-1, S-2, S-3 MCP Data Enhancement QC Package? Yes No

Temp. Upon Receipt 2.4°C

Lab Use Only

- X Sample Pick Up Only
- RIAL sampled; attach field hours
- X Shipped on ice
- Workorder No: 1512-2055

Containers: P=Poly, G=Glass, AG=Amber Glass, V=Vial, St=Sterile Preservatives: A=Ascorbic Acid, NH4=NH_4Cl, H=HCl, M=MeOH, N=HNO_3, NP=None, S=H_2SO_4, SB=$NaHSO_4$, SH=NaOH, T=$Na_2S_2O_3$, Z=ZnOAc
Matrix Codes: GW=Groundwater, SW=Surface Water, WW=Wastewater, DW=Drinking Water, S=Soil, SL=Sludge, A=Air, B=Bulk/Solid, WP=Wipe, O=________

Project: PROJECT# BEA15-10815 TO ORLEANS - NAUSET BEACH MOTEL
RI ANALYTICAL Work Order # 1512-28055

Sample Number:	1	2	Standards
Sample Identification:	HB-5: 0-4'	HB-6:0-4'	MA
Sample Date:	12/23/2015 @ 13:30AM	12/23/2015 @ 14:00	S-1/GW-1
PARAMETER			
EPH (mg/kg)			
C9-C18 Aliphatics	<21	740	1000
C19-C36 Aliphatics	<21	160	3000
Adj. C11-C22 Aromatics	<21	720	1000
Target PAH Analytes			
Naphthalene	<0.4	<0.4	4
2-Methylnaphthalene	<0.4	0.63	0.7
Acenaphthene	<0.4	0.61	4
Phenanthrene	<0.4	2.8	10

R.I. ANALYTICAL
Specialists in Environmental Services

CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.
Attn: Mr. David Bennett
1573 Main St.
P.O. Box 1743
Brewster, MA 02631

Date Received: 2/3/16
Date Reported: 2/8/16
P.O. #: BEA15-10815
Work Order #: 1602-02683

DESCRIPTION: PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Subject sample(s) has/have been analyzed by our Warwick, RI laboratory with the attached results.

Reference: All parameters were analyzed by U.S. EPA and Massachusetts Contingency Plan (MCP) approved methodologies where applicable. The specific methodologies are listed in the methods column of the Certificate of Analysis.

Data qualifiers (if present) are explained in full at the end of a given sample's analytical results.

Certification #: RI LAI00033, MA M-RI015, CT PH-0508, ME RI00015
NH 2537, NY 11726

This Certificate represents all data associated with the referenced work order and is paginated for completeness. The complete Certificate includes one attachment; the original Chain of Custody.

If you have any questions regarding this work, or if we may be of further assistance, please contact our customer service department.

Approved by:

Data Reporting

enc: Chain of Custody

Customer Name : Bennett Environmental Assoc.

Work Order #: 1602-02683

MassDEP Analytical Protocol Certification Form

Laboratory Name: R.I. Analytical Laboratories Work Order #: 1602-02683

Project / Location: RTN :

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):

1602-02683-001 through 1602-02683-027

Matrices: ☐ Groundwater/Surface Water ☒ Soil / Sediment ☐ Drinking Water ☐ Air ☐ Other

CAM Protocol (check all that apply below):

8260 VOC CAM II A ☐	7470/7471 Hg CAM III B ☐	MassDEP VPH CAM IV A ☐	8081 Pesticides CAM V B ☐	7196 Hex Cr CAM VI B ☐	MassDEP APH CAM IX A ☐
8270 SVOC CAM II B ☐	7010 Metals CAM III C ☐	MassDEP EPH CAM IV B ☒	8151 Herbicides CAM V C ☐	8330 Explosives CAM VIII A ☐	TO-15 VOC CAM IX B ☐
6010 Metals CAM III A ☐	6020 Metals CAM III D ☐	8082 PCB CAM V A ☐	9014 Total Cyanide /PAC CAM VI A ☐	6860 Perchlorate CAM V111 B ☐	

Affirmative responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	☒ Yes ☐ No
B	Were the analytical methods(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	☒ Yes ☐ No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	☒ Yes ☐ No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	☒ Yes ☐ No
E	a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s) ? (Refer to the individual method(s) for a list of significant modifications).	☒ Yes ☐ No
	b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	☐ Yes ☐ No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	☒ Yes ☐ No

Responses to Questions G,H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	☒ Yes ☐ No[1]

***Data User Note:** Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.*

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	☒ Yes ☐ No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	☐ Yes ☒ No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, is accurate and complete.

Signature: Sharon Baker for Position: Laboratory Director

Printed Name: Eric H. Jensen Date: 2/8/16

Case Narrative

Date: 2/8/2016

Bennett Environmental Assoc.
Attn: Mr. David Bennett

1573 Main St.
P.O. Box 1743
Brewster, MA 02631

Project: PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Work Order #: 1602-02683

All QA/QC procedures required by the EPH Method were followed. All performance/acceptance standards for the required QA/QC procedures were achieved or otherwise stated in this case narrative. A fractionation check was performed on the silica gel lot associated with this sample and found to pass the method criteria unless otherwise stated here. The data reported for this sample was not corrected for instrument/solvent baseline effects. No significant modifications were made to the EPH Method.

The following exceptions were noted for this Work Order:

Extractable Petroleum Hydrocarbons

Question I - The EPH Method limited PAH list was reported as requested on the Chain of Custody.

There were no additional exceptions or analytical issues to discuss concerning the testing requirements for the project.

R.I. Analytical Laboratories, Inc.
CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 001
SAMPLE DESCRIPTION: ZONE A SW-N: 5-6'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/01/2016 @ 09:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	14:31	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	14:31	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	14:31	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	14:31	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	14:31	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	14:31	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	14:31	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	14:31	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	66		40-140%	MADEP EPH-04-1.1	2/5/16	14:31	KS
Ortho-terphenyl	85		40-140%	MADEP EPH-04-1.1	2/5/16	14:31	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	94		40-140%	MADEP EPH-04-1.1	2/5/16	14:31	KS
2-Bromonaphthalene	96		40-140%	MADEP EPH-04-1.1	2/5/16	14:31	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

R.I. Analytical Laboratories, Inc.
CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 002
SAMPLE DESCRIPTION: ZONE A SW-S: 0-6' X2
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/01/2016 @ 09:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<24	24	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:10	KS
C19-C36 Aliphatics	<24	24	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:10	KS
Unadj. C11-C22 Aromatics	<24	24	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:10	KS
Adj. C11-C22 Aromatics	<24	24	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:10	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:10	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:10	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:10	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:10	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	51		40-140%	MADEP EPH-04-1.1	2/5/16	15:10	KS
Ortho-terphenyl	71		40-140%	MADEP EPH-04-1.1	2/5/16	15:10	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	92		40-140%	MADEP EPH-04-1.1	2/5/16	15:10	KS
2-Bromonaphthalene	97		40-140%	MADEP EPH-04-1.1	2/5/16	15:10	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

R.I. Analytical Laboratories, Inc.
CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 003
SAMPLE DESCRIPTION: ZONE A SW-E: 0-6' X2
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/01/2016 @ 10:30

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<24	24	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:48	KS
C19-C36 Aliphatics	<24	24	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:48	KS
Unadj. C11-C22 Aromatics	<24	24	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:48	KS
Adj. C11-C22 Aromatics	<24	24	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:48	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:48	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:48	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:48	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	15:48	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	56		40-140%	MADEP EPH-04-1.1	2/5/16	15:48	KS
Ortho-terphenyl	76		40-140%	MADEP EPH-04-1.1	2/5/16	15:48	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	92		40-140%	MADEP EPH-04-1.1	2/5/16	15:48	KS
2-Bromonaphthalene	89		40-140%	MADEP EPH-04-1.1	2/5/16	15:48	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

R.I. Analytical Laboratories, Inc.
CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 004
SAMPLE DESCRIPTION: ZONE A SW-W: 0-6'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/01/2016 @ 09:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<24	24	mg/kg dry	MADEP EPH-04-1.1	2/5/16	16:26	KS
C19-C36 Aliphatics	<24	24	mg/kg dry	MADEP EPH-04-1.1	2/5/16	16:26	KS
Unadj. C11-C22 Aromatics	<24	24	mg/kg dry	MADEP EPH-04-1.1	2/5/16	16:26	KS
Adj. C11-C22 Aromatics	<24	24	mg/kg dry	MADEP EPH-04-1.1	2/5/16	16:26	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	16:26	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	16:26	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	16:26	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	16:26	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	46		40-140%	MADEP EPH-04-1.1	2/5/16	16:26	KS
Ortho-terphenyl	65		40-140%	MADEP EPH-04-1.1	2/5/16	16:26	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	92		40-140%	MADEP EPH-04-1.1	2/5/16	16:26	KS
2-Bromonaphthalene	93		40-140%	MADEP EPH-04-1.1	2/5/16	16:26	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

R.I. Analytical Laboratories, Inc.
CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 005
SAMPLE DESCRIPTION: ZONE A BOH @ 6'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/01/2016 @ 10:30

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:05	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:05	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:05	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:05	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:05	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:05	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:05	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:05	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	57		40-140%	MADEP EPH-04-1.1	2/5/16	17:05	KS
Ortho-terphenyl	79		40-140%	MADEP EPH-04-1.1	2/5/16	17:05	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	94		40-140%	MADEP EPH-04-1.1	2/5/16	17:05	KS
2-Bromonaphthalene	98		40-140%	MADEP EPH-04-1.1	2/5/16	17:05	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

R.I. Analytical Laboratories, Inc.
CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 006
SAMPLE DESCRIPTION: ZONE A CLEAN OB STOCKPILE
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 10:30

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:43	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:43	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:43	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:43	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:43	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:43	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:43	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	17:43	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	54		40-140%	MADEP EPH-04-1.1	2/5/16	17:43	KS
Ortho-terphenyl	75		40-140%	MADEP EPH-04-1.1	2/5/16	17:43	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	91		40-140%	MADEP EPH-04-1.1	2/5/16	17:43	KS
2-Bromonaphthalene	95		40-140%	MADEP EPH-04-1.1	2/5/16	17:43	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

R.I. Analytical Laboratories, Inc.
CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 007
SAMPLE DESCRIPTION: ZONE B SW-NE: 0-9'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 08:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	23	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:21	KS
C19-C36 Aliphatics	<22	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:21	KS
Unadj. C11-C22 Aromatics	<22	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:21	KS
Adj. C11-C22 Aromatics	<22	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:21	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:21	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:21	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:21	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:21	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	68		40-140%	MADEP EPH-04-1.1	2/5/16	18:21	KS
Ortho-terphenyl	87		40-140%	MADEP EPH-04-1.1	2/5/16	18:21	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	97		40-140%	MADEP EPH-04-1.1	2/5/16	18:21	KS
2-Bromonaphthalene	102		40-140%	MADEP EPH-04-1.1	2/5/16	18:21	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

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Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 008
SAMPLE DESCRIPTION: ZONE B SW-EN: 0-9'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 08:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:59	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:59	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:59	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:59	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:59	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:59	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:59	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	18:59	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	62		40-140%	MADEP EPH-04-1.1	2/5/16	18:59	KS
Ortho-terphenyl	86		40-140%	MADEP EPH-04-1.1	2/5/16	18:59	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	90		40-140%	MADEP EPH-04-1.1	2/5/16	18:59	KS
2-Bromonaphthalene	94		40-140%	MADEP EPH-04-1.1	2/5/16	18:59	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

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Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 009
SAMPLE DESCRIPTION: ZONE B SW-ES: 0-9'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 08:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	19:38	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	19:38	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	19:38	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	19:38	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	19:38	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	19:38	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	19:38	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	19:38	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	59		40-140%	MADEP EPH-04-1.1	2/5/16	19:38	KS
Ortho-terphenyl	79		40-140%	MADEP EPH-04-1.1	2/5/16	19:38	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	94		40-140%	MADEP EPH-04-1.1	2/5/16	19:38	KS
2-Bromonaphthalene	95		40-140%	MADEP EPH-04-1.1	2/5/16	19:38	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

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Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 010
SAMPLE DESCRIPTION: ZONE B SW-SE: 0-9'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 08:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:16	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:16	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:16	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:16	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:16	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:16	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:16	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:16	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	54		40-140%	MADEP EPH-04-1.1	2/5/16	20:16	KS
Ortho-terphenyl	68		40-140%	MADEP EPH-04-1.1	2/5/16	20:16	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	91		40-140%	MADEP EPH-04-1.1	2/5/16	20:16	KS
2-Bromonaphthalene	81		40-140%	MADEP EPH-04-1.1	2/5/16	20:16	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

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Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 011
SAMPLE DESCRIPTION: ZONE B SW-NW: 0-9'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 09:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<22	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:55	KS
C19-C36 Aliphatics	<22	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:55	KS
Unadj. C11-C22 Aromatics	<22	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:55	KS
Adj. C11-C22 Aromatics	<22	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:55	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:55	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:55	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:55	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	20:55	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	55		40-140%	MADEP EPH-04-1.1	2/5/16	20:55	KS
Ortho-terphenyl	75		40-140%	MADEP EPH-04-1.1	2/5/16	20:55	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	93		40-140%	MADEP EPH-04-1.1	2/5/16	20:55	KS
2-Bromonaphthalene	97		40-140%	MADEP EPH-04-1.1	2/5/16	20:55	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

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Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 012
SAMPLE DESCRIPTION: ZONE B SW-WN: 0-9'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 09:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<22	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	21:33	KS
C19-C36 Aliphatics	<22	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	21:33	KS
Unadj. C11-C22 Aromatics	<22	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	21:33	KS
Adj. C11-C22 Aromatics	<22	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	21:33	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	21:33	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	21:33	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	21:33	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	21:33	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	42		40-140%	MADEP EPH-04-1.1	2/5/16	21:33	KS
Ortho-terphenyl	63		40-140%	MADEP EPH-04-1.1	2/5/16	21:33	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	96		40-140%	MADEP EPH-04-1.1	2/5/16	21:33	KS
2-Bromonaphthalene	100		40-140%	MADEP EPH-04-1.1	2/5/16	21:33	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

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Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 013
SAMPLE DESCRIPTION: ZONE B SW-WS: 0-9'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 09:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:10	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:10	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:10	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:10	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:10	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:10	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:10	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:10	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	56		40-140%	MADEP EPH-04-1.1	2/5/16	22:10	KS
Ortho-terphenyl	77		40-140%	MADEP EPH-04-1.1	2/5/16	22:10	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	93		40-140%	MADEP EPH-04-1.1	2/5/16	22:10	KS
2-Bromonaphthalene	94		40-140%	MADEP EPH-04-1.1	2/5/16	22:10	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

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Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 014
SAMPLE DESCRIPTION: ZONE B SW-SW: 0-9'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 09:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:48	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:48	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:48	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:48	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:48	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:48	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:48	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	22:48	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	55		40-140%	MADEP EPH-04-1.1	2/5/16	22:48	KS
Ortho-terphenyl	77		40-140%	MADEP EPH-04-1.1	2/5/16	22:48	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	92		40-140%	MADEP EPH-04-1.1	2/5/16	22:48	KS
2-Bromonaphthalene	96		40-140%	MADEP EPH-04-1.1	2/5/16	22:48	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

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Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 015
SAMPLE DESCRIPTION: ZONE B BOH-S @ 9'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 09:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	110	20	mg/kg dry	MADEP EPH-04-1.1	2/5/16	23:26	KS
C19-C36 Aliphatics	24	20	mg/kg dry	MADEP EPH-04-1.1	2/5/16	23:26	KS
Unadj. C11-C22 Aromatics	56	20	mg/kg dry	MADEP EPH-04-1.1	2/5/16	23:26	KS
Adj. C11-C22 Aromatics	56	20	mg/kg dry	MADEP EPH-04-1.1	2/5/16	23:26	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	23:26	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	23:26	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	23:26	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	23:26	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	63		40-140%	MADEP EPH-04-1.1	2/5/16	23:26	KS
Ortho-terphenyl	86		40-140%	MADEP EPH-04-1.1	2/5/16	23:26	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	94		40-140%	MADEP EPH-04-1.1	2/5/16	23:26	KS
2-Bromonaphthalene	104		40-140%	MADEP EPH-04-1.1	2/5/16	23:26	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

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Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 016
SAMPLE DESCRIPTION: ZONE B BOH-N @ 9'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 09:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:03	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:03	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:03	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:03	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:03	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:03	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:03	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:03	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	59		40-140%	MADEP EPH-04-1.1	2/5/16	0:03	KS
Ortho-terphenyl	83		40-140%	MADEP EPH-04-1.1	2/5/16	0:03	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	88		40-140%	MADEP EPH-04-1.1	2/5/16	0:03	KS
2-Bromonaphthalene	90		40-140%	MADEP EPH-04-1.1	2/5/16	0:03	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

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Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 017
SAMPLE DESCRIPTION: ZONE B CLEAN OB STOCKPILE
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 09:00

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<22	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:42	KS
C19-C36 Aliphatics	<22	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:42	KS
Unadj. C11-C22 Aromatics	<22	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:42	KS
Adj. C11-C22 Aromatics	<22	22	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:42	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:42	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:42	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:42	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/5/16	0:42	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	53		40-140%	MADEP EPH-04-1.1	2/5/16	0:42	KS
Ortho-terphenyl	77		40-140%	MADEP EPH-04-1.1	2/5/16	0:42	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	94		40-140%	MADEP EPH-04-1.1	2/5/16	0:42	KS
2-Bromonaphthalene	96		40-140%	MADEP EPH-04-1.1	2/5/16	0:42	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

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Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 018
SAMPLE DESCRIPTION: ZONE C SW-N: 0-9'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 11:25

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	12:40	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	12:40	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	12:40	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	12:40	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	12:40	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	12:40	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	12:40	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	12:40	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	61		40-140%	MADEP EPH-04-1.1	2/6/16	12:40	KS
Ortho-terphenyl	84		40-140%	MADEP EPH-04-1.1	2/6/16	12:40	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	93		40-140%	MADEP EPH-04-1.1	2/6/16	12:40	KS
2-Bromonaphthalene	95		40-140%	MADEP EPH-04-1.1	2/6/16	12:40	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

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Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 019
SAMPLE DESCRIPTION: ZONE C SW-S: 0-9'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 11:25

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:18	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:18	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:18	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:18	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:18	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:18	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:18	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:18	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	52		40-140%	MADEP EPH-04-1.1	2/6/16	13:18	KS
Ortho-terphenyl	75		40-140%	MADEP EPH-04-1.1	2/6/16	13:18	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	93		40-140%	MADEP EPH-04-1.1	2/6/16	13:18	KS
2-Bromonaphthalene	96		40-140%	MADEP EPH-04-1.1	2/6/16	13:18	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

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Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 020
SAMPLE DESCRIPTION: ZONE C SW-E: 0-9'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 11:25

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:56	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:56	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:56	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:56	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:56	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:56	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:56	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	13:56	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	55		40-140%	MADEP EPH-04-1.1	2/6/16	13:56	KS
Ortho-terphenyl	72		40-140%	MADEP EPH-04-1.1	2/6/16	13:56	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	86		40-140%	MADEP EPH-04-1.1	2/6/16	13:56	KS
2-Bromonaphthalene	82		40-140%	MADEP EPH-04-1.1	2/6/16	13:56	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	14:10	JPB

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Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 021
SAMPLE DESCRIPTION: ZONE C SW-W: 0-9'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 11:25

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	14:34	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	14:34	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	14:34	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	14:34	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	14:34	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	14:34	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	14:34	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	14:34	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	65		40-140%	MADEP EPH-04-1.1	2/6/16	14:34	KS
Ortho-terphenyl	89		40-140%	MADEP EPH-04-1.1	2/6/16	14:34	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	95		40-140%	MADEP EPH-04-1.1	2/6/16	14:34	KS
2-Bromonaphthalene	97		40-140%	MADEP EPH-04-1.1	2/6/16	14:34	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	18:00	JPB

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Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 022
SAMPLE DESCRIPTION: ZONE C BOH @ 9'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 11:25

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:12	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:12	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:12	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:12	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:12	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:12	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:12	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:12	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	74		40-140%	MADEP EPH-04-1.1	2/6/16	15:12	KS
Ortho-terphenyl	99		40-140%	MADEP EPH-04-1.1	2/6/16	15:12	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	97		40-140%	MADEP EPH-04-1.1	2/6/16	15:12	KS
2-Bromonaphthalene	101		40-140%	MADEP EPH-04-1.1	2/6/16	15:12	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	18:00	JPB

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Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 023
SAMPLE DESCRIPTION: ZONE D SW-N: 0-5'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 14:30

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<25	25	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:50	KS
C19-C36 Aliphatics	<25	25	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:50	KS
Unadj. C11-C22 Aromatics	<25	25	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:50	KS
Adj. C11-C22 Aromatics	<25	25	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:50	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:50	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:50	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:50	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	15:50	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	53		40-140%	MADEP EPH-04-1.1	2/6/16	15:50	KS
Ortho-terphenyl	67		40-140%	MADEP EPH-04-1.1	2/6/16	15:50	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	94		40-140%	MADEP EPH-04-1.1	2/6/16	15:50	KS
2-Bromonaphthalene	98		40-140%	MADEP EPH-04-1.1	2/6/16	15:50	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	18:00	JPB

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Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 024
SAMPLE DESCRIPTION: ZONE D SW-S: 0-5'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 14:30

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	16:29	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	16:29	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	16:29	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	16:29	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	16:29	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	16:29	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	16:29	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	16:29	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	68		40-140%	MADEP EPH-04-1.1	2/6/16	16:29	KS
Ortho-terphenyl	97		40-140%	MADEP EPH-04-1.1	2/6/16	16:29	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	100		40-140%	MADEP EPH-04-1.1	2/6/16	16:29	KS
2-Bromonaphthalene	103		40-140%	MADEP EPH-04-1.1	2/6/16	16:29	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	18:00	JPB

R.I. Analytical Laboratories, Inc.
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Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 025
SAMPLE DESCRIPTION: ZONE D SW-E: 0-5'
SAMPLE TYPE: GRAB
SAMPLE DATE/TIME: 2/02/2016 @ 14:30

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:07	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:07	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:07	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:07	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:07	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:07	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:07	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:07	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	69		40-140%	MADEP EPH-04-1.1	2/6/16	17:07	KS
Ortho-terphenyl	96		40-140%	MADEP EPH-04-1.1	2/6/16	17:07	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	96		40-140%	MADEP EPH-04-1.1	2/6/16	17:07	KS
2-Bromonaphthalene	100		40-140%	MADEP EPH-04-1.1	2/6/16	17:07	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	18:00	JPB

R.I. Analytical Laboratories, Inc.
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Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 026
SAMPLE DESCRIPTION: ZONE D SW-W: 0-5'
SAMPLE TYPE: GRAB **SAMPLE DATE/TIME:** 2/02/2016 @ 14:30

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:45	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:45	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:45	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:45	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:45	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:45	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:45	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	17:45	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	75		40-140%	MADEP EPH-04-1.1	2/6/16	17:45	KS
Ortho-terphenyl	99		40-140%	MADEP EPH-04-1.1	2/6/16	17:45	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	95		40-140%	MADEP EPH-04-1.1	2/6/16	17:45	KS
2-Bromonaphthalene	98		40-140%	MADEP EPH-04-1.1	2/6/16	17:45	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	18:00	JPB

R.I. Analytical Laboratories, Inc.
CERTIFICATE OF ANALYSIS

Bennett Environmental Assoc.

