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Memorandum

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Subject	**Town of Orleans, MA** **Water Quality and Wastewater Planning** **Task Number 10.1.B.2 – NT Demonstration Projects** **Technical Memorandum for Landfill Field Investigation and Risk Evaluation for 1,4-Dioxane in Groundwater**
Project Number	60476644
From	Thomas Parece, P.E., AECOM Project Manager
Date	June 30, 2017

Approvals	Date	Signature / Initials
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1. Introduction

This Technical Memorandum provides information regarding groundwater assessment, risk evaluation, and recommended risk management actions to address the detection of 1,4-dioxane at the at the Orleans Municipal Landfill and former septage lagoons (the landfill). The investigation was implemented between January and June 2017 and was completed in conjunction with an investigation of nitrogen compounds in groundwater at the landfill. The landfill is located in the Town Cove/Nauset Marsh Estuarine System watershed. The assessment work reported here was implemented to investigate 1,4-dioxane emanating from the landfill in groundwater and potentially migrating downgradient. 1,4-dioxane had been recently identified in groundwater at concentrations greater than the current Massachusetts regulatory limit of 0. 3 µg/L.

2. Orleans Landfill Site Description and Background

A. The landfill consists of approximately 21 acres of Town-owned land located off Lots Hollow Road (Figure 1). The property includes a natural kettle hole that was used for solid waste disposal from the 1950s until 1991. The unlined solid waste fill area was closed and a 13-acre area was capped with a final cover system at a maximum elevation of approximately 110 feet above mean sea level (MSL) in 2005. The landfill property also includes an active solid waste transfer station and yard waste composting and stockpile area (Figure 2). The yard waste composting area is in part located on a land area formerly used for septage waste disposal to lagoons. Six unlined septage lagoons, used between 1950 and 1989, were located just to the north of the capped solid waste area at an approximate elevation of 50 feet above MSL. Landfill drainage and transfer station stormwater are infiltrated along a drainage swale located over the former septage disposal area. The septage lagoons were partially excavated, filled and covered with sand in the 1990s. Part of the area over the lagoons has been paved with asphalt (see Figure 2). The landfill property is downgradient (and outside the Zone of Contribution) of the Town of Orleans public well located to the south. Adjacent properties also include the Charles Moore Ice Arena to the west and commercial/industrial properties to the north and east. Plans have been developed by Weston and Sampson for the construction of a new Department of Public Works and Natural Resources (DPW) facility on portions of the landfill property starting in late 2017.

   The landfill cap and associated drainage system was installed in 2005 to cap the solid waste and prevent continued infiltration of precipitation. The landfill cap system and transfer station stormwater management system are shown in Figure 3. The landfill cap includes a subgrade of compacted soil materials on top of waste which is overlain by:

   - A gas venting layer consisting of a minimum thickness of six inches of soil with a minimum saturated hydraulic conductivity of 1.2×10^{-3} centimeters per second, overlain by
   - A low permeability layer consisting of a 40 mil textured high-density polyethylene geomembrane, flexible membrane liner, overlain by
   - A drainage layer consisting of soil with a minimum thickness of twelve inches and a minimum saturated hydraulic conductivity of 1.2×10^{-2} cm/sec with a perforated pipe subdrain system constructed within the drainage soil that discharges to the stormwater swales, overlain by
   - A vegetative support layer comprised of a minimum thickness of twelve inches of soil, with a vegetative cover seed mix.

   The cover system was completed with a minimum top slope of 5 percent and side-slopes no greater than 3:1. Stormwater runoff controls were constructed to maintain the integrity of the final cover, prevent ponding of water on areas of the final cover, and to control stormwater runoff to prevent off-site flooding impacts. The current stormwater control system includes a perimeter swale around the entire landfill and a 108,000 cubic foot (808,000 gallon) capacity retention basin located in the northeast corner of the site. The retention basin includes a sediment forebay and was designed to fully control the twenty-five year storm event prior to discharge through an emergency spillway. Stormwater system modifications are planned for implementation during construction of the new DPW facility at the landfill in 2017.

B. Groundwater samples were first tested in May of 2015 by Barnstable County Health for low-level concentrations of the solvent 1,4,-dioxane to comply with new MassDEP requirements. Prior to this investigation 1,4-dioxane had only been detected in Monitoring Well (MW) MW-2D (124-134) at concentrations ranging from 1.4 µg/L to 2.0 µg/L, four to seven times the new Massachusetts regulatory limit of 0. 3 µg/L. The former Massachusetts regulatory limit was 0.3 µg/L. Barnstable County Health test results are included in Table 1.

3. Landfill Groundwater Monitoring Well Network

The following groundwater monitoring wells were in place prior to this assessment:

- MW-1S and 1D on the west side of the landfill property;
- MW-2S and 2D to the north;
- MW-3S and 3D to the east;
- MW-4S and 4D to the south;
- MW-5S and 5D to the northeast; and
- MW-E6B and E6A to the north.

Monitoring well installed prior to this investigation shown of Figure 2 were renamed and identified with a naming convention that included the former name (e.g. MW-2S), and the projected depth interval in feet below ground surface for the screened interval (e.g. MW-2S (84-94). New monitoring wells installed by AECOM used the same naming convention.

Four of the shallow landfill water table monitoring wells originally identified as MW-1S through MW-4S, were installed in 1992 as part of an assessment associated with the septage lagoon closure. Deeper screened monitoring wells originally identified as MW-1D, MW-2D, MW-3D, and MW-4D, were installed as part of the 1994 landfill Comprehensive Site Assessment, completing the well couplets at these locations. One additional couplet (MW-5S and MW-5D) was also installed in 1994. Monitoring well couplet MW-E6B and MW-E6A was installed by AECOM in 2016 for nitrogen assessment.

The landfill monitoring wells have been routinely sampled by Barnstable County Health twice a year for nitrate, dissolved iron and manganese, and volatile organic compounds. 1,4-dioxane at the required detection limit was added to the sampling plan starting in May 2015.

4. Initial Conceptual Site Model Prior to the Current Assessment

A. Conceptual Site Model

A Conceptual Site Model (CSM) is a tool used to provide a framework of information to help understand and communicate what is known about a potential problem, visualize available information, identify gaps in data, and prioritize response actions. The following paragraphs provide a narrative version of the initial CSM for the landfill concerning 1,4-dioxane in groundwater.

B. Potential Sources of 1,4-Dioxane in Groundwater

1,4-dioxane has been used in many products, including paint strippers, dyes, greases, varnishes and waxes. 1,4-dioxane is also found as an impurity in antifreeze and aircraft deicing fluids and in some consumer products including deodorants, shampoos and cosmetics (EPA, 2014).

The detection of 1,4-dioxane in groundwater at the landfill may have resulted from disposal of solvents and/or consumer products containing 1,4-dioxane in solid waste and in septage discharged to the former lagoons. Municipal operations at the landfill started in the 1950s. Operations included use of septage lagoons until 1989 and solid waste disposal until 1991. The location of septage disposal may have changed over time. Current operations include a transfer station and stockpiling and composting of yard wastes. The solid waste landfill was capped with an impermeable cover in 2005, reducing the infiltration of water through solid waste material. 1,4,-dioxane released from the landfill in the past and residual leachate generated from the capped landfill may be ongoing sources of the detected 1,4-dioxane.

Drainage structures constructed to manage runoff from the cap include an unlined rip rap swale that passes directly over part of the former septage lagoon area. Pre-cast catch basins installed in the paved areas at the transfer station also direct stormwater runoff to the riprap swale leading to the stormwater detention basin.

The runoff from the landfill cap infiltrating through the former septage lagoons area may be intensifying the release of residual material in the former septage lagoons. Leachate from compost operations and stormwater runoff from the transfer station is also infiltrated in the vicinity of the former septage lagoons.

C. Groundwater Flow and Potential Contaminant Transport

1,4-dioxane is soluble in groundwater and generally transported with groundwater flow by advection with little retardation. There is some potential for natural attenuation through dilution and biological degradations under specific conditions. Although 1,4-dioxane is relatively resistant to biodegradation in groundwater, it may be degraded by microorganisms under aerobic conditions in the presence of a suitable co-metabolic substrate (an alternative food/energy source that stimulates the production of enzymes that degrade 1,4-dioxane). Methane has been found to be a co-metabolic substrate for 1,4-dioxane degradation (Schaefer et al., 2016).

Regional groundwater contour maps prepared by the United States Geological Survey (USGS) with the Cape Cod Commission and previous assessment reports associated with the landfill indicate divergent groundwater flow to the north northwest, north, and northeast toward Town Cove (Walter et al., 2004 and Coastal Engineering, 1999). Based on the location of the landfill near the high point of the watershed it is anticipated that groundwater at the landfill will move deeper into the aquifer as it migrates in the downgradient direction due to groundwater gradients and accretion of infiltrating precipitation.

Boring logs for landfill monitoring wells show subsurface sediments that consist of glacial outwash sands and gravel with thin layers of more silty sand, silt and clay. The depth to groundwater varies significantly with location due to land surface elevation differences associated with the topography of the kettle hole in which the landfill was constructed.

Groundwater elevation measurements, characterization of the aquifer sediments, and aquifer tests were used by Coastal Engineering to estimate groundwater velocity and flow direction in the vicinity of the landfill (Coastal Engineering, 1999). The hydraulic conductivity of aquifer materials was determined from aquifer testing at various locations. The hydraulic conductivity determined at shallow screen locations ranged from 5.6 feet/day at MW-1S (56-66) to 70.88 feet/day at MW-2S (84-94). In general, a higher hydraulic conductivity indicates the potential for faster groundwater flow, depending on the gradient. The hydraulic conductivity determined at deeper screen locations ranged from 14.14 feet/day at MW-3D (84-94) to 147.74 feet/day at MW-1D (99-109) (Coastal Engineering, 1999). The methods used to test hydraulic conductivity provided information for the immediate vicinity of well screens.

The slope of the potentiometric surface (the water table) derived from water elevation measurements were used to determine the hydraulic gradient and flow direction. According to the Comprehensive Site Assessment prepared for landfill closure by Coastal Engineering in 1999, there is the potential for divergent flow (groundwater flow in more than one direction) from the landfill area. The shallow screen wells indicated a consistent gradient of 0.012 to the northeast while deeper screen wells showed variation in flow direction including flow to the north and north northwest. Measurements indicated an average gradient of 0.003 to the north 0.0006 to the northwest respectively. The 1990s data also indicated vertical gradients at all monitoring well couplets (downward at MW-1, MW-2, MW-3, and MW-4 and upward at MW-5). The variation in the vertical gradient and divergent groundwater flow direction could be the due to local mounding effects from stormwater, differences in aquifer material permeability, and the location of the landfill in a recharge area of the groundwater system. A downward vertical gradient indicates groundwater flow deeper into the aquifer. The porosity was estimated by Coastal Engineering at 0.30 from soil samples collected during soil boring installation. Based on these data, Coastal Engineering calculated the horizontal groundwater velocity at a range of 0.029 feet/day to 2.84 feet/day.

The groundwater velocity likely variable from point to point around the landfill, and can be expected to vary along the long flow path from groundwater recharge to ultimate discharge to surface water. Slower flow is more likely in silty sand layers as compared to groundwater in medium sand layers. Town Cove is located approximately 5,450 feet downgradient on a heading of 40 degrees northeast, consistent with the direction of shallow groundwater flow at the site. The travel time for groundwater from the landfill to Town Cove has been estimated to range up to 50 years (USGS, 2004).

D. Initial 1,4-Dioxane Information

Barnstable County Health Department (BCHD) has sampled landfill monitoring wells semiannually for 1,4-dioxane starting in May 2015 and through the most recent sampling in March 2017 the compound had only been detected in BCHD MW-2D (124-134) (see Table 1). Landfill groundwater monitoring data has included limited measurements of dissolved oxygen that indicate deeper groundwater is anoxic. Shallow groundwater is generally aerobic (>1 - 2 mg/L dissolved oxygen). Groundwater conditions at MW-2D (124-134) appear to be anoxic while the shallow well MW-2S (84-94) at this location is screened in more aerobic groundwater.

The source and extent of 1,4-dioxane is unknown. Assessment of the horizontal and vertical extent of 1,4-dioxane in groundwater immediately downgradient of the landfill and septage lagoons was determined to be necessary to determine the potential watershed area that may be affected by contaminant migration and provide a basis for evaluation of risk management options.

The CSM for 1,4-dioxane in groundwater at the landfill indicates that the compound has remained persistent in one monitoring well since the start of monitoring by BCHD in 2015. Due to the mobility of 1,4-dioxane in groundwater this indicates an ongoing source. Due to its physical characteristics, 1,4-dioxane has the potential to migrate long distances at groundwater velocity with little attenuation, affecting groundwater quality over a wide area that is currently undefined.

Potential sources of 1,4-dioxane in groundwater include historical landfill and septage lagoon operations and current transfer station operations.

5. 1,4-Dioxane Assessment

Assessment plans included actions to define groundwater contaminant sources and the horizontal and vertical extent of 1,4-dioxane in groundwater immediately downgradient of the landfill and septage lagoons.

Assessment activities included:

- An evaluation of the landfill cap drainage design and operation of stormwater management systems in the vicinity of the transfer station and material composting areas;
- Sampling of general transfer station stormwater for 1,4,dioxane analyses;
- Sampling of compost leachate for 1,4-dioxane analyses;
- Groundwater sampling of selected pre-existing groundwater monitoring wells for 1,4-dioxane analyses;
- Installation and sampling of new groundwater monitoring wells placed near potential contaminant source areas and adjacent, upgradient, crossgradient, and downgradient of MW-2D (124-134), including some with multi-level screen intervals (Note that values in parentheses have been added to show the depth of the screen in feet below ground surface);
- Groundwater monitoring including measuring groundwater elevations based on surveyed top of well casing elevations and depth to groundwater, collection of groundwater field parameters, and collection of groundwater samples for laboratory analyses of 1,4-dioxane;
- An evaluation of groundwater hydrogeology and groundwater flow in the vicinity of the landfill based on data collected; and

- Installation of new monitoring wells downgradient of the landfill closer to Town Cove monitoring well locations MW-11 (91-101), and MW-12 (87-97) for groundwater analyses.

Note that during the field effort MW-1D (99-109) was reconstructed to repair a bent and obstructed well casing so that it could be sampled by BCHD in routine landfill monitoring. A sample of groundwater collected from the repaired MW-1D (99-109) by BCHD in March 2017 had no detectable concentration of 1,4-dioxane. Potential source area and nearfield downgradient monitoring well locations are shown on Figure 2. Downgradient watershed sampling locations are shown on Figure 4.

6. Results of 1,4-Dioxane Assessment

A. Evaluation of Potential Sources of 1,4-Dioxane

Potential sources investigated included:

- Transfer Station stormwater;
- Composting operations stormwater;
- Former septage lagoons; and the
- Capped solid waste landfill area.

A sample of general transfer station runoff was collected from Stormdrain-1 located adjacent to the Gift Shop building (Figure 2). 1,4-dioxane was not detected (<0.25 µg/L) in stormwater and general transfer station stormwater does not appear to be a current source of 1,4-dioxane (Table 2).

The landfill composting operation processes yard waste that includes leaves, brush, garden, and landscape trimmings. Generally yard waste includes green waste and brown waste. Green waste is primarily fresh plant material such as grass clippings and garden waste that contains appreciable amounts of nitrogen, phosphorus, and mineral nutrients. Brown waste includes dry leaves, hay, and brush that contain primarily carbon, with a high carbon/nitrate (C/N) ratio (Chatterjee et al., 2013).

Compost operations include the maintenance of aerated windrows of yard waste in an area to the north of the capped landfill on both paved and unpaved surface. An assessment of the concentration of 1,4-dioxane in stormwater originating from an area of paved surface that includes yard waste composting operations was completed. A sample of runoff from the paved composting area was collected for 1,4-dioxane analyses at Stormdrain-2, located near the east end of the riprap swale (Figure 2). 1,4-dioxane was not detected (<0.25 µg/L) in stormwater from the compost operations area. Stormwater originating from the compost area does not appear to be a current source of 1,4-dioxane (Table 2).

The former septage lagoons were assessed as a potential source of 1,4-dioxane by the collection of groundwater samples for analyses from monitoring wells installed through the former septage lagoon area. A section of the unlined riprap perimeter swale to the north of the landfill cap receives runoff from the landfill cap drainage layer on the north and west sides of the landfill as well as stormwater from the transfer station catch basins. This section of swale is located above the former septage lagoons. Based on landfill drawings and observation, landfill drainage and stormwater infiltrates through the swale and does not flow east to the retention basin except during significant storm events. This results in a significant recharge to groundwater through the residual organic material in the septage lagoon area, potentially mobilizing 1,4-dioxane to groundwater if a source is present in the subsurface in this area. MW-7S (55-65) was installed adjacent to the stormwater infiltrations swale through one of the former septage disposal lagoon areas. Soil samples were collected with split spoons as the soil boring for MW-7S (55-65) was completed. Organic material was encountered approximately 12 feet below land surface with a septage odor. MW-7S (55-65) is also upgradient of MW-2D (124-134) where 1,4-dioxane had been previously detected. Groundwater test results for MW 7S (55-65) screened at the water table elevation indicated 1,4-dioxane was not detected (<0.25 µg/L) indicating the septage disposal lagoons are not a likely current source of 1,4-dioxane in groundwater (Table 3).

The solid waste disposed at the landfill does appear to be a current source of 1,4-dioxane in groundwater. A groundwater sample collected from MW-7D (115-125) was found to contain 1.7 µg/L 1,4-dioxane. This well screen is set deeper than the elevation of groundwater recharging through the former septage lagoons at an elevation where anaerobic groundwater is flowing out from under the capped solid waste area. 1,4-dioxane was also detected downgradient of MW-7D (115-125) at MW-E6 (88-98), at an intermediate location between MW-7D (115-125) and downgradient MW-2D (124-134).

1,4-dioxane was also detected cross gradient approximately 1,200 feet to the east of MW-2 (124-134) at MW-8 (84-94) at a concentration of 0.649 µg/L. A shallower monitoring well at this location (MW-8 (36-46) was sampled but 1,4-dioxane was not detected. This detection at MW-8 (84-94) indicates 1,4-dioxane may be migrating downgradient of the landfill solid waste area over a wide front, basically across the width of the watershed. More information regarding the groundwater assessment is included in the following section.

B. Groundwater Assessment and Potential Migration of 1,4-Dioxane

Groundwater monitoring wells, including single and multi-screen wells, were installed on the landfill property and in public roadways immediately downgradient of the landfill property to assess the nearfield horizontal and vertical extent of groundwater contamination. As indicated above monitoring wells were renamed and identified with a naming convention that included the location (e.g. MW-2), and the projected depth interval in feet below ground surface (e.g. MW-2S (84-94). Monitoring well locations and screen depths were selected based on previously available assessment data and available information regarding the direction of groundwater flow. The objective was to install new monitoring wells in or adjacent to potential source areas to identify sources, in deeper groundwater than previously assessed to evaluate vertical distribution, and cross gradient to determine the lateral extent of 1,4-dioxane. The monitoring wells were installed in two phases of work to collect initial information and then focus on filling gaps in data based on the results of the first phase of work. Initial monitoring well locations were selected to assess the extent of groundwater contamination around existing MW-2D (124-134), where 1,4-dioxane had been previously detected and to assess a wider area downgradient of the landfill.

Monitoring wells installed during Phase 1 included:

- MW-2 (140-150) adjacent to and deeper than MW-2S (84-94) and MW-2D (124-134);
- MW-7S (55-65), MW-7D (115-125) upgradient of MW-2S (84-94) and MW-2D (124-134), adjacent to the north side of the capped landfill and the drainage swale over the septage lagoons;
- MW-8 (36-46) located cross gradient of MW-2S (84-94) and MW-2D (124-134), to the east and downgradient of the east side of the landfill on Giddiah Hill Road;
- MW-9 (92-102), located cross gradient to the west of MW-2S (84-94) and MW-2D (124-134), adjacent to Lots Hollow Road; and
- MW-10 (85-95) located downgradient of MW-2S (84-94) and MW-2D (124-134), on Finlay Road (Figure 2).

Phase 2 monitoring wells included:

- MW-2 (161—171) installed deeper than and MW-2 (140-150);
- MW-5 (140-150) installed deeper than MW-5D (124-134);
- MW-6 (88-98) installed deeper than MW-E6-A (64-74);
- MW-7 (90-100) installed intermediate between MW-7S (55-65), MW-7D (115-125);
- MW-8 (84-94) installed deeper than MW-8 (36-46);
- MW-11 (91-101) installed downgradient if the landfill in the Town Cove watershed;

- MW-12 (87-97) installed downgradient if the landfill in the Town Cove watershed; and
- MW-13 (74-84) installed adjacent to the landfill stormwater infiltration pond between MW-5 and MW-8 locations.

The depth to groundwater at monitoring wells varies depending on location. All new monitoring wells are 2-inch PVC wells with 10 foot screens installed with hollow stem auger drilling by Desmond Well Drilling Inc. using a CME-75rig mounted on a GMC 7500.

The new and selected previously existing monitoring wells were developed by pumping and sampled using the US EPA low flow methodology on multiple occasions for field parameters, nitrogen compounds and selected anions, elements and, dissolved organic carbon (DOC), and 1,4-dioxane. The results for field parameters and 1,4-dioxane are included in Table 3. Laboratory reports for all analyses are included in Appendix A. Monitoring well construction details are included in Table 4 and elevation and depth to water data is included in Table 5. Survey data is included in Appendix B.

Water table elevations were recorded prior to purging wells for sampling. Groundwater elevations indicate flow to the north and northeast. Variations in groundwater elevation at cluster well locations also indicate the potential for a steep downward vertical gradient at some locations.