Date Received: 2/3/16

Work Order #: 1602-02683

PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL

Sample # 027
SAMPLE DESCRIPTION: ZONE D BOH @ 5'
SAMPLE TYPE: GRAB
SAMPLE DATE/TIME: 2/02/2016 @ 14:30

PARAMETER	SAMPLE RESULTS	DET. LIMIT	UNITS	METHOD	DATE ANALYZED		ANALYST
EPH/PAH							
C9-C18 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	18:23	KS
C19-C36 Aliphatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	18:23	KS
Unadj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	18:23	KS
Adj. C11-C22 Aromatics	<21	21	mg/kg dry	MADEP EPH-04-1.1	2/6/16	18:23	KS
Target PAH Analytes							
Naphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	18:23	KS
2-Methylnaphthalene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	18:23	KS
Acenaphthene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	18:23	KS
Phenanthrene	<0.4	0.4	mg/kg dry	MADEP EPH-04-1.1	2/6/16	18:23	KS
Extraction Surrogates			RANGE				
5-alpha-Androstane	72		40-140%	MADEP EPH-04-1.1	2/6/16	18:23	KS
Ortho-terphenyl	99		40-140%	MADEP EPH-04-1.1	2/6/16	18:23	KS
Fractionation Surrogates			RANGE				
2-Fluorobiphenyl	91		40-140%	MADEP EPH-04-1.1	2/6/16	18:23	KS
2-Bromonaphthalene	92		40-140%	MADEP EPH-04-1.1	2/6/16	18:23	KS
Extraction Date				MADEP EPH-04-1.1	2/4/16	18:00	JPB

QA/QC Report

Client: Bennett Environmental Assoc.
WO #: 1602-02683
Date: 2/8/2016

-Method Blanks Results-

Parameter	Units	Results	Date Analyzed
Extractable Petroleum Hydrocarbons with PAH			
C9-C18 Aliphatics	mg/kg dry	<20	2/5/2016
C19-C36 Aliphatics	mg/kg dry	<20	2/5/2016
Unadj. C11-C22 Aromatics	mg/kg dry	<20	2/5/2016
Adj. C11-C22 Aromatics	mg/kg dry	<20	2/5/2016
Target PAH Analytes			2/5/2016
Naphthalene	mg/kg dry	<0.4	2/5/2016
2-Methylnaphthalene	mg/kg dry	<0.4	2/5/2016
Acenaphthene	mg/kg dry	<0.4	2/5/2016
Phenanthrene	mg/kg dry	<0.4	2/5/2016
Extraction Surrogates	**RANGE**		2/5/2016
5-alpha-Androstane	40-140%	69	2/5/2016
Ortho-terphenyl	40-140%	94	2/5/2016
Fractionation Surrogates	**RANGE**		2/5/2016
2-Fluorobiphenyl	40-140%	90	2/5/2016
2-Bromonaphthalene	40-140%	89	2/5/2016

-LCS/LCS Duplicate Data Results-

Parameter	CRM Acceptance Limits	Spike Conc	LCS Conc	LCS % Rec	LCS Dup Conc	LCS DUP % Rec	% RPD	Date Analyzed
Extractable Petroleum Hydrocarbons with PAH - Solids								
Target PAH Analytes								
Naphthalene		3.33	2.05	62	2.63	79	25	2/5/2016
2-Methylnaphthalene		3.33	2.21	66	2.79	84	23	2/5/2016
Acenaphthene		3.33	2.46	74	3.00	90	20	2/5/2016
Phenanthrene		3.33	2.86	86	3.32	100	15	2/5/2016
Aliphatic Analytes								
n-Nonane		3.33	0.993	30	1.04	31	5	2/5/2016
n-Decane		3.33	1.34	40	1.45	44	8	2/5/2016
n-Dodecane		3.33	1.65	50	1.84	55	11	2/5/2016
n-Tetradecane		3.33	1.90	57	2.13	64	11	2/5/2016
n-Hexadecane		3.33	2.15	65	2.40	72	11	2/5/2016
n-Octadecane		3.33	2.33	70	2.57	77	10	2/5/2016
n-Nonadecane		3.33	2.23	67	2.45	74	9	2/5/2016
n-Eicosane		3.33	2.61	78	2.88	86	10	2/5/2016
n-Docasane		3.33	2.24	67	2.37	71	6	2/5/2016
n-Tetracosane		3.33	2.38	71	2.55	77	7	2/5/2016
n-Hexacosane		3.33	2.46	74	2.63	79	7	2/5/2016
n-Octacosane		3.33	2.52	76	2.70	81	7	2/5/2016
n-Triacontane		3.33	2.60	78	2.77	83	6	2/5/2016
n-Hexatriacontane		3.33	2.57	77	2.70	81	5	2/5/2016
Extraction Surrogates								
5-alpha-Androstane			63		64			2/5/2016
Ortho-terphenyl			96		105			2/5/2016
Fractionation Surrogates								
2-Fluorobiphenyl			86		99			2/5/2016
2-Bromonaphthalene			90		101			2/5/2016
Breakthrough Analytes								
Naphthalene-			0		0			2/5/2016
2-Methylnaphthalene-			0		0			2/5/2016
Target PAH Analytes								
Naphthalene		3.33	2.16	65	2.56	77	17	2/6/2016
2-Methylnaphthalene		3.33	2.35	71	2.72	82	15	2/6/2016
Acenaphthene		3.33	2.66	80	2.96	89	11	2/6/2016
Phenanthrene		3.33	3.09	93	3.29	99	6	2/6/2016
Aliphatic Analytes								
n-Nonane		3.33	1.21	36	1.19	36	2	2/6/2016
n-Decane		3.33	1.58	47	1.61	48	2	2/6/2016
n-Dodecane		3.33	1.94	58	2.03	61	5	2/6/2016
n-Tetradecane		3.33	2.23	67	2.37	71	6	2/6/2016
n-Hexadecane		3.33	2.52	76	2.70	81	7	2/6/2016
n-Octadecane		3.33	2.73	82	2.95	89	8	2/6/2016
n-Nonadecane		3.33	2.61	78	2.83	85	8	2/6/2016
n-Eicosane		3.33	3.08	92	2.99	90	3	2/6/2016
n-Docasane		3.33	2.58	77	3.04	91	16	2/6/2016
n-Tetracosane		3.33	2.77	83	3.02	91	9	2/6/2016
n-Hexacosane		3.33	2.87	86	3.11	93	8	2/6/2016
n-Octacosane		3.33	2.93	88	3.15	95	7	2/6/2016
n-Triacontane		3.33	3.00	90	3.19	96	6	2/6/2016
n-Hexatriacontane		3.33	2.85	86	2.93	88	3	2/6/2016

QA/QC Report

Client: Bennett Environmental Assoc.

WO #: 1602-02683

Date: 2/8/2016

-LCS/LCS Duplicate Data Results-

Parameter	CRM Acceptance Limits	Spike Conc	LCS Conc	LCS % Rec	LCS Dup Conc	LCS DUP % Rec	% RPD	Date Analyzed
Extractable Petroleum Hydrocarbons with PAH - Solids (cont'd)								
Extraction Surrogates								
5-alpha-Androstane				75		74		2/6/2016
Ortho-terphenyl				99		103		2/6/2016
Fractionation Surrogates								
2-Fluorobiphenyl				86		96		2/6/2016
2-Bromonaphthalene				91		99		2/6/2016
Breakthrough Analytes								
Naphthalene-				0		0		2/6/2016
2-Methylnaphthalene-				0		0		2/6/2016

R.I. ANALYTICAL
Specialists in Environmental Services

CHAIN OF CUSTODY RECORD

41 Illinois Avenue
Warwick, RI 02888-3007
800-937-2580 • Fax: 401-738-1970

131 Coolidge St., Suite 105
Hudson, MA 01749-1331
800-937-2580 • Fax: 978-568-0078

02-03-16

Date Collected	Time Collected	Field Sample Identification	Grab or Composite	# of Containers & Type C	Preservation Code P	Matrix Code M	EPH with 4PAHs
2/1/16	9:00 am	Zone A SW-N: 5-6'	G	1G	NP	S	X
2/1/16	9:00 am	Zone A SW-S: 0-6' x2	G	1G	NP	S	X
2/1/16	10:30 am	Zone A SW-E: 0-6' x2	G	1G	NP	S	X
2/1/16	9:00 am	Zone A SW-W: 0-6'	G	1G	NP	S	X
2/1/16	10:30 am	Zone A BOH@6'	G	1G	NP	S	X
2/2/16	10:30 am	Zone A Clean OB Stockpile	G	1G	NP	S	X
2/2/16	8:00 am	Zone B SW-NE: 0-9'	G	1G	NP	S	X
2/2/16	8:00 am	Zone B SW-EN: 0-9'	G	1G	NP	S	X
2/2/16	8:00 am	Zone B SW-ES: 0-9'	G	1G	NP	S	X
2/2/16	8:00 am	Zone B SW- SE:0-9'	G	1G	NP	S	X
2/2/16	9:00 am	Zone B SW-NW: 0-9'	G	1G	NP	S	X
2/2/16	9:00 am	Zone B SW-WN: 0-9'	G	1G	NP	S	X
2/2/16	9:00 am	Zone B SW-WS: 0-9'	G	1G	NP	S	X
2/2/16	9:00 am	Zone B SW-SW: 0-9'	G	1G	NP	S	X

Client Information

Company Name: Bennett Environmental Associates, Inc.
Address: 1573 Main St. / P.O. Box 1743
City / State / Zip: Brewster, MA 02631
Telephone: 508-896-1706 Fax: 508-896-5109
Contact Person: D. Bennett/JT

Project Information

Project Name: T.O. Orleans – Nauset Beach Motel
P.O. Number: BEA15-10815 Project Number: BEA15-10815
Report To: D. Bennett Phone: 508-896-1706 Fax 508-896-5109
Sampled by: JTW
Quote No:
Email report to these addresses: dbennett@bennett-ea.com; jtadema-wielandt@bennett-

Relinquished By Signatures	Date	Time	Received By Signatures	Date	Time
[signature]	2/2/16	4:30 pm	BEA office Fridge	2/2/16	4:30 pm
BEA Fridge	2-3-16	12 15	[signature]	2-3-16	1215
[signature]	2-3-16	1615	[signature]	2-3-16	1615

Turn Around Time

	Normal	EMAIL Report
X	5 Business days. Possible surcharge	
	Rush – Date Due: ___/___/___	

Project Comments

Circle if applicable: GW-1, GW-2, GW-3, S-1, S-2, S-3 MCP Data Enhancement QC Package? Yes No

Temp. Upon Receipt 3.4 °C

Lab Use Only

✓	Sample Pick Up Only
	RIAL sampled; attach field hours
✓	Shipped on ice

Workorder No: 1602-02683

Containers: P=Poly, G=Glass, AG=Amber Glass, V=Vial, St=Sterile Preservatives: A=Ascorbic Acid, NH4=NH_4Cl, H=HCl, M=MeOH, N=HNO_3, NP=None, S=H_2SO_4, SB=$NaHSO_4$, SH=NaOH, T=$Na_2S_2O_3$, Z=ZnOAc
Matrix Codes: GW=Groundwater, SW=Surface Water, WW=Wastewater, DW=Drinking Water, S=Soil, SL=Sludge, A=Air, B=Bulk/Solid, WP=Wipe, O=________

R.I. ANALYTICAL
Specialists in Environmental Services

CHAIN OF CUSTODY RECORD

41 Illinois Avenue
Warwick, RI 02888-3007
800-937-2580 • Fax: 401-738-1970

131 Coolidge St., Suite 105
Hudson, MA 01749-1331
800-937-2580 • Fax: 978-568-0078

02-03-16

Date Collected	Time Collected	Field Sample Identification	Grab or Composite	# of Containers & Type C	Preservation Code P	Matrix Code M	EPH with 4PAHs
2/2/16	9:00 am	Zone B BOH-S@9'	G	1G	NP	S	X
2/2/16	9:00 am	Zone B BOH-N@9'	G	1G	NP	S	X
2/2/16	9:00 am	Zone B Clean OB Stockpile	G	1G	NP	S	X
2/2/16	11:25 am	Zone C SW-N: 0-9'	G	1G	NP	S	X
2/2/16	11:25 am	Zone C SW-S: 0-9'	G	1G	NP	S	X
2/2/16	11:25 am	Zone C SW-E: 0-9'	G	1G	NP	S	X
2/2/16	11:25 am	Zone C SW-W: 0-9'	G	1G	NP	S	X
2/2/16	11:25 am	Zone C BOH@9'	G	1G	NP	S	X
2/2/16	2:30 pm	Zone D SW-N: 0-5'	G	1G	NP	S	X
2/2/16	2:30 pm	Zone D SW-S: 0-5'	G	1G	NP	S	X
2/2/16	2:30 pm	Zone D SW-E: 0-5'	G	1G	NP	S	X
2/2/16	2:30 pm	Zone D SW-W: 0-5'	G	1G	NP	S	X
2/2/16	2:30 pm	Zone D BOH@5'	G	1G	NP	S	X
				20			

Client Information

Company Name: Bennett Environmental Associates, Inc.
Address: 1573 Main St. / P.O. Box 1743
City / State / Zip: Brewster, MA 02631
Telephone: 508-896-1706 Fax: 508-896-5109
Contact Person: D. Bennett/JT

Project Information

Project Name: T.O. Orleans – Nauset Beach Motel
P.O. Number: BEA15-10815 Project Number: BEA15-10815
Report To: D. Bennett Phone: 508-896-1706 Fax 508-896-5109
Sampled by: JTW
Email report to these addresses: dbennett@bennett-ea.com; jtadema-wielandt@bennett-
Quote No:

Relinquished By Signatures	Date	Time	Received By Signatures	Date	Time
[signature]	2/2/16	4:30 pm	BEA office Fridge	2/2/16	4:30 pm
BEA Fridge	2-3-16	1215	[signature]	2-3-16	1215
[signature]	2-3-16	1415	[signature]	2-3-16	1615

Turn Around Time

	Normal	EMAIL Report
X	5 Business days. Possible surcharge	
	Rush – Date Due: __/__/__	

Project Comments

Circle if applicable: GW-1, GW-2, GW-3, S-1, S-2, S-3 MCP Data Enhancement QC Package? Yes No

Temp. Upon Receipt 3.4 °C

Lab Use Only

✓	Sample Pick Up Only
	RIAL sampled; attach field hours
✓	Shipped on ice

Workorder No: 1602-02683

Containers: P=Poly, G=Glass, AG=Amber Glass, V=Vial, St=Sterile Preservatives: A=Ascorbic Acid, NH4=NH_4Cl, H=HCl, M=MeOH, N=HNO_3, NP=None, S=H_2SO_4, SB=$NaHSO_4$, SH=NaOH, T=$Na_2S_2O_3$, Z=ZnOAc
Matrix Codes: GW=Groundwater, SW=Surface Water, WW=Wastewater, DW=Drinking Water, S=Soil, SL=Sludge, A=Air, B=Bulk/Solid, WP=Wipe, O=____

Sample Number:	1	2	3	4	5
Sample Identification:	ZONE A SW-N: 5-6'	ZONE A SW-S: 0-6' X2	ZONE A SW-E: 0-6' X2	ZONE A SW-W: 0-6'	ZONE A BOH @ 6'
Sample Date:	2/1/2016 @ 09:00	2/1/2016 @ 09:00	2/1/2016 @ 10:30	2/1/2016 @ 09:00	2/1/2016 @ 10:30
Parameter					
EPH/PAH (mg/kg dry)					
C9-C18 Aliphatics	<21	<24	<24	<24	<21
C19-C36 Aliphatics	<21	<24	<24	<24	<21
Adj. C11-C22 Aromatics	<21	<24	<24	<24	<21
Target PAH Analytes					
Naphthalene	<0.4	<0.4	<0.4	<0.4	<0.4
2-Methylnaphthalene	<0.4	<0.4	<0.4	<0.4	<0.4
Acenaphthene	<0.4	<0.4	<0.4	<0.4	<0.4
Phenanthrene	<0.4	<0.4	<0.4	<0.4	<0.4

6	7	8	9	10	11
ZONE A CLEAN OB STOCKPILE	ZONE B SW-NE: 0-9'	ZONE B SW-EN: 0-9'	ZONE B SW-ES: 0-9'	ZONE B SW-SE: 0-9'	ZONE B SW-NW: 0-9'
2/2/2016 @ 10:30	2/2/2016 @ 08:00	2/2/2016 @ 08:00	2/2/2016 @ 08:00	2/2/2016 @ 08:00	2/2/2016 @ 09:00
<21	23	<21	<21	<21	<22
<21	<22	<21	<21	<21	<22
<21	<22	<21	<21	<21	<22
<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

Project: PROJECT# BEA15-10815 T.O. ORLEANS - NAUSET BEACH MOTEL
RI ANALYTICAL Work Order #: 160202683

12	13	14	15	16	17
ZONE B SW-WN: 0-9'	ZONE B SW-WS: 0-9'	ZONE B SW-SW: 0-9'	ZONE B BOH-S @ 9'	ZONE B BOH-N @ 9'	ZONE B CLEAN OB STOCKPILE
2/2/2016 @ 09:00	2/2/2016 @ 09:00	2/2/2016 @ 09:00	2/2/2016 @ 09:00	2/2/2016 @ 09:00	2/2/2016 @ 09:00
<22	<21	<21	110	<21	<22
<22	<21	<21	24	<21	<22
<22	<21	<21	56	<21	<22
<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

18 ZONE C SW-N: 0-9' 2/2/2016 @ 11:25	19 ZONE C SW-S: 0-9' 2/2/2016 @ 11:25	20 ZONE C SW-E: 0-9' 2/2/2016 @ 11:25	21 ZONE C SW-W: 0-9' 2/2/2016 @ 11:25	22 ZONE C BOH @ 9' 2/2/2016 @ 11:25	23 ZONE D SW-N: 0-5' 2/2/2016 @ 14:30	24 ZONE D SW-S: 0-5' 2/2/2016 @ 14:30
<21	<21	<21	<21	<21	<25	<21
<21	<21	<21	<21	<21	<25	<21
<21	<21	<21	<21	<21	<25	<21
<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

25	26	27	Standards
ZONE D SW-E: 0-5'	ZONE D SW-W: 0-5'	ZONE D BOH @ 5'	MA
2/2/2016 @ 14:30	2/2/2016 @ 14:30	2/2/2016 @ 14:30	S-1 / GW-1
<21	<21	<21	1000
<21	<21	<21	3000
<21	<21	<21	1000
<0.4	<0.4	<0.4	4
<0.4	<0.4	<0.4	0.7
<0.4	<0.4	<0.4	4
<0.4	<0.4	<0.4	10

Appendix E

Test Pit Data and Soil Evaluator Forms

COASTAL engineering co.

260 Cranberry Highway
Orleans, MA 02653
508.255.6511 P 508.255.6700 F

Orleans | Sandwich | Nantucket

coastalengineeringcompany.com

CEC File No: C18470.00

Date: 03/25/16

COMMONWEALTH OF MASSACHUSETTS
ORLEANS, MASSACHUSETTS

Soil Suitability Assessment for On-site Sewage Disposal

Performed by: *John G. Schnaible, R.S.*
Witnessed by: *Brian Dudley, DEP-SERO*

Location Address or Lot #: *Map 38, Parcel 16* *223 Beach Road* *Orleans, MA*	**Owner's Name** *Town of Orleans* *c/o AECOM* *Attn: Thomas Parece* **Address:** *usapimaging@aecom.com* *tom.parece@aecom.com*

New Construction ☒ Repair ☐

Office Review

Published Soil Survey Available: No ☐ Yes ☒
Year Published: *1993* Publication Scale: *1:25000* Soil Map Unit: *CoB*
Drainage Class: *Well Drained* Soil Limitations: *Poor Filter*

Surficial Geologic Report Available: No ☐ Yes ☒
Year Published: *1971* Publication Scale: *1:24000*
Geologic Material (Map Unit): *Nauset Height Deposits*
Landform: *Outwash Plain*

Flood Insurance Rate Map:
Above 500 year flood boundary No ☐ Yes ☒
Within 500 year flood boundary No ☒ Yes ☐
Within 100 year flood boundary No ☒ Yes ☐

Wetland Area:
National Wetland Inventory (map unit) *Upland*
Wetlands Conservancy Program Map (map unit) --

Current Water Resource Conditions (USGS): Month: *January*
Range: Above Normal ☐ Normal ☒ Below Normal ☐
Other References Reviewed: *USGS Quad Maps and Groundwater Maps*

On-site Review

Deep Hole Number: 1 Date: 02/19/16 Time: 8:45 Weather: Sunny

Location (identify on site plan) Rear of Lot

Land Use: Residential Slope (%): 3-8 Surface Stones: No

Vegetation: Oak Trees and Cedar Trees

Landform: Outwash Plain

Position on landscape (sketch on the back): See Sketch

Distances from:

Open Water Body 200+ feet
Possible Wet Area 200+ feet
Drinking Water Well 100+ feet

Drainageway 100+ feet
Property Line 50'± feet
Other

DEEP OBSERVATION HOLE LOG					
Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0" – 7"	A	Sandy Loam	10 YR 3/2		
7" – 16"	B	Silt Loam	10 YR 5/8		
16" – 30"	C1	Silt Loam	10 YR 5/8		
30" – 150"	C2	Sand	10 YR 6/6		Medium sand, loose

Parent Material (geologic) Proglacial Outwash Depth to Bedrock: 200'+
Depth to Groundwater: Standing Water in the Hole: None Weeping from Pit Face: None
Estimated Seasonal High Ground Water: 50'±

On-site Review

Deep Hole Number: 2 Date: 02/19/16 Time: 9:15 Weather: Sunny

Location (identify on site plan) Rear of Lot

Land Use: Residential Slope (%): 3-8 Surface Stones: No

Vegetation: Oak Trees and Cedar Trees

Landform: Outwash Plain

Position on landscape (sketch on the back): See Sketch

Distances from:

Open Water Body 200+ feet
Possible Wet Area 200+ feet
Drinking Water Well 100+ feet

Drainageway 100+ feet
Property Line 50'± feet
Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0" – 36"	Fill				
36" – 38"	A	Loamy Sand	10 YR 2/2		
38" – 72"	B	Loamy Sand	10 YR 4/6		
72" – 162"	C	Sand	10 YR 6/6		Medium to fine sand, loose

Parent Material (geologic) Proglacial Outwash Depth to Bedrock: 200'+

Depth to Groundwater: Standing Water in the Hole: None Weeping from Pit Face: None

Estimated Seasonal High Ground Water: 50'±

On-site Review

Deep Hole Number: 3 Date: 02/19/16 Time: 9:45 Weather: Sunny

Location (identify on site plan) Middle of Lot

Land Use: Residential Slope (%): 3-8 Surface Stones: No

Vegetation: Oak Trees and Cedar Trees

Landform: Outwash Plain

Position on landscape (sketch on the back): See Sketch

Distances from:

Open Water Body 200+ feet
Possible Wet Area 200+ feet
Drinking Water Well 100+ feet

Drainageway 100+ feet
Property Line 50'± feet
Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0" – 12"	Fill				
12" – 18"	A	Loamy Sand	10 YR 4/2		
18" – 30"	B	Loamy Sand	10 YR 4/6		
30" – 112"	C1	Sandy Loam	10 YR 6/6		
112" – 165"	C2	Sand	10 YR 6/6		Medium sand, loose

Parent Material (geologic) Proglacial Outwash Depth to Bedrock: 200'+
Depth to Groundwater: Standing Water in the Hole: None Weeping from Pit Face: None
Estimated Seasonal High Ground Water: 50'±

On-site Review

Deep Hole Number: 4 Date: 02/19/16 Time: 10:15 Weather: Sunny

Location (identify on site plan) Front of Lot

Land Use: Residential Slope (%): 3-8 Surface Stones: No

Vegetation: Oak Trees and Cedar Trees

Landform: Outwash Plain

Position on landscape (sketch on the back): See Sketch

Distances from:

Open Water Body 200+ feet
Possible Wet Area 200+ feet
Drinking Water Well 100+ feet

Drainageway 100+ feet
Property Line 25'± feet
Other

DEEP OBSERVATION HOLE LOG					
Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0" – 13"	A	Loamy Sand	10 YR 3/2		
13" – 32"	B	Loamy Sand	7.5 YR 4/4		
32" – 72"	C1	Sand	10 YR 6/6		Fine sand
72" – 168"	C2	Silt Loam	10 YR 6/2		Dense
168" – 204"	C3	Sand	10 YR 6/6		Medium sand, loose

Parent Material (geologic) Proglacial Outwash Depth to Bedrock: 200'+
Depth to Groundwater: Standing Water in the Hole: None Weeping from Pit Face: None
Estimated Seasonal High Ground Water: 50'±

On-site Review

Deep Hole Number: *5* Date: *02/19/16* Time: *10:45* Weather: *Sunny*

Location (identify on site plan) *Front of Lot*

Land Use: *Residential* Slope (%): *3-8* Surface Stones: *No*

Vegetation: *Oak Trees and Cedar Trees*

Landform: *Outwash Plain*

Position on landscape (sketch on the back): *See Sketch*

Distances from:

Open Water Body *200+* feet
Possible Wet Area *200+* feet
Drinking Water Well *100+* feet

Drainageway *100+* feet
Property Line *25'±* feet
Other

DEEP OBSERVATION HOLE LOG					
Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0" – 7"	*A*	*Loamy Sand*	*10 YR 3/3*		
7" – 24"	*B*	*Loamy Sand*	*10 YR 5/3*		
24" – 78"	*C1*	*Sand*	*10 YR 5/4*		*Fine sand*
78" – 118"	*C2*	*Loamy Sand*	*10 YR 6/2*		*Friable*
118" – 164"	*C3*	*Sand*	*10 YR 6/6*		*Medium to coarse sand with gravels, loose*

Parent Material (geologic) *Proglacial Outwash* Depth to Bedrock: *200'+*
Depth to Groundwater: Standing Water in the Hole: *None* Weeping from Pit Face: *None*
Estimated Seasonal High Ground Water: *50'±*

On-site Review

Deep Hole Number: 6 Date: 02/19/16 Time: 11:15 Weather: Sunny

Location (identify on site plan) Rear of Lot

Land Use: Residential Slope (%): 3-8 Surface Stones: No

Vegetation: Oak Trees and Cedar Trees

Landform: Outwash Plain

Position on landscape (sketch on the back): See Sketch

Distances from:

Open Water Body 200+ feet Drainageway 100+ feet
Possible Wet Area 200+ feet Property Line 25'+ feet
Drinking Water Well 100+ feet Other

DEEP OBSERVATION HOLE LOG					
Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0" – 9"	A	Loamy Sand	10 YR 3/2		
9" – 22"	B	Loamy Sand	10 YR 6/6		
22" – 96"	C1	Silt Loam	10 YR 5/1		Dense
96" – 180"	C2	Sand	10 YR 7/4		Fine sand
180" – 204"	C3	Silt Loam	10 YR 6/3		

Parent Material (geologic) Proglacial Outwash Depth to Bedrock: 200'+
Depth to Groundwater: Standing Water in the Hole: None Weeping from Pit Face: None
Estimated Seasonal High Ground Water: 50'±

On-site Review

Deep Hole Number: 7 Date: 02/19/16 Time: 11:45 Weather: Sunny

Location (identify on site plan) MIddle of Lot

Land Use: Residential Slope (%): 3-8 Surface Stones: No

Vegetation: Oak Trees and Cedar Trees

Landform: Outwash Plain

Position on landscape (sketch on the back): See Sketch

Distances from:

Open Water Body 200+ feet
Possible Wet Area 200+ feet
Drinking Water Well 100+ feet

Drainageway 100+ feet
Property Line 100+ feet
Other

DEEP OBSERVATION HOLE LOG

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0" – 48"	Fill				
48" – 108"	C1	Sand	10 YR 6/6		Medium to fine sand
108" – 156"	C2	Sand	10 YR 6/6		Medium sand, loose, dry

Parent Material (geologic) Proglacial Outwash Depth to Bedrock: 200'+

Depth to Groundwater: Standing Water in the Hole: None Weeping from Pit Face: None

Estimated Seasonal High Ground Water: 50'±

Location Address or Lot No. *223 Beach Road*

COMMONWEALTH OF MASSACHUSETTS
Orleans, Massachusetts

PERCOLATION TEST*		
Date: 02/18/16		Time: 9:00
Observation Hole #	*1*	--
Depth of Perc	*58"*	--
Start Pre-soak	*0:00*	--
End Pre-soak	*6:40*	--
Time at 12"	*0:00*	--
Time at 9"	*0:41*	--
Time at 6"	*1:20*	--
Time (9" - 6")	*0:39*	--
Rate Min./Inch	*<2*	--

**** Minimum of 1 percolation test must be performed on both the primary area AND reserve area.***

Site Passed ☒ Site Failed ☐

Performed by: *John G. Schnaible*

Witnessed by: *Brian Dudley*

Comments: *The C2 in DOH #1, the C in DOH #2, the C2 in DOH #3, the C3 in DOH #4, the C3 in DOH #5, and the C2 in DOH #7 are considered suitable for the subsurface disposal of sewage. DOH #6 soils are not qualified.*

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coastalengineeringcompany.com

Job *C18470.00*
Sheet No *10* Of *11*
Calculated by: *JGS* Date: *02/18/16*
Scale *See Attached Plan*

SKETCH PLAN SHOWING DEEP OBSERVATION HOLE LOCATIONS:

See Attached Plan

Determination for Seasonal High Water Table

Method Used: N/A

- ☐ Depth observed standing in observation hole ________inches
- ☐ Depth weeping from side of observation hole________inches
- ☐ Depth to soil mottles ____________inches
- ☐ Ground water adjustment________________feet

Index Well Number_______Reading Date_______Index well level______________

Adjustment Factor_______Adjusted ground water level______________

Depth of Naturally Occurring Pervious Material

Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

Yes

If not, what is the depth of naturally occurring pervious material?

____

Certification

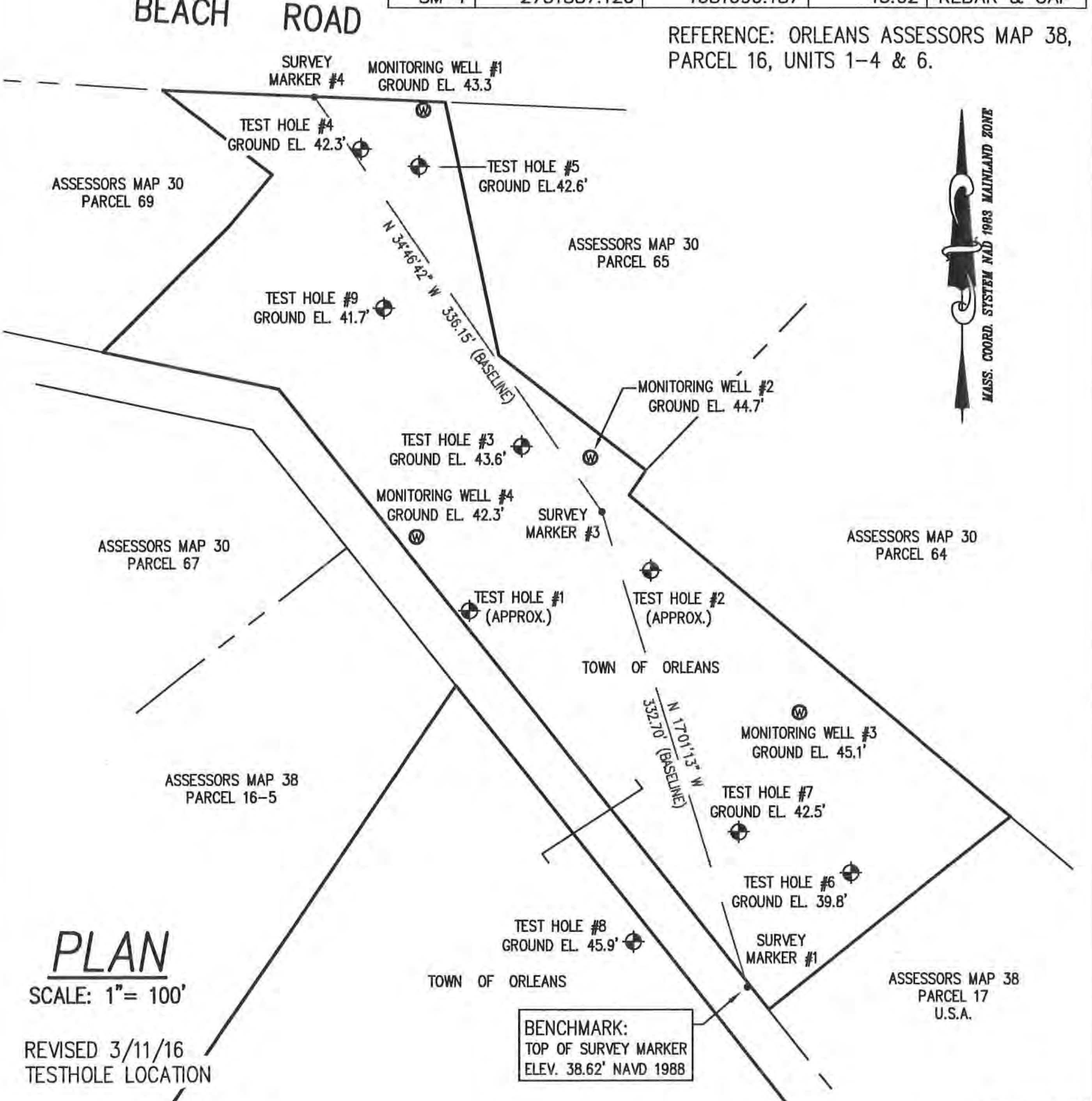
I certify that on *April 1995* I have passed the examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017.

Signature________________ SE 2166 Date *03/25/16*

JGS/dlb

F:\SDSKPROJ\C18000\C18470\C18470-00 Beach St\C18470-WP.dwg Mar 11, 2016 - 3:06pm

Point	Northing	Easting	Elevation	Description
WELL 1	2751878.494	1081768.949	43.03	TOP OF PIPE
WELL 2	2751647.290	1081880.269	44.42	TOP OF PIPE
WELL 3	2751476.907	1082020.569	44.66	TOP OF PIPE
WELL 4	2751594.281	1081764.428	42.00	TOP OF PIPE
SM 1	2751292.896	1081985.313	38.62	REBAR & CAP
SM 3	2751611.023	1081887.928	44.52	REBAR & CAP
SM 4	2751887.126	1081696.187	43.02	REBAR & CAP



DRAWN BY: JDM
C18470WP.dwg

COASTAL engineering co.
260 Cranberry Hwy. Orleans, MA 02653
508.255.6511 P 508.255.6700 F

WELL PLAN OF LAND FOR AECOM

ORLEANS, MA

BEACH STREET

SHEET NO.	SKC-1
PROJECT NO.	C18470.00
SCALE	1"=100'
DATE	~~1/19/2016~~

Appendix F

Soil Boring Logs

GEOLOGIC LOG

PROJECT : Town of Orleans, MA		SHEET 1 of 3	BORING NO. MW-1
SITE LOCATION: 223 Beach Road, Orleans	JOB NO.: 60476644		
Groundwater Discharge Beds	LOCATION: N: 2751878.494 E: 1081768.949	Elevation: 43.03 PVC	Total Depth: 65 ft
DRILL CONTRACTOR : NE Geotech	ENG/GEO : M. Owen	BEGUN : 12/28/15 8:30 AM	
DRILL RIG : Geoprobe® Model 5400	DRILLER : Nash	FINISHED : 12/28/15 14:10 PM	
Weather : Very cold, clear and windy. 20 degrees		Ground Water (Date/Depth) : 3-31-16 / 40.12	
Drilling Method : Direct Push	Drilling Fluid : Potable Water	Top of Rock (Depth/Elev.) : N/A	

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
					0-5 ft soil sample from vac truck excavation of top 5 feet of hole for utility clearnace. Brown fine SAND with silt and cobbles.		Well Construction Details 2" PVC Casing from 55' to Ground Surface 2" well screen from 65' to 55' Sand Pack - 40" to 29' Bentonite Seal - 29' to 27' Grout from 27 to 9'
5					5-10 ft tan to light brown, medium to fine SAND with trace gravel and silt		
	SS1			4ft			
10	(5-10 ft)						
					10-15 ft tan to light brown coarse to medium SAND with trace fine sand and silt		SAND
	SS2			4.75			
15	(10-15 ft)						
					15-20 ft tan to light brown coares to medium SAND with very coarse to fine sand		
	SS3			4.75			
	(15-20 ft)						

Sample Types:		SPT Resistance		Approve/Date
SS = Split Spoon	trace 0 to 5%			
ST = Shelby Tube	few 5 to 10%	Cohesionless Density: 0-4 Very Loose	Cohesive Consisten 0-2 Very Soft	
R = Rock Core	little 15 to 25%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
= Lab Sample	some 30 to 45%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	
	mostly >50%			

GEOLOGIC LOG

AECOM

PROJECT : **Town of Orleans, MA**		SHEET 1 of 3	BORING NO. **MW-4**
SITE LOCATION: 223 Beach Road, Orleans Groundwater Discharge Beds	JOB NO.: **60476644** LOCATION: N: 2751594.281 E: 1081764.428	Elevation: 42.00 PVC	Total Depth: 60 ft
DRILL CONTRACTOR : NE Geotech	ENG/GEO : M. Owen	BEGUN : 12/29/15 8:30 AM	
DRILL RIG : Geoprobe® Model 5400	DRILLER : Nash	FINISHED : 12/29/15 12:00 PM	
2-inch	Weather : Very cold, clear and windy. 20 degrees	Ground Water (Date/Depth) : 3-31-16 / 39.20	
Drilling Method : Direct Push	Drilling Fluid : None	Top of Rock (Depth/Elev.) : N/A	

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
					0-5ft Backfill from Vac Truck excavation of top 5 feet of hole for utility clearnace		2" PVC Casing from 65' to Ground Surface 2" well screen from 65' to 55' Sand Pack - 40" to 29' Bentonite Seal - 29' to 27' Grout from 27 to 9'
5					5-10 ft Tan to light brown, fine SAND with trace silt		
	SS1			4.5 ft			
10	(5-10 ft)				10-14 ft tan to light brown medium to fine SAND with trace coarse sand		Gravel lens at 10' Gravel lems at 12.5'
	SS2			5 ft	14-15 ft light tan to brown, fine SAND with trace medium to coarse sand		
15	(10-15 ft)				15-20 ft tan to light brown medium SAND with very coarse sand and gravel		Gravel lens at 19'
	SS3			5			
	(15-20 ft)						

Sample Types:		SPT Resistance		Approve/Date
SS = Split Spoon	trace 0 to 5%			
ST = Shelby Tube	few 5 to 10%			
R = Rock Core	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consistency 0-2 Very Soft	
= Lab Sample	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

AECOM

GEOLOGIC LOG

PROJECT : Town of Orleans, MA		SHEET	BORING NO.
SITE LOCATION: DISTRICT 3	JOB NO.: 60476644	2 of 3	MW-4
Groundwater Discharge Beds	LOCATION: N: 2751594.281 E: 1081764.428	Elevation: 42.00 PVC	Total Depth: 60 ft

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
					20-25 ft light tan to light brown, coarse SAND		
	SS4			5ft			
25	(20-25 ft)						
					25-30ft tan to light brown coarse to medium SAND with trace fine sand		
	SS5			4.5			
30	(25-30 ft)						
					30-33 ft tan to light brown, very coarse SAND with few gravel		
					33-34 lt brown, coarse to medium SAND with trace fine sand		
	SS6			4.5 ft			
35	(30-35 ft)				34-35 ft tan to light brown, very coarse SAND with trace gravel		
					35-36 ft light tan to light brown, very coarse SAND		
					36-37 ft light tan to light brown, fine SAND with trace medium sand		
					37-38.5 light brown gravelly SAND with few coarse to medium sand		
	SS7			5ft	38.5-40 ft tan to light brown, fine SAND with trace medium sand		
40	(35-40 ft)						
					40-42 ft light tan to light brown, fine SAND with little silt		
					42-43.5 ft light tan to light brown, medium SAND with trace fine sand		Water table at 43'
					43.5-44 ft light tan to light brown, fine SAND with trace silt		Clay lens at 42.5'
	SS8			5ft			
45	(40-45 ft)				44-45 ft light tan to light brown, medium SAND with trace fine sand		

Sample Types:		SPT Resistance		Approve/Date
SS = Split Spoon	trace 0 to 5%			
ST = Shelby Tube	few 5 to 10%			
R = Rock Core	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consisten 0-2 Very Soft	
= Lab Sample	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

GEOLOGIC LOG

PROJECT : Town of Orleans, MA		SHEET	BORING NO.
SITE LOCATION: DISTRICT 3	JOB NO.: 60476644	3 of 3	MW-4
0	LOCATION: N: 2751594.281 E: 1081764.428	Elevation: 42.00 PVC	Total Depth: 60 ft

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
					45-46.5 ft tan to brown, fine SAND with trace medium sand		
					46.5-48 fine SAND and CLAY layers with trace silt		
	SS9			3.5	48-49 ft light tan to light brown, medium to fine SAND		
50	(45-50 ft)				49-50 ft light tan to light brown, very coarse to coarse SAND, with trace medium to fine sand		
					50-52.5 ft lt brown, very coarse to coarse SAND with trace medium sand		
					52.5-53.5 ft lt brown, fine SAND with few silt and clay layers		
	SS10			3.5 ft			
55	(50-55 ft)				53.5-55 ft lt brown, medium SAND with trace fine sand		
60							
65							
70							

Sample Types:			SPT Resistance		Approve/Date
SS = Split Spoon	few	5 to 10%			
ST = Shelby Tube	little	15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consisten 0-2 Very Soft	
R = Rock Core	some	30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
= Lab Sample	mostly	>50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	
	trace	0 to 5%			

GEOLOGIC LOG

PROJECT : Town of Orleans, MA		SHEET	BORING NO.
SITE LOCATION: 223 Beach Road, Orleans	JOB NO.: 60476644	2 of 3	MW-1
Groundwater Discharge Beds	LOCATION: N: 2751878.494 E: 1081768.949	Elevation: 43.03 PVC	Total Depth: 65 ft

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
					20-22 ft light tan to light brown coarse SAND with few medium sand		
					22-23 ft tan medium SAND		
	SS4			5ft			
25	(20-25 ft)				23-25 ft tan to light brown coarse to medium SAND		
					25-30ft tan to light brown coarse to medium SAND with trace fine sand		
	SS5			4.5			
30	(25-30 ft)						
					30-33 ft tan to light brown coarse to medium SAND		
					33-33.5 lt brown medium SAND with trace fine sand and silt		SAND
	SS6			5ft			
35	(30-35 ft)				33.5-35 ft tan to light brown coarse to medium SAND		
					35-40 ft tan to light brown coarse to medium SAND with trace coares and fine sand		
	SS7			5ft			
40	(35-40 ft)						
					40-43 ft dark tan to brown coarse to medium SAND		Water table at 42 feet
					43-43.5 ft tan to light brown very coarse SAND with trace coarse sand		
	SS8			5ft			
45	(40-45 ft)				43.5-45 tan to brown coarse to medium SAND with trace fine sand		

Sample Types:	trace 0 to 5%	SPT Resistance		Approve/Date
SS = Split Spoon	few 5 to 10%			
ST = Shelby Tube	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consisten 0-2 Very Soft	
R = Rock Core	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
= Lab Sample	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

GEOLOGIC LOG

PROJECT : **Town of Orleans, MA**		SHEET 3 of 3	BORING NO. **MW-1**
SITE LOCATION: 223 Beach Road, Orleans	JOB NO.: **60476644**		
Groundwater Discharge Beds	LOCATION: N: 2751878.494 E: 1081768.949	Elevation: 43.03 PVC	Total Depth: 65 ft

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
					45-50 ft lt brown, coarse to medium SAND with trace fine sand		
	SS9			2ft			
50	(45-50 ft)						
					50-55 ft lt brown, coarse to medium SAND with trace fine sand		
	SS10			4ft			SAND
55	(50-55 ft)						
					55-60 ft lt brown, coarse to medium SAND with trace fine sand and silt		
					CLAY lens at 58.5		
	SS11						
60	(55-60 ft)						
					60-65 ft lt brown, medium SAND with trace fine sand and silt		
	SS12			3			
65	(60-65 ft)						
70							

Sample Types:	trace 0 to 5%	SPT Resistance		Approve/Date
SS = Split Spoon	few 5 to 10%			
ST = Shelby Tube	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consisten 0-2 Very Soft	
R = Rock Core	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
= Lab Sample	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

GEOLOGIC LOG

AECOM

PROJECT : **Town of Orleans, MA**		SHEET 1 of 3	BORING NO. **MW-2**
SITE LOCATION: 223 Beach Road, Orleans Groundwater Discharge Beds	JOB NO.: **60476644** LOCATION: N: 2751647.290 E: 1081880.269	Elevation: 44.42 PVC	Total Depth: 55 ft
DRILL CONTRACTOR : NE Geotech	ENG/GEO : M. Owen	BEGUN : 12/29/15 4.00 PM	
DRILL RIG : Geoprobe® Model 5400	DRILLER : Nash	FINISHED : 12/29/15 6:00 PM	
2-inch	Weather : Very cold, clear and windy. 20 degrees	Ground Water (Date/Depth) : 3-31-16 / 41.78	
Drilling Method : Direct Push	Drilling Fluid : None	Top of Rock (Depth/Elev.) : N/A	

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
					No Samples Collected		2" PVC Casing from 65' to Ground Surface 2" well screen from 65' to 55' Sand Pack - 40" to 29' Bentonite Seal - 29' to 27' Grout from 27 to 9'
5							
10	(5-10 ft)						
15	(10-15 ft)						
	(15-20 ft)						

Sample Types:		SPT Resistance		Approve/Date
SS = Split Spoon	trace 0 to 5%			
ST = Shelby Tube	few 5 to 10%			
R = Rock Core	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consistenc 0-2 Very Soft	
▒ = Lab Sample	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

GEOLOGIC LOG

AECOM

PROJECT : Town of Orleans, MA		SHEET	BORING NO.
SITE LOCATION: DISTRICT 3	JOB NO.: **60476644**	2 of 3	**MW-2**
Groundwater Discharge Beds	LOCATION: N: 2751647.290 E: 1081880.269	Elevation: 44.42 PVC	Total Depth: 55 ft

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
25	(20-25 ft)						
30	(25-30 ft)						
	SS6			4.5 ft			
35	(30-35 ft)						
	SS7			5ft			
40	(35-40 ft)						
							Water table at 43'
							Clay lens at 42.5'
	SS8			5ft			
45	(40-45 ft)						

Sample Types:		SPT Resistance		Approve/Date
SS = Split Spoon	few 5 to 10%			
ST = Shelby Tube	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consistency 0-2 Very Soft	
R = Rock Core	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
= Lab Sample	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	
	trace 0 to 5%			

AECOM

GEOLOGIC LOG

PROJECT : Town of Orleans, MA		SHEET	BORING NO.
SITE LOCATION: DISTRICT 3	JOB NO.: 60476644	3 of 3	MW-2
0	LOCATION: N: 2751647.290 E: 1081880.269	Elevation: 44.42 PVC	Total Depth: 55 ft

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
50	(45-50 ft)						
55	(50-55 ft)						
60							
65							
70							

Sample Types:	trace 0 to 5%	SPT Resistance		Approve/Date
SS = Split Spoon	few 5 to 10%			
ST = Shelby Tube	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consistency 0-2 Very Soft	
R = Rock Core	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
= Lab Sample	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

AECOM

GEOLOGIC LOG

PROJECT : **Town of Orleans, MA**		SHEET 1 of 3	BORING NO. **MW-3**
SITE LOCATION: 223 Beach Road, Orleans Groundwater Discharge Beds	JOB NO.: **60476644**		
	LOCATION: N: 2751476.907 E: 1082020.569	Elevation: 44.66 PVC	Total Depth: 55 ft
DRILL CONTRACTOR : NE Geotech	ENG/GEO : M. Owen	BEGUN : 12/29/15 12:30 AM	
DRILL RIG : Geoprobe® Model 5400	DRILLER : Nash	FINISHED : 12/29/15 4:00 PM	
2-inch	Weather : Very cold, clear and windy. 20 degrees	Ground Water (Date/Depth) : 3-31-16 / 42.09	
Drilling Method : Direct Push	Drilling Fluid : Potable Water	Top of Rock (Depth/Elev.) : N/A	

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
					0-5 ft soil sample from vac truck excavation of top 5 feet of hole for utility clearnace. Brown fine SAND with silt and cobbles.		Well Construction Details 2" PVC Casing from 55' to Ground Surface 2" well screen from 65' to 55' Sand Pack - 40" to 29' Bentonite Seal - 29' to 27' Grout from 27 to 9'
5					5-10 ft dark tan to light brown,very coarse to coarse SAND with trace gravel		
	SS1			4			
10	(5-10 ft)				10-13 ft tan to light brown, very coarse SAND with trace gravel		
					13-14 ft tan to light brown, coarse to medium SAND		
	SS2			5 ft			SAND
15	(10-15 ft)				14-15 ft light tan to brown, very coarse SAND with trace medium to coarse sand		
					15-19 ft tan to light brown coarse SAND with trave very coarse sand		
	SS3			5	19-20 ft tan to light brown, very coarse SAND with trace gravel		
	(15-20 ft)						

Sample Types:		SPT Resistance		Approve/Date
SS = Split Spoon	trace 0 to 5%			
ST = Shelby Tube	few 5 to 10%			
R = Rock Core	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consisten 0-2 Very Soft	
= Lab Sample	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

GEOLOGIC LOG

PROJECT : Town of Orleans, MA		SHEET	BORING NO.
SITE LOCATION: DISTRICT 3	JOB NO.: 60476644	2 of 3	MW-3
Groundwater Discharge Beds	LOCATION: N: 2751476.907 E: 1082020.569	Elevation: 44.66 PVC	Total Depth: 55 ft

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
					20-25 ft light tan to light brown, coarse to medium SAND		
	SS4			4.5 ft			
25	(20-25 ft)						
					25-30ft tan to light brown coarse to medium SAND		
	SS5			4.5			
30	(25-30 ft)						SAND
					30-35ft tan to light brown, coarse to medium SAND with trace very coarse sand and gravel		
	SS6			4.25 ft			
35	(30-35 ft)						
					35-38 ft light tan to light brown, coarse SAND with trace very coarse sand		
					Gravel lens at 38'		
	SS7			5ft	38-40 ft tan to light brown, medium SAND		
40	(35-40 ft)						
					40-44 ft light tan to light brown, coarse to medium SAND with trace fine sand		
	SS8			3.5 ft	44-45 ft light tan to light brown, very coarse SAND with trace coarse to medium		
45	(40-45 ft)						

Sample Types:		SPT Resistance		Approve/Date
SS = Split Spoon	trace 0 to 5%			
ST = Shelby Tube	few 5 to 10%	Cohesionless Density: 0-4 Very Loose	Cohesive Consistency: 0-2 Very Soft	
R = Rock Core	little 15 to 25%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
= Lab Sample	some 30 to 45%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	
	mostly >50%			

GEOLOGIC LOG

PROJECT : **Town of Orleans, MA**		SHEET	BORING NO.
SITE LOCATION: DISTRICT 3	JOB NO.: **60476644**	3 of 3	**MW-3**
0	LOCATION: N: 2751476.907 E: 1082020.569	Elevation: 44.66 PVC	Total Depth: 55 ft

Depth (ft)	Sample Type/No.	N Value	Blow Count (per 6 in.) or Drilling Rate(min/ft)	Sample Recovery or REC & RQD	SAMPLE DESCRIPTION	ASTM CLASS	GENERALIZED STRATIGRAPHIC DESCRIPTION *(dashed where inferred)*
					45-50 ft tan to light brown, coarse SAND with trace medium sand, very coarse sand at 48.5		
	SS9			3.5			
50	(45-50 ft)						
					50-54 ft lt brown, coarse to medium SAND		SAND
	SS10			3.5 ft			
55	(50-55 ft)				54-55 ft lt brown, coarse SAND with trace medium sand		
60							
65							
70							

Sample Types:	trace 0 to 5%	SPT Resistance		Approve/Date
SS = Split Spoon	few 5 to 10%			
ST = Shelby Tube	little 15 to 25%	Cohesionless Density: 0-4 Very Loose	Cohesive Consistency 0-2 Very Soft	
R = Rock Core	some 30 to 45%	5-9 Loose 10-29 Med. Dense	3-4 Soft, 5-8 M/Stiff, 9-15 Stiff	
= Lab Sample	mostly >50%	30-49 Dense 50+ Very Dense	16-30 V-Stiff, 31+ Hard	

Appendix G

Laboratory Reports - Grain Size Analysis

CERTIFICATE OF ANALYSIS

Mark Owens
AECOM Environment - ENSR
250 Apollo Drive
Chelmsford, MA 01824

RE: Orleans MA (60476644 Task 01.1)
ESS Laboratory Work Order Number: 1603079

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 3:53 pm, Mar 08, 2016

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with NELAC Standards, A2LA and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

Subcontracted Analyses

CTS - Cranston, RI	Grain Size Analysis, Hydrometer Analyses

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1603079

SAMPLE RECEIPT

The following samples were received on March 03, 2016 for the analyses specified on the enclosed Chain of Custody Record.