Cross sections showing screened intervals at selected monitoring wells with posted 1,4-dioxane results are included in Figures 5 and 6. The cross sections are oriented cross gradient (northwest to southeast) and up to downgradient (southwest to northeast) respectively. Groundwater data indicates the presence shallow more aerobic groundwater underlain by anaerobic groundwater containing detectable concentrations of 1,4-dioxane emanating from the landfill. Shallow more aerobic groundwater extends to a depth of approximately 20 feet below the water table in most areas and 1,4-dioxane was not detected in the shallow groundwater.

The maximum concentration of 1,4-dioxane was observed in a February 2017 groundwater sample at 2.05 µg/L, detected in MW-2 (140-150) which is screened in deep groundwater at an elevation of -59.6 to -69.6 MSL, 6 to 16 feet deeper than the bottom of MW-2D (124-134). The water table at this location was measured at 13 feet MSL.

Groundwater elevation data indicates the 1,4-dioxane originating from the solid waste in the landfill is migrating downgradient in a north to northeasterly direction. Groundwater monitoring data indicates a gap the area with detectable 1,4-dioxane downgradient of the landfill between the location of MW-5 and MW-13 (See cross section Figure 5). This may be the result of recharge of stormwater to the infiltration pond near MW-13 pushing landfill plume water deeper in this area. The rate of migration depend on the aquifer material present at different elevations. Based on a previous assessment the calculated the horizontal groundwater velocity is expected to range from 0.029 feet/day to 2.84 feet/day in low permeability fine sand and silty material and medium sand respectively.

Based on the position of the landfill high in the watershed to Town Cove, there is divergent flow downgradient that will likely widen the plume. 1,4-dioxane migration in groundwater is expected to occur at significant depth below the water table, up to approximately 140 feet below the water table or more based on the particle track model. The results of a particle track model (MODPATH based on an AECOM-modified USGS MODFLOW model) for groundwater flow from the landfill showing plan view and a longitudinal section showing migration depth are included in Figure 7. The modeled particle migration only depicts groundwater flow, not dispersion, retardation, degradation, or source term decay of groundwater contaminants that may modify contaminant migration. Monitoring wells installed at downgradient locations in the watershed including MW-11 (91-101) and MW-12 (87-97) had no detectable concentrations of 1,4-dioxane.

7. Risk Evaluation, Conclusions, and Recommendations

The results of this investigation provide sufficient information to refine the conceptual site model for 1,4-dioxane detected in groundwater at the landfill. The source of 1,4-dioxane appears to be the solid waste in the capped but unlined landfill area. While the cap minimizes infiltration, the landfill is expected to generate leachate that will infiltrate to groundwater as the landfill settles over time. Based on the likely distributed small sources of 1,4-dioxane in the waste material and the settling of the landfill over time, the landfill will likely release 1,4-dioxane for the foreseeable future.

The position of the landfill near the high end of the watershed results in divergent groundwater flow out from under the landfill likely producing a wide plume of low concentration 1,4-dioxane that will move deeper into the aquifer and follow a deep flow path to Town Cove. The migration rate will be higher in more permeable layers of aquifer and slower in less permeable layers. The expected movement, with plume dive to deeper groundwater, will likely leave shallower groundwater unaffected in downgradient areas.

The Town of Orleans provides municipal water to all areas of the affected watershed with sources of water supply from other unaffected areas. Potential exposure to 1,4,-dioxane in groundwater will be managed by the Town of Orleans by identifying and eliminating potential exposure points and preventing the development of future exposure points. The Orleans DPW and Health Department have identified a small number of residences still using groundwater in the Town Cove watershed and is proceeding with connections to Town water. All potential exposure points will be eliminated in this process.

It is recommended that the Town of Orleans develop a permitting system for all potential private supply and irrigation wells within the watershed to manage water use and require testing where necessary.

1,4-dioxane is not expected to have adverse effects on surface water at Town Cove as groundwater from the landfill eventually discharges to surface water. While the Massachusetts Contingency Plan GW-1 regulatory standard protective of drinking water is 0.3 µg/L 1,4-dioxane, the Massachusetts Contingency Plan GW-3 groundwater standard, developed to be protective of the environment for groundwater to discharging to surface water is 50,000 µg/L of 1,4-dioxane (MassDEP, 2017). The maximum concentration of 1,4-dioxane detected at the landfill was 2 µg/L and therefore there is no foreseeable risk to surface water resources.

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Tables

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Table 1: Landfill Monitoring Barnstable County Health Results

Sample ID	**MW-2D (124-134)**				
Top of Screen Elevation (ft)	-22.40				
Bottom of Screen Elevation (ft)	-32.40				
Sampling Date	5/15	9/15	3/16	9/16	3/17
1,4-Dioxane	1.9	1.6	1.4	2.0	1.6

Data From Barnstable County Landfill Monitoring

Table 2 Orleans Landfill Stormwater Analyses

Sample ID	**Stormwater 1**	**Stormwater 2**
Sample Description	Transfer Station Runoff	Compost Runoff
Sampling Date	2/8/2017	2/8/2017
Laboratory Analyses		
1,4-Dioxane	<0.25	<0.25

Notes:

Bold - detected above the Minimum Detection Limit

Table 3 Orleans Landfill Groundwater Analyses

Sample ID	**MW-1S (56-66)**	**MW-1D(99-109)**	**MW-2S (84-94)**	**MW-2D (124-134)**	
Top of Screen Elevation (ft)	27.30	-15.70	17.30	-22.40	
Bottom of Screen Elevation (ft)	17.30	-25.70	7.30	-32.40	
Sampling Date	2/8/2017	2/8/2017	02/06/2017	02/06/2017	02/06/2017 (DUP)
Field Measurements					
pH (SU)	5.3	5.6	4.8	6.0	6.0
Temperature (^{o}C)	14.1	13.7	16.0	15.5	15.5
Dissolved Oxygen (DO; mg/L)	3.0	4.2	1.6	0.1	0.1
Dissolved Oxygen (DO; %)	-	-	16.2	0.6	0.6
Redox Potential (ORP; mV)	120.2	138.3	129.8	54.5	54.5
Specific Conductivity (µS/cm)[c]	137.0	172.0	751.0	800.0	800.0
Laboratory Analyses					
Organic Compounds					
1,4-Dioxane	<0.25	<0.25	<0.25	**1.84**	**1.7**

Notes:

Bold - detected above the Minimum Detection Limit

E. Data point appears to be in error

(124-134)-Well screen depth below land surface

Table 3 Orleans Landfill Groundwater Analyses

Sample ID	**MW-2(140-150)**	**MW-5 (140-150)**	**MW-E6-A (64-74)**	**MW-E6-B (54-64)**
Top of Screen Elevation (ft)	-38.70	-38.30	7.60	17.80
Bottom of Screen Elevation (ft)	-48.70	-48.30	-2.40	7.80
Sampling Date	02/06/2017	3/27/2017	2/6/2017	2/6/2017
Field Measurements				
pH (SU)	6.0	6.1	5.6	5.4
Temperature (^{o}C)	15.2	14.6	14.9	14.9
Dissolved Oxygen (DO; mg/L)	0.1	0.17	0.15	1.45
Dissolved Oxygen (DO; %)	0.8	1.6	1.5	14.5
Redox Potential (ORP; mV)	65.1	195.9	56.4	71.2
Specific Conductivity (µS/cm)[c]	637.0	377.0	1069.0	743.0
Laboratory Analyses				
Organic Compounds				
1,4-Dioxane	**2.05**	<0.25	<0.25	<0.25

Notes:

Bold - detected above the Minimum Detection Limit

E. Data point appears to be in error (124-134)-Well screen depth below land surface

Table 3 Orleans Landfill Groundwater Analyses

Sample ID	**MW-6 (88-98)**	**MW-7S(55-65)**		**MW-7D(115-125)**	**MW-7(90-100)**
Top of Screen Elevation (ft)	-15.80	14.80		-45.10	-90.00
Bottom of Screen Elevation (ft)	-25.80	4.80		-55.10	-100.00
Sampling Date	02/06/2017	02/06/2017	02/06/2017 (DUP)	02/06/2017	3/28/2017
Field Measurements					
pH (SU)	6.5	5.7	5.7	6.2	5.5
Temperature (^{o}C)	14.0	12.7	12.7	12.7	12.5
Dissolved Oxygen (DO; mg/L)	0.12	0.69	0.69	0.2	0.0
Dissolved Oxygen (DO; %)	1.2	6.5	6.5	1.9	0.1
Redox Potential (ORP; mV)	-82.1	39.4	39.4	-64.1	-7.2
Specific Conductivity (µS/cm)[c]	900.0	665.0	665.0	510.0	1534.0
Laboratory Analyses					
Organic Compounds					
1,4-Dioxane	**0.687**	<0.25	<0.25	**1.7**	<0.25

Notes:

Bold - detected above the Minimum Detection Limit

E. Data point appears to be in error (124-134)-Well screen depth below land surface

Table 3 Orleans Landfill Groundwater Analyses

Sample ID	**MW-8(36-46)**	**MW-8 (84-94)**	**MW-9(92-102)**	**MW-10(85-95)**	**MW-13 (74-84)**
Top of Screen Elevation (ft)	23.10	-24.80	13.50	9.00	-17.00
Bottom of Screen Elevation (ft)	13.10	-34.80	9.00	-1.00	-27.00
Sampling Date	2/8/2017	3/27/2017	2/8/2017	2/8/2017	3/29/2017
Field Measurements					
pH (SU)	4.5	5.8	5.0	5.6	5.3
Temperature (^{o}C)	14.6	13.4	15.9	14.6	13.1
Dissolved Oxygen (DO; mg/L)	2.1	0.4	7.4	9.4	0.8
Dissolved Oxygen (DO; %)	20.5	3.7	-	-	7.9
Redox Potential (ORP; mV)	175.6	156.3	139.1	118.9	49.9
Specific Conductivity (µS/cm)[c]	397.0	297.0	297.0	175.0	480.0
Laboratory Analyses					
Organic Compounds					
1,4-Dioxane	<0.25	**0.649**	<0.25	<0.25	<0.25

Notes:

Bold - detected above the Minimum Detection Limit

E. Data point appears to be in error

(124-134)-Well screen depth below land surface

Table 3 Orleans Landfill Groundwater Analyses

Sample ID	**MW-11 (91-101)**	**MW-12 (87-97)**
Top of Screen Elevation (ft)	-41.60	NA
Bottom of Screen Elevation (ft)	-51.60	NA
Sampling Date	3/29/2017	3/29/2017
Field Measurements		
pH (SU)	5.8	5.4
Temperature (^{o}C)	12.2	13.1
Dissolved Oxygen (DO; mg/L)	0.8	0.3
Dissolved Oxygen (DO; %)	7.4	2.4
Redox Potential (ORP; mV)	112.1	102.5
Specific Conductivity (µS/cm)[c]	152.0	179.0
Laboratory Analyses		
Organic Compounds		
1,4-Dioxane	<0.25	<0.25

Notes:

Bold - detected above the Minimum Detection Limit

E. Data point appears to be in error (124-134)-Well screen depth below land surface

Table 4 Orleans Landfill Monitoring Well Construction Details

Location	Surface Elevation (ft)	TOC Elevation (ft)	Total Well Depth (ft bgs)	Screen Beginning Depth (ft bgs)	Screen End Depth (ft bgs)	Top Screen Elevation (ft)	Bottom Screen Elevation (ft)	Mid-Screen Elevation (ft)	Screen Length (ft)	Inst. Date	Address
MW-1S(56-66)	83.3	85.18	66.0	56.00	66.00	27.30	17.30	22.30	10.0	existing	Landfill
MW-1D(99-109)	83.3	85.11	109.0	99.00	109.00	-15.70	-25.70	-20.70	10.0	existing	Landfill
MW-2S(84-94)	101.3	101.49	94.0	84.00	94.00	17.30	7.30	12.30	10.0	existing	Landfill
MW-2D(124-134)	101.6	101.42	134.0	124.00	134.00	-22.40	-32.40	-27.40	10.0	existing	Landfill
MW-2(140-150) *	101.3	102.80	150.0	140.00	150.00	-38.70	-48.70	-43.70	10.0	1/18/2017	Landfill
MW-2 (161-171)	101.4	102.9	171.0	161.00	171.00	-59.60	-69.60	-64.60	10.0	March 2017	Landfill
MW-3S(50-60)	68.6	70.32	60.0	50.00	60.00	18.60	8.60	13.60	10.0	existing	Landfill
MW-3D(84-94)	68.8	69.74	94.0	84.00	94.00	-15.20	-25.20	-20.20	10.0	existing	Landfill
MW-5S(78-88)	102.1	103.91	88.0	78.00	88.00	24.10	14.10	19.10	10.0	existing	Powerline ROW
MW-5D(124-134)	102.0	103.89	134.0	124.00	134.00	-22.00	-32.00	-27.00	10.0	existing	Powerline ROW
MW-5 (140-150)	101.7	103.6	150.0	140.00	150.00	-38.30	-48.30	-43.30	10.0	March 2017	Powerline ROW
MW-6A(64-74)	71.6	71.22	74.0	64.00	74.00	7.60	-2.40	2.60	10.0	1/21/2016	Landfill
MW-6B(54-64)	71.8	71.40	64.0	54.00	64.00	17.80	7.80	12.80	10.0	1/21/2016	Landfill
MW-6C(52-62)	71.9	71.55	62.0	52.00	62.00	19.90	9.90	14.90	10.0	1/21/2016	Landfill
MW-E6(88-98) *	72.2	71.91	98.0	88.00	98.00	-15.80	-25.80	-20.80	10.0	1/17/2017	Landfill
MW-7S(55-65) *	69.8	71.64	65.0	55.00	65.00	14.80	4.80	9.80	10.0	1/19/2017	Landfill
MW-7D(115-125) *	69.9	71.66	125.0	115.00	125.00	-45.10	-55.10	-50.10	10.0	1/20/2017	Landfill
MW-7 (90-100)	69.7	71.4	100.0	90.00	100.00	-20.30	-30.30	-25.30	10.0	3/2/2017	Landfill
MW-8(36-46) *	59.1	58.80	46.0	36.00	46.00	23.10	13.10	18.10	10.0	1/25/2017	Giddiah Hill Road
MW-8 (84-94)	59.2	58.8	94.0	84.00	94.00	-24.80	-34.80	-29.80	10.0	3/1/2017	Giddiah Hill Road
MW-9(92-102) *	105.5	107.32	102.0	92.00	102.00	13.50	3.50	8.50	10.0	1/25/2017	Landfill
MW-10(85-95) *	94.0	93.69	95.0	85.00	95.00	9.00	-1.00	4.00	10.0	1/26/2017	Finlay Road
MW-13 (74-84)	57.0	59.3	84.0	74.0	84.0	-17.00	-27.00	-22.00	10.0	March 2017	Landfill
MW-11 (91-101)	49.4	48.97	101.0	91.0	101.0	-41.60	-51.60	-46.60	10.0	March 2017	Elementary School
MW-12-(87-97)	NA	NA	97.0	87.0	97.0	NA	NA	NA	10.0	March 2017	Snow Library

Notes: TOC = Top of Casing
bgs = below
ground surface
NA = Not
Available

All new wells constructed with 2-inch Schedule 40 PVC threaded flush joint casings, 10 ft screens with Schedule 40 PVC .010" 10 slot well screen

Table 5 Orleans Landfill Groundwater Elevations

Well ID	Location	TOC Elevation (ft)	Depth to Water (ft)				GW Elevation (ft)	Notes
			2/3/2017	2/6/2017	2/28/2017	03/27/2017-03/29/2017		
MW-1S(56-66)	Landfill	85.18	61.95	62.0	61.88	-	23	Perched Water
MW-1D(99-109)	Landfill	85.11	70.60	70.5	70.33	-	15	
MW-2S(84-94)	Landfill	101.49	87.90	-	87.63	-	14	
MW-2D(124-134)	Landfill	101.42	88.42	88.4	88.20	-	13	
MW-2(140-150) *	Landfill	102.80	89.82	-	89.60	89.38	13	
MW-2 (161-171)	Landfill	101.40	NI	NI	NI	89.57	12	
MW-3S(50-60)	Landfill	70.32	54.20	55.3	54.94	-	15	
MW-3D(84-94)	Landfill	69.74	54.90	55.0	54.66	-	15	
MW-5S(78-88)	ROW	103.91	90.28	-	89.94	-	14	
MW-5D(124-134)	ROW	103.89	89.90	-	89.67	-	14	
MW-5 (140-150)	ROW	101.68	NI	NI	NI	89.50	12	
MW-6A(64-74)	Landfill	71.22	56.35	56.4	56.41	-	15	
MW-6B(54-64)	Landfill	71.40	56.40	56.5	56.33	-	15	
MW-6C(52-62)	Landfill	71.55	NS	NS	NS	-	NA	
MW-E6(88-98) *	Landfill	71.91	57.77	57.8	57.51	-	14	
MW-7S(55-65) *	Landfill	71.64	66.50	56.6	56.22	56.31	15	
MW-7D(115-125) *	Landfill	71.66	57.30	57.3	57.03	56.92	15	
MW-7 (90-100)	Landfill	69.70	NI	NI	NI	56.66	13	
MW-8(36-46) *	Giddiah Hill Rd	58.80	35.05	34.9	34.62	34.45	24	Perched Water
MW-8 (84-94)	Giddiah Hill Rd	NA	NI	NI	NI	43.07	NA	
MW-9(92-102) *	Landfill	107.32	93.50	93.3	93.11	-	14	
MW-10(85-95) *	Finlay Rd	93.69	81.12	82.1	80.95	-	13	
MW-13 (74-84)	Landfill	57.00	NI	NI	NI	44.07	13	
MW-11 (91-101)	Elementary School	48.97	NI	NI	NI	37.58	11	
MW-12-(87-97)	Snow Library	NA	NI	NI	NI	35.67	NA	

NS- no sampled
NI- not installed
NA- not available

Figures

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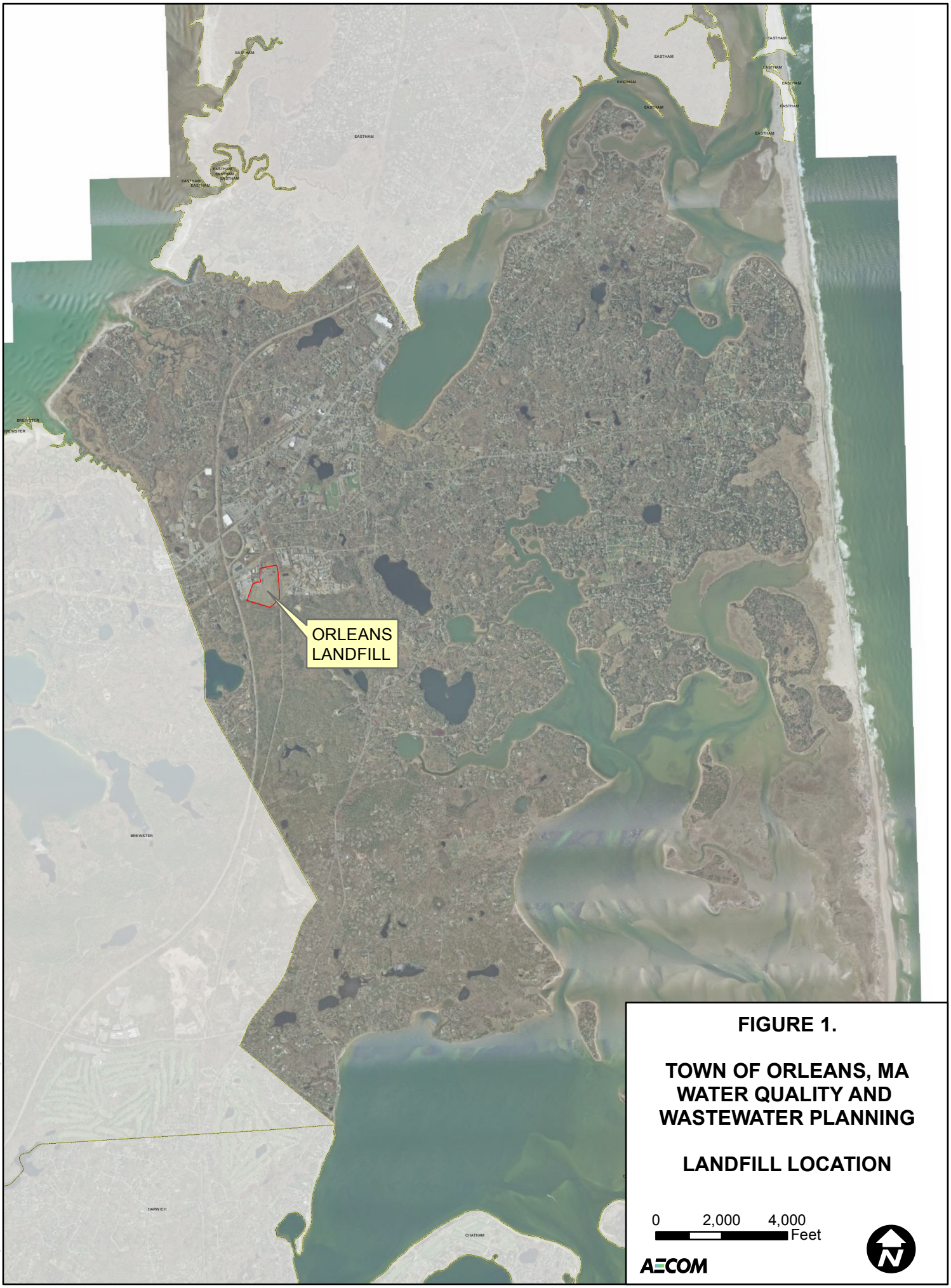

FIGURE 1.

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

LANDFILL LOCATION

0 2,000 4,000
Feet

AECOM

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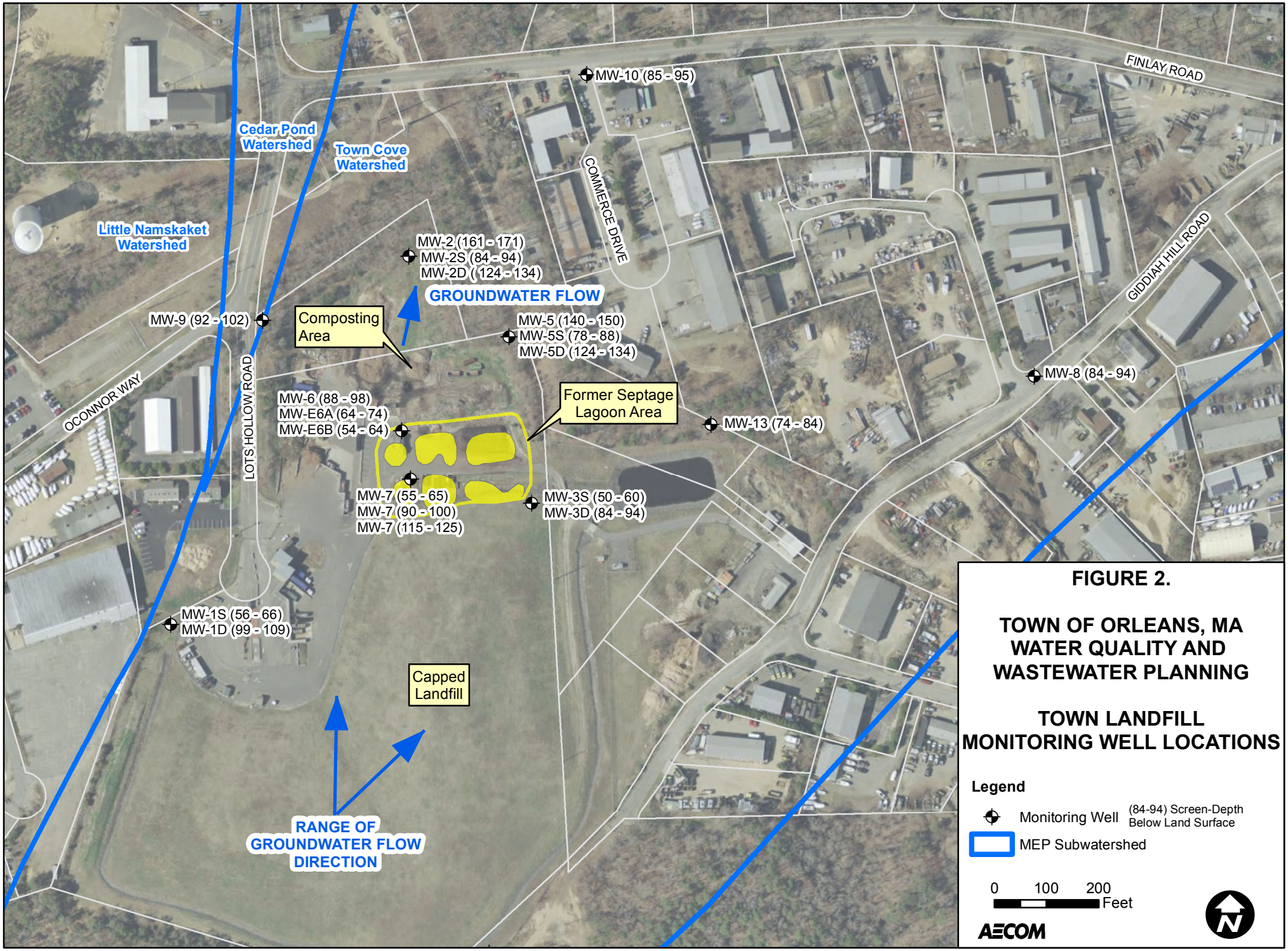


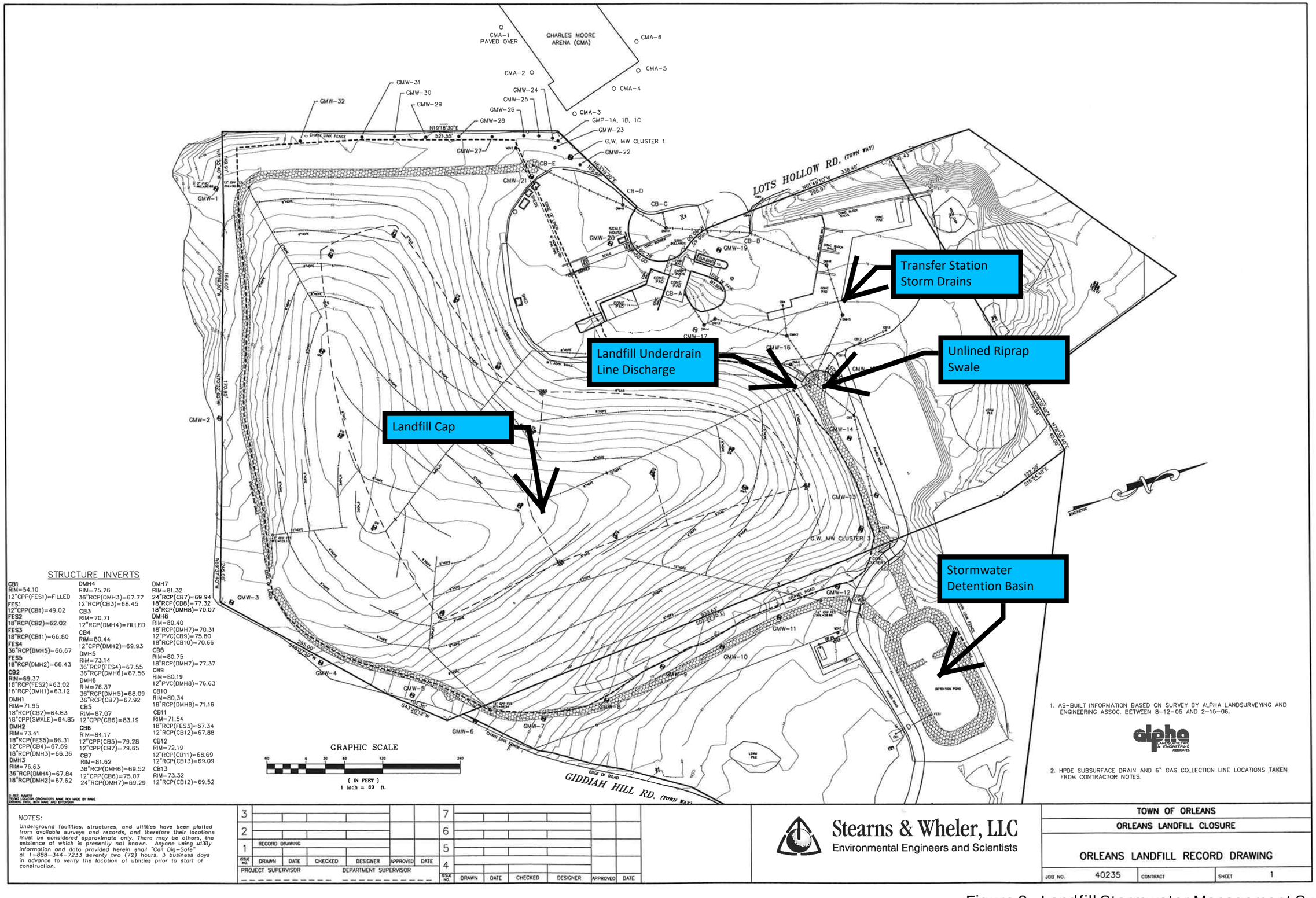
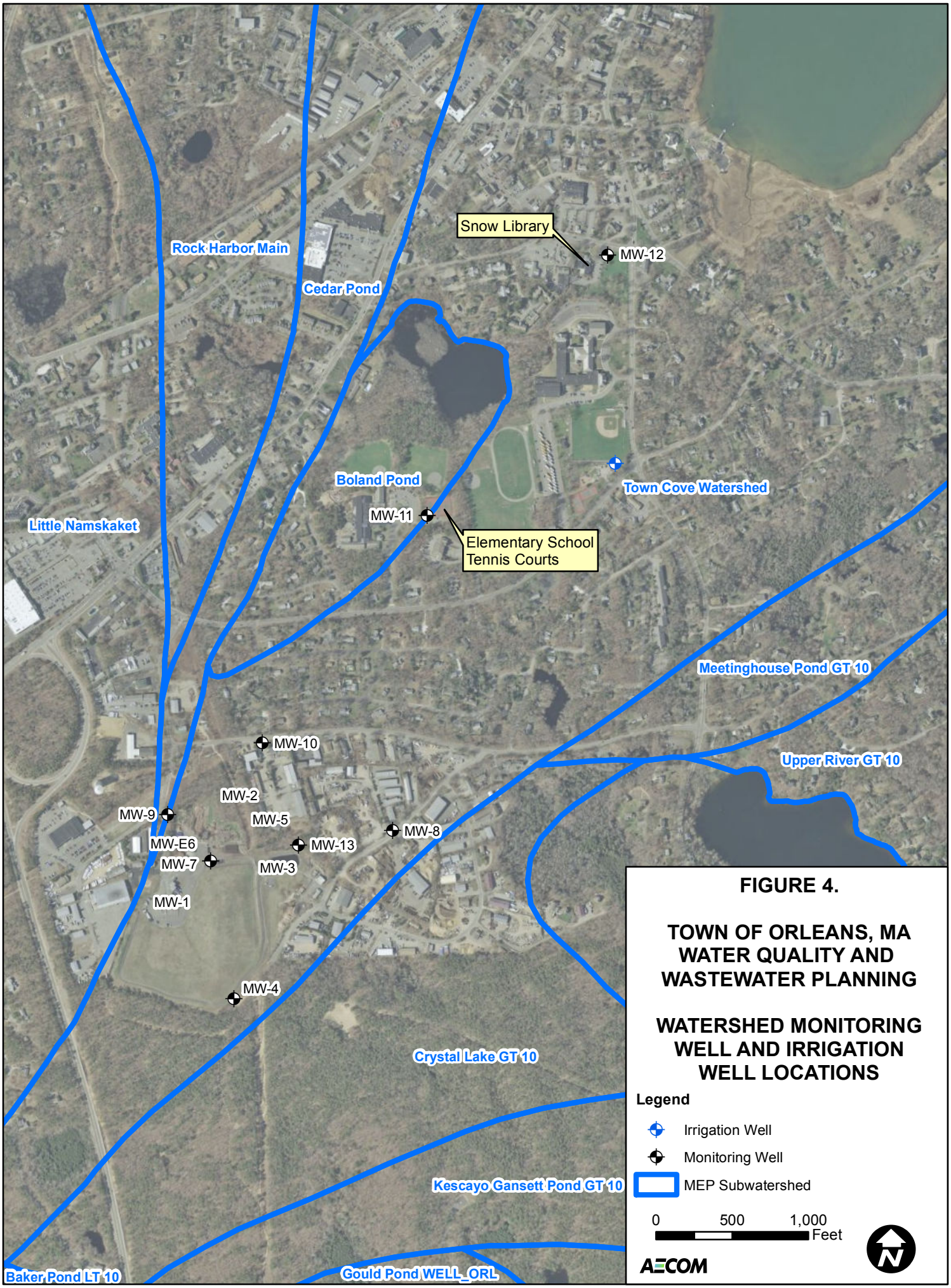


Figure 3 - Landfill Stormwater Management System



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A
NORTHWEST

A'
SOUTHEAST

MW-9(92-102)
MW-2S(84-94)
MW-2 (161-171)
MW-2D(124-134)
MW-2(140-150)
MW-5 (140-150)
MW-5S(78-88)
MW-5D(124-134)
MW-13(74-84)
MW-8(36-46)
MW-8 (84-94)

Unsaturated Zone

Approximate Water Table

Saturated Zone

<0.25
<0.25
NM
<0.25
NM
1.84
<0.25
2.05
NM
<0.25
0.649

Elevation (ft)
110
100
90
80
70
60
50
40
30
20
10
0
−10
−20
−30
−40
−50
−60
−70
−80

Horizontal Scale (ft)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1561

1,4-DIOXANE DATA

NOTES:
1. DATA REPRESENTATIVE BASED ON SAMPLING EVENTS CONDUCTED IN FEBRUARY AND MARCH 2017.
2. NM=NOT MEASURED

LANDFILL CROSS SECTION A-A': 1,4-DIOXANE DATA
WATER QUALITY AND WASTEWTER PLANNING
TOWN OF ORLEANS, MA
Project No.: 60476644 Date: 2017-06-29

Figure: 5

AECOM

Project Management Initials: Designer:____ Checked:____ Approved:____ ANSI B 11" x 17"

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Project Management Initials: Designer: Checked: Approved: ANSI B 11" x 17"

B
SOUTHWEST

B'
NORTHEAST

MW-7D(115-125)
MW-7(90-100)
MW-7S(55-65)
MW-6A(64-74)
MW-6B(54-64)
MW-6C(52-62)
MW-E6(88-98)
MW-2(140-150)
MW-2 (161-171)
MW-2S(84-94)
MW-2D(124-134)
MW-10(85-95)

Unsaturated Zone

Approximate Water Table

Saturated Zone

<0.25
<0.25
<0.25
<0.25
<0.25
0.687
1.84
2.05
1.7
NM

Elevation (ft)

Horizontal Scale (ft)

1,4-DIOXANE DATA
NOTES:
1. DATA REPRESENTATIVE BASED ON SAMPLING EVENTS CONDUCTED IN FEBRUARY AND MARCH 2017.
2. NM=NOT MEASURED

LANDFILL CROSS SECTION B-B': 1, 4 DIOXANE DATA
WATER QUALITY AND WASTEWTER PLANNING
TOWN OF ORLEANS, MA
Project No.: 60476644 Date: 2017-06-14

AECOM
Figure: 6

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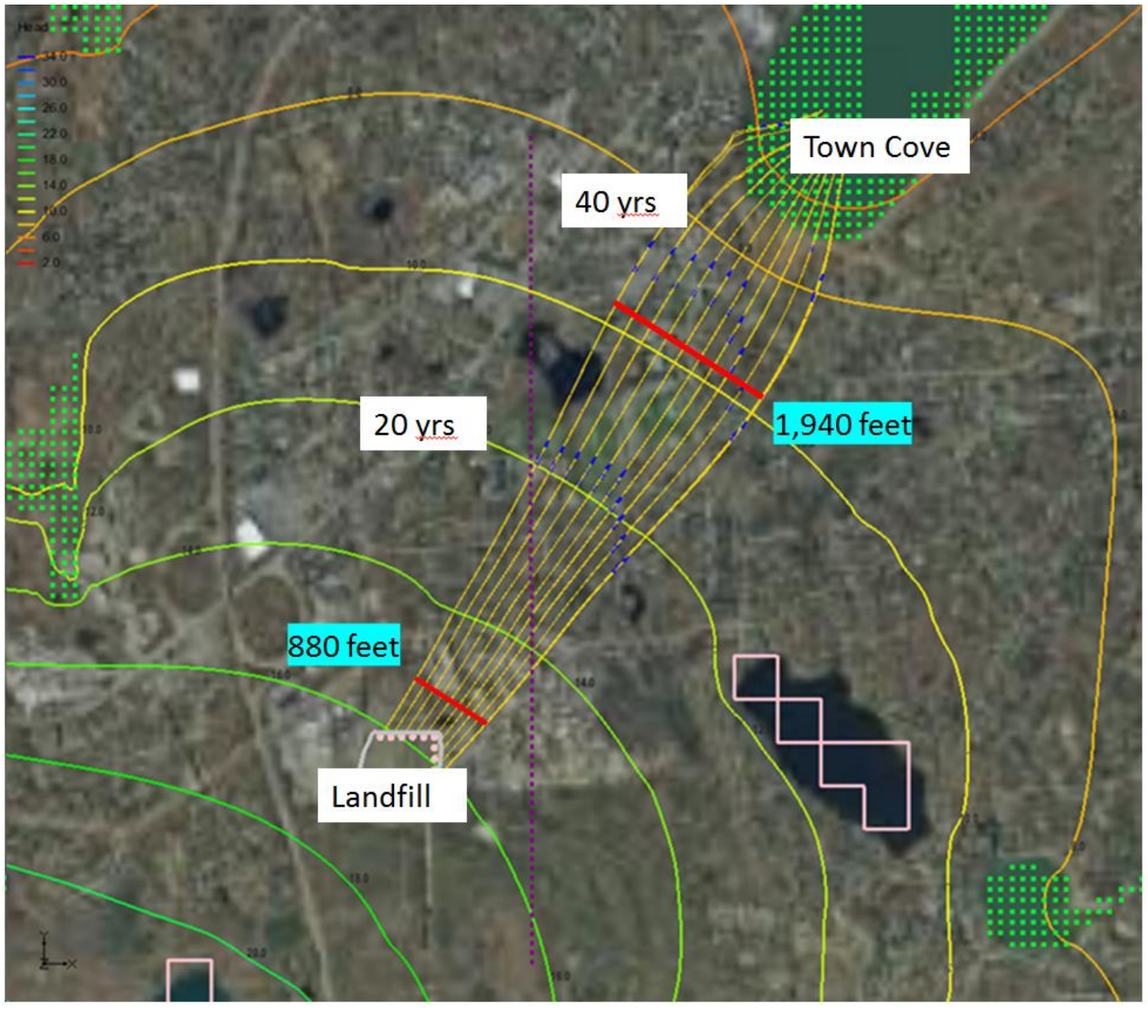

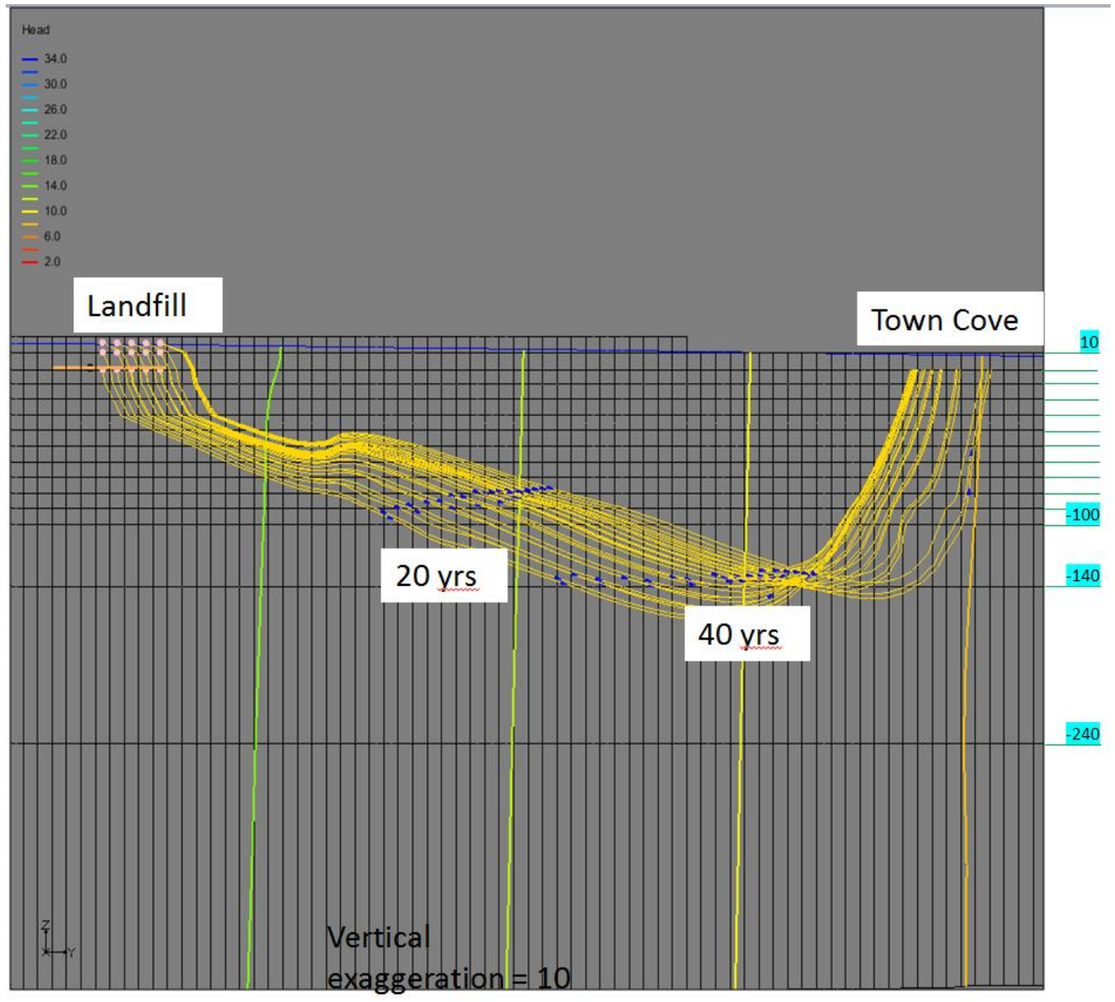

FIGURE 7

TOWN OF ORLEANS, MA
WATER QUALITY AND WASTEWATER PLANNING

LANDFILL GROUNDWATER FLOW –
PARTICLE TRACKING

AECOM

Appendix A

Laboratory Reports

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CERTIFICATE OF ANALYSIS

Mark Owen
AECOM Environment - ENSR
9 Jonathon Bourne Dr.
Pocasset, MA 02559

RE: Orleans MA (60476644)
ESS Laboratory Work Order Number: 1702113

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 5:08 pm, Feb 15, 2017

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 TNI and relative state standards, 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: 1702113