The samples and analyses listed below were analyzed in accordance with the Guidelines Establishing Test Procedures for the Analysis of Pollutants, 40 CFR Part 136, as amended.

Lab Number	Sample Name	Matrix	Analysis
1603079-01	Hole 1 22-23	Solid	§
1603079-02	Hole 1 27-28	Solid	§
1603079-03	Hole 1 58.5	Solid	§
1603079-04	Hole 1 63 - 64	Solid	§
1603079-05	Hole 3 38-40	Solid	§
1603079-06	Hole 3 43-44	Solid	§
1603079-07	Hole 4 48-49	Solid	§
1603079-08	Hole 4 52-53	Solid	§

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1603079

PROJECT NARRATIVE

No unusual observations noted.

End of Project Narrative.

DATA USABILITY LINKS

Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1603079

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015D - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH / VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035 - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1603079

Classical Chemistry

Client Sample ID: Hole 1 22-23
Date Sampled: 12/28/15 00:00

ESS Laboratory Sample ID: 1603079-01
Sample Matrix: Solid

All methods used are in accordance with 40 CFR 136.

Analyte	Results	Units	MRL	Method	DF	Analyst	Analyzed
Grain Size	**See Attached**						
Hydrometer	**See Attached**						

Client Sample ID: Hole 1 27-28
Date Sampled: 12/28/15 00:00

ESS Laboratory Sample ID: 1603079-02
Sample Matrix: Solid

All methods used are in accordance with 40 CFR 136.

Analyte	Results	Units	MRL	Method	DF	Analyst	Analyzed
Grain Size	**See Attached**						
Hydrometer	**See Attached**						

Client Sample ID: Hole 1 58.5
Date Sampled: 12/28/15 00:00

ESS Laboratory Sample ID: 1603079-03
Sample Matrix: Solid

All methods used are in accordance with 40 CFR 136.

Analyte	Results	Units	MRL	Method	DF	Analyst	Analyzed
Grain Size	**See Attached**						
Hydrometer	**See Attached**						

Client Sample ID: Hole 1 63 - 64
Date Sampled: 12/28/15 00:00

ESS Laboratory Sample ID: 1603079-04
Sample Matrix: Solid

All methods used are in accordance with 40 CFR 136.

Analyte	Results	Units	MRL	Method	DF	Analyst	Analyzed
Grain Size	**See Attached**						
Hydrometer	**See Attached**						

Client Sample ID: Hole 3 38-40
Date Sampled: 12/29/15 00:00

ESS Laboratory Sample ID: 1603079-05
Sample Matrix: Solid

All methods used are in accordance with 40 CFR 136.

Analyte	Results	Units	MRL	Method	DF	Analyst	Analyzed
Grain Size	**See Attached**						
Hydrometer	**See Attached**						

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
ESS Laboratory Work Order: 1603079

Classical Chemistry

Client Sample ID: Hole 3 43-44
Date Sampled: 12/29/15 00:00
ESS Laboratory Sample ID: 1603079-06
Sample Matrix: Solid

All methods used are in accordance with 40 CFR 136.

Analyte	Results	Units	MRL	Method	DF	Analyst	Analyzed
Grain Size	**See Attached**						
Hydrometer	**See Attached**						

Client Sample ID: Hole 4 48-49
Date Sampled: 12/29/15 00:00
ESS Laboratory Sample ID: 1603079-07
Sample Matrix: Solid

All methods used are in accordance with 40 CFR 136.

Analyte	Results	Units	MRL	Method	DF	Analyst	Analyzed
Grain Size	**See Attached**						
Hydrometer	**See Attached**						

Client Sample ID: Hole 4 52-53
Date Sampled: 12/29/15 00:00
ESS Laboratory Sample ID: 1603079-08
Sample Matrix: Solid

All methods used are in accordance with 40 CFR 136.

Analyte	Results	Units	MRL	Method	DF	Analyst	Analyzed
Grain Size	**See Attached**						
Hydrometer	**See Attached**						

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
ESS Laboratory Work Order: 1603079

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1603079

Notes and Definitions

Z-08	See Attached
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1603079

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/water/dwp-services/labcert/documents/AllLabs.xls

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.depweb.state.pa.us/portal/server.pt/community/labs/13780/laboratory_accreditation_program/590095

LABORATORY TESTING DATA SHEET

Project Name 223 Beach Road
Project No. 60476644.01 ESS = 1603079
Project Manager Mark Owens

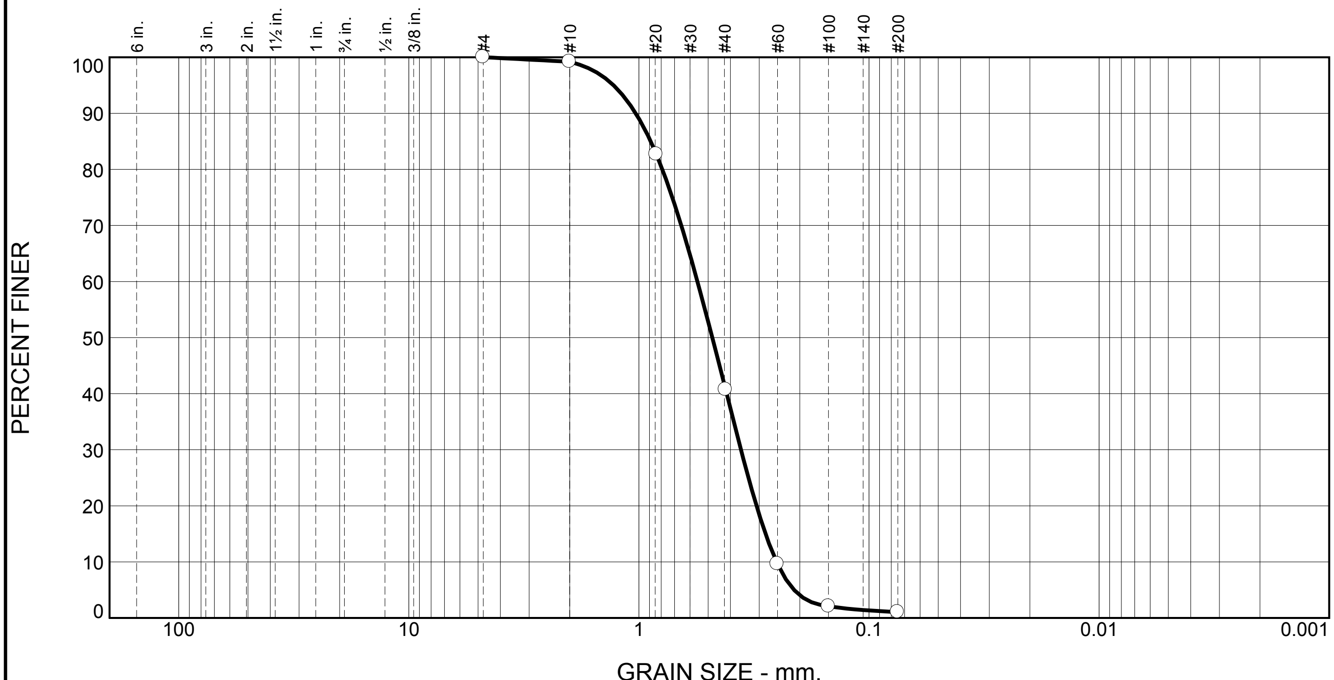
Client ESS/AECOM
Location Orleans, MA
Date 3/8/2016

Reviewed By Matthew Pulgla
Date Reviewed 3/8/2016

Boring/ Test Pit No.	Depth (ft)	Sample Date	Lab No.	ESS ID	Identification Tests						Resistivity (ASTM G187-05)			
					Natural Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Dry unit wt. pcf	As Received Resistance (ohm.m)	Saturated Resistance (ohm.m)	Laboratory Log and Soil Description
Hole 1	22-23	12/28/15	16-S-241					0	98.9	1.1				Light brown poorly graded sand (SP)
Hole 1	27-28	12/28/15	16-S-242					0.2	98.8	1.0				Light brown poorly graded sand (SP)
Hole 1	58.5	12/28/15	16-S-243					0	23.1	76.9				Brown silt with sand (ML)
Hole 1	63.4	12/28/15	16-S-244					0	95.1	4.9				Brown poorly graded sand (SP)
Hole 2	38-40	12/29/15	16-S-245					0	98.4	1.6				Brown poorly graded sand (SP)
Hole 2	43-44	12/29/15	16-S-246					0	98.8	1.2				Brown poorly graded sand (SP)
Hole 2	48-49	12/29/15	16-S-247					0	72.9	27.1				Light brown silty sand (SM)
Hole 2	52-53	12/29/15	16-S-248					0	78.2	21.8				Light brown silty sand (SM)

THIELSCH ENGINEERING
195 Frances Avenue
Cranston, RI 02910
401-467-6454

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.8	57.6	40.5	1.1	

TEST RESULTS (D422)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.2		
#20	82.7		
#40	40.7		
#60	9.6		
#100	2.1		
#200	1.1		

* (no specification provided)

Material Description

Light brown poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 1.0327 D_{85}= 0.8890 D_{60}= 0.5567
D_{50}= 0.4796 D_{30}= 0.3601 D_{15}= 0.2818
D_{10}= 0.2524 C_u= 2.21 C_c= 0.92

Remarks

Date Received: 3/3/16 **Date Tested:** 3/7/16
Tested By: MS
Checked By: Matthew Polsky
Title: Laboratory Manager

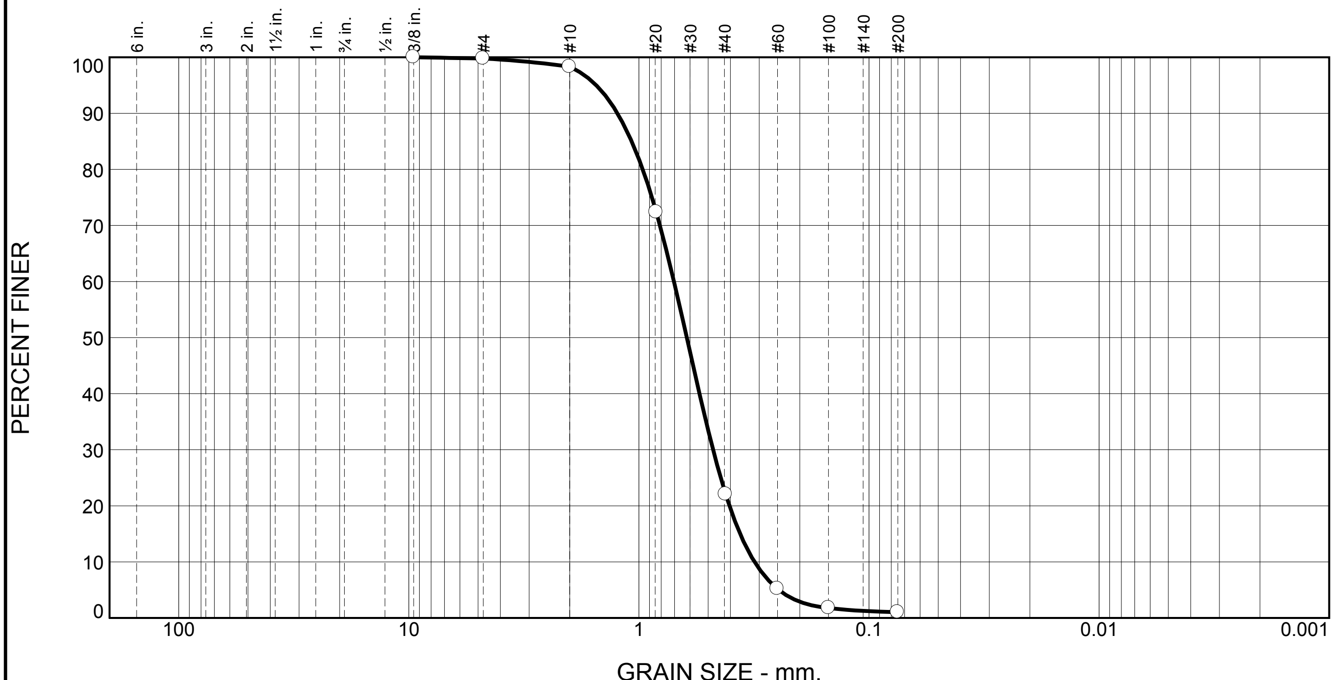
Source of Sample: Hole 1 **Depth:** 22-23' **Date Sampled:** 12/28/15

Thielsch Engineering Inc.

Cranston, RI

Client: AECOM
Project: 223 Beach Road
Orleans, MA
Project No: 60476644.01 **Figure** 16-S-241

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	1.5	75.6	21.7	1.0	

TEST RESULTS (D422)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.375"	100.0		
#4	99.8		
#10	98.3		
#20	72.4		
#40	22.1		
#60	5.2		
#100	1.8		
#200	1.0		

* (no specification provided)

Material Description

Light brown poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 1.2400 D_{85}= 1.0754 D_{60}= 0.7043
D_{50}= 0.6194 D_{30}= 0.4760 D_{15}= 0.3634
D_{10}= 0.3145 C_u= 2.24 C_c= 1.02

Remarks

Date Received: 3/3/16 **Date Tested:** 3/7/16
Tested By: MS
Checked By: Matthew Polsky
Title: Laboratory Manager

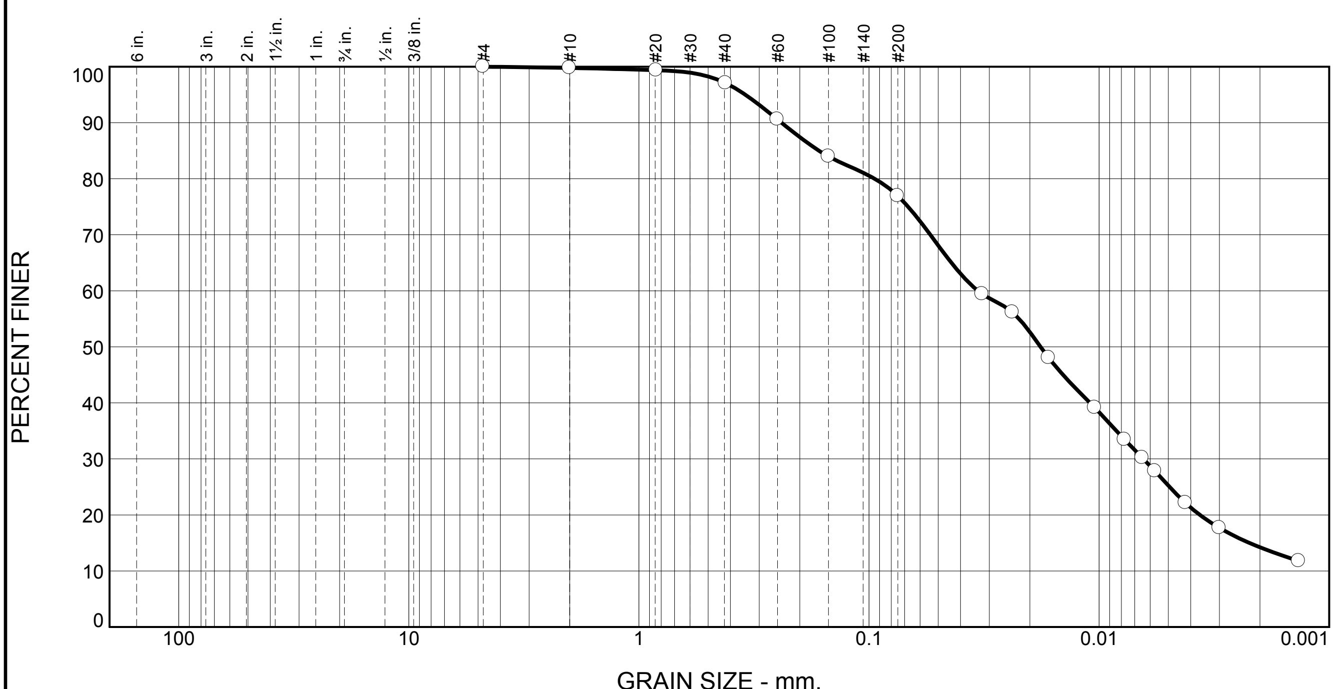
Source of Sample: Hole 1 **Depth:** 27-28' **Date Sampled:** 12/28/15

Thielsch Engineering Inc.

Cranston, RI

Client: AECOM
Project: 223 Beach Road
Orleans, MA
Project No: 60476644.01 **Figure** 16-S-242

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	2.6	20.3	62.7	14.2

TEST RESULTS (D422)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.8		
#20	99.4		
#40	97.1		
#60	90.6		
#100	84.0		
#200	76.9		
0.0322 mm.	59.4		
0.0238 mm.	56.2		
0.0166 mm.	48.1		
0.0104 mm.	39.1		
0.0078 mm.	33.5		
0.0065 mm.	30.2		
0.0057 mm.	27.8		
0.0042 mm.	22.1		
0.0030 mm.	17.7		
0.0014 mm.	11.8		

* (no specification provided)

Material Description

Brown silt with sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= ML AASHTO (M 145)= A-4(0)

Coefficients

D_{90}= 0.2401 D_{85}= 0.1649 D_{60}= 0.0337
D_{50}= 0.0180 D_{30}= 0.0064 D_{15}= 0.0022
D_{10}= C_u= C_c=

Remarks

Date Received: 3/3/16 **Date Tested:** 3/8/16
Tested By: AS/MS
Checked By: Matthew Polsky
Title: Laboratory Manager

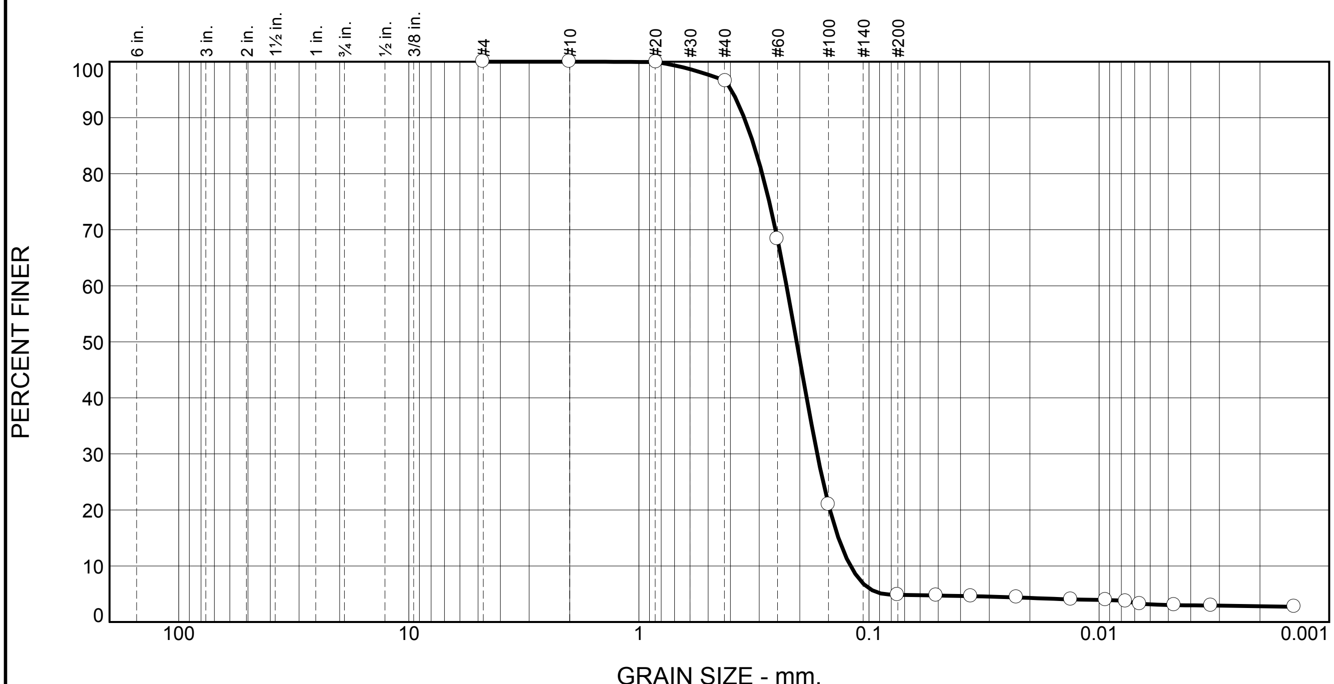
Source of Sample: Hole 1 **Depth:** 58.5' **Date Sampled:** 12/28/15

Thielsch Engineering Inc.

Cranston, RI

Client: AECOM
Project: 223 Beach Road
Orleans, MA
Project No: 60476644.01 **Figure** 16-S-243

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	3.4	91.7	2.1	2.8

TEST RESULTS (D422)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	100.0		
#20	99.9		
#40	96.6		
#60	68.4		
#100	21.0		
#200	4.9		
0.0509 mm.	4.7		
0.0360 mm.	4.6		
0.0228 mm.	4.4		
0.0132 mm.	4.0		
0.0094 mm.	3.9		
0.0077 mm.	3.7		
0.0067 mm.	3.2		
0.0047 mm.	3.0		
0.0033 mm.	2.9		
0.0014 mm.	2.7		

* (no specification provided)

Material Description

Brown poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 0.3486 D_{85}= 0.3159 D_{60}= 0.2283
D_{50}= 0.2064 D_{30}= 0.1679 D_{15}= 0.1358
D_{10}= 0.1204 C_u= 1.90 C_c= 1.03

Remarks

Date Received: 3/3/16 **Date Tested:** 3/8/16
Tested By: AS/MS
Checked By: Matthew Polsky
Title: Laboratory Manager

Source of Sample: Hole 1 **Depth:** 63-64' **Date Sampled:** 12/28/15

Thielsch Engineering Inc.

Cranston, RI

Client: AECOM
Project: 223 Beach Road
Orleans, MA
Project No: 60476644.01 **Figure** 16-S-244

Particle Size Distribution Report

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	40.1	58.2	1.6	

TEST RESULTS (D422)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.9		
#20	95.9		
#40	58.9		
#60	20.5		
#100	5.0		
#200	1.6		

* (no specification provided)

Material Description

Brown poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-3

Coefficients

D_{90}= 0.7080 D_{85}= 0.6343 D_{60}= 0.4263
D_{50}= 0.3750 D_{30}= 0.2897 D_{15}= 0.2232
D_{10}= 0.1932 C_u= 2.21 C_c= 1.02

Remarks

Date Received: 3/3/16 **Date Tested:** 3/7/16
Tested By: AS/MS
Checked By: Matthew Polsky
Title: Laboratory Manager

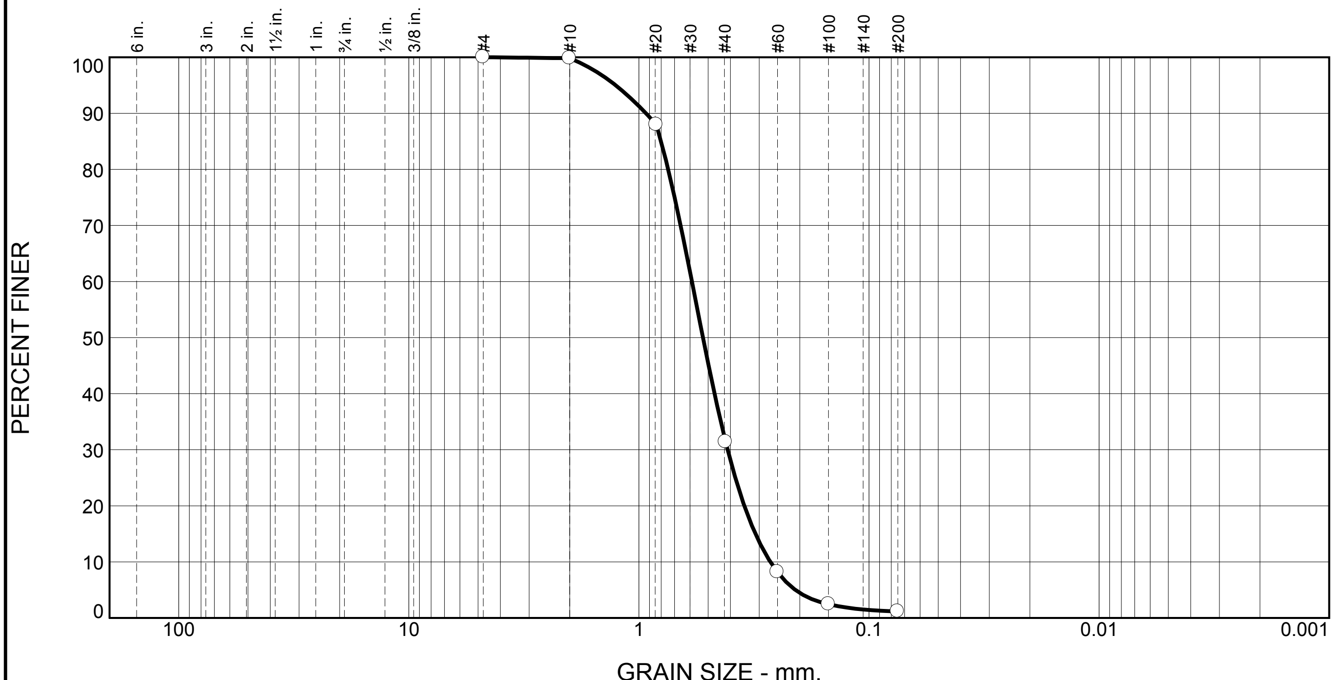
Source of Sample: Hole 2 **Depth:** 38-40' **Date Sampled:** 12/29/15

Thielsch Engineering Inc.