SAMPLE RECEIPT

The following samples were received on February 06, 2017 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
1702113-01	MW-2S (84-94)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 8270D SIM, 9038, 9250
1702113-02	MW-2D (124-134)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 8270D SIM, 9038, 9250
1702113-03	MW-2D (124-134) DUP	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 8270D SIM, 9038, 9250
1702113-04	MW-5S (78-88)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 9038, 9250
1702113-05	MW-5D (124-134)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 9038, 9250
1702113-06	MW-6A (64-74)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 8270D SIM, 9038, 9250
1702113-07	MW-6B (54-64)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 8270D SIM, 9038, 9250
1702113-08	MW-6 (88-98)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 8270D SIM, 9038, 9250
1702113-09	MW-7S (55-65)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 8270D SIM, 9038, 9250
1702113-10	MW-7D (115-125)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 8270D SIM, 9038, 9250
1702113-11	MW-2 (140-150)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 8270D SIM, 9038, 9250
1702113-12	MW-7S (55-65) DUP	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 8270D SIM, 9038, 9250

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1702113

PROJECT NARRATIVE

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution
C7B0084-TUN1 **DDT breakdown > 20%**

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: 1702113

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
8015C - 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: MW-2S (84-94)
Date Sampled: 02/06/17 14:55
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-01
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	02/07/17 22:29	10	10	CB70703
Manganese	**0.545** (0.020)		200.7		1	KJK	02/07/17 22:29	10	10	CB70703

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2S (84-94)
Date Sampled: 02/06/17 14:55
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-01
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
Boron	**0.281** (0.050)		200.7		1	KJK	02/07/17 20:34	50	25	CB70701

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2S (84-94)
Date Sampled: 02/06/17 14:55
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-01
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 2/7/17 18:00

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	02/08/17 1:40	C7B0106	CB70742

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	54 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2S (84-94)
Date Sampled: 02/06/17 14:55
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-01
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
Ammonia as N	**0.14** (0.10)		350.1		1	JLK	02/08/17 18:37	mg/L	CB70721
Chloride	**88.8** (3.0)		9250		1	JLK	02/10/17 16:03	mg/L	CB71038
Dissolved Organic Carbon (Average)	**9.49** (0.500)		5310B		1	DEL	02/07/17 18:47	mg/L	[CALC]
Nitrate as N	**18.8** (1.01)		353.2		50	JLK	02/07/17 19:53	mg/L	[CALC]
Nitrite as N	**0.041** (0.010)		353.2		1	JLK	02/07/17 17:26	mg/L	CB70728
Sulfate	**77.0** (50.0)		9038		10	EEM	02/07/17 17:25	mg/L	CB70718
Total Kjeldahl Nitrogen as N	**2.13** (0.20)		351.2		1	EEM	02/08/17 15:12	mg/L	CB70707
Total Nitrogen	**21.0** (1.20)		4500N		50	EEM	02/08/17 15:12	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2D (124-134)
Date Sampled: 02/06/17 14:20
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-02
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	02/07/17 22:33	10	10	CB70703
Manganese	**5.12** (0.020)		200.7		1	KJK	02/07/17 22:33	10	10	CB70703

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2D (124-134)
Date Sampled: 02/06/17 14:20
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-02
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
Boron	**0.259** (0.050)		200.7		1	KJK	02/07/17 20:39	50	25	CB70701

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2D (124-134)
Date Sampled: 02/06/17 14:20
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-02
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 2/7/17 18:00

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	**1.84** (0.250)		8270D SIM		1	02/08/17 2:16	C7B0106	CB70742

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	64 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2D (124-134)
Date Sampled: 02/06/17 14:20
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-02
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
Ammonia as N	**11.5** (1.00)		350.1		10	JLK	02/08/17 18:51	mg/L	CB70721
Chloride	**97.7** (3.0)		9250		1	JLK	02/10/17 16:05	mg/L	CB71038
Dissolved Organic Carbon (Average)	**7.20** (0.500)		5310B		1	DEL	02/07/17 19:51	mg/L	[CALC]
Nitrate as N	**0.208** (0.030)		353.2		1	JLK	02/07/17 19:54	mg/L	[CALC]
Nitrite as N	**0.014** (0.010)		353.2		1	JLK	02/07/17 17:02	mg/L	CB70728
Sulfate	**52.5** (25.0)		9038		5	EEM	02/07/17 17:25	mg/L	CB70718
Total Kjeldahl Nitrogen as N	**13.7** (1.00)		351.2		5	EEM	02/08/17 16:38	mg/L	CB70707
Total Nitrogen	**13.9** (1.02)		4500N		5	EEM	02/08/17 16:38	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2D (124-134) DUP
Date Sampled: 02/06/17 14:25
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-03
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.113** (0.100)		200.7		1	KJK	02/07/17 22:37	10	10	CB70703
Manganese	**5.10** (0.020)		200.7		1	KJK	02/07/17 22:37	10	10	CB70703

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2D (124-134) DUP
Date Sampled: 02/06/17 14:25
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-03
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
Boron	**0.254** (0.050)		200.7		1	KJK	02/07/17 20:43	50	25	CB70701

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2D (124-134) DUP
Date Sampled: 02/06/17 14:25
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-03
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 2/7/17 18:00

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	**1.70** (0.250)		8270D SIM		1	02/08/17 2:52	C7B0106	CB70742

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	*67 %*		*15-115*

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2D (124-134) DUP
Date Sampled: 02/06/17 14:25
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-03
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
Ammonia as N	**11.2** (1.00)		350.1		10	JLK	02/08/17 18:55	mg/L	CB70721
Chloride	**99.2** (3.0)		9250		1	JLK	02/10/17 16:06	mg/L	CB71038
Dissolved Organic Carbon (Average)	**8.61** (0.500)		5310B		1	DEL	02/07/17 20:03	mg/L	[CALC]
Nitrate as N	**0.180** (0.030)		353.2		1	JLK	02/07/17 19:55	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/07/17 17:03	mg/L	CB70728
Sulfate	**52.0** (25.0)		9038		5	EEM	02/07/17 17:25	mg/L	CB70718
Total Kjeldahl Nitrogen as N	**14.7** (1.00)		351.2		5	EEM	02/08/17 16:39	mg/L	CB70707
Total Nitrogen	**14.8** (1.02)		4500N		5	EEM	02/08/17 16:39	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-5S (78-88)
Date Sampled: 02/06/17 16:15
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-04
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.101** (0.100)		200.7		1	KJK	02/07/17 22:41	10	10	CB70703
Manganese	**0.112** (0.020)		200.7		1	KJK	02/07/17 22:41	10	10	CB70703

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-5S (78-88)
Date Sampled: 02/06/17 16:15
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-04
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
Boron	**0.108** (0.050)		200.7		1	KJK	02/07/17 20:47	50	25	CB70701

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-5S (78-88)
Date Sampled: 02/06/17 16:15
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-04
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
Ammonia as N	**0.12** (0.10)		350.1		1	JLK	02/08/17 18:41	mg/L	CB70721
Chloride	**63.5** (3.0)		9250		1	JLK	02/10/17 16:06	mg/L	CB71038
Nitrate as N	**17.3** (1.01)		353.2		50	JLK	02/07/17 19:59	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/07/17 17:04	mg/L	CB70728
Sulfate	**55.0** (25.0)		9038		5	EEM	02/07/17 17:25	mg/L	CB70718
Total Kjeldahl Nitrogen as N	**2.19** (0.20)		351.2		1	EEM	02/08/17 15:15	mg/L	CB70707
Total Nitrogen	**19.5** (1.20)		4500N		50	EEM	02/08/17 15:15	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-5D (124-134)
Date Sampled: 02/06/17 16:30
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-05
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.622** (0.100)		200.7		1	KJK	02/07/17 22:58	10	10	CB70703
Manganese	**0.524** (0.020)		200.7		1	KJK	02/07/17 22:58	10	10	CB70703

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-5D (124-134)
Date Sampled: 02/06/17 16:30
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-05
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
Boron	**0.056** (0.050)		200.7		1	KJK	02/07/17 21:04	50	25	CB70701

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-5D (124-134)
Date Sampled: 02/06/17 16:30
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-05
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
Ammonia as N	**12.7** (1.00)		350.1		10	JLK	02/08/17 18:56	mg/L	CB70721
Chloride	**66.1** (3.0)		9250		1	JLK	02/10/17 16:07	mg/L	CB71038
Nitrate as N	**0.046** (0.030)		353.2		1	JLK	02/07/17 20:02	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/07/17 17:06	mg/L	CB70728
Sulfate	**24.0** (5.0)		9038		1	EEM	02/07/17 17:25	mg/L	CB70718
Total Kjeldahl Nitrogen as N	**13.9** (1.00)		351.2		5	EEM	02/08/17 16:40	mg/L	CB70707
Total Nitrogen	**13.9** (1.02)		4500N		5	EEM	02/08/17 16:40	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6A (64-74)
Date Sampled: 02/06/17 12:15
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-06
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.147** (0.100)		200.7		1	KJK	02/07/17 23:02	10	10	CB70703
Manganese	**0.053** (0.020)		200.7		1	KJK	02/07/17 23:02	10	10	CB70703

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6A (64-74)
Date Sampled: 02/06/17 12:15
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-06
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
Boron	**0.100** (0.050)		200.7		1	KJK	02/07/17 21:08	50	25	CB70701

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6A (64-74)
Date Sampled: 02/06/17 12:15
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-06
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 2/7/17 18:00

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	02/08/17 3:28	C7B0106	CB70742

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	65 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6A (64-74)
Date Sampled: 02/06/17 12:15
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-06
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
Ammonia as N	ND (0.10)		350.1		1	JLK	02/08/17 18:44	mg/L	CB70721
Chloride	**280** (15.0)		9250		5	JLK	02/10/17 16:17	mg/L	CB71038
Dissolved Organic Carbon (Average)	**8.07** (0.500)		5310B		1	DEL	02/07/17 20:16	mg/L	[CALC]
Nitrate as N	**7.20** (0.210)		353.2		10	JLK	02/07/17 20:03	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/07/17 17:07	mg/L	CB70728
Sulfate	**34.4** (10.0)		9038		2	EEM	02/07/17 17:25	mg/L	CB70718
Total Kjeldahl Nitrogen as N	**1.70** (0.20)		351.2		1	EEM	02/08/17 15:17	mg/L	CB70707
Total Nitrogen	**8.90** (0.40)		4500N		10	EEM	02/08/17 15:17	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6B (54-64)
Date Sampled: 02/06/17 11:40
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-07
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.158** (0.100)		200.7		1	KJK	02/07/17 23:06	10	10	CB70703
Manganese	**0.038** (0.020)		200.7		1	KJK	02/07/17 23:06	10	10	CB70703

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6B (54-64)
Date Sampled: 02/06/17 11:40
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-07
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
Boron	**0.109** (0.050)		200.7		1	KJK	02/07/17 21:12	50	25	CB70701

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6B (54-64)
Date Sampled: 02/06/17 11:40
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-07
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 2/7/17 18:00

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	02/08/17 4:05	C7B0106	CB70742

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	67 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6B (54-64)
Date Sampled: 02/06/17 11:40
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-07
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
Ammonia as N	**0.11** (0.10)		350.1		1	EEM	02/15/17 15:31	mg/L	CB71417
Chloride	**151** (6.0)		9250		2	JLK	02/10/17 16:18	mg/L	CB71038
Dissolved Organic Carbon (Average)	**6.68** (0.500)		5310B		1	DEL	02/07/17 20:53	mg/L	[CALC]
Nitrate as N	**16.3** (1.01)		353.2		50	JLK	02/07/17 20:04	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/07/17 17:08	mg/L	CB70728
Sulfate	**41.5** (25.0)		9038		5	EEM	02/07/17 17:25	mg/L	CB70718
Total Kjeldahl Nitrogen as N	**1.50** (0.20)		351.2		1	EEM	02/08/17 15:17	mg/L	CB70707
Total Nitrogen	**17.8** (1.20)		4500N		50	EEM	02/08/17 15:17	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6 (88-98)
Date Sampled: 02/06/17 11:10
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-08
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**18.4** (0.100)		200.7		1	KJK	02/07/17 23:10	10	10	CB70703
Manganese	**2.49** (0.020)		200.7		1	KJK	02/07/17 23:10	10	10	CB70703

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6 (88-98)
Date Sampled: 02/06/17 11:10
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-08
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
Boron	**0.241** (0.050)		200.7		1	KJK	02/07/17 21:16	50	25	CB70701

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6 (88-98)
Date Sampled: 02/06/17 11:10
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-08
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 2/7/17 18:00

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	**0.687** (0.250)		8270D SIM		1	02/08/17 4:40	C7B0106	CB70742

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	*35 %*		*15-115*

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6 (88-98)
Date Sampled: 02/06/17 11:10
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-08
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
Ammonia as N	**0.12** (0.10)		350.1		1	JLK	02/08/17 18:45	mg/L	CB70721
Chloride	**173** (6.0)		9250		2	JLK	02/10/17 16:18	mg/L	CB71038
Dissolved Organic Carbon (Average)	**8.75** (0.500)		5310B		1	DEL	02/07/17 21:05	mg/L	[CALC]
Nitrate as N	**0.051** (0.030)		353.2		1	JLK	02/07/17 20:05	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/07/17 17:09	mg/L	CB70728
Sulfate	**22.5** (5.0)		9038		1	EEM	02/07/17 17:25	mg/L	CB70718
Total Kjeldahl Nitrogen as N	**24.1** (2.00)		351.2		10	EEM	02/08/17 16:41	mg/L	CB70707
Total Nitrogen	**24.2** (2.02)		4500N		10	EEM	02/08/17 16:41	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7S (55-65)
Date Sampled: 02/06/17 10:10
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-09
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.342** (0.100)		200.7		1	KJK	02/07/17 23:14	10	10	CB70703
Manganese	**0.024** (0.020)		200.7		1	KJK	02/07/17 23:14	10	10	CB70703

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7S (55-65)
Date Sampled: 02/06/17 10:10
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-09
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
Boron	**0.078** (0.050)		200.7		1	KJK	02/07/17 21:20	50	25	CB70701

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7S (55-65)
Date Sampled: 02/06/17 10:10
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-09
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 2/7/17 19:00

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	02/08/17 5:16	C7B0106	CB70742

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	56 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7S (55-65)
Date Sampled: 02/06/17 10:10
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-09
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
Ammonia as N	**0.34** (0.10)		350.1		1	JLK	02/08/17 18:46	mg/L	CB70721
Chloride	**127** (6.0)		9250		2	JLK	02/10/17 16:19	mg/L	CB71038
Dissolved Organic Carbon (Average)	**16.0** (0.500)		5310B		1	DEL	02/07/17 21:18	mg/L	[CALC]
Nitrate as N	**8.68** (0.210)		353.2		10	JLK	02/07/17 19:46	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/07/17 17:10	mg/L	CB70728
Sulfate	**29.6** (5.0)		9038		1	EEM	02/07/17 17:25	mg/L	CB70718
Total Kjeldahl Nitrogen as N	**1.92** (0.20)		351.2		1	EEM	02/08/17 15:25	mg/L	CB70707
Total Nitrogen	**10.6** (0.40)		4500N		10	EEM	02/08/17 15:25	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7D (115-125)
Date Sampled: 02/06/17 09:40
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-10
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**18.3** (0.100)		200.7		1	KJK	02/07/17 23:19	10	10	CB70703
Manganese	**3.21** (0.020)		200.7		1	KJK	02/07/17 23:19	10	10	CB70703

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7D (115-125)
Date Sampled: 02/06/17 09:40
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-10
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
Boron	**0.138** (0.050)		200.7		1	KJK	02/07/17 21:24	50	25	CB70701

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7D (115-125)
Date Sampled: 02/06/17 09:40
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-10
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 2/7/17 19:00

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	**1.70** (0.250)		8270D SIM		1	02/08/17 5:52	C7B0106	CB70742

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	43 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7D (115-125)
Date Sampled: 02/06/17 09:40
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-10
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
Ammonia as N	**2.74** (0.10)		350.1		1	JLK	02/08/17 18:47	mg/L	CB70721
Chloride	**55.3** (3.0)		9250		1	JLK	02/10/17 16:11	mg/L	CB71038
Dissolved Organic Carbon (Average)	**5.83** (0.500)		5310B		1	DEL	02/07/17 21:30	mg/L	[CALC]
Nitrate as N	ND (0.030)		353.2		1	JLK	02/07/17 19:47	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/07/17 17:13	mg/L	CB70728
Sulfate	**36.2** (10.0)		9038		2	EEM	02/07/17 17:25	mg/L	CB70718
Total Kjeldahl Nitrogen as N	**3.17** (0.20)		351.2		1	EEM	02/08/17 15:26	mg/L	CB70707
Total Nitrogen	**3.17** (0.22)		4500N		1	EEM	02/08/17 15:26	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2 (140-150)
Date Sampled: 02/06/17 10:15
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-11
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.107** (0.100)		200.7		1	KJK	02/07/17 23:23	10	10	CB70703
Manganese	**5.46** (0.020)		200.7		1	KJK	02/07/17 23:23	10	10	CB70703

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2 (140-150)
Date Sampled: 02/06/17 10:15
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-11
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
Boron	**0.281** (0.050)		200.7		1	KJK	02/07/17 21:29	50	25	CB70701

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2 (140-150)
Date Sampled: 02/06/17 10:15
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-11
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 2/7/17 19:00

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	**2.05** (0.250)		8270D SIM		1	02/08/17 6:27	C7B0106	CB70742

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	49 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2 (140-150)
Date Sampled: 02/06/17 10:15
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-11
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
Ammonia as N	**11.9** (1.00)		350.1		10	JLK	02/08/17 18:57	mg/L	CB70721
Chloride	**49.0** (3.0)		9250		1	JLK	02/10/17 16:12	mg/L	CB71038
Dissolved Organic Carbon (Average)	**6.95** (0.500)		5310B		1	DEL	02/07/17 21:43	mg/L	[CALC]
Nitrate as N	ND (0.030)		353.2		1	JLK	02/07/17 19:48	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/07/17 17:14	mg/L	CB70728
Sulfate	**62.0** (25.0)		9038		5	EEM	02/07/17 17:25	mg/L	CB70718
Total Kjeldahl Nitrogen as N	**12.8** (1.00)		351.2		5	EEM	02/08/17 16:42	mg/L	CB70707
Total Nitrogen	**12.8** (1.02)		4500N		5	EEM	02/08/17 16:42	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7S (55-65) DUP
Date Sampled: 02/06/17 13:45
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-12
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.271** (0.100)		200.7		1	KJK	02/07/17 23:27	10	10	CB70703
Manganese	**0.024** (0.020)		200.7		1	KJK	02/07/17 23:27	10	10	CB70703

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7S (55-65) DUP
Date Sampled: 02/06/17 13:45
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-12
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
Boron	**0.084** (0.050)		200.7		1	KJK	02/07/17 21:33	50	25	CB70701

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7S (55-65) DUP
Date Sampled: 02/06/17 13:45
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-12
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 2/7/17 19:00

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	02/08/17 7:03	C7B0106	CB70742

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	48 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7S (55-65) DUP
Date Sampled: 02/06/17 13:45
Percent Solids: N/A

ESS Laboratory Work Order: 1702113
ESS Laboratory Sample ID: 1702113-12
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
Ammonia as N	**0.13** (0.10)		350.1		1	JLK	02/08/17 18:49	mg/L	CB70721
Chloride	**124** (6.0)		9250		2	JLK	02/10/17 16:19	mg/L	CB71038
Dissolved Organic Carbon (Average)	**14.1** (0.500)		5310B		1	DEL	02/08/17 17:11	mg/L	[CALC]
Nitrate as N	**12.8** (1.01)		353.2		50	JLK	02/07/17 20:12	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/07/17 17:15	mg/L	CB70728
Sulfate	**33.6** (10.0)		9038		2	EEM	02/07/17 17:25	mg/L	CB70718
Total Kjeldahl Nitrogen as N	**2.38** (0.20)		351.2		1	EEM	02/08/17 15:27	mg/L	CB70707
Total Nitrogen	**15.2** (1.20)		4500N		50	EEM	02/08/17 15:27	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1702113

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Dissolved Metals										
Batch CB70703 - 200.7/6010BNoDigest										
Blank										
Iron	ND	0.100	mg/L							
Manganese	ND	0.020	mg/L							
LCS										
Iron	2.44		mg/L	2.500		98	80-120			
Manganese	0.490		mg/L	0.5000		98	80-120			
Total Metals										
Batch CB70701 - 3005A										
Blank										
Boron	ND	0.050	mg/L							
LCS										
Boron	0.241	0.050	mg/L	0.2500		96	85-115			
8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution										
Batch CB70742 - 3535A										
Blank										
1,4-Dioxane	ND	0.250	ug/L							
Surrogate: 1,4-Dioxane-d8	*3.71*		ug/L	*5.000*		*74*	*15-115*			
LCS										
1,4-Dioxane	10.8	0.250	ug/L	10.00		108	40-140			
Surrogate: 1,4-Dioxane-d8	*3.37*		ug/L	*5.000*		*67*	*15-115*			
LCS Dup										
1,4-Dioxane	10.5	0.250	ug/L	10.00		105	40-140	3	20	
Surrogate: 1,4-Dioxane-d8	*3.39*		ug/L	*5.000*		*68*	*15-115*			
Classical Chemistry										
Batch CB70707 - TKN Prep										
Blank										
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Nitrogen	ND	0.20	mg/L							
LCS										
Total Kjeldahl Nitrogen as N	18.9	2.00	mg/L	18.80		101	80-120			
Total Kjeldahl Nitrogen as N	18.9	2.00	mg/L	18.80		101	80-120			
Total Nitrogen	18.9	2.00	mg/L							
Batch CB70718 - General Preparation										
Blank										
Sulfate	ND	5.0	mg/L							
LCS										
Sulfate	9.6		mg/L	9.988		96	85-115			

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1702113

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CB70721 - NH4 Prep										
Blank										
Ammonia as N	ND	0.10	mg/L							
LCS										
Ammonia as N	0.10	0.10	mg/L	0.09994		100	80-120			
LCS										
Ammonia as N	1.04	0.10	mg/L	0.9994		104	80-120			
Batch CB70728 - [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							
LCS										
Nitrate as N	ND		mg/L							
Nitrite as N	0.248		mg/L	0.2497		100	90-110			
Nitrite as N	0.248		mg/L	0.2497		100	90-110			
Batch CB70729 - [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	0.462		mg/L							
Nitrate/Nitrite as N	0.462		mg/L	0.5000		92	90-110			
Nitrate/Nitrite as N	0.462		mg/L	0.5000		92	90-110			
Total Nitrogen	0.462		mg/L							
Batch CB70741 - General Preparation										
Blank										
Dissolved Organic Carbon (1)	ND	0.500	mg/L							
Dissolved Organic Carbon (2)	ND	0.500	mg/L							
Dissolved Organic Carbon (Average)	ND	0.500	mg/L							
LCS										
Dissolved Organic Carbon (1)	4.47	0.500	mg/L	5.000		89	80-120			
Dissolved Organic Carbon (2)	4.55	0.500	mg/L	5.000		91	80-120			
Dissolved Organic Carbon (Average)	4.51	0.500	mg/L							
LCS Dup										
Dissolved Organic Carbon (1)	4.55	0.500	mg/L	5.000		91	80-120	2	200	
Dissolved Organic Carbon (2)	4.60	0.500	mg/L	5.000		92	80-120	1	200	
Dissolved Organic Carbon (Average)	4.57	0.500	mg/L							
Batch CB71038 - General Preparation										
Blank										
Chloride	ND	3.0	mg/L							

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1702113

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CB71038 - General Preparation										
LCS										
Chloride	30.4		mg/L	30.00		101	90-110			
Batch CB71417 - General Preparation										
Blank										
Ammonia as N	ND	0.10	mg/L							
LCS										
Ammonia as N	0.09	0.10	mg/L	0.09994		91	80-120			
LCS										
Ammonia as N	0.95	0.10	mg/L	0.9994		95	80-120			

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1702113

Notes and Definitions

U	Analyte included in the analysis, but not detected
DDT	DDT breakdown > 20%
D	Diluted.
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: 1702113

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/dwp/partners/labCert.shtml

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.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

Shipped/Delivered Via: ESS Courier

ESS Project ID: 1702113
Date Received: 2/6/2017
Project Due Date: 2/13/2017
Days for Project: 5 Day

1. Air bill manifest present? No
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? Yes
   Temp: 4.1 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 / (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 VOA vials frozen: Date: Time: By:

Sample Receiving Notes:

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	102849	Yes	No	Yes	VOA Vial - HCl	HCl	
01	102850	Yes	No	Yes	VOA Vial - HCl	HCl	
01	102877	Yes	NA	Yes	1L Amber - Unpres	NP	
01	102878	Yes	NA	Yes	1L Amber - Unpres	NP	
01	102888	Yes	NA	Yes	250 mL Poly - HNO3	HNO3	
01	102898	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4	
01	102908	Yes	NA	Yes	500 mL Poly - Unpres	NP	
01	102918	Yes	NA	Yes	250 mL Amber - Unpres	NP	
01	102928	Yes	NA	Yes	250 mL Poly - Unpres	NP	
02	102847	Yes	No	Yes	VOA Vial - HCl	HCl	
02	102848	Yes	No	Yes	VOA Vial - HCl	HCl	
02	102875	Yes	NA	Yes	1L Amber - Unpres	NP	
02	102876	Yes	NA	Yes	1L Amber - Unpres	NP	
02	102887	Yes	NA	Yes	250 mL Poly - HNO3	HNO3	
02	102897	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4	
02	102907	Yes	NA	Yes	500 mL Poly - Unpres	NP	
02	102917	Yes	NA	Yes	250 mL Amber - Unpres	NP	
02	102927	Yes	NA	Yes	250 mL Poly - Unpres	NP	
03	102845	Yes	No	Yes	VOA Vial - HCl	HCl	
03	102846	Yes	No	Yes	VOA Vial - HCl	HCl	
03	102873	Yes	NA	Yes	1L Amber - Unpres	NP	
03	102874	Yes	NA	Yes	1L Amber - Unpres	NP	
03	102886	Yes	NA	Yes	250 mL Poly - HNO3	HNO3	
03	102896	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4	

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

ESS Project ID: 1702113

Date Received: 2/6/2017

03	102906	Yes	NA	Yes	500 mL Poly - Unpres	NP
03	102916	Yes	NA	Yes	250 mL Amber - Unpres	NP
03	102926	Yes	NA	Yes	250 mL Poly - Unpres	NP
04	102852	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
04	102854	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4
04	102856	Yes	NA	Yes	500 mL Poly - Unpres	NP
04	102858	Yes	NA	Yes	250 mL Poly - Unpres	NP
05	102851	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
05	102853	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4
05	102855	Yes	NA	Yes	500 mL Poly - Unpres	NP
05	102857	Yes	NA	Yes	250 mL Poly - Unpres	NP
06	102843	Yes	No	Yes	VOA Vial - HCl	HCl
06	102844	Yes	No	Yes	VOA Vial - HCl	HCl
06	102871	Yes	NA	Yes	1L Amber - Unpres	NP
06	102872	Yes	NA	Yes	1L Amber - Unpres	NP
06	102885	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
06	102895	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4
06	102905	Yes	NA	Yes	500 mL Poly - Unpres	NP
06	102915	Yes	NA	Yes	250 mL Amber - Unpres	NP
06	102925	Yes	NA	Yes	250 mL Poly - Unpres	NP
07	102841	Yes	No	Yes	VOA Vial - HCl	HCl
07	102842	Yes	No	Yes	VOA Vial - HCl	HCl
07	102869	Yes	NA	Yes	1L Amber - Unpres	NP
07	102870	Yes	NA	Yes	1L Amber - Unpres	NP
07	102884	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
07	102894	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4
07	102904	Yes	NA	Yes	500 mL Poly - Unpres	NP
07	102914	Yes	NA	Yes	250 mL Amber - Unpres	NP
07	102924	Yes	NA	Yes	250 mL Poly - Unpres	NP
08	102839	Yes	No	Yes	VOA Vial - HCl	HCl
08	102840	Yes	No	Yes	VOA Vial - HCl	HCl
08	102867	Yes	NA	Yes	1L Amber - Unpres	NP
08	102868	Yes	NA	Yes	1L Amber - Unpres	NP
08	102883	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
08	102893	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4
08	102903	Yes	NA	Yes	500 mL Poly - Unpres	NP
08	102913	Yes	NA	Yes	250 mL Amber - Unpres	NP
08	102923	Yes	NA	Yes	250 mL Poly - Unpres	NP
09	102837	Yes	No	Yes	VOA Vial - HCl	HCl
09	102838	Yes	No	Yes	VOA Vial - HCl	HCl
09	102865	Yes	NA	Yes	1L Amber - Unpres	NP
09	102866	Yes	NA	Yes	1L Amber - Unpres	NP
09	102882	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
09	102892	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4
09	102902	Yes	NA	Yes	500 mL Poly - Unpres	NP
09	102912	Yes	NA	Yes	250 mL Amber - Unpres	NP
09	102922	Yes	NA	Yes	250 mL Poly - Unpres	NP
10	102835	Yes	No	Yes	VOA Vial - HCl	HCl
10	102836	Yes	No	Yes	VOA Vial - HCl	HCl
10	102863	Yes	NA	Yes	1L Amber - Unpres	NP
10	102864	Yes	NA	Yes	1L Amber - Unpres	NP
10	102881	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
10	102891	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4
10	102901	Yes	NA	Yes	500 mL Poly - Unpres	NP
10	102911	Yes	NA	Yes	250 mL Amber - Unpres	NP
10	102921	Yes	NA	Yes	250 mL Poly - Unpres	NP
11	102833	Yes	No	Yes	VOA Vial - HCl	HCl
11	102834	Yes	No	Yes	VOA Vial - HCl	HCl
11	102861	Yes	NA	Yes	1L Amber - Unpres	NP
11	102862	Yes	NA	Yes	1L Amber - Unpres	NP
11	102880	Yes	NA	Yes	250 mL Poly - HNO3	HNO3
11	102890	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4
11	102900	Yes	NA	Yes	500 mL Poly - Unpres	NP
11	102910	Yes	NA	Yes	250 mL Amber - Unpres	NP
11	102920	Yes	NA	Yes	250 mL Poly - Unpres	NP
12	102831	Yes	No	Yes	VOA Vial - HCl	HCl
12	102832	Yes	No	Yes	VOA Vial - HCl	HCl
12	102859	Yes	NA	Yes	1L Amber - Unpres	NP
12	102860	Yes	NA	Yes	1L Amber - Unpres	NP
12	102879	Yes	NA	Yes	250 mL Poly - HNO3	HNO3

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

ESS Project ID: 1702113
Date Received: 2/6/2017

12	102889	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4
12	102899	Yes	NA	Yes	500 mL Poly - Unpres	NP
12	102909	Yes	NA	Yes	250 mL Amber - Unpres	NP
12	102919	Yes	NA	Yes	250 mL Poly - Unpres	NP

2nd Review
Are barcode labels on correct containers? (Yes) / No

Completed By: _____ Date & Time: 2/6/17 2025

Reviewed By: _____ Date & Time: 2/6/17 2040

Delivered By: _____ 2/6/17 2040

ESS Laboratory

Division of Thielsch Engineering, Inc.

185 Frances Avenue, Cranston, RI 02910-2211
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 1702113

Turn Time _____ Standard Other_____

Regulatory State: MA RI CT NH NJ NY ME Other_____

Is this project for any of the following:(please circle)
MA-MCP Navy USACE CT DEP Other_____

Reporting Limits - _____

Electonic Deliverables Excel Access PDF

Co. Name AECOM	Project #	Project Name Oneans Landfill	
Contact Person Julianne Marron	Address 250 Apollo Dr		
City Chelmsford	State MA	Zip	PO #
Tel. 781-561-5558	Fax.	email:	

Analysis: NH4, TN; NO2, NO3, SO4, Cl; Dissolved Metals; 1,4 Dioxane; DOC; Boron

ESS Lab ID	Date	Collection Time	Grab -G Composite-C	Matrix	Sample ID	Pres Code	# of Containers	Type of Container	Vol of Container
1	02/06/17	~~0940~~ 1455	G	GW	MW-2S(84-94)		7		
2	02/06/17	~~1010~~ 1920	G	GW	MW-2D(124-134)		7		
3	02/06/17	~~1015~~ 1425	G	GW	MW-2D(124-134)DUP		7		
4	02/06/17	1615	G	GW	MW-5S(78-88)		4		
5	02/06/17	1630	G	GW	MW-5D(124-134)		4		
6	02/06/17	1215	G	GW	MW-6A(64-74)		7		
7	02/06/17	1140	G	GW	MW-6B(54-64)		7		
8	02/06/17	1110	G	GW	MW-6(88-98)		7		
9	02/06/17	1010	G	GW	MW-7S(55-65)		7		
10	02/06/17	0940	G	GW	MW-7D(115-125)		7		

Container Type: P-Poly G-Glass AG-Amber Glass S-Sterile V-VOA

Matrix S-Soil SD-Solid D-Sludge WW-Wastewater GW-Groundwater SW-Surface Water DW-Drinking Water O-Oil W-Wipes F-Filter

3.3
3.6
3.8
4.1

Cooler Present ____Yes ____No

Seals Intact ____ Yes ____No NA:____

Cooler Temperature: September 9:50 2/6/17

Internal Use Only

[ ] ~~Pickup~~

[ ] Technician____

Preservation Code: 1-NP, 2-HCl, 3-H2SO4, 4-HNO3, 5-NaOH, 6-MeOH, 7-Asorbic Acid, 8-ZnAct, 9-_____

Sampled by :

Comments:

Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)
Brittney Murrell 02/06/17	2/6/17 16:42	2/6/17 19:50	2/6/17 1957
Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)

* By circling MA-MCP, client acknowledges samples were collected in accordance with MADEP CAM VIIA

Please fax to the laboratory all changes to Chain of Custody

1 (White) Lab Copy
2 (Yellow) Client Receipt

ESS Laboratory

Division of Thielsch Engineering, Inc.

185 Frances Avenue, Cranston, RI 02910-2211
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 1702113

Turn Time ______ Standard Other______

Regulatory State: MA RI CT NH NJ NY ME Other______

Is this project for any of the following:(please circle)
MA-MCP Navy USACE CT DEP Other______

Reporting Limits - ______

Electonic Deliverables Excel Access PDF

Co. Name: AECOM
Project #:
Project Name:
Contact Person: Julianne Marsh
Address: 250 Apollo Dr
City: Chelmsford
State: MA
Zip:
PO #:
Tel.: 781-561-5558
Fax:
email:

ESS Lab ID	Date	Collection Time	Grab -G Composite-C	Matrix	Sample ID	Pres Code	# of Containers	Type of Container	Vol of Container	NH4, TN	NO2, NO3, SO4, Cl, TN	Dissolved metals	1,4 Dioxane	DOC	Boron
11	01/06/17	1015	G	GW	MW-2 (140-150)		7			X	X	X	X	X	X
12	01/06/17	1345	G	GW	MW-7S (55-65) DUP		7			X	X	X	X	X	X

Container Type: P-Poly G-Glass AG-Amber Glass S-Sterile V-VOA

Matrix: S-Soil SD-Solid D-Sludge WW-Wastewater GW-Groundwater SW-Surface Water DW-Drinking Water O-Oil W-Wipes F-Filter

Cooler Present ______ Yes ______ No

Seals Intact ____ Yes ____ No NA:___

Cooler Temperature: Ice Temp 11:50 2/6/17

3.3
7.6
3.4
4.1

Internal Use Only
[ ] Pickup
[ ] Technician___

Preservation Code: 1-NP, 2-HCl, 3-H2SO4, 4-HNO3, 5-NaOH, 6-MeOH, 7-Asorbic Acid, 8-ZnAct, 9-____

Sampled by :

Comments:

Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)
[signature] 01/06/17	[signature] 2/6/17 8:12	[signature] 2/6/17 11:52	[signature] 2/6/17 1957
Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)

* By circling MA-MCP, client acknowledges samples were collected in accordance with MADEP CAM VIIA

Please fax to the laboratory all changes to Chain of Custody

1 (White) Lab Copy
2 (Yellow) Client Receipt

CERTIFICATE OF ANALYSIS

Mark Owen
AECOM Environment - ENSR
9 Jonathon Bourne Dr.
Pocasset, MA 02559

RE: Orleans MA (60476644)
ESS Laboratory Work Order Number: 1702186

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 3:43 pm, Feb 16, 2017

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 TNI and relative state standards, 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: 1702186

SAMPLE RECEIPT

The following samples were received on February 08, 2017 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
1702186-01	Stormwater 1	Surface Water	350.1, 351.2, 353.2, 4500N, 5310B, 8270D SIM, 9038, 9250
1702186-02	Stormwater 2	Surface Water	350.1, 351.2, 353.2, 4500N, 5310B, 8270D SIM, 9038, 9250

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1702186

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: 1702186

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
8015C - 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: Stormwater 1
Date Sampled: 02/08/17 11:00
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702186
ESS Laboratory Sample ID: 1702186-01
Sample Matrix: Surface Water
Units: ug/L
Analyst: VSC
Prepared: 2/13/17 18:30

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	02/15/17 0:24	C7B0188	CB71341

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	58 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: Stormwater 1
Date Sampled: 02/08/17 11:00
Percent Solids: N/A

ESS Laboratory Work Order: 1702186
ESS Laboratory Sample ID: 1702186-01
Sample Matrix: Surface Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	**0.67** (0.10)		350.1		1	JLK	02/13/17 17:27	mg/L	CB71005
Chloride	**455** (30.0)		9250		10	JLK	02/10/17 16:20	mg/L	CB71038
Dissolved Organic Carbon (Average)	**39.6** (5.00)		5310B		10	DEL	02/10/17 18:13	mg/L	[CALC]
Nitrate as N	**0.424** (0.030)		353.2		1	JLK	02/08/17 22:35	mg/L	[CALC]
Nitrite as N	**0.026** (0.010)		353.2		1	JLK	02/08/17 20:43	mg/L	CB70837
Sulfate	ND (5.0)		9038		1	JLK	02/13/17 17:30	mg/L	CB71323
Total Kjeldahl Nitrogen as N	**4.05** (0.20)		351.2		1	EEM	02/14/17 16:26	mg/L	CB71332
Total Nitrogen	**4.50** (0.22)		4500N		1	EEM	02/14/17 16:26	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: Stormwater 2
Date Sampled: 02/08/17 10:45
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702186
ESS Laboratory Sample ID: 1702186-02
Sample Matrix: Surface Water
Units: ug/L
Analyst: VSC
Prepared: 2/13/17 18:30

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	02/15/17 0:58	C7B0188	CB71341

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	*59 %*		*15-115*

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: Stormwater 2
Date Sampled: 02/08/17 10:45
Percent Solids: N/A

ESS Laboratory Work Order: 1702186
ESS Laboratory Sample ID: 1702186-02
Sample Matrix: Surface Water

All methods used are in accordance with 40 CFR 136.

Classical Chemistry

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Units	Batch
Ammonia as N	**2.92** (0.10)		350.1		1	JLK	02/13/17 17:43	mg/L	CB71005
Chloride	**188** (15.0)		9250		5	JLK	02/10/17 16:21	mg/L	CB71038
Dissolved Organic Carbon (Average)	**175** (5.00)		5310B		10	DEL	02/10/17 18:51	mg/L	[CALC]
Nitrate as N	**10.5** (1.01)		353.2		50	JLK	02/08/17 23:05	mg/L	[CALC]
Nitrite as N	**0.150** (0.010)		353.2		1	JLK	02/08/17 20:44	mg/L	CB70837
Sulfate	**5.9** (5.0)		9038		1	JLK	02/13/17 17:30	mg/L	CB71323
Total Kjeldahl Nitrogen as N	**16.4** (2.00)		351.2		10	EEM	02/14/17 16:57	mg/L	CB71332
Total Nitrogen	**27.1** (3.00)		4500N		50	EEM	02/14/17 16:57	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1702186

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution										
Batch CB71341 - 3535A										
Blank										
1,4-Dioxane	ND	0.250	ug/L							
Surrogate: 1,4-Dioxane-d8	*3.11*		ug/L	*5.000*		*62*	*15-115*			
LCS										
1,4-Dioxane	10.9	0.250	ug/L	10.00		109	40-140			
Surrogate: 1,4-Dioxane-d8	*3.41*		ug/L	*5.000*		*68*	*15-115*			
LCS Dup										
1,4-Dioxane	10.7	0.250	ug/L	10.00		107	40-140	2	20	
Surrogate: 1,4-Dioxane-d8	*3.46*		ug/L	*5.000*		*69*	*15-115*			
Classical Chemistry										
Batch CB70837 - [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							
LCS										
Nitrate as N	ND		mg/L							
Nitrite as N	0.247		mg/L	0.2497		99	90-110			
Nitrite as N	0.247		mg/L	0.2497		99	90-110			
Batch CB70838 - [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	0.483		mg/L							
Nitrate/Nitrite as N	0.483		mg/L	0.5000		97	90-110			
Nitrate/Nitrite as N	0.483		mg/L	0.5000		97	90-110			
Total Nitrogen	0.483		mg/L							
Batch CB71005 - General Preparation										
Blank										
Ammonia as N	ND	0.10	mg/L							
LCS										
Ammonia as N	0.10	0.10	mg/L	0.09994		103	80-120			
LCS										
Ammonia as N	1.10	0.10	mg/L	0.9994		110	80-120			
Batch CB71037 - General Preparation										
Blank										
Dissolved Organic Carbon (1)	ND	0.500	mg/L							
Dissolved Organic Carbon (2)	ND	0.500	mg/L							

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1702186

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CB71037 - [CALC]										
Dissolved Organic Carbon (Average)	ND	0.500	mg/L							
LCS										
Dissolved Organic Carbon (1)	4.70	0.500	mg/L	5.000		94	80-120			
Dissolved Organic Carbon (2)	4.86	0.500	mg/L	5.000		97	80-120			
Dissolved Organic Carbon (Average)	4.78	0.500	mg/L							
LCS Dup										
Dissolved Organic Carbon (1)	4.79	0.500	mg/L	5.000		96	80-120	2	200	
Dissolved Organic Carbon (2)	4.84	0.500	mg/L	5.000		97	80-120	0.3	200	
Dissolved Organic Carbon (Average)	4.82	0.500	mg/L							
Batch CB71038 - General Preparation										
Blank										
Chloride	ND	3.0	mg/L							
LCS										
Chloride	30.4		mg/L	30.00		101	90-110			
Batch CB71323 - General Preparation										
Blank										
Sulfate	ND	5.0	mg/L							
LCS										
Sulfate	9.5		mg/L	9.988		95	85-115			
Batch CB71332 - TKN Prep										
Blank										
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Nitrogen	ND	0.20	mg/L							
LCS										
Total Kjeldahl Nitrogen as N	20.8	2.00	mg/L	18.80		111	80-120			
Total Kjeldahl Nitrogen as N	20.8	2.00	mg/L	18.80		111	80-120			
Total Nitrogen	20.8	2.00	mg/L							

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1702186

Notes and Definitions

U	Analyte included in the analysis, but not detected
D	Diluted.
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: 1702186

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/dwp/partners/labCert.shtml

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.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

Shipped/Delivered Via: ESS Courier

ESS Project ID: 1702186
Date Received: 2/8/2017
Project Due Date: 2/15/2017
Days for Project: 5 Day

1. Air bill manifest present? No
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? Yes
   Temp: 3.1 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 / (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 VOA vials frozen: Date: Time: By:

Sample Receiving Notes:

500 ml poly unpres. for sample 1 was rec'd with lid from 500ml poly HNO3 - raised sample pH to 3.
Rec'd 2 bottles for dissolved lab filtered metals for sample 2 not on COC. RL 2/8/17
No collection dates on COC.