Cranston, RI

Client: AECOM
Project: 223 Beach Road
Orleans, MA
Project No: 60476644.01 **Figure** 16-S-245

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	67.6	31.0	1.2	

TEST RESULTS (D422)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.8		
#20	88.0		
#40	31.4		
#60	8.2		
#100	2.5		
#200	1.2		

* (no specification provided)

Material Description

Brown poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SP **AASHTO (M 145)=** A-1-b

Coefficients

D_{90}= 0.9321 D_{85}= 0.8009 D_{60}= 0.5885
D_{50}= 0.5267 D_{30}= 0.4118 D_{15}= 0.3116
D_{10}= 0.2685 C_u= 2.19 C_c= 1.07

Remarks

Date Received: 3/3/16 **Date Tested:** 3/7/16

Tested By: AS/MS

Checked By: Matthew Polsky

Title: Laboratory Manager

Source of Sample: Hole 2 **Depth:** 43-44' **Date Sampled:** 12/29/15

Thielsch Engineering Inc.

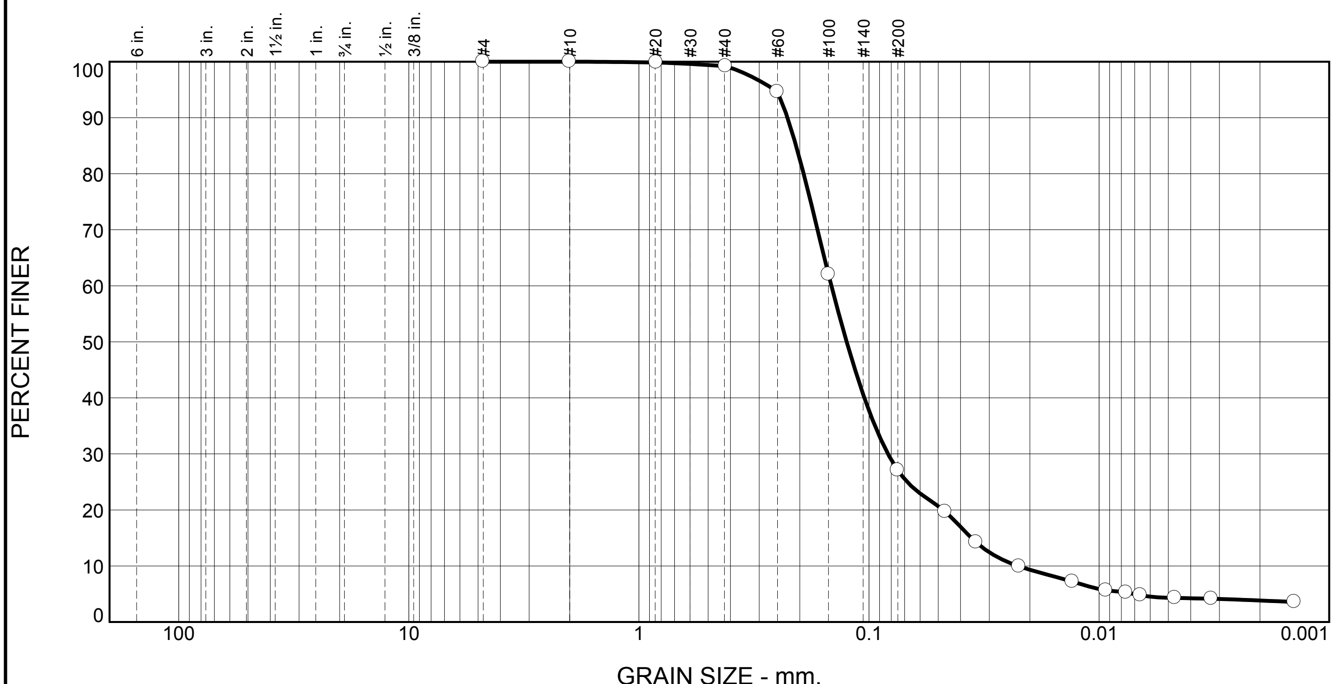
Cranston, RI

Client: AECOM

Project: 223 Beach Road
Orleans, MA

Project No: 60476644.01 **Figure** 16-S-246

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.8	72.1	23.3	3.8

TEST RESULTS (D422)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	100.0		
#20	99.9		
#40	99.2		
#60	94.6		
#100	62.0		
#200	27.1		
0.0467 mm.	19.7		
0.0343 mm.	14.2		
0.0223 mm.	10.0		
0.0131 mm.	7.2		
0.0093 mm.	5.7		
0.0076 mm.	5.3		
0.0066 mm.	4.8		
0.0047 mm.	4.3		
0.0033 mm.	4.2		
0.0014 mm.	3.6		

* (no specification provided)

Material Description

Light brown silty sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.2260 D_{85}= 0.2075 D_{60}= 0.1457
D_{50}= 0.1251 D_{30}= 0.0827 D_{15}= 0.0359
D_{10}= 0.0224 C_u= 6.49 C_c= 2.09

Remarks

Date Received: 3/3/16 **Date Tested:** 3/8/16
Tested By: AS/MS
Checked By: Matthew Polsky
Title: Laboratory Manager

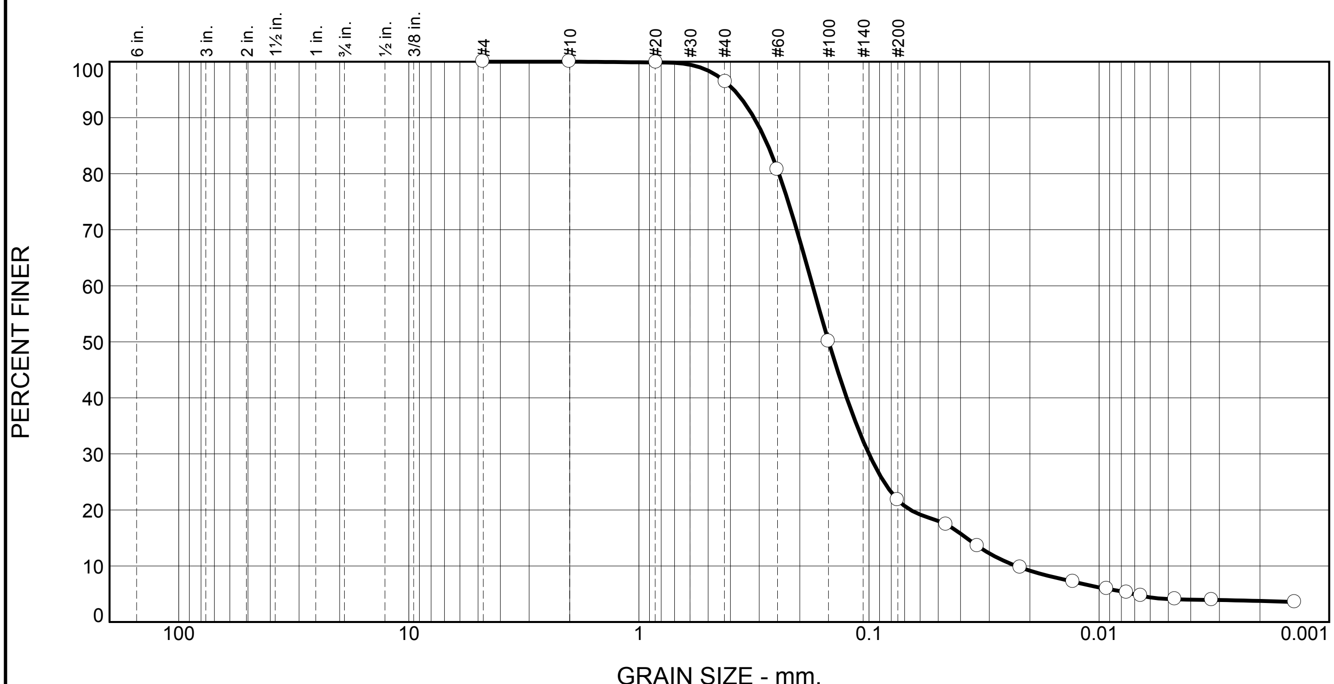
Source of Sample: Hole 2 **Depth:** 48-49' **Date Sampled:** 12/29/15

Thielsch Engineering Inc.

Cranston, RI

Client: AECOM
Project: 223 Beach Road
Orleans, MA
Project No: 60476644.01 **Figure** 16-S-247

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	3.4	74.8	18.0	3.8

TEST RESULTS (D422)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	100.0		
#20	99.9		
#40	96.4		
#60	80.8		
#100	50.1		
#200	21.8		
0.0462 mm.	17.4		
0.0337 mm.	13.6		
0.0220 mm.	9.7		
0.0129 mm.	7.2		
0.0092 mm.	5.9		
0.0076 mm.	5.3		
0.0066 mm.	4.7		
0.0047 mm.	4.1		
0.0032 mm.	3.9		
0.0014 mm.	3.6		

* (no specification provided)

Material Description

Light brown silty sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 0.3159 D_{85}= 0.2748 D_{60}= 0.1758
D_{50}= 0.1497 D_{30}= 0.1000 D_{15}= 0.0377
D_{10}= 0.0229 C_u= 7.68 C_c= 2.49

Remarks

Date Received: 3/3/16 **Date Tested:** 3/8/16
Tested By: AS/MS
Checked By: Matthew Polsky
Title: Laboratory Manager

Source of Sample: Hole 2 **Depth:** 48-49' **Date Sampled:** 12/29/15

Thielsch Engineering Inc.

Cranston, RI

Client: AECOM
Project: 223 Beach Road
Orleans, MA
Project No: 60476644.01 **Figure** 16-S-248

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

Shipped/Delivered Via: ESS Courier

ESS Project ID: 1603079
Date Received: 3/3/2016
Project Due Date: 3/8/2016
Days for Project: 3 Day

1. Air bill manifest present? Yes
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? No
   Temp: N/A Iced with: None
5. Was COC signed and dated by client? Yes

6. Does COC match bottles? Yes
7. Is COC complete and correct? Yes
8. Were samples received intact? Yes
9. **Were labs informed about <u>short holds & rushes</u>?** Yes / No / NA
10. Were any analyses received outside of hold time? Yes / No

11. Any Subcontracting needed? Yes / No
    ESS Sample IDs: 01-08
    Analysis: Grain Size / Hyd.
    TAT: 3 Day

12. Were VOAs received? Yes / No
    a. Air bubbles in aqueous VOAs? Yes / No
    b. Does methanol cover soil completely? Yes / No / NA

13. Are the samples properly preserved? Yes / No
    a. If metals preserved upon receipt: Date: ____ Time: ____ By: ____
    b. Low Level VOAs brought to freezer: Date: ____ Time: ____ By: ____

Sample Receiving Notes:
COC = Hole 1 63.4 label = Hole 1 63-64 CW 3/3/16

14. Was there a need to contact Project Manager? Yes / No 3/3/16
    a. Was there a need to contact the client? Yes / No
    Who was contacted? ____ Date: ____ Time: ____ By: ____

Sample Number	Container ID	Proper Container	Air Bubbles Present	Sufficient Volume	Container Type	Preservative	Record pH (Cyanide and 608 Pesticides)
01	14032	Yes	NA	Yes	Driller Jar	NP	
02	14031	Yes	NA	Yes	Driller Jar	NP	
03	14030	Yes	NA	Yes	Driller Jar	NP	
04	14029	Yes	NA	Yes	Driller Jar	NP	
05	14028	Yes	NA	Yes	Driller Jar	NP	
06	14027	Yes	NA	Yes	Driller Jar	NP	
07	14026	Yes	NA	Yes	Driller Jar	NP	
08	14025	Yes	NA	Yes	Driller Jar	NP	

2nd Review
Are barcode labels on correct containers? Yes / No

Completed By: [signature] Date & Time: 3/3/16 1630

Reviewed By: [signature] Date & Time: 3/3/16 1635

1603079

SOILS LABORATORY TESTING ASSIGNMENT SHEET

THIELSCH ENGINEERING 401-467-6454 195 Frances Ave., Cranston, RI 02910

Project Name: Orleans - 223 Beach Road
CTS Project No.: 60476644.01
ESS Project No.:
Project Manager: Mark Owen

Client: AECOM
Site Location: 223 Beach Road
Date Assigned:
Date Received:

Assigned By:
Collected By: MRO / JS
Received By:
Date Required:

	Sample Information						Identification Tests							Permeability		Compaction			Strength		Consol.	Notes
	Boring/ Test Pit No.	Sample No.	Depth Ft.	Sample Date	ESS SAMPLE ID	Lab No.	Water Cont. %	LL & PL %	Org. %	Sieve -200 %	Hyd -2μ %	G_s	γ_t pcf	Sand	Clay	Mod.	Std.	CBR	Tor-vane	Type Test $\bar{\sigma}_c$ or σ_c	Cc/ 1+eo	
							D2216	D4318	D2974	D422		D854		D2434	D5084	D1557	D698	D1883		D2166/ D4767/ D2850	D2435	#
1	Hole 1		22-23	12-28-15							✓											
2	Hole 1		27-28	↓							✓											
3	Hole 1		58.5	↓							✓											
4	Hole 1		63 - 64 ~~63.4~~	↓	per Mark Owen hdm 3/7/16						✓											
5	Hole 3		38-40	12-29/15							✓											
6	Hole 3		43-44	↓							✓											
7	Hole 4		48-49	↓							✓											
8	Hole 4		52-53	↓							✓											

Notes:

1603079

SOILS LABORATORY TESTING ASSIGNMENT SHEET

THIELSCH ENGINEERING 401-467-6454 195 Frances Ave., Cranston, RI 02910

Project Name	Orleans - 223 Beach Road	Client	AECOM	Assigned By	
CTS Project No.	60476644.01	Site Location	223 Beach Road	Collected By	MRO / JS
ESS Project No.		Date Assigned		Received By	
Project Manager	Mark Owen	Date Received		Date Required	

	Sample Information						Identification Tests							Permeability		Compaction			Strength		Consol.	Notes
	Boring/ Test Pit No.	Sample No.	Depth Ft.	Sample Date	ESS SAMPLE ID	Lab No.	Water Cont. %	LL & PL %	Org. %	Sieve -200 %	Hyd -2μ %	G_s	γ_t pcf	Sand	Clay	Mod.	Std.	CBR	Tor-vane	Type Test $\bar{\sigma}_c$ or σ_c	Cc/ 1+eo	
							D2216	D4318	D2974	D422		D854		D2434	D5084	D1557	D698	D1883		D2166/ D4767/ D2850	D2435	#
1	Hole 1		22-23	12-28-15							✓											
2	Hole 1		27-28								✓											
3	Hole 1		58.5								✓											
4	Hole 1		63.4								✓											
5	Hole 3		38-40	12-29/15							✓											
6	Hole 3		43-44								✓											
7	Hole 4		48-49								✓											
8	Hole 4		52-53								✓											

Notes:

CERTIFICATE OF ANALYSIS

Mark Owen
AECOM Environment - ENSR
9 Jonathon Bourne Dr.
Pocasset, MA 02559

RE: Orleans MA (60476644 Task 01.1)
ESS Laboratory Work Order Number: 1603367

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

Laurel Stoddard
Laboratory Director

REVIEWED
By ESS Laboratory at 12:34 pm, Mar 22, 2016

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with NELAC Standards, A2LA and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

Subcontracted Analvses
CTS - Cranston, RI Gradation

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1603367

SAMPLE RECEIPT

The following samples were received on March 15, 2016 for the analyses specified on the enclosed Chain of Custody Record.

The samples and analyses listed below were analyzed in accordance with the Guidelines Establishing Test Procedures for the Analysis of Pollutants, 40 CFR Part 136, as amended.

Lab Number	Sample Name	Matrix	Analysis
1603367-01	Well 3 - 1 - 20-22 - 16-S-289	Solid	§
1603367-02	Well 3 - 2 - 35-37 - 16-S-290	Solid	§
1603367-03	Well 4 - 3 - 18-20 - 16-S-291	Solid	§
1603367-04	Well 4 - 4 - 30-32 - 16-S-292	Solid	§

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
ESS Laboratory Work Order: 1603367

PROJECT NARRATIVE

No unusual observations noted.

End of Project Narrative.

DATA USABILITY LINKS

Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
ESS Laboratory Work Order: 1603367

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015D - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH / VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035 - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: Well 3 - 1 - 20-22 - 16-S-289
Date Sampled: 03/03/16 00:00

ESS Laboratory Work Order: 1603367
ESS Laboratory Sample ID: 1603367-01
Sample Matrix: Solid

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Gradation	**See Attached** (N/A)								

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: Well 3 - 2 - 35-37 - 16-S-290
Date Sampled: 03/03/16 00:00

ESS Laboratory Work Order: 1603367
ESS Laboratory Sample ID: 1603367-02
Sample Matrix: Solid

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Gradation	**See Attached** (N/A)								

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: Well 4 - 3 - 18-20 - 16-S-291
Date Sampled: 03/03/16 00:00

ESS Laboratory Work Order: 1603367
ESS Laboratory Sample ID: 1603367-03
Sample Matrix: Solid

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Gradation	**See Attached** (N/A)								

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: Well 4 - 4 - 30-32 - 16-S-292
Date Sampled: 03/03/16 00:00

ESS Laboratory Work Order: 1603367
ESS Laboratory Sample ID: 1603367-04
Sample Matrix: Solid

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Gradation	**See Attached** (N/A)								

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
ESS Laboratory Work Order: 1603367

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
ESS Laboratory Work Order: 1603367

Notes and Definitions

Z-08	See Attached
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1603367

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/water/dwp-services/labcert/documents/AllLabs.xls

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.depweb.state.pa.us/portal/server.pt/community/labs/13780/laboratory_accreditation_program/590095

LABORATORY TESTING DATA SHEET

Project Name Orleans GWDP
Project No. 60476644.01.01
Project Manager Mark Owens

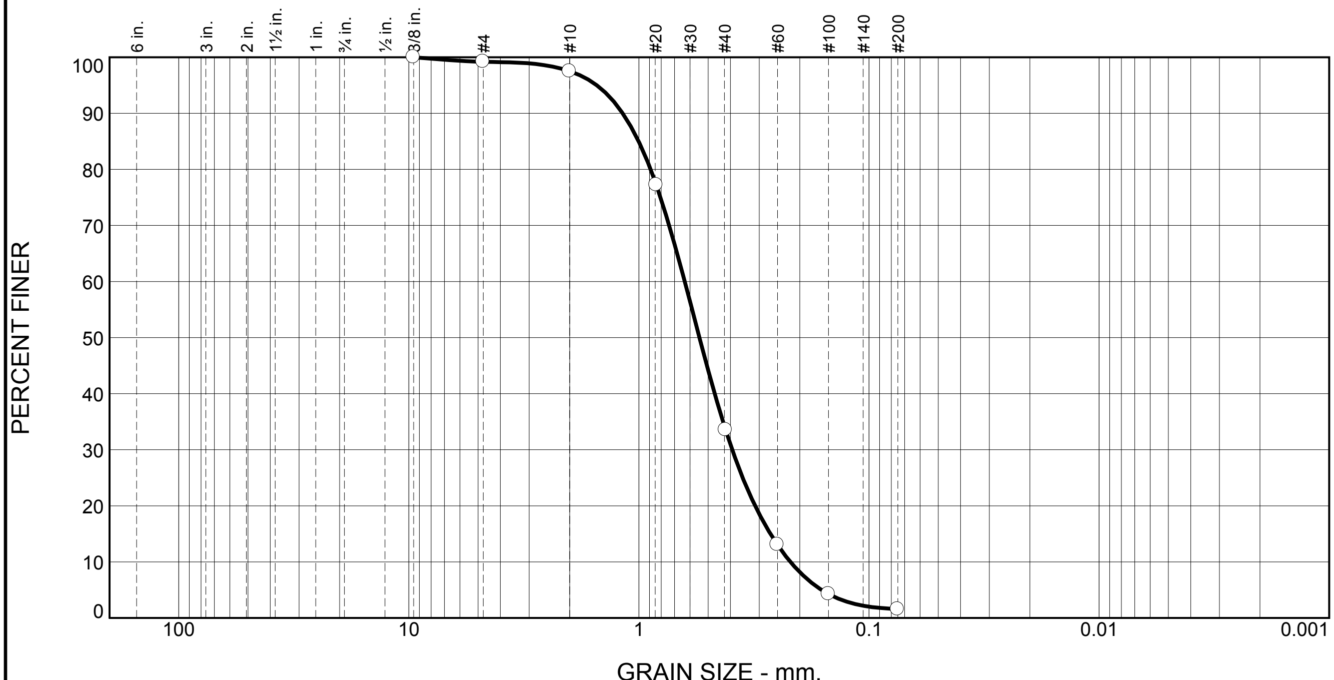
Client ESS/AECOM
Location Orleans, MA
Date 3/15/2016

Reviewed By Matthew Pelge
Date Reviewed 3/15/2016

Boring/ Test Pit No.	Sample No.	Depth	Lab No.	Sample Date	Identification Tests							Resistivity (ASTM G187-05)			
					Natural Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Organic %	Dry unit wt. pcf	As Received Resistance (ohm.m)	Saturated Resistance (ohm.cm)	Laboratory Log and Soil Description
Well 3	1	20-22	16-S-289	3/3/16				0.8	97.6	1.6					Orange-brown poorly graded sand (SP)
Well 3	2	35-37	16-S-290	3/3/16				10.2	88.2	1.6					Orange-brown poorly graded sand (SP)
Well 4	3	18-20	16-S-291	3/3/16				16.5	80.5	3.0					Brown poorly graded sand with gravel (SP)
Well 4	4	30-32	16-S-292	3/3/16				0	97.7	2.3					Orange-brown poorly graded sand (SP)

THIELSCH ENGINEERING
195 Frances Avenue
Cranston, RI 02910 401-467-6454

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.8	1.7	63.3	32.6	1.6	

TEST RESULTS (D422)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.375"	100.0		
#4	99.2		
#10	97.5		
#20	77.2		
#40	33.5		
#60	13.1		
#100	4.3		
#200	1.6		

* (no specification provided)

Material Description

Orange-brown poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SP **AASHTO (M 145)=**

Coefficients

D_{90}= 1.1764 D_{85}= 1.0030 D_{60}= 0.6324
D_{50}= 0.5455 D_{30}= 0.3933 D_{15}= 0.2683
D_{10}= 0.2196 C_u= 2.88 C_c= 1.11

Remarks

Date Received: 3/11/16 **Date Tested:** 3/15/16
Tested By: GG/MS
Checked By: Matthew Polsky
Title: Laboratory Manager

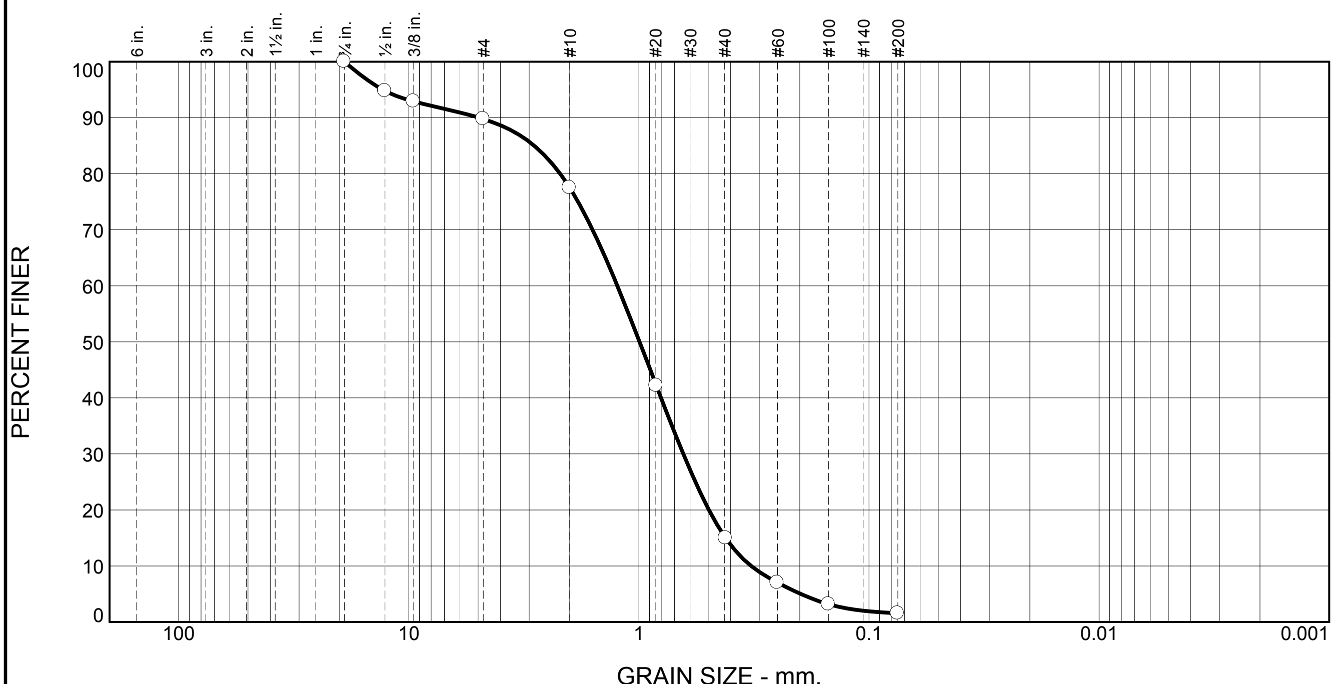
Source of Sample: Well 3 **Depth:** 20-22' **Date Sampled:** 3/3/16
Sample Number: 1

Thielsch Engineering Inc.