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	103564	Yes	No	Yes	VOA Vial - HCl	HCl	
01	103565	Yes	No	Yes	VOA Vial - HCl	HCl	
01	103568	Yes	NA	Yes	1L Amber - Unpres	NP	
01	103569	Yes	NA	Yes	1L Amber - Unpres	NP	
01	103571	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4	
01	103573	Yes	NA	Yes	500 mL Poly - Unpres	NP	
01	103575	Yes	NA	Yes	250 mL Amber - Unpres	NP	
02	103562	Yes	No	Yes	VOA Vial - HCl	HCl	
02	103563	Yes	No	Yes	VOA Vial - HCl	HCl	
02	103566	Yes	NA	Yes	1L Amber - Unpres	NP	
02	103567	Yes	NA	Yes	1L Amber - Unpres	NP	
02	103570	Yes	NA	Yes	500 mL Poly - H2SO4	H2SO4	
02	103572	Yes	NA	Yes	500 mL Poly - Unpres	NP	
02	103574	Yes	NA	Yes	250 mL Amber - Unpres	NP	
02	103576	Yes	NA	Yes	250 mL Poly - Unpres	NP	
02	103623	Yes	NA	Yes	250 mL Poly - Unpres	NP	

2nd Review
Are barcode labels on correct containers? (Yes) / No

Completed By: RL
Reviewed
Date & Time: 2/8/17 1822

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

ESS Project ID: 1702186

Date Received: 2/8/2017

By: [signature] Date & Time: 2/8/17 1830

Delivered By: [signature] 2/8/17 1830

ESS Laboratory

Division of Thielsch Engineering, Inc.

185 Frances Avenue, Cranston, RI 02910-2211
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 102186

Turn Time ✓ Standard Other_____

Regulatory State: (MA) RI CT NH NJ NY ME Other_____

Reporting Limits - MCP

Is this project for any of the following:(please circle)
MA-MCP Navy USACE CT DEP Other_____

Electonic Deliverables (Excel) Access (PDF)

Co. Name AECOM	Project # 60476644	Project Name orleanslandfillphase1	
Contact Person Julianne Mamon	Address 250 Apollo DR		
City Chelmsford	State MA	Zip 01824	PO # 17915
Tel. 978-905-2419	Fax	email: Julianne.Mamon@aecom.com	

Analysis: NH4, TN; NO3, NO2, SO4, Cl, TDS; 1,4 Dioxane; DOC

ESS Lab ID	Date	Collection Time	Grab -G Composite-C	Matrix	Sample ID	Pres Code	# of Containers	Type of Container	Vol of Container
1	02/08/17	11.00	G	SW	Stormwater1		5		
2	02/08/17	1045	G	SW	Stormwater 2		5		
~~3~~	~~02/ /17~~		G	SW	~~Stormwater3~~		5		
~~4~~	~~02/ /17~~		G	SW	~~Stormwater4~~		5		
~~5~~	~~02/ /17~~		G	SW	~~Stormwater2DUP~~		5		
	mkm 2/9/17								

Container Type: P-Poly G-Glass AG-Amber Glass S-Sterile V-VOA

Matrix: S-Soil SD-Solid D-Sludge WW-Wastewater GW-Groundwater SW-Surface Water DW-Drinking Water O-Oil W-Wipes F-Filter

Cooler Present ✓ Yes ____ No

Seals Intact ____ Yes ____ No NA:____

Cooler Temperature: 3.1 2.8 2.6 ice RB

Internal Use Only

[✓] Pickup

[ ] Technician____

Preservation Code: 1-NP, 2-HCl, 3-H2SO4, 4-HNO3, 5-NaOH, 6-MeOH, 7-Asorbic Acid, 8-ZnAct, 9-_____

Sampled by: J Begley, C Hayden

Comments: SW = stormwater

Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)
C Hayden 2/8/17 1625	2/8/17 16:25	2/8/17 17:50	2/8/17 1755
Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)

* By circling MA-MCP, client acknowledges samples were collected in accordance with MADEP CAM VIIA

Please fax to the laboratory all changes to Chain of Custody

1 (White) Lab Copy
2 (Yellow) Client Receipt

ESS Laboratory

Division of Thielsch Engineering, Inc.

185 Frances Avenue, Cranston, RI 02910-2211
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 102186

Turn Time ✓ Standard Other_____

Regulatory State: (MA) RI CT NH NJ NY ME Other_____

Reporting Limits - MCP

Is this project for any of the following:(please circle)
MA-MCP Navy USACE CT DEP Other_____

Electonic Deliverables (Excel) Access (PDF)

Co. Name AECOM	Project # 60476644	Project Name orleanslandfillphase1	
Contact Person Julianne Mamon	Address 250 Apollo DR		
City Chelmsford	State MA	Zip 01824	PO # 17915
Tel. 978-905-2419	Fax	email: Julianne.Mamon@aecom.com	

Analysis: NH4, TN; NO3, SO4, Cl, TP; 1,4 Dioxane; DOC

ESS Lab ID	Date	Collection Time	Grab -G Composite-C	Matrix	Sample ID	Pres Code	# of Containers	Type of Container	Vol of Container
1	02/17	11.00	G	SW	Stormwater1		5		
2	02/17	1045	G	SW	Stormwater2		5		
~~3~~	~~02/17~~		G	SW	Stormwater3		5		
~~4~~	~~02/17~~		G	SW	Stormwater4		5		
~~5~~	~~02/17~~		G	SW	Stormwater2DUP		5		

Container Type: P-Poly G-Glass AG-Amber Glass S-Sterile V-VOA

Matrix: S-Soil SD-Solid D-Sludge WW-Wastewater GW-Groundwater SW-Surface Water DW-Drinking Water O-Oil W-Wipes F-Filter

Cooler Present ✓ Yes ____ No

Seals Intact ____ Yes ____ No NA:____

Cooler Temperature: 3.1 2.8 2.6 ice RB

Internal Use Only
[✓] Pickup
[ ] Technician____

Preservation Code: 1-NP, 2-HCl, 3-H2SO4, 4-HNO3, 5-NaOH, 6-MeOH, 7-Asorbic Acid, 8-ZnAct, 9-_____

Sampled by: J Begley, C Hayden

Comments: SW = stormwater

Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)
C Hayden 2/8/17 1625	2/8/17 16:25	2/8/17 17:50	2/8/17 1755
Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)

* By circling MA-MCP, client acknowledges samples were collected in accordance with MADEP CAM VIIA

Please fax to the laboratory all changes to Chain of Custody

1 (White) Lab Copy
2 (Yellow) Client Receipt

CERTIFICATE OF ANALYSIS

Mark Owen
AECOM Environment - ENSR
9 Jonathon Bourne Dr.
Pocasset, MA 02559

RE: Orleans MA (60476644)
ESS Laboratory Work Order Number: 1702187

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 3:22 pm, Feb 21, 2017

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 TNI and relative state standards, 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: 1702187

SAMPLE RECEIPT

The following samples were received on February 08, 2017 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
1702187-01	MW-1S (56-66)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 8270D SIM, 9038, 9250
1702187-02	MW-1D (99-109)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 8270D SIM, 9038, 9250
1702187-03	MW-3S (50-60)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 9038, 9250
1702187-04	MW-3D (84-94)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 9038, 9250
1702187-05	MW-8 (36-46)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 8270D SIM, 9038, 9250
1702187-06	MW-9 (92-102)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 8270D SIM, 9038, 9250
1702187-07	MW-10 (85-95)	Ground Water	200.7, 350.1, 351.2, 353.2, 4500N, 5310B, 8270D SIM, 9038, 9250

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1702187

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: 1702187

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
8015C - 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: MW-1S (56-66)
Date Sampled: 02/08/17 11:40
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-01
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	02/17/17 14:41	10	10	CB71501
Manganese	**0.369** (0.020)		200.7		1	KJK	02/17/17 14:41	10	10	CB71501

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-1S (56-66)
Date Sampled: 02/08/17 11:40
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-01
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 2/13/17 18:30

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	02/15/17 1:33	C7B0188	CB71341

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	68 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-1S (56-66)
Date Sampled: 02/08/17 11:40
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-01
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
Ammonia as N	ND (0.10)		350.1		1	JLK	02/13/17 17:44	mg/L	CB71005
Chloride	**13.2** (3.0)		9250		1	JLK	02/10/17 16:41	mg/L	CB71039
Nitrate as N	**3.60** (0.110)		353.2		5	JLK	02/08/17 22:56	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/08/17 20:45	mg/L	CB70837
Sulfate	**6.7** (5.0)		9038		1	JLK	02/13/17 17:30	mg/L	CB71323
Total Kjeldahl Nitrogen as N	**1.24** (0.20)		351.2		1	EEM	02/14/17 16:33	mg/L	CB71332
Total Nitrogen	**4.84** (0.30)		4500N		5	EEM	02/14/17 16:33	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-1D (99-109)
Date Sampled: 02/08/17 12:05
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-02
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	02/17/17 14:45	10	10	CB71501
Manganese	**0.083** (0.020)		200.7		1	KJK	02/17/17 14:45	10	10	CB71501

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-1D (99-109)
Date Sampled: 02/08/17 12:05
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-02
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 2/13/17 18:30

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	02/15/17 2:08	C7B0188	CB71341

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	57 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-1D (99-109)
Date Sampled: 02/08/17 12:05
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-02
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
Ammonia as N	**0.51** (0.10)		350.1		1	JLK	02/13/17 17:45	mg/L	CB71005
Chloride	**32.5** (3.0)		9250		1	JLK	02/10/17 16:43	mg/L	CB71039
Nitrate as N	**3.28** (0.110)		353.2		5	JLK	02/08/17 22:57	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/08/17 20:46	mg/L	CB70837
Sulfate	**8.7** (5.0)		9038		1	JLK	02/13/17 17:30	mg/L	CB71323
Total Kjeldahl Nitrogen as N	**1.21** (0.20)		351.2		1	EEM	02/14/17 16:34	mg/L	CB71332
Total Nitrogen	**4.48** (0.30)		4500N		5	EEM	02/14/17 16:34	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-3S (50-60)
Date Sampled: 02/08/17 09:55
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-03
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	02/17/17 14:50	10	10	CB71501
Manganese	**0.180** (0.020)		200.7		1	KJK	02/17/17 14:50	10	10	CB71501

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-3S (50-60)
Date Sampled: 02/08/17 09:55
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-03
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
Boron	ND (0.050)		200.7		1	KJK	02/18/17 17:10	50	25	CB71337

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-3S (50-60)
Date Sampled: 02/08/17 09:55
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-03
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
Ammonia as N	ND (0.10)		350.1		1	JLK	02/13/17 17:46	mg/L	CB71005
Chloride	**324** (30.0)		9250		10	JLK	02/10/17 16:43	mg/L	CB71039
Nitrate as N	**0.601** (0.030)		353.2		1	JLK	02/08/17 22:40	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/08/17 20:47	mg/L	CB70837
Sulfate	ND (5.0)		9038		1	JLK	02/13/17 17:30	mg/L	CB71323
Total Kjeldahl Nitrogen as N	**0.61** (0.20)		351.2		1	EEM	02/14/17 16:35	mg/L	CB71332
Total Nitrogen	**1.21** (0.22)		4500N		1	EEM	02/14/17 16:35	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-3D (84-94)
Date Sampled: 02/08/17 10:25
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-04
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**34.6** (0.100)		200.7		1	KJK	02/17/17 14:54	10	10	CB71501
Manganese	**2.66** (0.020)		200.7		1	KJK	02/17/17 14:54	10	10	CB71501

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-3D (84-94)
Date Sampled: 02/08/17 10:25
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-04
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
Boron	ND (0.050)		200.7		1	KJK	02/18/17 17:26	50	25	CB71337

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-3D (84-94)
Date Sampled: 02/08/17 10:25
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-04
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
Ammonia as N	**4.63** (0.10)		350.1		1	JLK	02/13/17 17:47	mg/L	CB71005
Chloride	**159** (15.0)		9250		5	JLK	02/10/17 16:44	mg/L	CB71039
Nitrate as N	ND (0.030)		353.2		1	JLK	02/08/17 22:41	mg/L	[CALC]
Nitrite as N	**0.014** (0.010)		353.2		1	JLK	02/08/17 20:48	mg/L	CB70837
Sulfate	**14.1** (5.0)		9038		1	JLK	02/13/17 17:30	mg/L	CB71323
Total Kjeldahl Nitrogen as N	**5.75** (0.40)		351.2		2	EEM	02/14/17 16:58	mg/L	CB71332
Total Nitrogen	**5.75** (0.42)		4500N		2	EEM	02/14/17 16:58	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-8 (36-46)
Date Sampled: 02/08/17 15:05
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-05
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	02/17/17 15:10	10	10	CB71501
Manganese	**0.095** (0.020)		200.7		1	KJK	02/17/17 15:10	10	10	CB71501

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-8 (36-46)
Date Sampled: 02/08/17 15:05
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-05
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
Boron	**0.090** (0.050)		200.7		1	KJK	02/18/17 17:30	50	25	CB71337

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-8 (36-46)
Date Sampled: 02/08/17 15:05
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-05
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 2/14/17 15:30

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	02/15/17 2:43	C7B0188	CB71341

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	54 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-8 (36-46)
Date Sampled: 02/08/17 15:05
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-05
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
Ammonia as N	**0.11** (0.10)		350.1		1	JLK	02/13/17 17:49	mg/L	CB71005
Chloride	**55.1** (3.0)		9250		1	JLK	02/10/17 16:45	mg/L	CB71039
Dissolved Organic Carbon (Average)	**4.42** (0.500)		5310B		1	DEL	02/10/17 19:03	mg/L	[CALC]
Nitrate as N	**5.52** (0.210)		353.2		10	JLK	02/08/17 23:06	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/08/17 20:49	mg/L	CB70837
Sulfate	**37.8** (10.0)		9038		2	JLK	02/13/17 17:30	mg/L	CB71323
Total Kjeldahl Nitrogen as N	**2.03** (0.20)		351.2		1	EEM	02/14/17 16:36	mg/L	CB71332
Total Nitrogen	**7.55** (0.40)		4500N		10	EEM	02/14/17 16:36	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-9 (92-102)
Date Sampled: 02/08/17 13:20
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-06
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	02/17/17 15:14	10	10	CB71501
Manganese	**0.491** (0.020)		200.7		1	KJK	02/17/17 15:14	10	10	CB71501

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-9 (92-102)
Date Sampled: 02/08/17 13:20
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-06
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
Boron	ND (0.050)		200.7		1	KJK	02/18/17 17:34	50	25	CB71337

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-9 (92-102)
Date Sampled: 02/08/17 13:20
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-06
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 2/14/17 15:30

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	02/15/17 3:18	C7B0188	CB71341

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	48 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-9 (92-102)
Date Sampled: 02/08/17 13:20
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-06
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
Ammonia as N	**0.34** (0.10)		350.1		1	JLK	02/13/17 17:50	mg/L	CB71005
Chloride	**65.5** (3.0)		9250		1	JLK	02/10/17 16:45	mg/L	CB71039
Dissolved Organic Carbon (Average)	**1.55** (0.500)		5310B		1	DEL	02/10/17 19:15	mg/L	[CALC]
Nitrate as N	**20.2** (2.01)		353.2		100	JLK	02/08/17 23:09	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/08/17 20:51	mg/L	CB70837
Sulfate	**15.5** (5.0)		9038		1	JLK	02/13/17 17:30	mg/L	CB71323
Total Kjeldahl Nitrogen as N	**2.83** (0.20)		351.2		1	EEM	02/14/17 16:37	mg/L	CB71332
Total Nitrogen	**23.0** (2.20)		4500N		100	EEM	02/14/17 16:37	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-10 (85-95)
Date Sampled: 02/08/17 14:10
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-07
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	02/17/17 15:18	10	10	CB71501
Manganese	**0.072** (0.020)		200.7		1	KJK	02/17/17 15:18	10	10	CB71501

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-10 (85-95)
Date Sampled: 02/08/17 14:10
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-07
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
Boron	ND (0.050)		200.7		1	KJK	02/18/17 17:39	50	25	CB71337

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-10 (85-95)
Date Sampled: 02/08/17 14:10
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-07
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 2/14/17 15:30

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	02/15/17 3:54	C7B0188	CB71341

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	62 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-10 (85-95)
Date Sampled: 02/08/17 14:10
Percent Solids: N/A

ESS Laboratory Work Order: 1702187
ESS Laboratory Sample ID: 1702187-07
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
Ammonia as N	ND (0.10)		350.1		1	JLK	02/13/17 17:51	mg/L	CB71005
Chloride	**42.9** (3.0)		9250		1	JLK	02/10/17 16:47	mg/L	CB71039
Dissolved Organic Carbon (Average)	ND (0.500)		5310B		1	DEL	02/10/17 19:27	mg/L	[CALC]
Nitrate as N	**2.44** (0.110)		353.2		5	JLK	02/08/17 23:01	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	02/08/17 20:52	mg/L	CB70837
Sulfate	ND (5.0)		9038		1	JLK	02/13/17 17:30	mg/L	CB71323
Total Kjeldahl Nitrogen as N	**0.85** (0.20)		351.2		1	EEM	02/14/17 16:38	mg/L	CB71332
Total Nitrogen	**3.29** (0.30)		4500N		5	EEM	02/14/17 16:38	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1702187

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Dissolved Metals										
Batch CB71501 - 200.7/6010BNoDigest										
Blank										
Iron	ND	0.100	mg/L							
Manganese	ND	0.020	mg/L							
LCS										
Iron	2.33		mg/L	2.500		93	80-120			
Manganese	0.455		mg/L	0.5000		91	80-120			
Total Metals										
Batch CB71337 - 3005A										
Blank										
Boron	ND	0.050	mg/L							
LCS										
Boron	0.251	0.050	mg/L	0.2500		100	85-115			
LCS Dup										
Boron	0.259	0.050	mg/L	0.2500		103	85-115	3	20	
8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution										
Batch CB71341 - 3535A										
Blank										
1,4-Dioxane	ND	0.250	ug/L							
Surrogate: 1,4-Dioxane-d8	*3.11*		ug/L	*5.000*		*62*	*15-115*			
LCS										
1,4-Dioxane	10.9	0.250	ug/L	10.00		109	40-140			
Surrogate: 1,4-Dioxane-d8	*3.41*		ug/L	*5.000*		*68*	*15-115*			
LCS Dup										
1,4-Dioxane	10.7	0.250	ug/L	10.00		107	40-140	2	20	
Surrogate: 1,4-Dioxane-d8	*3.46*		ug/L	*5.000*		*69*	*15-115*			
Classical Chemistry										
Batch CB70837 - [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							
LCS										
Nitrate as N	ND		mg/L							
Nitrite as N	0.247		mg/L	0.2497		99	90-110			
Nitrite as N	0.247		mg/L	0.2497		99	90-110			
Batch CB70838 - [CALC]										
Blank										
Nitrate as N	ND	0.020	mg/L							

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1702187

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CB70838 - General Preparation										
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	0.483		mg/L							
Nitrate/Nitrite as N	0.483		mg/L	0.5000		97	90-110			
Nitrate/Nitrite as N	0.483		mg/L	0.5000		97	90-110			
Total Nitrogen	0.483		mg/L							
Batch CB71005 - General Preparation										
Blank										
Ammonia as N	ND	0.10	mg/L							
LCS										
Ammonia as N	0.10	0.10	mg/L	0.09994		103	80-120			
LCS										
Ammonia as N	1.10	0.10	mg/L	0.9994		110	80-120			
Batch CB71037 - General Preparation										
Blank										
Dissolved Organic Carbon (1)	ND	0.500	mg/L							
Dissolved Organic Carbon (2)	ND	0.500	mg/L							
Dissolved Organic Carbon (Average)	ND	0.500	mg/L							
LCS										
Dissolved Organic Carbon (1)	4.70	0.500	mg/L	5.000		94	80-120			
Dissolved Organic Carbon (2)	4.86	0.500	mg/L	5.000		97	80-120			
Dissolved Organic Carbon (Average)	4.78	0.500	mg/L							
LCS Dup										
Dissolved Organic Carbon (1)	4.79	0.500	mg/L	5.000		96	80-120	2	200	
Dissolved Organic Carbon (2)	4.84	0.500	mg/L	5.000		97	80-120	0.3	200	
Dissolved Organic Carbon (Average)	4.82	0.500	mg/L							
Batch CB71039 - General Preparation										
Blank										
Chloride	ND	3.0	mg/L							
LCS										
Chloride	31.4		mg/L	30.00		105	90-110			
Batch CB71323 - General Preparation										
Blank										
Sulfate	ND	5.0	mg/L							
LCS										
Sulfate	9.5		mg/L	9.988		95	85-115			
Batch CB71332 - TKN Prep										
Blank										
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1702187