Cranston, RI

Client: AECOM
Project: Orleans GWDP
Orleans, MA
Project No: 60476644.01.01 **Figure** 16-S-289

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.2	12.3	62.2	13.7	1.6	

TEST RESULTS (D422)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75"	100.0		
.5"	94.8		
.375"	92.9		
#4	89.8		
#10	77.5		
#20	42.2		
#40	15.0		
#60	7.0		
#100	3.2		
#200	1.6		

* (no specification provided)

Material Description

Orange-brown poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SP **AASHTO (M 145)=**

Coefficients

D_{90}= 4.9527 D_{85}= 2.8514 D_{60}= 1.2414
D_{50}= 0.9937 D_{30}= 0.6413 D_{15}= 0.4203
D_{10}= 0.3251 C_u= 3.82 C_c= 1.02

Remarks

Date Received: 3/11/16 **Date Tested:** 3/15/16
Tested By: GG/MS
Checked By: Matthew Polsky
Title: Laboratory Manager

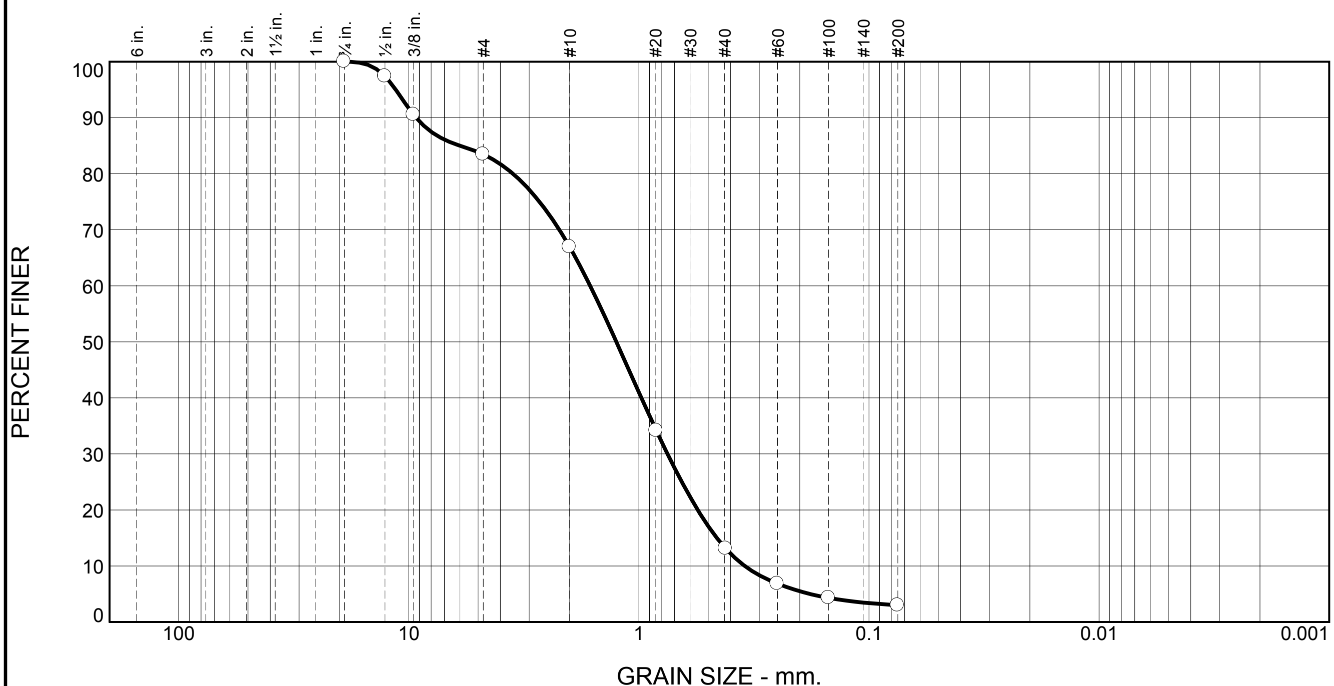
Source of Sample: Well 3 **Depth:** 35-37' **Date Sampled:** 3/3/16
Sample Number: 2

Thielsch Engineering Inc.

Cranston, RI

Client: AECOM
Project: Orleans GWDP
Orleans, MA
Project No: 60476644.01.01 **Figure** 16-S-290

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	16.5	16.6	53.5	10.4	3.0	

TEST RESULTS (D422)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.75"	100.0		
.5"	97.4		
.375"	90.6		
#4	83.5		
#10	66.9		
#20	34.2		
#40	13.1		
#60	6.9		
#100	4.3		
#200	3.0		

* (no specification provided)

Material Description

Brown poorly graded sand with gravel

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SP **AASHTO (M 145)=**

Coefficients

D_{90}= 9.3073 D_{85}= 6.0018 D_{60}= 1.6287
D_{50}= 1.2536 D_{30}= 0.7511 D_{15}= 0.4586
D_{10}= 0.3466 C_u= 4.70 C_c= 1.00

Remarks

Date Received: 3/11/16 **Date Tested:** 3/15/16
Tested By: GG/MS
Checked By: Matthew Polsky
Title: Laboratory Manager

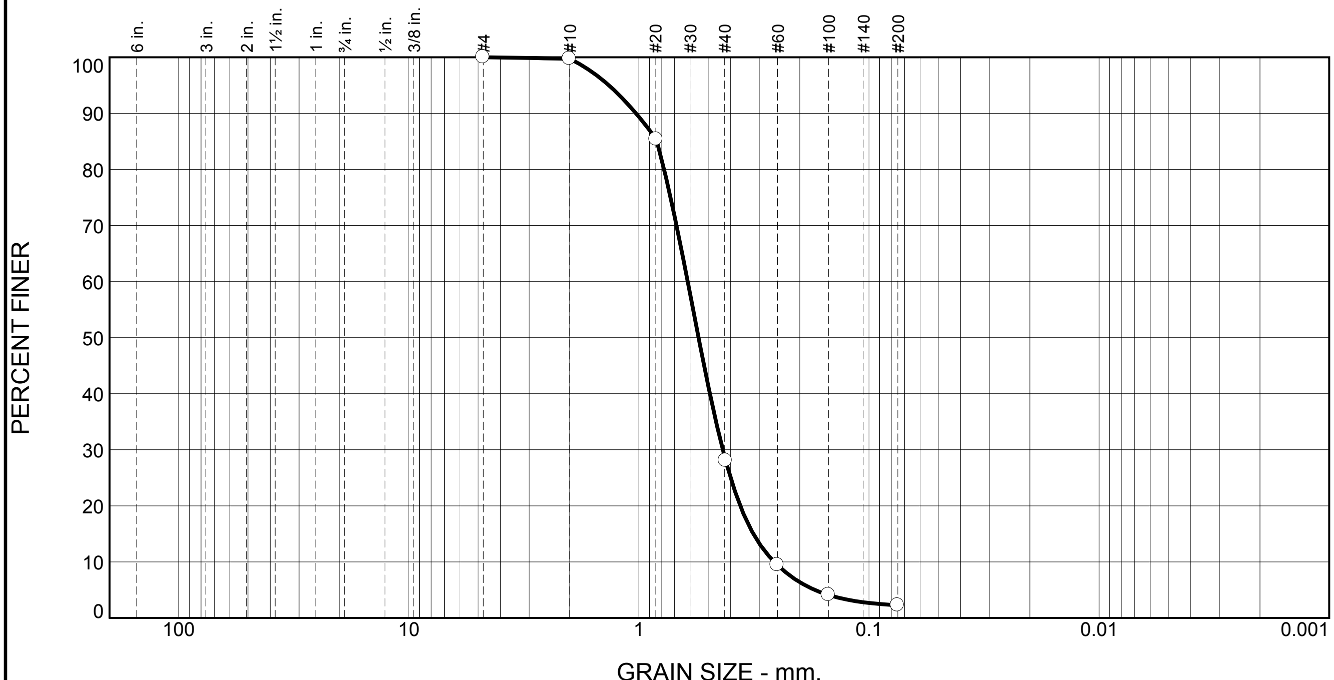
Source of Sample: Well 4 **Depth:** 18-20' **Date Sampled:** 3/3/16
Sample Number: 3

Thielsch Engineering Inc.

Cranston, RI

Client: AECOM
Project: Orleans GWDP
Orleans, MA
Project No: 60476644.01.01 **Figure** 16-S-291

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.3	70.9	26.5	2.3	

TEST RESULTS (D422)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.7		
#20	85.3		
#40	28.1		
#60	9.4		
#100	4.1		
#200	2.3		

* (no specification provided)

Material Description

Orange-brown poorly graded sand

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SP **AASHTO (M 145)=**

Coefficients

D_{90}= 1.0300 D_{85}= 0.8354 D_{60}= 0.6139
D_{50}= 0.5505 D_{30}= 0.4322 D_{15}= 0.3182
D_{10}= 0.2582 C_u= 2.38 C_c= 1.18

Remarks

Date Received: 3/11/16 **Date Tested:** 3/15/16
Tested By: GG/MS
Checked By: Matthew Polsky
Title: Laboratory Manager

Source of Sample: Well 4 **Depth:** 30-32'
Sample Number: 4
Date Sampled: 3/3/16

Thielsch Engineering Inc.

Cranston, RI

Client: AECOM
Project: Orleans GWDP
Orleans, MA
Project No: 60476644.01.01 **Figure** 16-S-292

ESS Laboratory Sample and Cooler Receipt Checklist

Client: ESS Laboratory

Shipped/Delivered Via: Other

ESS Project ID: 1603367
Date Received: 3/15/2016
Project Due Date: 3/22/2016
Days for Project: 5 Day

1. Air bill manifest present? Yes
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? NA
4. Is a Cooler Present? NA
   Temp: NA Iced with: None
5. Was COC signed and dated by client? NA

6. Does COC match bottles? NA
7. Is COC complete and correct? NA
8. Were samples received intact? NA
9. **Were labs informed about <u>short holds & rushes</u>?** Yes / No / NA
10. Were any analyses received outside of hold time? Yes / No

11. Any Subcontracting needed? Yes / No
    ESS Sample IDs:
    Analysis:
    TAT:

12. Were VOAs received? Yes / No
    a. Air bubbles in aqueous VOAs? Yes / No
    b. Does methanol cover soil completely? Yes / No / NA

13. Are the samples properly preserved? Yes / No NA ⓣ 3.15.16
    a. If metals preserved upon receipt: Date: Time: By:
    b. Low Level VOAs brought to freezer: Date: Time: By:

Sample Receiving Notes:
CTS TESTING ⓣ 3.15.16

14. Was there a need to contact Project Manager? Yes / No
    a. Was there a need to contact the client? Yes / No
    Who was contacted? Date: Time: By:

Sample Number	Container ID	Proper Container	Air Bubbles Present	Sufficient Volume	Container Type	Preservative	Record pH (Cyanide and 608 Pesticides)
01	17215	Yes	NA	Yes	Other	NP	
02	17218	Yes	NA	Yes	Other	NP	
03	17217	Yes	NA	Yes	Other	NP	
04	17216	Yes	NA	Yes	Other	NP	

2nd Review
Are barcode labels on correct containers? Yes / No

Completed By: [signature] Date & Time: 3.15.16 1418

Reviewed By: Date & Time:

1603367

LABORATORY TESTING DATA SHEET

Project Name Orleans GWDP
Project No. 60476644.01.01
Project Manager Mark Owens

Client ESS/AECOM
Location Orleans, MA
Date 3/15/2016

Reviewed By Matthew Pelzer
Date Reviewed 3/15/2016

Boring/ Test Pit No.	Sample No.	Depth	Lab No.	Sample Date	Identification Tests: Natural Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Organic %	Resistivity (ASTM G187-05): Dry unit wt. pcf	As Received Resistance (ohm.m)	Saturated Resistance (ohm.cm)	Laboratory Log and Soil Description
Well 3	1	20-22	16-S-289	3/3/16				0.8	97.6	1.6					Orange-brown poorly graded sand (SP)
Well 3	2	35-37	16-S-290	3/3/16				10.2	88.2	1.6					Orange-brown poorly graded sand (SP)
Well 4	3	18-20	16-S-291	3/3/16				16.5	80.5	3.0					Brown poorly graded sand with gravel (SP)
Well 4	4	30-32	16-S-292	3/3/16				0	97.7	2.3					Orange-brown poorly graded sand (SP)

THIELSCH ENGINEERING
195 Frances Avenue
Cranston, RI 02910
401-467-6454

Appendix H

Hydraulic Conductivity Approximation Report

Hydraulic Conductivity Approximation
223 Beach Road Orleans, MA

Summary of Equations:

Vukovic and Soro n=0.255*(1+0.83^u) U=(d60/d10)

$$\boxed{n = 0.255\left(1 + 0.83^{U}\right)}$$

Sheperds

$$\boxed{K_{sat} = b * (d_{50})^{c}}$$

b and c are read from Sheperds Chart

Hazen Ksat=c(d10)^2; c=1.0 to 1.5; d10 (mm)

$$\boxed{K = \frac{g}{v} \times 6 \times 10^{-4}\left[1 + 10(n - 0.26)\right] d_{10}^{2}}$$

Kozeny-Carman Ksat=g/viscosity*8.3*0.0018[n^3/(1-n)^2]*d10^2

$$\boxed{K = \frac{g}{v} \times 8.3 \times 10^{-3}\left[\frac{n^{3}}{(1-n)^{2}}\right] d_{10}^{2}}$$

Slitcher Ksat=g/viscosity*1*0.01*n^3.287*d10^2

$$\boxed{K = \frac{g}{v} \times 1 \times 10^{-2}\, n^{3.287}\, d_{10}^{2}}$$

g	9.81	m/s^2
viscosity	1.004E-06	m^2/s

Summary of Results

Soil sample	*Depth (ft)*	*D10 (mm)*	*D50 (mm)*	*D60 (mm)*	*U(d60/d10)*	*n (porosity)*	*Classification*	*Fines(%)*	**Kozeny-Carman Ksat (ft/day)**	**Sheperds Ksat (ft/day)**	**Hazen Ksat (ft/day)**	**Slitcher Ksat (ft/day)**	**Well Average (FT/day)**	**Well 1 average (ft/day)**	**Well 3 average (ft/day)**	**Well 4 average (ft/day)**	**Site Average (FT/day)**
									Most widely accepted, fine sand with d10 between 0.1 to 3mm	*Wide range of application (see Sheperds Equation chart)*	*Uniformly graded sand and fine sand with d10 between 0.1 to 3mm, and U<5*	*Applicable for grain-size between 0.01mm and 5mm*					
Hole 1	22-23	0.2524	0.4796	0.5567	2.21	0.42	poorly graded SAND	0.01	336.13	138.86	279.34	105.05	**214.85**	**199.44**	**215.93**	**154.06**	**188.93**
Hole 1	27-28	0.3145	0.6194	0.7043	2.24	0.42	poorly graded SAND	0.01	516.72	211.78	432.16	161.92	**330.64**				
Hole 1	58.5		0.018	0.0337			SILT with SAND	0.77									
Hole 1	63.4	0.1204	0.2064	0.2283	1.9	0.43	poorly graded SAND	0.05	84.99	34.55	65.98	25.82	**52.83**				
Hole 3	20-22	0.2196	0.5455	0.6324	2.88	0.40	poorly graded SAND	1.60	205.97	171.73	195.57	67.94	**160.30**				
Hole 3	35-37	0.3251	0.9937	1.2414	3.82	0.38	poorly graded SAND	1.60	347.30	461.95	386.56	121.80	**329.41**				
Hole 3	38-40	0.1932	0.375	0.4263	2.21	0.42	poorly graded SAND	0.02	196.94	92.53	163.67	61.55	**128.67**				
Hole 3	43-44	0.2685	0.5267	0.5885	2.19	0.42	poorly graded SAND	0.01	382.92	162.07	316.87	119.47	**245.33**				
Hole 4	18-20	0.3466	1.2536	1.6287	4.7	0.36	poorly graded SAND with gravel	3.00	318.91	677.78	401.61	117.05	**378.84**				
Hole 4	30-32	0.2582	0.5505	0.6139	2.38	0.42	poorly graded SAND	2.30	332.69	174.33	286.50	105.51	**224.76**				
Hole 4	48-49	0.0224	0.1251	0.1457	6.49	0.33	Silty SAND	0.27	0.94	15.12	1.43	0.37	**5.47**				
Hole 4	52-53	0.0229	0.1497	0.1758	7.68	0.32	Silty SAND	0.22	0.81	20.33	1.36	0.33	**7.16**				

Soil is outside the predicting equation applicability range

Appendix I

Laboratory Reports – Water Quality

CERTIFICATE OF ANALYSIS

Mark Owens
AECOM Environment - ENSR
9 Jonathon Bourne Dr.
Pocasset, MA 02559

RE: Orleans MA (60476644 task 01.1)
ESS Laboratory Work Order Number: 1602068

This signed Certificate of Analysis is our approved release of your analytical results. These results are only representative of sample aliquots received at the laboratory. ESS Laboratory expects its clients to follow all regulatory sampling guidelines. Beginning with this page, the entire report has been paginated. This report should not be copied except in full without the approval of the laboratory. Samples will be disposed of thirty days after the final report has been delivered. If you have any questions or concerns, please feel free to call our Customer Service Department.

REVIEWED
By ESS Laboratory at 11:01 am, Feb 10, 2016

Laurel Stoddard
Laboratory Director

Analytical Summary
The project as described above has been analyzed in accordance with the ESS Quality Assurance Plan. This plan utilizes the following methodologies: US EPA SW-846, US EPA Methods for Chemical Analysis of Water and Wastes per 40 CFR Part 136, APHA Standard Methods for the Examination of Water and Wastewater, American Society for Testing and Materials (ASTM), and other recognized methodologies. The analyses with these noted observations are in conformance to the Quality Assurance Plan. In chromatographic analysis, manual integration is frequently used instead of automated integration because it produces more accurate results.

The test results present in this report are in compliance with NELAC Standards, A2LA and/or client Quality Assurance Project Plans (QAPP). The laboratory has reviewed the following: Sample Preservations, Hold Times, Initial Calibrations, Continuing Calibrations, Method Blanks, Blank Spikes, Blank Spike Duplicates, Duplicates, Matrix Spikes, Matrix Spike Duplicates, Surrogates and Internal Standards. Any results which were found to be outside of the recommended ranges stated in our SOPs will be noted in the Project Narrative.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
ESS Laboratory Work Order: 1602068

SAMPLE RECEIPT

The following samples were received on February 03, 2016 for the analyses specified on the enclosed Chain of Custody Record.

The samples and analyses listed below were analyzed in accordance with the Guidelines Establishing Test Procedures for the Analysis of Pollutants, 40 CFR Part 136, as amended.

Lab Number	Sample Name	Matrix	Analysis
1602068-01	MW3-020216-1	Ground Water	200.7, 353.2, 365.1, 4500N, 624, 9250
1602068-02	MW1-020216-1	Ground Water	200.7, 353.2, 365.1, 4500N, 624, 9250
1602068-03	MW2-020216-1	Ground Water	200.7, 353.2, 365.1, 4500N, 624, 9250
1602068-04	MW4-020216-1	Ground Water	200.7, 353.2, 365.1, 4500N, 624, 9250
1602068-05	MW4-020216-2	Ground Water	200.7, 353.2, 365.1, 4500N, 624, 9250
1602068-06	Trip Blank	Aqueous	624

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1602068

PROJECT NARRATIVE

624 Volatile Organic Compounds

CB60434-BSD1	**Blank Spike recovery is above upper control limit (B+).**
	2-Chloroethyl vinyl ether (193% @ 70-130%)
CB60434-BSD1	**Relative percent difference for duplicate is outside of criteria (D+).**
	2-Chloroethyl vinyl ether (60% @ 25%)
CZB0072-CCV1	**Continuing Calibration %Diff/Drift is below control limit (CD-).**
	2-Chloroethyl vinyl ether (32% @ 30%)

No other observations noted.

End of Project Narrative.

DATA USABILITY LINKS

Definitions of Quality Control Parameters

Semivolatile Organics Internal Standard Information

Semivolatile Organics Surrogate Information

Volatile Organics Internal Standard Information

Volatile Organics Surrogate Information

EPH and VPH Alkane Lists

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
ESS Laboratory Work Order: 1602068

CURRENT SW-846 METHODOLOGY VERSIONS

Analytical Methods

1010A - Flashpoint
6010C - ICP
6020A - ICP MS
7010 - Graphite Furnace
7196A - Hexavalent Chromium
7470A - Aqueous Mercury
7471B - Solid Mercury
8011 - EDB/DBCP/TCP
8015D - GRO/DRO
8081B - Pesticides
8082A - PCB
8100M - TPH
8151A - Herbicides
8260B - VOA
8270D - SVOA
8270D SIM - SVOA Low Level
9014 - Cyanide
9038 - Sulfate
9040C - Aqueous pH
9045D - Solid pH (Corrosivity)
9050A - Specific Conductance
9056A - Anions (IC)
9060A - TOC
9095B - Paint Filter
MADEP 04-1.1 - EPH / VPH

Prep Methods

3005A - Aqueous ICP Digestion
3020A - Aqueous Graphite Furnace / ICP MS Digestion
3050B - Solid ICP / Graphite Furnace / ICP MS Digestion
3060A - Solid Hexavalent Chromium Digestion
3510C - Separatory Funnel Extraction
3520C - Liquid / Liquid Extraction
3540C - Manual Soxhlet Extraction
3541 - Automated Soxhlet Extraction
3546 - Microwave Extraction
3580A - Waste Dilution
5030B - Aqueous Purge and Trap
5030C - Aqueous Purge and Trap
5035 - Solid Purge and Trap

SW846 Reactivity Methods 7.3.3.2 (Reactive Cyanide) and 7.3.4.1 (Reactive Sulfide) have been withdrawn by EPA. These methods are reported per client request and are not NELAP accredited.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW3-020216-1
Date Sampled: 02/02/16 11:00
Percent Solids: N/A

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-01
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A
All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Sodium	**35.8** (2.50)		200.7		1	KJK	02/03/16 22:25	50	25	CB60329

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW3-020216-1
Date Sampled: 02/02/16 11:00
Percent Solids: N/A
Initial Volume: 5
Final Volume: 5
Extraction Method: 5030B

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-01
Sample Matrix: Ground Water
Units: ug/L
Analyst: MD

All methods used are in accordance with 40 CFR 136.

624 Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1,1-Trichloroethane	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
1,1,2,2-Tetrachloroethane	ND (0.5)		624		1	02/04/16 15:07	CZB0072	CB60434
1,1,2-Trichloroethane	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
1,1-Dichloroethane	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
1,1-Dichloroethene	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
1,2-Dichlorobenzene	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
1,2-Dichloroethane	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
1,2-Dichloropropane	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
1,3-Dichlorobenzene	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
1,4-Dichlorobenzene	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
2-Chloroethyl vinyl ether	ND (10.0)		624		1	02/04/16 15:07	CZB0072	CB60434
Acrolein - Screen	ND (5.0)		624		1	02/04/16 15:07	CZB0072	CB60434
Acrylonitrile - Screen	ND (5.0)		624		1	02/04/16 15:07	CZB0072	CB60434
Benzene	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
Bromodichloromethane	ND (0.6)		624		1	02/04/16 15:07	CZB0072	CB60434
Bromoform	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
Bromomethane	ND (2.0)		624		1	02/04/16 15:07	CZB0072	CB60434
Carbon Tetrachloride	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
Chlorobenzene	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
Chloroethane	ND (2.0)		624		1	02/04/16 15:07	CZB0072	CB60434
Chloroform	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
Chloromethane	ND (2.0)		624		1	02/04/16 15:07	CZB0072	CB60434
cis-1,2-Dichloroethene	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
cis-1,3-Dichloropropene	ND (0.4)		624		1	02/04/16 15:07	CZB0072	CB60434
Dibromochloromethane	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
Ethylbenzene	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
Methylene Chloride	ND (4.0)		624		1	02/04/16 15:07	CZB0072	CB60434
Tetrachloroethene	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
Toluene	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
trans-1,2-Dichloroethene	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
trans-1,3-Dichloropropene	ND (0.5)		624		1	02/04/16 15:07	CZB0072	CB60434
Trichloroethene	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW3-020216-1
Date Sampled: 02/02/16 11:00
Percent Solids: N/A
Initial Volume: 5
Final Volume: 5
Extraction Method: 5030B

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-01
Sample Matrix: Ground Water
Units: ug/L
Analyst: MD

All methods used are in accordance with 40 CFR 136.

624 Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Trichlorofluoromethane	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434
Vinyl Chloride	ND (1.0)		624		1	02/04/16 15:07	CZB0072	CB60434

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichloroethane-d4	*109 %*		*70-130*
Surrogate: 4-Bromofluorobenzene	*98 %*		*70-130*
Surrogate: Dibromofluoromethane	*106 %*		*70-130*
Surrogate: Toluene-d8	*107 %*		*70-130*

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW3-020216-1
Date Sampled: 02/02/16 11:00
Percent Solids: N/A

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-01
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Chloride	**53.1** (3.0)		9250		1	EEM	02/08/16 14:52	mg/L	CB60815
Nitrate as N	**1.66** (0.110)		353.2		5	JLK	02/03/16 13:53	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/03/16 13:07	mg/L	CB60338
Ortho-phosphate as P	ND (0.10)		365.1		1	JLK	02/04/16 8:35	mg/L	CB60401
Total Nitrogen	**1.66** (0.30)		4500N		5	JLK	02/06/16 9:55	mg/L	[CALC]
Total Phosphate as P	ND (0.10)		365.1		1	EEM	02/04/16 16:18	mg/L	CB60420

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW1-020216-1
Date Sampled: 02/02/16 13:10
Percent Solids: N/A

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-02
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Sodium	**95.0** (2.50)		200.7		1	KJK	02/03/16 22:30	50	25	CB60329

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW1-020216-1
Date Sampled: 02/02/16 13:10
Percent Solids: N/A
Initial Volume: 5
Final Volume: 5
Extraction Method: 5030B

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-02
Sample Matrix: Ground Water
Units: ug/L
Analyst: MD

All methods used are in accordance with 40 CFR 136.

624 Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1,1-Trichloroethane	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
1,1,2,2-Tetrachloroethane	ND (0.5)		624		1	02/04/16 15:32	CZB0072	CB60434
1,1,2-Trichloroethane	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
1,1-Dichloroethane	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
1,1-Dichloroethene	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
1,2-Dichlorobenzene	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
1,2-Dichloroethane	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
1,2-Dichloropropane	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
1,3-Dichlorobenzene	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
1,4-Dichlorobenzene	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
2-Chloroethyl vinyl ether	ND (10.0)		624		1	02/04/16 15:32	CZB0072	CB60434
Acrolein - Screen	ND (5.0)		624		1	02/04/16 15:32	CZB0072	CB60434
Acrylonitrile - Screen	ND (5.0)		624		1	02/04/16 15:32	CZB0072	CB60434
Benzene	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
Bromodichloromethane	ND (0.6)		624		1	02/04/16 15:32	CZB0072	CB60434
Bromoform	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
Bromomethane	ND (2.0)		624		1	02/04/16 15:32	CZB0072	CB60434
Carbon Tetrachloride	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
Chlorobenzene	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
Chloroethane	ND (2.0)		624		1	02/04/16 15:32	CZB0072	CB60434
Chloroform	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
Chloromethane	ND (2.0)		624		1	02/04/16 15:32	CZB0072	CB60434
cis-1,2-Dichloroethene	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
cis-1,3-Dichloropropene	ND (0.4)		624		1	02/04/16 15:32	CZB0072	CB60434
Dibromochloromethane	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
Ethylbenzene	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
Methylene Chloride	ND (4.0)		624		1	02/04/16 15:32	CZB0072	CB60434
Tetrachloroethene	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
Toluene	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
trans-1,2-Dichloroethene	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
trans-1,3-Dichloropropene	ND (0.5)		624		1	02/04/16 15:32	CZB0072	CB60434
Trichloroethene	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW1-020216-1
Date Sampled: 02/02/16 13:10
Percent Solids: N/A
Initial Volume: 5
Final Volume: 5
Extraction Method: 5030B

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-02
Sample Matrix: Ground Water
Units: ug/L
Analyst: MD

All methods used are in accordance with 40 CFR 136.

624 Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Trichlorofluoromethane	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434
Vinyl Chloride	ND (1.0)		624		1	02/04/16 15:32	CZB0072	CB60434

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichloroethane-d4	*109 %*		*70-130*
Surrogate: 4-Bromofluorobenzene	*99 %*		*70-130*
Surrogate: Dibromofluoromethane	*108 %*		*70-130*
Surrogate: Toluene-d8	*105 %*		*70-130*

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW1-020216-1
Date Sampled: 02/02/16 13:10
Percent Solids: N/A

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-02
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Chloride	**140** (15.0)		9250		5	EEM	02/08/16 15:06	mg/L	CB60815
Nitrate as N	**1.90** (0.110)		353.2		5	JLK	02/03/16 13:56	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/03/16 13:10	mg/L	CB60338
Ortho-phosphate as P	ND (0.10)		365.1		1	JLK	02/04/16 8:36	mg/L	CB60401
Total Nitrogen	**1.90** (0.30)		4500N		5	JLK	02/06/16 9:55	mg/L	[CALC]
Total Phosphate as P	ND (0.10)		365.1		1	EEM	02/04/16 16:19	mg/L	CB60420

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW2-020216-1
Date Sampled: 02/02/16 15:25
Percent Solids: N/A

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-03
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A
All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Sodium	**44.1** (5.00)		200.7		2	KJK	02/09/16 19:28	50	25	CB60329

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW2-020216-1
Date Sampled: 02/02/16 15:25
Percent Solids: N/A
Initial Volume: 5
Final Volume: 5
Extraction Method: 5030B

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-03
Sample Matrix: Ground Water
Units: ug/L
Analyst: MD

All methods used are in accordance with 40 CFR 136.

624 Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1,1-Trichloroethane	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
1,1,2,2-Tetrachloroethane	ND (0.5)		624		1	02/04/16 15:57	CZB0072	CB60434
1,1,2-Trichloroethane	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
1,1-Dichloroethane	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
1,1-Dichloroethene	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
1,2-Dichlorobenzene	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
1,2-Dichloroethane	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
1,2-Dichloropropane	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
1,3-Dichlorobenzene	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
1,4-Dichlorobenzene	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
2-Chloroethyl vinyl ether	ND (10.0)		624		1	02/04/16 15:57	CZB0072	CB60434
Acrolein - Screen	ND (5.0)		624		1	02/04/16 15:57	CZB0072	CB60434
Acrylonitrile - Screen	ND (5.0)		624		1	02/04/16 15:57	CZB0072	CB60434
Benzene	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
Bromodichloromethane	ND (0.6)		624		1	02/04/16 15:57	CZB0072	CB60434
Bromoform	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
Bromomethane	ND (2.0)		624		1	02/04/16 15:57	CZB0072	CB60434
Carbon Tetrachloride	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
Chlorobenzene	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
Chloroethane	ND (2.0)		624		1	02/04/16 15:57	CZB0072	CB60434
Chloroform	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
Chloromethane	ND (2.0)		624		1	02/04/16 15:57	CZB0072	CB60434
cis-1,2-Dichloroethene	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
cis-1,3-Dichloropropene	ND (0.4)		624		1	02/04/16 15:57	CZB0072	CB60434
Dibromochloromethane	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
Ethylbenzene	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
Methylene Chloride	ND (4.0)		624		1	02/04/16 15:57	CZB0072	CB60434
Tetrachloroethene	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
Toluene	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
trans-1,2-Dichloroethene	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
trans-1,3-Dichloropropene	ND (0.5)		624		1	02/04/16 15:57	CZB0072	CB60434
Trichloroethene	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW2-020216-1
Date Sampled: 02/02/16 15:25
Percent Solids: N/A
Initial Volume: 5
Final Volume: 5
Extraction Method: 5030B

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-03
Sample Matrix: Ground Water
Units: ug/L
Analyst: MD

All methods used are in accordance with 40 CFR 136.

624 Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Trichlorofluoromethane	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434
Vinyl Chloride	ND (1.0)		624		1	02/04/16 15:57	CZB0072	CB60434

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichloroethane-d4	*108 %*		*70-130*
Surrogate: 4-Bromofluorobenzene	*98 %*		*70-130*
Surrogate: Dibromofluoromethane	*109 %*		*70-130*
Surrogate: Toluene-d8	*106 %*		*70-130*

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW2-020216-1
Date Sampled: 02/02/16 15:25
Percent Solids: N/A

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-03
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Chloride	**74.4** (3.0)		9250		1	EEM	02/08/16 14:54	mg/L	CB60815
Nitrate as N	**1.56** (0.110)		353.2		5	JLK	02/03/16 13:57	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/03/16 13:11	mg/L	CB60338
Ortho-phosphate as P	ND (0.10)		365.1		1	JLK	02/04/16 8:37	mg/L	CB60401
Total Nitrogen	**1.56** (0.30)		4500N		5	JLK	02/06/16 9:56	mg/L	[CALC]
Total Phosphate as P	ND (0.10)		365.1		1	EEM	02/04/16 16:20	mg/L	CB60420

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW4-020216-1
Date Sampled: 02/02/16 17:00
Percent Solids: N/A

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-04
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Sodium	**30.9** (5.00)		200.7		2	KJK	02/09/16 19:45	50	25	CB60329

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW4-020216-1
Date Sampled: 02/02/16 17:00
Percent Solids: N/A
Initial Volume: 5
Final Volume: 5
Extraction Method: 5030B

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-04
Sample Matrix: Ground Water
Units: ug/L
Analyst: MD

All methods used are in accordance with 40 CFR 136.

624 Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1,1-Trichloroethane	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
1,1,2,2-Tetrachloroethane	ND (0.5)		624		1	02/04/16 16:23	CZB0072	CB60434
1,1,2-Trichloroethane	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
1,1-Dichloroethane	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
1,1-Dichloroethene	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
1,2-Dichlorobenzene	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
1,2-Dichloroethane	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
1,2-Dichloropropane	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
1,3-Dichlorobenzene	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
1,4-Dichlorobenzene	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
2-Chloroethyl vinyl ether	ND (10.0)		624		1	02/04/16 16:23	CZB0072	CB60434
Acrolein - Screen	ND (5.0)		624		1	02/04/16 16:23	CZB0072	CB60434
Acrylonitrile - Screen	ND (5.0)		624		1	02/04/16 16:23	CZB0072	CB60434
Benzene	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
Bromodichloromethane	ND (0.6)		624		1	02/04/16 16:23	CZB0072	CB60434
Bromoform	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
Bromomethane	ND (2.0)		624		1	02/04/16 16:23	CZB0072	CB60434
Carbon Tetrachloride	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
Chlorobenzene	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
Chloroethane	ND (2.0)		624		1	02/04/16 16:23	CZB0072	CB60434
Chloroform	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
Chloromethane	ND (2.0)		624		1	02/04/16 16:23	CZB0072	CB60434
cis-1,2-Dichloroethene	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
cis-1,3-Dichloropropene	ND (0.4)		624		1	02/04/16 16:23	CZB0072	CB60434
Dibromochloromethane	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
Ethylbenzene	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
Methylene Chloride	ND (4.0)		624		1	02/04/16 16:23	CZB0072	CB60434
Tetrachloroethene	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
Toluene	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
trans-1,2-Dichloroethene	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
trans-1,3-Dichloropropene	ND (0.5)		624		1	02/04/16 16:23	CZB0072	CB60434
Trichloroethene	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW4-020216-1
Date Sampled: 02/02/16 17:00
Percent Solids: N/A
Initial Volume: 5
Final Volume: 5
Extraction Method: 5030B

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-04
Sample Matrix: Ground Water
Units: ug/L
Analyst: MD

All methods used are in accordance with 40 CFR 136.

624 Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Trichlorofluoromethane	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434
Vinyl Chloride	ND (1.0)		624		1	02/04/16 16:23	CZB0072	CB60434

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichloroethane-d4	*111 %*		*70-130*
Surrogate: 4-Bromofluorobenzene	*97 %*		*70-130*
Surrogate: Dibromofluoromethane	*108 %*		*70-130*
Surrogate: Toluene-d8	*107 %*		*70-130*

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW4-020216-1
Date Sampled: 02/02/16 17:00
Percent Solids: N/A

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-04
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Chloride	**50.5** (3.0)		9250		1	EEM	02/08/16 14:54	mg/L	CB60815
Nitrate as N	**0.683** (0.030)		353.2		1	JLK	02/03/16 13:48	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/03/16 13:12	mg/L	CB60338
Ortho-phosphate as P	ND (0.10)		365.1		1	JLK	02/04/16 8:38	mg/L	CB60401
Total Nitrogen	**0.68** (0.22)		4500N		1	JLK	02/06/16 9:57	mg/L	[CALC]
Total Phosphate as P	**0.14** (0.10)		365.1		1	EEM	02/04/16 16:21	mg/L	CB60420

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW4-020216-2
Date Sampled: 02/02/16 17:17
Percent Solids: N/A

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-05
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 3005A

All methods used are in accordance with 40 CFR 136.

Total Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Sodium	**28.6** (5.00)		200.7		2	KJK	02/09/16 19:49	100	50	CB60329

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW4-020216-2
Date Sampled: 02/02/16 17:17
Percent Solids: N/A
Initial Volume: 5
Final Volume: 5
Extraction Method: 5030B

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-05
Sample Matrix: Ground Water
Units: ug/L
Analyst: MD

All methods used are in accordance with 40 CFR 136.

624 Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1,1-Trichloroethane	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
1,1,2,2-Tetrachloroethane	ND (0.5)		624		1	02/04/16 16:48	CZB0072	CB60434
1,1,2-Trichloroethane	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
1,1-Dichloroethane	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
1,1-Dichloroethene	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
1,2-Dichlorobenzene	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
1,2-Dichloroethane	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
1,2-Dichloropropane	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
1,3-Dichlorobenzene	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
1,4-Dichlorobenzene	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
2-Chloroethyl vinyl ether	ND (10.0)		624		1	02/04/16 16:48	CZB0072	CB60434
Acrolein - Screen	ND (5.0)		624		1	02/04/16 16:48	CZB0072	CB60434
Acrylonitrile - Screen	ND (5.0)		624		1	02/04/16 16:48	CZB0072	CB60434
Benzene	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
Bromodichloromethane	ND (0.6)		624		1	02/04/16 16:48	CZB0072	CB60434
Bromoform	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
Bromomethane	ND (2.0)		624		1	02/04/16 16:48	CZB0072	CB60434
Carbon Tetrachloride	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
Chlorobenzene	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
Chloroethane	ND (2.0)		624		1	02/04/16 16:48	CZB0072	CB60434
Chloroform	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
Chloromethane	ND (2.0)		624		1	02/04/16 16:48	CZB0072	CB60434
cis-1,2-Dichloroethene	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
cis-1,3-Dichloropropene	ND (0.4)		624		1	02/04/16 16:48	CZB0072	CB60434
Dibromochloromethane	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
Ethylbenzene	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
Methylene Chloride	ND (4.0)		624		1	02/04/16 16:48	CZB0072	CB60434
Tetrachloroethene	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
Toluene	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
trans-1,2-Dichloroethene	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
trans-1,3-Dichloropropene	ND (0.5)		624		1	02/04/16 16:48	CZB0072	CB60434
Trichloroethene	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW4-020216-2
Date Sampled: 02/02/16 17:17
Percent Solids: N/A
Initial Volume: 5
Final Volume: 5
Extraction Method: 5030B

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-05
Sample Matrix: Ground Water
Units: ug/L
Analyst: MD

All methods used are in accordance with 40 CFR 136.

624 Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Trichlorofluoromethane	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434
Vinyl Chloride	ND (1.0)		624		1	02/04/16 16:48	CZB0072	CB60434

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichloroethane-d4	*110 %*		*70-130*
Surrogate: 4-Bromofluorobenzene	*98 %*		*70-130*
Surrogate: Dibromofluoromethane	*109 %*		*70-130*
Surrogate: Toluene-d8	*106 %*		*70-130*

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW4-020216-2
Date Sampled: 02/02/16 17:17
Percent Solids: N/A

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-05
Sample Matrix: Ground Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Chloride	**49.7** (3.0)		9250		1	EEM	02/08/16 14:56	mg/L	CB60815
Nitrate as N	**0.136** (0.030)		353.2		1	JLK	02/03/16 13:49	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/03/16 13:13	mg/L	CB60338
Ortho-phosphate as P	ND (0.10)		365.1		1	JLK	02/04/16 8:39	mg/L	CB60401
Total Nitrogen	ND (0.22)		4500N		1	JLK	02/06/16 10:00	mg/L	[CALC]
Total Phosphate as P	ND (0.10)		365.1		1	EEM	02/04/16 16:22	mg/L	CB60420

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: Trip Blank
Date Sampled: 02/02/16 00:00
Percent Solids: N/A
Initial Volume: 5
Final Volume: 5
Extraction Method: 5030B

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-06
Sample Matrix: Aqueous
Units: ug/L
Analyst: MD

All methods used are in accordance with 40 CFR 136.

624 Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,1,1-Trichloroethane	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
1,1,2,2-Tetrachloroethane	ND (0.5)		624		1	02/04/16 14:17	CZB0072	CB60434
1,1,2-Trichloroethane	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
1,1-Dichloroethane	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
1,1-Dichloroethene	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
1,2-Dichlorobenzene	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
1,2-Dichloroethane	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
1,2-Dichloropropane	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
1,3-Dichlorobenzene	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
1,4-Dichlorobenzene	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
2-Chloroethyl vinyl ether	ND (10.0)		624		1	02/04/16 14:17	CZB0072	CB60434
Acrolein - Screen	ND (5.0)		624		1	02/04/16 14:17	CZB0072	CB60434
Acrylonitrile - Screen	ND (5.0)		624		1	02/04/16 14:17	CZB0072	CB60434
Benzene	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
Bromodichloromethane	ND (0.6)		624		1	02/04/16 14:17	CZB0072	CB60434
Bromoform	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
Bromomethane	ND (2.0)		624		1	02/04/16 14:17	CZB0072	CB60434
Carbon Tetrachloride	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
Chlorobenzene	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
Chloroethane	ND (2.0)		624		1	02/04/16 14:17	CZB0072	CB60434
Chloroform	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
Chloromethane	ND (2.0)		624		1	02/04/16 14:17	CZB0072	CB60434
cis-1,2-Dichloroethene	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
cis-1,3-Dichloropropene	ND (0.4)		624		1	02/04/16 14:17	CZB0072	CB60434
Dibromochloromethane	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
Ethylbenzene	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
Methylene Chloride	ND (4.0)		624		1	02/04/16 14:17	CZB0072	CB60434
Tetrachloroethene	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
Toluene	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
trans-1,2-Dichloroethene	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
trans-1,3-Dichloropropene	ND (0.5)		624		1	02/04/16 14:17	CZB0072	CB60434
Trichloroethene	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: Trip Blank
Date Sampled: 02/02/16 00:00
Percent Solids: N/A
Initial Volume: 5
Final Volume: 5
Extraction Method: 5030B

ESS Laboratory Work Order: 1602068
ESS Laboratory Sample ID: 1602068-06
Sample Matrix: Aqueous
Units: ug/L
Analyst: MD

All methods used are in accordance with 40 CFR 136.

624 Volatile Organic Compounds

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
Trichlorofluoromethane	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434
Vinyl Chloride	ND (1.0)		624		1	02/04/16 14:17	CZB0072	CB60434

	%Recovery	Qualifier	Limits
Surrogate: 1,2-Dichloroethane-d4	*105 %*		*70-130*
Surrogate: 4-Bromofluorobenzene	*100 %*		*70-130*
Surrogate: Dibromofluoromethane	*105 %*		*70-130*
Surrogate: Toluene-d8	*105 %*		*70-130*

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
ESS Laboratory Work Order: 1602068

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Total Metals										
Batch CB60329 - 3005A										
Blank										
Sodium	ND	2.50	mg/L							
LCS										
Sodium	14.3	2.50	mg/L	12.50		115	85-115			
LCS Dup										
Sodium	13.7	2.50	mg/L	12.50		109	85-115	5	20	
624 Volatile Organic Compounds										
Batch CB60434 - 5030B										
Blank										
1,1,1-Trichloroethane	ND	1.0	ug/L							
1,1,2,2-Tetrachloroethane	ND	0.5	ug/L							
1,1,2-Trichloroethane	ND	1.0	ug/L							
1,1-Dichloroethane	ND	1.0	ug/L							
1,1-Dichloroethene	ND	1.0	ug/L							
1,2-Dichlorobenzene	ND	1.0	ug/L							
1,2-Dichloroethane	ND	1.0	ug/L							
1,2-Dichloropropane	ND	1.0	ug/L							
1,3-Dichlorobenzene	ND	1.0	ug/L							
1,4-Dichlorobenzene	ND	1.0	ug/L							
2-Chloroethyl vinyl ether	ND	10.0	ug/L							
Acrolein - Screen	ND	5.0	ug/L							
Acrylonitrile - Screen	ND	5.0	ug/L							
Benzene	ND	1.0	ug/L							
Bromodichloromethane	ND	0.6	ug/L							
Bromoform	ND	1.0	ug/L							
Bromomethane	ND	2.0	ug/L							
Carbon Tetrachloride	ND	1.0	ug/L							
Chlorobenzene	ND	1.0	ug/L							
Chloroethane	ND	2.0	ug/L							
Chloroform	ND	1.0	ug/L							
Chloromethane	ND	2.0	ug/L							
cis-1,2-Dichloroethene	ND	1.0	ug/L							
cis-1,3-Dichloropropene	ND	0.4	ug/L							
Dibromochloromethane	ND	1.0	ug/L							
Ethylbenzene	ND	1.0	ug/L							
Methylene Chloride	ND	4.0	ug/L							
Tetrachloroethene	ND	1.0	ug/L							
Toluene	ND	1.0	ug/L							
trans-1,2-Dichloroethene	ND	1.0	ug/L							
trans-1,3-Dichloropropene	ND	0.5	ug/L							
Trichloroethene	ND	1.0	ug/L							
Trichlorofluoromethane	ND	1.0	ug/L							
Vinyl Chloride	ND	1.0	ug/L							

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
ESS Laboratory Work Order: 1602068

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
624 Volatile Organic Compounds										
Batch CB60434 - 5030B										
Surrogate: 1,2-Dichloroethane-d4	*26.4*		ug/L	*25.00*		*106*	*70-130*			
Surrogate: 4-Bromofluorobenzene	*24.8*		ug/L	*25.00*		*99*	*70-130*			
Surrogate: Dibromofluoromethane	*26.7*		ug/L	*25.00*		*107*	*70-130*			
Surrogate: Toluene-d8	*26.7*		ug/L	*25.00*		*107*	*70-130*			
LCS										
1,1,1-Trichloroethane	10.3		ug/L	10.00		103	70-130			
1,1,2,2-Tetrachloroethane	9.5		ug/L	10.00		95	70-130			
1,1,2-Trichloroethane	9.4		ug/L	10.00		94	70-130			
1,1-Dichloroethane	9.2		ug/L	10.00		92	70-130			
1,1-Dichloroethene	10.7		ug/L	10.00		107	70-130			
1,2-Dichlorobenzene	9.8		ug/L	10.00		98	70-130			
1,2-Dichloroethane	9.6		ug/L	10.00		96	70-130			
1,2-Dichloropropane	9.1		ug/L	10.00		91	70-130			
1,3-Dichlorobenzene	9.9		ug/L	10.00		99	70-130			
1,4-Dichlorobenzene	10.0		ug/L	10.00		100	70-130			
2-Chloroethyl vinyl ether	51.8		ug/L	50.00		104	70-130			
Acrolein - Screen	8.4		ug/L	10.00		84	70-130			
Acrylonitrile - Screen	8.9		ug/L	10.00		89	70-130			
Benzene	9.4		ug/L	10.00		94	70-130			
Bromodichloromethane	10.0		ug/L	10.00		100	70-130			
Bromoform	10.7		ug/L	10.00		107	70-130			
Bromomethane	9.4		ug/L	10.00		94	70-130			
Carbon Tetrachloride	10.9		ug/L	10.00		109	70-130			
Chlorobenzene	10.2		ug/L	10.00		102	70-130			
Chloroethane	7.8		ug/L	10.00		78	70-130			
Chloroform	9.4		ug/L	10.00		94	70-130			
Chloromethane	9.9		ug/L	10.00		99	70-130			
cis-1,2-Dichloroethene	9.7		ug/L	10.00		97	70-130			
cis-1,3-Dichloropropene	9.1		ug/L	10.00		91	70-130			
Dibromochloromethane	10.1		ug/L	10.00		101	70-130			
Ethylbenzene	10.2		ug/L	10.00		102	70-130			
Methylene Chloride	9.5		ug/L	10.00		95	70-130			
Tetrachloroethene	8.3		ug/L	10.00		83	70-130			
Toluene	9.8		ug/L	10.00		98	70-130			
trans-1,2-Dichloroethene	10.0		ug/L	10.00		100	70-130			
trans-1,3-Dichloropropene	8.8		ug/L	10.00		88	70-130			
Trichloroethene	9.6		ug/L	10.00		96	70-130			
Trichlorofluoromethane	9.1		ug/L	10.00		91	70-130			
Vinyl Chloride	10.1		ug/L	10.00		101	70-130			
Surrogate: 1,2-Dichloroethane-d4	*26.3*		ug/L	*25.00*		*105*	*70-130*			
Surrogate: 4-Bromofluorobenzene	*27.0*		ug/L	*25.00*		*108*	*70-130*			
Surrogate: Dibromofluoromethane	*26.8*		ug/L	*25.00*		*107*	*70-130*			
Surrogate: Toluene-d8	*27.6*		ug/L	*25.00*		*110*	*70-130*			
LCS Dup										