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CB71332 - TKN Prep										
Total Kjeldahl Nitrogen as N	ND	0.20	mg/L							
Total Nitrogen	ND	0.20	mg/L							
LCS										
Total Kjeldahl Nitrogen as N	20.8	2.00	mg/L	18.80		111	80-120			
Total Kjeldahl Nitrogen as N	20.8	2.00	mg/L	18.80		111	80-120			
Total Nitrogen	20.8	2.00	mg/L							

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1702187

Notes and Definitions

U	Analyte included in the analysis, but not detected
D	Diluted.
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: 1702187

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/dwp/partners/labCert.shtml

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.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

ESS Laboratory

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CHAIN OF CUSTODY

ESS Lab # 1702187

Turn Time _____Standard Other_____

Regulatory State: MA RI CT NH NJ NY ME Other_____

Is this project for any of the following:(please circle)
MA-MCP Navy USACE CT DEP Other_____

Reporting Limits - _____

Electonic Deliverables Excel Access PDF

Co. Name AECOM	Project # 60476644	Project Name Orleans Landfill Phase I	
Contact Person Julianne Mamon	Address 250 Apollo DR		
City Chelmsford	State MA	Zip 01824	PO # 170115
Tel. 978-905-2419	Fax	email: Julianne.mamon@aecom.com	

ESS Lab ID	Date	Collection Time	Grab -G Composite-C	Matrix	Sample ID	Pres Code	# of Containers	Type of Container	Vol of Container	Analysis: NH4, TN	NO2, NO3, Sol. Cl, TN	1,4 Dioxane	DISS LF Metals	BOD	DOC					
1	02/8/17	1140	G	GW	MW-1S(56-66)					X	X	X	X							
2	02/8/17	1205	G	GW	MW-1D(99-109)					X	X	X	X							
3	02/8/17	0955	G	GW	MW-3S(50-60)					X	X		X	X						
4	02/8/17	1025	G	GW	MW-3D(84-94)					X	X		X	X						
5	02/8/17	1505	G	GW	MW-8(36-46)					X	X	X	X	X	X					
6	02/8/17	1320	G	GW	MW-9(92-102)					X	X	X	X	X	X					
7	02/8/17	1410	G	GW	MW-10(85-95)					X	X	X	X	X	X					

Container Type: P-Poly G-Glass AG-Amber Glass S-Sterile V-VOA

Matrix: S-Soil SD-Solid D-Sludge WW-Wastewater GW-Groundwater SW-Surface Water DW-Drinking Water O-Oil W-Wipes F-Filter

Cooler Present ✓ Yes ____No

Seals Intact ____ Yes ____No NA:___

Cooler Temperature: 2-8 2.6 3.1 ice

Internal Use Only

[✓] Pickup

[ ] Technician___

Preservation Code: 1-NP, 2-HCl, 3-H2SO4, 4-HNO3, 5-NaOH, 6-MeOH, 7-Asorbic Acid, 8-ZnAct, 9-_____

Sampled by : C. Hayden

Comments:

Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)
C Hayden 2/8/17 1625	2/8/17 16:25	2/8/17 17:50	2/8/17 1755
Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)	Relinquished by: (Signature, Date & Time)	Received by: (Signature, Date & Time)

* By circling MA-MCP, client acknowledges samples were collected in accordance with MADEP CAM VIIA

Please fax to the laboratory all changes to Chain of Custody

1 (White) Lab Copy
2 (Yellow) Client Receipt

CERTIFICATE OF ANALYSIS

Mark Owen
AECOM Environment - ENSR
9 Jonathon Bourne Dr.
Pocasset, MA 02559

RE: Orleans MA (60476644)
ESS Laboratory Work Order Number: 1703626

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 12:35 pm, Apr 04, 2017

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 TNI and relative state standards, 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: 1703626

SAMPLE RECEIPT

The following samples were received on March 28, 2017 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
1703626-01	MW-BC3B	Ground Water	200.7, 350.1, 353.2, 4500N, 5310B, 9038, 9250
1703626-02	MW-B2075A	Ground Water	200.7, 350.1, 353.2, 4500N, 5310B, 9038, 9250
1703626-03	MW-BX1C	Ground Water	200.7, 350.1, 353.2, 4500N, 5310B, 9038, 9250
1703626-04	MW-BX1B	Ground Water	200.7, 350.1, 353.2, 4500N, 5310B, 9038, 9250
1703626-05	MW-5 (140-150)	Ground Water	200.7, 350.1, 353.2, 4500N, 8270D SIM, 9038, 9250
1703626-06	MW-8 (36-46)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703626-07	MW-8 (84-94)	Ground Water	200.7, 350.1, 353.2, 4500N, 8270D SIM, 9038, 9250

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703626

PROJECT NARRATIVE

No unusual observations noted.

End of Project Narrative.

DATA USABILITY LINKS

To ensure you are viewing the most current version of the documents below, please clear your internet cookies for www.ESSLaboratory.com. Consult your IT Support personnel for information on how to clear your internet cookies.

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: 1703626

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
8015C - 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: MW-BC3B
Date Sampled: 03/27/17 13:55
Percent Solids: N/A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-01
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	03/28/17 16:37	10	10	CC72806
Manganese	**0.298** (0.020)		200.7		1	KJK	03/28/17 16:37	10	10	CC72806

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BC3B
Date Sampled: 03/27/17 13:55
Percent Solids: N/A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-01
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
Ammonia as N	**0.91** (0.10)		350.1		1	EEM	03/31/17 14:33	mg/L	CC73019
Chloride	**143** (30.0)		9250		10	EEM	03/30/17 15:43	mg/L	CC73028
Dissolved Organic Carbon (Average)	**1.86** (0.500)		5310B		1	CRR	03/28/17 15:04	mg/L	[CALC]
Nitrate as N	**2.20** (0.110)		353.2		5	JLK	03/28/17 21:18	mg/L	[CALC]
Nitrite as N	**0.032** (0.010)		353.2		1	JLK	03/28/17 19:23	mg/L	CC72840
Sulfate	**8.3** (5.0)		9038		1	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**2.59** (0.30)		4500N		5	JLK	03/30/17 17:31	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2075A
Date Sampled: 03/27/17 14:00
Percent Solids: N/A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-02
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.119** (0.100)		200.7		1	KJK	03/28/17 16:41	10	10	CC72806
Manganese	**0.529** (0.020)		200.7		1	KJK	03/28/17 16:41	10	10	CC72806

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-B2075A
Date Sampled: 03/27/17 14:00
Percent Solids: N/A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-02
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
Ammonia as N	ND (0.10)		350.1		1	EEM	03/31/17 14:34	mg/L	CC73019
Chloride	**246** (30.0)		9250		10	EEM	03/30/17 15:47	mg/L	CC73028
Dissolved Organic Carbon (Average)	**1.08** (0.500)		5310B		1	CRR	03/28/17 15:41	mg/L	[CALC]
Nitrate as N	**0.348** (0.030)		353.2		1	JLK	03/28/17 21:12	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/28/17 19:24	mg/L	CC72840
Sulfate	**5.7** (5.0)		9038		1	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**0.35** (0.22)		4500N		1	JLK	03/30/17 17:02	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BX1C
Date Sampled: 03/27/17 15:00
Percent Solids: N/A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-03
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	03/28/17 16:45	10	10	CC72806
Manganese	**0.566** (0.020)		200.7		1	KJK	03/28/17 16:45	10	10	CC72806

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BX1C
Date Sampled: 03/27/17 15:00
Percent Solids: N/A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-03
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
Ammonia as N	**1.09** (0.10)		350.1		1	EEM	03/31/17 14:35	mg/L	CC73019
Chloride	**49.6** (3.0)		9250		1	EEM	03/30/17 15:16	mg/L	CC73028
Dissolved Organic Carbon (Average)	**2.70** (0.500)		5310B		1	CRR	03/28/17 16:19	mg/L	[CALC]
Nitrate as N	**0.250** (0.030)		353.2		1	JLK	03/30/17 19:21	mg/L	[CALC]
Nitrite as N	**0.012** (0.010)		353.2		1	JLK	03/28/17 19:25	mg/L	CC72840
Sulfate	ND (5.0)		9038		1	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**1.52** (0.22)		4500N		1	JLK	04/03/17 21:19	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BX1B
Date Sampled: 03/27/17 15:20
Percent Solids: N/A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-04
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	03/28/17 16:50	10	10	CC72806
Manganese	**0.335** (0.020)		200.7		1	KJK	03/28/17 16:50	10	10	CC72806

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-BX1B
Date Sampled: 03/27/17 15:20
Percent Solids: N/A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-04
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
Ammonia as N	**0.40** (0.10)		350.1		1	EEM	03/31/17 14:36	mg/L	CC73019
Chloride	**43.1** (3.0)		9250		1	EEM	03/30/17 15:17	mg/L	CC73028
Dissolved Organic Carbon (Average)	**2.97** (0.500)		5310B		1	CRR	03/28/17 16:31	mg/L	[CALC]
Nitrate as N	**11.4** (0.410)		353.2		20	JLK	03/28/17 21:20	mg/L	[CALC]
Nitrite as N	**0.018** (0.010)		353.2		1	JLK	03/28/17 19:26	mg/L	CC72840
Sulfate	**7.6** (5.0)		9038		1	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**12.9** (0.60)		4500N		20	JLK	04/03/17 21:20	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-5 (140-150)
Date Sampled: 03/27/17 17:05
Percent Solids: N/A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-05
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.113** (0.100)		200.7		1	KJK	03/28/17 16:54	10	10	CC72806
Manganese	**1.37** (0.020)		200.7		1	KJK	03/28/17 16:54	10	10	CC72806

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-5 (140-150)
Date Sampled: 03/27/17 17:05
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-05
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 3/28/17 16:30

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	03/29/17 12:16	C7C0449	CC72749

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	62 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-5 (140-150)
Date Sampled: 03/27/17 17:05
Percent Solids: N/A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-05
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
Ammonia as N	**9.34** (1.00)		350.1		10	EEM	03/31/17 15:04	mg/L	CC73019
Chloride	**39.6** (3.0)		9250		1	EEM	03/30/17 15:18	mg/L	CC73028
Nitrate as N	ND (0.030)		353.2		1	JLK	03/28/17 22:15	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/28/17 21:46	mg/L	CC72848
Sulfate	**39.5** (25.0)		9038		5	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**10.6** (1.02)		4500N		5	JLK	04/03/17 21:20	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-8 (36-46)
Date Sampled: 03/27/17 18:05
Percent Solids: N/A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-06
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	03/28/17 16:58	10	10	CC72806
Manganese	**0.301** (0.020)		200.7		1	KJK	03/28/17 16:58	10	10	CC72806

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-8 (36-46)
Date Sampled: 03/27/17 18:05
Percent Solids: N/A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-06
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
Ammonia as N	**0.18** (0.10)		350.1		1	EEM	03/31/17 14:45	mg/L	CC73019
Chloride	**66.4** (3.0)		9250		1	EEM	03/30/17 15:19	mg/L	CC73028
Nitrate as N	**3.83** (0.210)		353.2		10	JLK	03/28/17 22:31	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/28/17 21:49	mg/L	CC72848
Sulfate	**24.3** (5.0)		9038		1	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**4.84** (0.40)		4500N		10	JLK	04/03/17 21:21	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-8 (84-94)
Date Sampled: 03/27/17 18:31
Percent Solids: N/A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-07
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	03/28/17 17:02	10	10	CC72806
Manganese	**0.406** (0.020)		200.7		1	KJK	03/28/17 17:02	10	10	CC72806

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-8 (84-94)
Date Sampled: 03/27/17 18:31
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-07
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 3/28/17 16:30

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	**0.649** (0.250)		8270D SIM		1	03/29/17 12:52	C7C0449	CC72749

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	52 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-8 (84-94)
Date Sampled: 03/27/17 18:31
Percent Solids: N/A

ESS Laboratory Work Order: 1703626
ESS Laboratory Sample ID: 1703626-07
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
Ammonia as N	**0.13** (0.10)		350.1		1	EEM	03/31/17 14:46	mg/L	CC73019
Chloride	**37.8** (3.0)		9250		1	EEM	03/30/17 15:24	mg/L	CC73028
Nitrate as N	**5.14** (0.210)		353.2		10	JLK	03/28/17 22:32	mg/L	[CALC]
Nitrite as N	**0.159** (0.010)		353.2		1	JLK	03/28/17 21:50	mg/L	CC72848
Sulfate	**16.9** (5.0)		9038		1	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**881** (40.2)		4500N		200	JLK	04/03/17 22:04	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703626

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Dissolved Metals										
Batch CC72806 - 200.7/6010BNoDigest										
Blank										
Iron	ND	0.100	mg/L							
Manganese	ND	0.020	mg/L							
LCS										
Iron	2.47		mg/L	2.500		99	80-120			
Manganese	0.488		mg/L	0.5000		98	80-120			
8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution										
Batch CC72749 - 3535A										
Blank										
1,4-Dioxane	ND	0.250	ug/L							
Surrogate: 1,4-Dioxane-d8	*3.26*		ug/L	*5.000*		*65*	*15-115*			
LCS										
1,4-Dioxane	10.5	0.250	ug/L	10.00		105	40-140			
Surrogate: 1,4-Dioxane-d8	*3.19*		ug/L	*5.000*		*64*	*15-115*			
LCS Dup										
1,4-Dioxane	10.8	0.250	ug/L	10.00		108	40-140	3	20	
Surrogate: 1,4-Dioxane-d8	*2.97*		ug/L	*5.000*		*59*	*15-115*			
Classical Chemistry										
Batch CC72836 - General Preparation										
Blank										
Dissolved Organic Carbon (1)	ND	0.500	mg/L							
Dissolved Organic Carbon (2)	ND	0.500	mg/L							
Dissolved Organic Carbon (Average)	ND	0.500	mg/L							
LCS										
Dissolved Organic Carbon (1)	4.93	0.500	mg/L	5.000		99	80-120			
Dissolved Organic Carbon (2)	5.30	0.500	mg/L	5.000		106	80-120			
Dissolved Organic Carbon (Average)	5.12	0.500	mg/L							
LCS Dup										
Dissolved Organic Carbon (1)	4.93	0.500	mg/L	5.000		99	80-120	0.04	200	
Dissolved Organic Carbon (2)	5.33	0.500	mg/L	5.000		107	80-120	0.6	200	
Dissolved Organic Carbon (Average)	5.13	0.500	mg/L							
Batch CC72840 - [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							
LCS										
Nitrate as N	ND		mg/L							
Nitrite as N	0.254		mg/L	0.2497		102	90-110			
Nitrite as N	0.254		mg/L	0.2497		102	90-110			

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703626

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CC72841 - [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	0.492		mg/L							
Nitrate/Nitrite as N	0.492		mg/L	0.5000		98	90-110			
Nitrate/Nitrite as N	0.492		mg/L	0.5000		98	90-110			
Total Nitrogen	0.492		mg/L							
Batch CC72848 - [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							
LCS										
Nitrate as N	ND		mg/L							
Nitrite as N	0.253		mg/L	0.2497		101	90-110			
Nitrite as N	0.253		mg/L	0.2497		101	90-110			
Batch CC72849 - [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	0.496		mg/L							
Nitrate/Nitrite as N	0.496		mg/L	0.5000		99	90-110			
Nitrate/Nitrite as N	0.496		mg/L	0.5000		99	90-110			
Total Nitrogen	0.496		mg/L							
Batch CC72924 - 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	18.6	2.00	mg/L	18.80		99	80-120			
Total Nitrogen	18.6	2.00	mg/L							
Batch CC73019 - NH4 Prep										
Blank										
Ammonia as N	ND	0.10	mg/L							
LCS										
Ammonia as N	0.09	0.10	mg/L	0.09994		91	80-120			

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703626

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CC73019 - NH4 Prep										
LCS										
Ammonia as N	1.02	0.10	mg/L	0.9994		102	80-120			
Batch CC73028 - General Preparation										
Blank										
Chloride	ND	3.0	mg/L							
LCS										
Chloride	31.0		mg/L	30.00		103	90-110			
Batch CC73032 - General Preparation										
Blank										
Sulfate	ND	5.0	mg/L							
LCS										
Sulfate	9.6		mg/L	9.988		96	85-115			
Batch CC73050 - [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	0.506		mg/L							
Nitrate/Nitrite as N	0.506		mg/L	0.5000		101	90-110			
Nitrate/Nitrite as N	0.506		mg/L	0.5000		101	90-110			
Total Nitrogen	0.506		mg/L							
Batch CC73110 - 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	20.9	2.00	mg/L	18.80		111	80-120			
Total Nitrogen	20.9	2.00	mg/L							

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703626

Notes and Definitions

U	Analyte included in the analysis, but not detected
D	Diluted.
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: 1703626

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/dwp/partners/labCert.shtml

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.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

Shipped/Delivered Via: ESS Courier

ESS Project ID: 1703626
Date Received: 3/28/2017
Project Due Date: 4/4/2017
Days for Project: 5 Day

1. Air bill manifest present? No
   Air No.: NA
2. Were custody seals present? No
3. Is radiation count <100 CPM? Yes
4. Is a Cooler Present? Yes
   Temp: 5.7 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 / 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 VOA vials frozen: Date: Time: By:

Sample Receiving Notes:

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	113180	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
01	113187	Yes	NA	Yes	500 mL Poly - Unpres	NP	
01	113194	Yes	NA	Yes	250 mL Poly - Unpres	NP	
01	113204	Yes	NA	Yes	250 mL Amber - Unpres	NP	
01	113215	Yes	NA	Yes	VOA Vial - HCl	HCl	
01	113216	Yes	NA	Yes	VOA Vial - HCl	HCl	
02	113181	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
02	113188	Yes	NA	Yes	500 mL Poly - Unpres	NP	
02	113195	Yes	NA	Yes	250 mL Poly - Unpres	NP	
02	113205	Yes	NA	Yes	250 mL Amber - Unpres	NP	
02	113217	Yes	NA	Yes	VOA Vial - HCl	HCl	
02	113218	Yes	NA	Yes	VOA Vial - HCl	HCl	
03	113182	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
03	113189	Yes	NA	Yes	500 mL Poly - Unpres	NP	
03	113196	Yes	NA	Yes	250 mL Poly - Unpres	NP	
03	113206	Yes	NA	Yes	250 mL Amber - Unpres	NP	
03	113219	Yes	NA	Yes	VOA Vial - HCl	HCl	
03	113220	Yes	NA	Yes	VOA Vial - HCl	HCl	
04	113183	Yes	NA	Yes	1L Poly - H2SO4	H2SO4	
04	113190	Yes	NA	Yes	500 mL Poly - Unpres	NP	
04	113197	Yes	NA	Yes	250 mL Poly - Unpres	NP	
04	113207	Yes	NA	Yes	250 mL Amber - Unpres	NP	
04	113221	Yes	NA	Yes	VOA Vial - HCl	HCl	
04	113222	Yes	NA	Yes	VOA Vial - HCl	HCl	

ESS Laboratory Sample and Cooler Receipt Checklist

Client: AECOM Environment - ENSR - KPB/MM

ESS Project ID: 1703626
Date Received: 3/28/2017

05	113184	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
05	113191	Yes	NA	Yes	500 mL Poly - Unpres	NP
05	113198	Yes	NA	Yes	250 mL Poly - Unpres	NP
05	113211	Yes	NA	Yes	1L Amber - Unpres	NP
05	113212	Yes	NA	Yes	1L Amber - Unpres	NP
06	113185	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
06	113192	Yes	NA	Yes	500 mL Poly - Unpres	NP
06	113200	Yes	NA	Yes	250 mL Poly - Unpres	NP
07	113186	Yes	NA	Yes	1L Poly - H2SO4	H2SO4
07	113193	Yes	NA	Yes	500 mL Poly - Unpres	NP
07	113202	Yes	NA	Yes	250 mL Poly - Unpres	NP
07	113213	Yes	NA	Yes	1L Amber - Unpres	NP
07	113214	Yes	NA	Yes	1L Amber - Unpres	NP

2nd Review
Are barcode labels on correct containers? (Yes) / No

Completed By: _____ Date & Time: 3/28/17 1027

Reviewed By: _____ Date & Time: 3/28/17 1029

Delivered By: _____ 3/28/17 1029

ESS Laboratory

Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston RI 02910
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 1703626

Turn Time: Rush
Regulatory State
Is this project for any of the following?: ○CT RCP ○MA MCP ○RGP
Reporting Limits
Electonic Deliverables: ☐Limit Checker ☐Standard Excel ☐Other (Please Specify →)

Company Name: AECOM
Contact Person: Julianne Marrion
Project #:
Project Name: ORLEANS mlp 3/28/17
Address: 9 Jonathan Bourne Drive
City: Pocasset
State: MA
Zip Code: 02259
PO #:
Telephone Number: 978-905-2419
FAX Number:
Email Address: Julianne.marrion@aecom.com

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	Analysis: TN, Ammonia	NO2,NO3, SO4,Cl	Dissolved Mn	DOC	1,4 Dioxane
1	03/27/17	1355	G	GW	MW-BC3B	X	X	X	X	
2	03/27/17	1400	G	GW	MW-B2075A	X	X	X	X	
3	03/27/17	1500	G	GW	MW-BX1C	X	X	X	X	
4	03/27/17	1520	G	GW	MW-BX1B	X	X	X	X	
5	03/27/17	1705	G	GW	MW-5(140-150)	X	X	X		X
6	03/27/17	1805	G	GW	MW-8(36-46)	X	X	X		
7	03/27/17	1831	G	GW	MW-8(84-94)	X	X	X		X