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
ESS Laboratory Work Order: 1602068

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
				624 Volatile Organic Compounds						
Batch CB60434 - 5030B										
1,1,1-Trichloroethane	11.0		ug/L	10.00		110	70-130	6	25	
1,1,2,2-Tetrachloroethane	9.9		ug/L	10.00		99	70-130	5	25	
1,1,2-Trichloroethane	9.7		ug/L	10.00		97	70-130	3	25	
1,1-Dichloroethane	9.7		ug/L	10.00		97	70-130	5	25	
1,1-Dichloroethene	11.3		ug/L	10.00		113	70-130	5	25	
1,2-Dichlorobenzene	10.1		ug/L	10.00		101	70-130	2	25	
1,2-Dichloroethane	10.2		ug/L	10.00		102	70-130	6	25	
1,2-Dichloropropane	9.7		ug/L	10.00		97	70-130	7	25	
1,3-Dichlorobenzene	10.3		ug/L	10.00		103	70-130	4	25	
1,4-Dichlorobenzene	10.2		ug/L	10.00		102	70-130	2	25	
2-Chloroethyl vinyl ether	96.3		ug/L	50.00		193	70-130	60	25	B+, D+
Acrolein - Screen	8.1		ug/L	10.00		81	70-130	4	25	
Acrylonitrile - Screen	9.4		ug/L	10.00		94	70-130	5	20	
Benzene	10.0		ug/L	10.00		100	70-130	6	25	
Bromodichloromethane	10.4		ug/L	10.00		104	70-130	4	25	
Bromoform	11.0		ug/L	10.00		110	70-130	3	25	
Bromomethane	10.0		ug/L	10.00		100	70-130	6	25	
Carbon Tetrachloride	11.3		ug/L	10.00		113	70-130	3	25	
Chlorobenzene	10.3		ug/L	10.00		103	70-130	2	25	
Chloroethane	8.4		ug/L	10.00		84	70-130	7	25	
Chloroform	10.1		ug/L	10.00		101	70-130	7	25	
Chloromethane	10.3		ug/L	10.00		103	70-130	4	25	
cis-1,2-Dichloroethene	10.5		ug/L	10.00		105	70-130	8	25	
cis-1,3-Dichloropropene	9.6		ug/L	10.00		96	70-130	5	25	
Dibromochloromethane	10.4		ug/L	10.00		104	70-130	3	25	
Ethylbenzene	10.4		ug/L	10.00		104	70-130	2	25	
Methylene Chloride	10.0		ug/L	10.00		100	70-130	6	25	
Tetrachloroethene	8.5		ug/L	10.00		85	70-130	3	25	
Toluene	10.4		ug/L	10.00		104	70-130	7	25	
trans-1,2-Dichloroethene	10.7		ug/L	10.00		107	70-130	7	25	
trans-1,3-Dichloropropene	9.2		ug/L	10.00		92	70-130	5	25	
Trichloroethene	10.2		ug/L	10.00		102	70-130	7	25	
Trichlorofluoromethane	9.6		ug/L	10.00		96	70-130	6	25	
Vinyl Chloride	10.7		ug/L	10.00		107	70-130	6	25	
Surrogate: 1,2-Dichloroethane-d4	*26.5*		ug/L	*25.00*		*106*	*70-130*			
Surrogate: 4-Bromofluorobenzene	*26.5*		ug/L	*25.00*		*106*	*70-130*			
Surrogate: Dibromofluoromethane	*26.9*		ug/L	*25.00*		*108*	*70-130*			
Surrogate: Toluene-d8	*26.8*		ug/L	*25.00*		*107*	*70-130*			
				Classical Chemistry						
Batch CB60338 - [CALC]										
Blank										
Nitrate as N	ND	0.010	mg/L							
Nitrite as N	ND	0.010	mg/L							
Nitrite as N	ND	0.010	mg/L							

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
ESS Laboratory Work Order: 1602068

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
				Classical Chemistry						
Batch CB60338 - [CALC]										
LCS										
Nitrate as N	ND		mg/L							
Nitrite as N	0.244		mg/L	0.2497		98	90-110			
Nitrite as N	0.244		mg/L	0.2497		98	90-110			
Batch CB60339 - [CALC]										
Blank										
Nitrate as N	ND	0.020	mg/L							
Nitrate/Nitrite as N	ND	0.020	mg/L							
Nitrate/Nitrite as N	ND	0.020	mg/L							
Total Nitrogen	ND	0.02	mg/L							
LCS										
Nitrate as N	0.461		mg/L							
Nitrate/Nitrite as N	0.461		mg/L	0.5000		92	90-110			
Nitrate/Nitrite as N	0.461		mg/L	0.5000		92	90-110			
Total Nitrogen	0.461		mg/L							
Batch CB60401 - General Preparation										
Blank										
Ortho-phosphate as P	ND	0.10	mg/L							
LCS										
Ortho-phosphate as P	0.49		mg/L	0.5000		99	90-110			
Batch CB60420 - TPO4 Prep										
Blank										
Total Phosphate as P	ND	0.10	mg/L							
LCS										
Total Phosphate as P	0.50	0.10	mg/L	0.5000		100	90-110			
Batch CB60535 - TKN Prep										
Blank										
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Nitrogen	ND	0.20	mg/L							
LCS										
Total Kjeldahl Nitrogen as N	15.5	2.00	mg/L	17.60		88	80-120			
Total Nitrogen	15.5	2.00	mg/L							
Batch CB60815 - General Preparation										
Blank										
Chloride	ND	3.0	mg/L							
LCS										
Chloride	28.3		mg/L	30.00		94	90-110			

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
ESS Laboratory Work Order: 1602068

Notes and Definitions

U	Analyte included in the analysis, but not detected
D+	Relative percent difference for duplicate is outside of criteria (D+).
D	Diluted.
CD-	Continuing Calibration %Diff/Drift is below control limit (CD-).
B+	Blank Spike recovery is above upper control limit (B+).
ND	Analyte NOT DETECTED at or above the MRL (LOQ), LOD for DoD Reports, MDL for J-Flagged Analytes
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference
MDL	Method Detection Limit
MRL	Method Reporting Limit
LOD	Limit of Detection
LOQ	Limit of Quantitation
DL	Detection Limit
I/V	Initial Volume
F/V	Final Volume
§	Subcontracted analysis; see attached report
1	Range result excludes concentrations of surrogates and/or internal standards eluting in that range.
2	Range result excludes concentrations of target analytes eluting in that range.
3	Range result excludes the concentration of the C9-C10 aromatic range.
Avg	Results reported as a mathematical average.
NR	No Recovery
[CALC]	Calculated Analyte
SUB	Subcontracted analysis; see attached report

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1602068

ESS LABORATORY CERTIFICATIONS AND ACCREDITATIONS

ENVIRONMENTAL

Rhode Island Potable and Non Potable Water: LAI00179
http://www.health.ri.gov/find/labs/analytical/ESS.pdf

Connecticut Potable and Non Potable Water, Solid and Hazardous Waste: PH-0750
http://www.ct.gov/dph/lib/dph/environmental_health/environmental_laboratories/pdf/OutofStateCommercialLaboratories.pdf

Maine Potable and Non Potable Water, and Solid and Hazardous Waste: RI00002
http://www.maine.gov/dhhs/mecdc/environmental-health/water/dwp-services/labcert/documents/AllLabs.xls

Massachusetts Potable and Non Potable Water: M-RI002
http://public.dep.state.ma.us/Labcert/Labcert.aspx

New Hampshire (NELAP accredited) Potable and Non Potable Water, Solid and Hazardous Waste: 2424
http://des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm

New York (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: 11313
http://www.wadsworth.org/labcert/elap/comm.html

New Jersey (NELAP accredited) Non Potable Water, Solid and Hazardous Waste: RI006
http://datamine2.state.nj.us/DEP_OPRA/OpraMain/pi_main?mode=pi_by_site&sort_order=PI_NAMEA&Select+a+Site:=58715

United States Department of Agriculture Soil Permit: P330-12-00139

Pennsylvania: 68-01752
http://www.depweb.state.pa.us/portal/server.pt/community/labs/13780/laboratory_accreditation_program/590095

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

Shipped/Delivered Via: ESS Courier

ESS Project ID: 1602068
Date Received: 2/3/2016
Project Due Date: 2/10/2016
Days for Project: 5 Day

1. Air bill manifest present? Yes
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? Yes
   Temp: 4.5 Iced with: Ice
5. Was COC signed and dated by client? Yes
6. Does COC match bottles? Yes
7. Is COC complete and correct? Yes
8. Were samples received intact? Yes
9. **Were labs informed about short holds & rushes?** Yes / No / NA
10. Were any analyses received outside of hold time? Yes / No

11. Any Subcontracting needed? Yes / No
    ESS Sample IDs:
    Analysis:
    TAT:

12. Were VOAs received? Yes / No
    a. Air bubbles in aqueous VOAs? Yes
    b. Does methanol cover soil completely? Yes / No / NA

13. Are the samples properly preserved? Yes / No
a. If metals preserved in SR: Date: Time: By:
b. Low Level VOAs brought to freezer: Date: Time: By:

Sample Receiving Notes:

COC = MW-4-020216 2/2/16 1700 ; Label = MW-4-020216 2/4/16 1500 WK 2/3/16

Was there a need to contact the client? Yes / No
Who was contacted? Date: Time: By:

Sample Number	Container ID	Proper Container	Air Bubbles Present	Sufficient Volume	Container Type	Preservative	Record pH (Cyanide and 608 Pesticides)
01	5989	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
01	5998	Yes	NA	Yes	500 mL Poly - Unpres	NP	
01	6003	Yes	NA	Yes	250 mL Poly - Unpres	NP	
01	6008	Yes	NA	Yes	250 mL Poly - HNO3	HNO3	
01	6021	Yes	No	Yes	VOA Vial - HCl	HCL	
01	6022	Yes	No	Yes	VOA Vial - HCl	HCL	
01	6023	Yes	No	Yes	VOA Vial - HCl	HCL	
02	5990	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
02	5997	Yes	NA	Yes	500 mL Poly - Unpres	NP	
02	6002	Yes	NA	Yes	250 mL Poly - Unpres	NP	
02	6007	Yes	NA	Yes	250 mL Poly - HNO3	HNO3	
02	6018	Yes	No	Yes	VOA Vial - HCl	HCL	
02	6019	Yes	No	Yes	VOA Vial - HCl	HCL	
02	6020	Yes	No	Yes	VOA Vial - HCl	HCL	
03	5993	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
03	5996	Yes	NA	Yes	500 mL Poly - Unpres	NP	
03	6001	Yes	NA	Yes	250 mL Poly - Unpres	NP	
03	6006	Yes	NA	Yes	250 mL Poly - HNO3	HNO3	
03	6015	Yes	No	Yes	VOA Vial - HCl	HCL	
03	6016	Yes	No	Yes	VOA Vial - HCl	HCL	
03	6017	Yes	No	Yes	VOA Vial - HCl	HCL	
04	5992	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
04	5995	Yes	NA	Yes	500 mL Poly - Unpres	NP	

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04	6000	Yes	NA	Yes	250 mL Poly - Unpres	NP
04	6005	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
04	6012	Yes	No	Yes	VOA Vial - HCl	HCL
04	6013	Yes	No	Yes	VOA Vial - HCl	HCL
04	6014	Yes	No	Yes	VOA Vial - HCl	HCL
05	5991	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
05	5994	Yes	NA	Yes	500 mL Poly - Unpres	NP
05	5999	Yes	NA	Yes	250 mL Poly - Unpres	NP
05	6004	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
05	6009	Yes	No	Yes	VOA Vial - HCl	HCL
05	6010	Yes	No	Yes	VOA Vial - HCl	HCL
05	6011	Yes	No	Yes	VOA Vial - HCl	HCL
06	6024	Yes	Yes	Yes	VOA Vial - HCl	HCL

2nd Review
Are barcode labels on correct containers? Yes / No

Completed By: Larisa Badge Date & Time: 2/3/16 1046

Reviewed By: [signature] Date & Time: 2/3/16 1052

ESS Laboratory

Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston, RI 02910-2211
Tel. (401) 461-7181 Fax (401) 461-4486
www.thielsch.com

CHAIN OF CUSTODY

Turn Time X Standard (2 Weeks) Other
If faster than 5 days, prior approval by laboratory is required #
State where samples were collected from: MA RI CT NH NJ NY ME USACE Other

Electronic Deliverables X Yes ___ No
Formats EXCEL

ESS LAB PROJECT ID 1602068
Special Detection Limits

Co. Name: AECOM
Project #:
Project Name (20 Char. or less): ORLEANS
Contact Person: MARK OWEN
Address: 9 JOHNATHON BOURNE DR
City: POCASSET State: MA Zip: PO#:
Telephone #: 508-335-1950 Fax #:
Email Address: MARK.OWEN@AECOM.COM

ESS LAB Sample#	Date	Collection Time	COMP	GRAB	MATRIX	Sample Identification (20 Char. or less)	Number of Containers	Type of Containers	NITRATE	NITRITE	TOTAL N	TOTAL PHOS	Cl⁻	Na⁺	ORTHO P	VOC
1	02/02/16	~~1310~~ 1100		X	GW	MW3-020216-1	7	P, V	1	1	1	1	1	1	1	3
2	02/02/16	1310		X	GW	MW-1-020216-1	7	↓	1	1	1	1	1	1	1	3
3	02/02/16	1525		X	GW	MW-2-020216-1	7	↓	1	1	1	1	1	1	1	3
4	02/02/16	1700		X	GW	MW-4-020216-1	7	↓	1	1	1	1	1	1	1	3
5	02/02/16	1717		X	GW	MW-4-020216-2	7	↓	1	1	1	1	1	1	1	3

Container Type: P-Poly G-Glass S-Sterile V-VOA
Matrix: S-Solid D-Sludge WW-Waste Water GW-Ground Water SW-Surface Water DW-Drinking Water O-Oil W-Wipes F-Filters

Cooler Present ✓ Yes ___ No
Seals Intact ___ Yes ___ No NA: ✓
Cooler Temp: 4.5 °C IR KAB 2/3/16 9:15

Internal Use Only
[ ] Pickup
[ ] Technicians ______

Comments: 06 – Rec'd trip blanks – KAB 2/3/16

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[signature]	2/3/16 0800	[signature]	2/3/16 [illegible]	[signature]	2/3/16 9:15	Laura Badger	2/3/16 10:09
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time

Please fax all changes to Chain of Custody in writing.

1 (White) Lab Copy 2 (Yellow) Client Receipt

ESS Laboratory

Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston, RI 02910

1/6/16

Julianne Marrion
Chemical Engineer, Process Engineering
AECOM
250 Apollo Drive
Chelmsford, MA 01824

Project ID: Orleans MA
Quote: 201601002

Dear Julianne:

ESS Laboratory is pleased to provide you with this quotation for analytical services. The analyses will be performed in accordance with the requirements of this quotation and is based upon a turnaround time of five (5) to seven (7) business days, unless other wise note. Expedited turnaround time must be pre-approved by ESS prior to submitting samples. Project status and online data access is available via our website (www.esslaboratory.com)

Matrix	Parameters	Method	Qty	Unit Price	Extended Price
Aqueous	Nitrate	353.2	30	$18.00	$540.00
Aqueous	Total Nitrogen	Calculation	30	$20.00	$600.00
Aqueous	Dissolved Iron	200.7	20	$8.00	$160.00
Aqueous	Dissolved Manganese	200.7	20	$8.00	$160.00
Aqueous	Dissolved Metals Digestion	200.7	20	$8.00	$160.00
Aqueous	Dissolved Metals Lab Filtration		20	$11.00	$220.00
Aqueous	Boron	200.7	20	$16.00	$320.00
Aqueous	Total Metals Digestion		20	$8.00	$160.00
Aqueous	Ammonia Nitrogen	SM 4500 NH3 B,D	30	$30.00	$900.00
Aqueous	Chloride	9250	30	$15.00	$450.00
Aqueous	Dissolved Organic Carbon	5310B	20	$45.00	$900.00
Aqueous	Nitrite	353.3	30	$18.00	$540.00
Aqueous	Orthophosphate	365.1	10	$15.00	$150.00
Aqueous	Sulfate	300.0	20	$18.00	$360.00
Aqueous	Total Phosphorus	365.1	10	$25.00	$250.00
Aqueous	Volatile Organics	624	10	$75.00	$750.00
Soil	Grainsize	ASTM D69134	10	$85.00	$850.00
					$7,470.00

Additional Surcharge of 15% per invoice if full data package is required.

To assure a successful completion of this project ESS will assign AECOM a Project Manager. This will afford you with a single point of contact to facilitate communications and logistics.

We are looking forward to providing you with quality analytical services and on time delivery. Should you have any questions or need additional information, please do not hesitate to call me.

Sincerely

Kevin Braga, Esq., M.B.A.
Senior Account Executive

ESS LABORTORY TERMS and CONDITIONS

1. The analyses will be performed in accordance with the requirements of each individual task order, chain of custody (COC), or Quality Assurance Project Plan (QAPP) that is received by the laboratory. All analysis will commence upon the receipt of the samples at the laboratory and any analyses that are cancelled after the fact will incur any prep or analyses charges covering work performed prior to notification.

2. Turnaround time begins on the next business day after sample receipt. All reports are due by COB (6 PM-EST) on the date due.

3. ESS Laboratory will email a sample confirmation notice. The confirmation contains Sample IDs, Project Name, and pricing. The client needs to review this information and inform ESS of any changes prior to release of the final report. Changes to reports and invoices after the fact will incur a $50 fee.

4. The laboratory standard turnaround time is 5 to 7 business days. For rush turn around, contact the laboratory for approval and see Turnaround Schedule for surcharges.

5. The cost of the analysis covers a PDF report, one EDD if requested, the bottle kits, coolers and Chain of Custodies excluding Encores (please give us at least 1 Business Day notice), scheduled courier pickup (please give us at least 1 Business Day notice), and disposal. Same Day pickups and Bottle orders (received after 4:00PM day before) may be subjected to a $50 charge and will be subject to availability.

6. If samples are put on hold, the client will be billed $4/jar/month starting at receipt. After 30 days, the client will be contacted to remove samples from hold. If client needs laboratory to dispose of sample, a $5/jar fee will be incurred. If client does not wish to pay for disposal, the samples will be returned to the client. ESS is not responsible for tracking hold times of analyses on samples that come in on hold. Example, if you send in 3 voa vials for one groundwater sample and the sample is received "on-hold" the fee would be $12.00 per month plus $15.00 disposal fee.

7. Project status and on-line data access is available at our website. Contact ESS to receive a secure User ID and Password.

Analytical Method Details - ESS Laboratory

Method	Analyte	MDL	MRL	Units	Surr. %R	DUP RPD	%R	Matrix Spike RPD	%R	Blank Spike RPD
Dissolved Metals in Aqueous										
200.7	Iron	0.0230	0.100	mg/L	-	20	75-125	20	80-120	20
200.7	Manganese	0.00600	0.0200	mg/L	-	20	75-125	20	80-120	20
Total Metals in Aqueous										
200.7	Boron	0.0140	0.100	mg/L	-	20	75-125	20	85-115	20
624 Volatile Organic Compounds in Aqueous										
624	1,1,1-Trichloroethane	0.200	1.00	ug/L	-	-	70-130	30	70-130	25
624	1,1,2,2-Tetrachloroethane	0.100	0.500	ug/L	-	-	70-130	30	70-130	25
624	1,1,2-Trichloroethane	0.200	1.00	ug/L	-	-	70-130	30	70-130	25
624	1,1-Dichloroethane	0.200	1.00	ug/L	-	-	70-130	30	70-130	25
624	1,1-Dichloroethene	0.300	1.00	ug/L	-	-	70-130	30	70-130	25
624	1,2-Dichlorobenzene	0.100	1.00	ug/L	-	-	70-130	30	70-130	25
624	1,2-Dichloroethane	0.200	1.00	ug/L	-	-	70-130	30	70-130	25
624	1,2-Dichloropropane	0.200	1.00	ug/L	-	-	70-130	30	70-130	25
624	1,3-Dichlorobenzene	0.200	1.00	ug/L	-	-	70-130	30	70-130	25
624	1,4-Dichlorobenzene	0.100	1.00	ug/L	-	-	70-130	30	70-130	25
624	2-Chloroethyl vinyl ether	1.00	10.0	ug/L	-	-	70-130	30	70-130	25
624	Acrolein - Screen	1.60	5.00	ug/L	-	-	70-130	30	70-130	25
624	Acrylonitrile - Screen	1.00	5.00	ug/L	-	-	70-130	20	70-130	20
624	Benzene	0.100	1.00	ug/L	-	-	70-130	30	70-130	25
624	Bromodichloromethane	0.100	0.600	ug/L	-	-	70-130	30	70-130	25
624	Bromoform	0.200	1.00	ug/L	-	-	70-130	30	70-130	25
624	Bromomethane	0.400	2.00	ug/L	-	-	70-130	30	70-130	25
624	Carbon Tetrachloride	0.100	1.00	ug/L	-	-	70-130	30	70-130	25
624	Chlorobenzene	0.100	1.00	ug/L	-	-	70-130	30	70-130	25
624	Chloroethane	0.400	2.00	ug/L	-	-	70-130	30	70-130	25
624	Chloroform	0.100	1.00	ug/L	-	-	70-130	30	70-130	25
624	Chloromethane	0.200	2.00	ug/L	-	-	70-130	30	70-130	25
624	cis-1,2-Dichloroethene	0.200	1.00	ug/L	-	-	70-130	30	70-130	25
624	cis-1,3-Dichloropropene	0.200	0.400	ug/L	-	-	70-130	30	70-130	25
624	Dibromochloromethane	0.200	1.00	ug/L	-	-	70-130	30	70-130	25
624	Ethylbenzene	0.100	1.00	ug/L	-	-	70-130	30	70-130	25

624	Methyl tert-Butyl Ether	0.300	1.00	ug/L	-	-	70-130	30	70-130	25
624	Methylene Chloride	0.200	4.00	ug/L	-	-	70-130	30	70-130	25
624	Tetrachloroethene	0.200	1.00	ug/L	-	-	70-130	30	70-130	25
624	Toluene	0.100	1.00	ug/L	-	-	70-130	30	70-130	25
624	trans-1,2-Dichloroethene	0.300	1.00	ug/L	-	-	70-130	30	70-130	25
624	trans-1,3-Dichloropropene	0.200	0.500	ug/L	-	-	70-130	30	70-130	25
624	Trichloroethene	0.200	1.00	ug/L	-	-	70-130	30	70-130	25
624	Trichlorofluoromethane	0.400	1.00	ug/L	-	-	70-130	30	70-130	25
624	Vinyl Chloride	0.200	1.00	ug/L	-	-	70-130	30	70-130	25
624	Fluorobenzene	0.500	1.00	ug/L	-	-	-	-	-	-
624	Chlorobenzene-d5	0.500	1.00	ug/L	-	-	-	-	-	-
624	1,4-Dichlorobenzene-D4	0.500	1.00	ug/L	-	-	-	-	-	-
624	Pentafluorobenzene	0.500	1.00	ug/L	-	-	-	-	-	-
624	1,2-Dichloroethane-d4	0.500	1.00	Surrogate	70-130	-	-	-	-	-
624	4-Bromofluorobenzene	0.500	1.00	Surrogate	70-130	-	-	-	-	-
624	Dibromofluoromethane	0.500	1.00	Surrogate	70-130	-	-	-	-	-
624	Toluene-d8	0.500	1.00	Surrogate	70-130	-	-	-	-	-
Classical Chemistry in Aqueous										
300.0	Sulfate	0.100	1.00	mg/L	-	20	90-110	-	90-110	-
350.1	Ammonia as N	0.0300	0.100	mg/L	-	20	75-125	-	80-120	-
351.2	Total Kjeldahl Nitrogen as N	0.0600	0.200	mg/L	-	20	75-125	-	80-120	20
353.2	Nitrate as N (EQuiS)	0.00500	0.0200	mg/L	-	20	90-110	-	90-110	10
353.2	Nitrate/Nitrite as N	0.00500	0.0200	mg/L	-	20	90-110	-	90-110	10
353.2	Nitrite as N	0.00300	0.0100	mg/L	-	20	90-110	-	90-110	20
353.3	Nitrite as N	0.00100	0.0100	mg/L	-	20	75-125	-	85-115	-
365.1	Ortho-phosphate as P	0.0300	0.100	mg/L	-	20	90-110	-	90-110	-
365.1	Total Phosphate as P	0.0300	0.100	mg/L	-	20	90-110	-	90-110	-
5310B	Dissolved Organic Carbon		1.0	mg/L	-	-	80-120	20	80-120	-
9250	Chloride	0.800	3.00	mg/L	-	20	75-125	-	90-110	-