Container Type: AC-Air Cassette AG-Amber Glass B-BOD Bottle C-Cubitainer G - Glass O-Other P-Poly S-Sterile V-Vial — P P P AG AG
Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz 10-8 oz 11-Other* — 6 5 3 3 6
Preservation Code: 1-Non Preserved 2-HCl 3-H2SO4 4-HNO3 5-NaOH 6-Methanol 7-Na2S2O3 8-ZnAce, NaOH 9-NH4Cl 10-DI H2O 11-Ascorbic Acid 12-Other* — 3 1 1 1 1
Number of Containers per Sample: 1 1 1 1 2

Laboratory Use Only
Cooler Present: Y
Seals Intact: NA
Cooler Temperature: 5.7 + 5.8 °C Iw 15 min 3/28/17 @ 8:15

Sampled by: BKM & CH
Comments: Please specify "Other" preservative and containers types in this space

Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)
Bradley Morrill AECOM 03/28/17 0700	3/28/17 7:?	3/28/17 8:15	3/28/17 0935
Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)

ESS Laboratory
Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston RI 02910
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 1703626

Turn Time: Rush
Regulatory State:
Is this project for any of the following?: ○ CT RCP ○ MA MCP ○ RGP

Reporting Limits:
Electonic Deliverables: ☒ Limit Checker ☐ Standard Excel ☐ Other (Please Specify →)

Company Name: AECOM
Contact Person: Julianne Marion
City: Pocasset
State: MA
Zip Code: 02559
Telephone Number: 978-905-2419
FAX Number:
Project #:
Project Name:
Address: 9 Jonathan Bourne Drive
PO #:
Email Address: Julianne.marion@aecom.com

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	TN, Ammonia	NO_2, NO_3, SO_4, Cl	Diss Metals	DOC	1,4 Dioxane
1	03/27/17	1355	G	GW	MW-BC3B	X	X	X	X	
2	03/27/17	1400	G	GW	MW-B2075A	X	X	X	X	
3	03/27/17	1500	G	GW	MW-BX1C	X	X	X	X	
4	03/27/17	1520	G	GW	MW-BX1B	X	X	X	X	
5	03/27/17	1705	G	GW	MW-5(140-150)	X	X	X		X
6	03/27/17	1805	G	GW	MW-8(36-46)	X	X	X		
7	03/27/17	1831	G	GW	MW-8(84-94)	X	X	X		X
Container Type: AC-Air Cassette, AG-Amber Glass, B-BOD Bottle, C-Cubitainer, G-Glass, O-Other, P-Poly, S-Sterile, V-Vial						P	P	P	AG	AG
Container Volume: 1-100 mL, 2-2.5 gal, 3-250 mL, 4-300 mL, 5-500 mL, 6-1L, 7-VOA, 8-2 oz, 9-4 oz, 10-8 oz, 11-Other*						6	5	3	3	6
Preservation Code: 1-Non Preserved, 2-HCl, 3-H2SO4, 4-HNO3, 5-NaOH, 6-Methanol, 7-Na2S2O3, 8-ZnAce, NaOH, 9-NH4Cl, 10-DI H2O, 11-Ascorbic Acid, 12-Other*						3	1	1	1	1
Number of Containers per Sample:						1	1	1	1	2

Laboratory Use Only
Cooler Present: Y
Seals Intact: NA
Cooler Temperature: 5.7 + 5.8 °C Iu   Kevin 3/28/17 @ 8[15]

Sampled by: BKM & CH
Comments:
Please specify "Other" preservative and containers types in this space

Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)
Bailey Morrill AECOM 03/28/17 0700	[signature] 3/28/17 7:00	[signature] 3/28/17 815	[signature] 3/28/17 0935
Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)

CERTIFICATE OF ANALYSIS

Julianne Marrion
AECOM Environment - ENSR
9 Jonathan Bourne Dr
Pocasset, MA 02559

RE: Orleans MA (60476644)
ESS Laboratory Work Order Number: 1703684

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

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 TNI and relative state standards, 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: 1703684

SAMPLE RECEIPT

The following samples were received on March 29, 2017 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
1703684-01	MW-7S (55-65)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250, RSK175
1703684-02	MW-7D (115-125)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250, RSK175
1703684-03	MW-7 (90-100)	Ground Water	200.7, 350.1, 353.2, 4500N, 8270D SIM, 9038, 9250, RSK175
1703684-04	MW-6A (64-74)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703684-05	MW-6B (54-64)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703684-06	MW-E6 (88-98)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703684-07	MW-2 (140-150)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703684-08	MW-2 (160-170)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703684-09	MW-2S (84-94)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703684-10	MW-2D (124-134)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703684-11	MW-10 (85-95)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703684-12	LS-1	Ground Water	350.1, 353.2, 4500N

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703684

PROJECT NARRATIVE

No unusual observations noted.

End of Project Narrative.

DATA USABILITY LINKS

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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: 1703684

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
8015C - 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: MW-7S (55-65)
Date Sampled: 03/28/17 09:55
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-01
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.216** (0.100)		200.7		1	KJK	03/29/17 17:28	10	10	CC72946
Manganese	**0.031** (0.020)		200.7		1	KJK	03/29/17 17:28	10	10	CC72946

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CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7S (55-65)
Date Sampled: 03/28/17 09:55
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-01
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
Ammonia as N	**0.15** (0.10)		350.1		1	EEM	03/31/17 14:51	mg/L	CC73019
Chloride	**369** (30.0)		9250		10	EEM	03/30/17 15:48	mg/L	CC73028
Nitrate as N	**4.96** (0.210)		353.2		10	JLK	03/30/17 19:22	mg/L	[CALC]
Nitrite as N	**0.012** (0.010)		353.2		1	JLK	03/29/17 17:38	mg/L	CC72951
Sulfate	**15.5** (5.0)		9038		1	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**8.67** (0.40)		4500N		10	JLK	04/03/17 21:26	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7S (55-65)
Date Sampled: 03/28/17 09:55
Percent Solids: N/A
Initial Volume: 1
Final Volume: 1
Extraction Method: No Prep

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-01
Sample Matrix: Ground Water
Units: ug/L
Analyst: ZLC
Prepared: 4/4/17 8:39

All methods used are in accordance with 40 CFR 136.

Methane / Ethane / Ethene by Headspace GCFID (RSK175)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
Methane	ND (2.0)		RSK175		1	ZLC	04/04/17 9:46	C7D0026	CD70409

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7D (115-125)
Date Sampled: 03/28/17 10:00
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-02
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**17.5** (0.100)		200.7		1	KJK	03/29/17 17:32	10	10	CC72946
Manganese	**2.72** (0.020)		200.7		1	KJK	03/29/17 17:32	10	10	CC72946

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CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7D (115-125)
Date Sampled: 03/28/17 10:00
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-02
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
Ammonia as N	**2.59** (0.10)		350.1		1	EEM	04/04/17 12:25	mg/L	CD70303
Chloride	**57.2** (3.0)		9250		1	EEM	03/30/17 15:28	mg/L	CC73028
Nitrate as N	ND (0.030)		353.2		1	JLK	03/30/17 19:25	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/29/17 17:40	mg/L	CC72951
Sulfate	**34.2** (10.0)		9038		2	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**0.57** (0.22)		4500N		1	JLK	04/03/17 21:27	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7D (115-125)
Date Sampled: 03/28/17 10:00
Percent Solids: N/A
Initial Volume: 1
Final Volume: 1
Extraction Method: No Prep

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-02
Sample Matrix: Ground Water
Units: ug/L
Analyst: ZLC
Prepared: 4/4/17 8:39

All methods used are in accordance with 40 CFR 136.

Methane / Ethane / Ethene by Headspace GCFID (RSK175)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
Methane	ND (2.0)		RSK175		1	ZLC	04/04/17 9:52	C7D0026	CD70409

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7 (90-100)
Date Sampled: 03/28/17 10:45
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-03
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**7.51** (0.100)		200.7		1	KJK	03/29/17 17:36	10	10	CC72946
Manganese	**0.331** (0.020)		200.7		1	KJK	03/29/17 17:36	10	10	CC72946

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7 (90-100)
Date Sampled: 03/28/17 10:45
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-03
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 3/30/17 17:20

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	03/31/17 14:14	C7C0505	CC72972

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	44 %		15-115

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CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7 (90-100)
Date Sampled: 03/28/17 10:45
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-03
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
Ammonia as N	**0.19** (0.10)		350.1		1	EEM	04/04/17 12:26	mg/L	CD70303
Chloride	**428** (60.0)		9250		20	EEM	03/30/17 15:55	mg/L	CC73028
Nitrate as N	**0.154** (0.030)		353.2		1	JLK	03/30/17 19:26	mg/L	[CALC]
Nitrite as N	**0.015** (0.010)		353.2		1	JLK	03/29/17 17:41	mg/L	CC72951
Sulfate	**18.7** (5.0)		9038		1	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**1.06** (0.22)		4500N		1	JLK	04/03/17 21:27	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-7 (90-100)
Date Sampled: 03/28/17 10:45
Percent Solids: N/A
Initial Volume: 1
Final Volume: 1
Extraction Method: No Prep

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-03
Sample Matrix: Ground Water
Units: ug/L
Analyst: ZLC
Prepared: 4/4/17 8:39

All methods used are in accordance with 40 CFR 136.

Methane / Ethane / Ethene by Headspace GCFID (RSK175)

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	Sequence	Batch
Methane	ND (2.0)		RSK175		1	ZLC	04/04/17 10:08	C7D0026	CD70409

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6A (64-74)
Date Sampled: 03/28/17 11:00
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-04
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.107** (0.100)		200.7		1	KJK	03/29/17 17:40	10	10	CC72946
Manganese	**0.050** (0.020)		200.7		1	KJK	03/29/17 17:40	10	10	CC72946

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CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6A (64-74)
Date Sampled: 03/28/17 11:00
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-04
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
Ammonia as N	ND (0.10)		350.1		1	EEM	04/04/17 12:27	mg/L	CD70303
Chloride	**331** (30.0)		9250		10	EEM	03/30/17 15:56	mg/L	CC73028
Nitrate as N	**2.61** (0.110)		353.2		5	JLK	03/30/17 19:27	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/29/17 17:42	mg/L	CC72951
Sulfate	**27.8** (5.0)		9038		1	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**3.94** (0.30)		4500N		5	JLK	04/03/17 21:28	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6B (54-64)
Date Sampled: 03/28/17 11:40
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-05
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	03/29/17 17:44	10	10	CC72946
Manganese	**0.026** (0.020)		200.7		1	KJK	03/29/17 17:44	10	10	CC72946

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CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-6B (54-64)
Date Sampled: 03/28/17 11:40
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-05
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
Ammonia as N	ND (0.10)		350.1		1	EEM	04/04/17 12:30	mg/L	CD70303
Chloride	**167** (30.0)		9250		10	EEM	03/30/17 15:58	mg/L	CC73028
Nitrate as N	**8.27** (0.210)		353.2		10	JLK	03/30/17 19:28	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/29/17 17:43	mg/L	CC72951
Sulfate	**43.5** (25.0)		9038		5	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**36.3** (2.20)		4500N		10	JLK	04/03/17 21:51	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-E6 (88-98)
Date Sampled: 03/28/17 12:00
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-06
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**13.5** (0.100)		200.7		1	KJK	03/29/17 19:54	10	10	CC72946
Manganese	**2.39** (0.020)		200.7		1	KJK	03/29/17 19:54	10	10	CC72946

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CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-E6 (88-98)
Date Sampled: 03/28/17 12:00
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-06
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
Ammonia as N	**22.6** (1.00)		350.1		10	EEM	04/04/17 13:00	mg/L	CD70303
Chloride	**196** (30.0)		9250		10	EEM	03/30/17 15:59	mg/L	CC73028
Nitrate as N	ND (0.030)		353.2		1	JLK	03/30/17 19:31	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/29/17 17:44	mg/L	CC72951
Sulfate	**21.5** (5.0)		9038		1	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**13.6** (1.02)		4500N		5	JLK	04/03/17 21:51	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2 (140-150)
Date Sampled: 03/28/17 15:35
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-07
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.908** (0.100)		200.7		1	KJK	03/29/17 19:59	10	10	CC72946
Manganese	**5.12** (0.020)		200.7		1	KJK	03/29/17 19:59	10	10	CC72946

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CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2 (140-150)
Date Sampled: 03/28/17 15:35
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-07
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
Ammonia as N	**11.2** (1.00)		350.1		10	EEM	04/04/17 13:01	mg/L	CD70303
Chloride	**46.1** (3.0)		9250		1	EEM	03/30/17 15:34	mg/L	CC73028
Nitrate as N	ND (0.030)		353.2		1	JLK	03/30/17 19:32	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/29/17 17:50	mg/L	CC72951
Sulfate	**63.5** (25.0)		9038		5	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**17.2** (1.02)		4500N		5	JLK	04/03/17 21:52	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2 (160-170)
Date Sampled: 03/28/17 14:35
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-08
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.647** (0.100)		200.7		1	KJK	03/29/17 20:03	10	10	CC72946
Manganese	**6.72** (0.020)		200.7		1	KJK	03/29/17 20:03	10	10	CC72946

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CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2 (160-170)
Date Sampled: 03/28/17 14:35
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-08
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
Ammonia as N	**13.7** (1.00)		350.1		10	EEM	04/04/17 13:02	mg/L	CD70303
Chloride	**43.6** (3.0)		9250		1	EEM	03/30/17 15:39	mg/L	CC73028
Nitrate as N	ND (0.030)		353.2		1	JLK	03/30/17 19:33	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/29/17 17:51	mg/L	CC72951
Sulfate	**32.8** (10.0)		9038		2	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**2.45** (0.22)		4500N		1	JLK	04/03/17 21:31	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2S (84-94)
Date Sampled: 03/28/17 15:15
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-09
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	03/29/17 20:19	10	10	CC72946
Manganese	**0.528** (0.020)		200.7		1	KJK	03/29/17 20:19	10	10	CC72946

ESS Laboratory
Division of Thielsch Engineering, Inc.

BAL Laboratory
The Microbiology Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2S (84-94)
Date Sampled: 03/28/17 15:15
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-09
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
Ammonia as N	ND (0.10)		350.1		1	EEM	04/04/17 12:42	mg/L	CD70303
Chloride	**94.8** (3.0)		9250		1	EEM	03/30/17 15:40	mg/L	CC73028
Nitrate as N	**1.05** (0.050)		353.2		2	JLK	03/30/17 20:23	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/29/17 17:52	mg/L	CC72951
Sulfate	**81.0** (50.0)		9038		10	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**14.7** (1.04)		4500N		5	JLK	04/03/17 21:53	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2D (124-134)
Date Sampled: 03/28/17 15:45
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-10
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.107** (0.100)		200.7		1	KJK	03/29/17 20:23	10	10	CC72946
Manganese	**4.48** (0.020)		200.7		1	KJK	03/29/17 20:23	10	10	CC72946

ESS Laboratory
Division of Thielsch Engineering, Inc.

BAL Laboratory
The Microbiology Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-2D (124-134)
Date Sampled: 03/28/17 15:45
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-10
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
Ammonia as N	**10.9** (1.00)		350.1		10	EEM	04/04/17 13:12	mg/L	CD70303
Chloride	**134** (30.0)		9250		10	EEM	03/30/17 16:00	mg/L	CC73028
Nitrate as N	**2.32** (0.110)		353.2		5	JLK	03/30/17 20:24	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/29/17 17:53	mg/L	CC72951
Sulfate	**51.0** (25.0)		9038		5	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**2.89** (0.30)		4500N		5	JLK	04/03/17 21:35	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-10 (85-95)
Date Sampled: 03/28/17 17:15
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-11
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.375** (0.100)		200.7		1	KJK	03/29/17 20:40	10	10	CC72946
Manganese	**0.028** (0.020)		200.7		1	KJK	03/29/17 20:40	10	10	CC72946

ESS Laboratory
Division of Thielsch Engineering, Inc.

BAL Laboratory
The Microbiology Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-10 (85-95)
Date Sampled: 03/28/17 17:15
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-11
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
Ammonia as N	ND (0.10)		350.1		1	EEM	04/04/17 12:44	mg/L	CD70303
Chloride	**39.1** (3.0)		9250		1	EEM	03/30/17 15:42	mg/L	CC73028
Nitrate as N	**2.50** (0.110)		353.2		5	JLK	03/30/17 20:25	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/29/17 17:54	mg/L	CC72951
Sulfate	**6.1** (5.0)		9038		1	EEM	03/30/17 17:30	mg/L	CC73032
Total Nitrogen	**2.83** (0.30)		4500N		5	JLK	04/04/17 18:23	mg/L	[CALC]

ESS Laboratory
Division of Thielsch Engineering, Inc.

BAL Laboratory
The Microbiology Division of Thielsch Engineering, Inc.

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: LS-1
Date Sampled: 03/28/17 09:00
Percent Solids: N/A

ESS Laboratory Work Order: 1703684
ESS Laboratory Sample ID: 1703684-12
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
Ammonia as N	**4.94** (0.10)		350.1		1	EEM	04/04/17 12:45	mg/L	CD70303
Nitrate as N	**1.20** (0.110)		353.2		5	JLK	03/30/17 20:26	mg/L	[CALC]
Nitrite as N	**0.428** (0.010)		353.2		1	JLK	03/29/17 17:54	mg/L	CC72951
Total Nitrogen	**98.5** (10.1)		4500N		50	JLK	04/04/17 18:42	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703684

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Dissolved Metals										
Batch CC72946 - 200.7/6010BNoDigest										
Blank										
Iron	ND	0.100	mg/L							
Manganese	ND	0.020	mg/L							
LCS										
Iron	2.49		mg/L	2.500		100	80-120			
Manganese	0.502		mg/L	0.5000		100	80-120			
8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution										
Batch CC72972 - 3535A										
Blank										
1,4-Dioxane	ND	0.250	ug/L							
Surrogate: 1,4-Dioxane-d8	*2.46*		ug/L	*5.000*		*49*	*15-115*			
LCS										
1,4-Dioxane	11.1	0.250	ug/L	10.00		111	40-140			
Surrogate: 1,4-Dioxane-d8	*2.86*		ug/L	*5.000*		*57*	*15-115*			
LCS Dup										
1,4-Dioxane	11.4	0.250	ug/L	10.00		114	40-140	2	20	
Surrogate: 1,4-Dioxane-d8	*3.04*		ug/L	*5.000*		*61*	*15-115*			
Classical Chemistry										
Batch CC72951 - [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							
LCS										
Nitrate as N	ND		mg/L							
Nitrite as N	0.248		mg/L	0.2497		99	90-110			
Nitrite as N	0.248		mg/L	0.2497		99	90-110			
Batch CC73019 - NH4 Prep										
Blank										
Ammonia as N	ND	0.10	mg/L							
LCS										
Ammonia as N	0.09	0.10	mg/L	0.09994		91	80-120			
LCS										
Ammonia as N	1.02	0.10	mg/L	0.9994		102	80-120			
Batch CC73028 - General Preparation										
Blank										
Chloride	ND	3.0	mg/L							
LCS										
Chloride	31.0		mg/L	30.00		103	90-110			

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703684

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CC73032 - General Preparation										
Blank										
Sulfate	ND	5.0	mg/L							
LCS										
Sulfate	9.6		mg/L	9.988		96	85-115			
Batch CC73050 - [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	0.506		mg/L							
Nitrate/Nitrite as N	0.506		mg/L	0.5000		101	90-110			
Nitrate/Nitrite as N	0.506		mg/L	0.5000		101	90-110			
Total Nitrogen	0.506		mg/L							
Batch CC73110 - 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	20.9	2.00	mg/L	18.80		111	80-120			
Total Nitrogen	20.9	2.00	mg/L							
Batch CD70303 - General Preparation										
Blank										
Ammonia as N	ND	0.10	mg/L							
LCS										
Ammonia as N	0.10	0.10	mg/L	0.09994		98	80-120			
LCS										
Ammonia as N	1.03	0.10	mg/L	0.9994		103	80-120			
Batch CD70351 - 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	15.9	2.00	mg/L	18.80		85	80-120			
Total Nitrogen	15.9	2.00	mg/L							
Methane / Ethane / Ethene by Headspace GCFID (RSK175)										
Batch CD70409 - No Prep										
Blank										
Methane	ND	2.0	ug/L							

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703684

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Methane / Ethane / Ethene by Headspace GCFID (RSK175)										
Batch CD70409 - No Prep										
LCS										
Methane	24.8		ug/L	36.00		69	60-140			
LCS Dup										
Methane	22.0		ug/L	36.00		61	60-140	12	30	

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703684

Notes and Definitions

U	Analyte included in the analysis, but not detected
D	Diluted.
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: 1703684

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/dwp/partners/labCert.shtml

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.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703684

Items for Project Management Review

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Classical Chemistry

1703684-01	Sampled->Prepared > 2.00 days
1703684-02	Sampled->Prepared > 2.00 days
1703684-03	Sampled->Prepared > 2.00 days
1703684-04	Sampled->Prepared > 2.00 days
1703684-05	Sampled->Prepared > 2.00 days
1703684-06	Sampled->Prepared > 2.00 days
1703684-07	Sampled->Prepared > 2.00 days
1703684-08	Sampled->Prepared > 2.00 days
1703684-09	Sampled->Prepared > 2.00 days
1703684-10	Sampled->Prepared > 2.00 days
1703684-11	Sampled->Prepared > 2.00 days
1703684-12	Sampled->Prepared > 2.00 days

Dissolved Metals

Methane / Ethane / Ethene by Headspace GC/FID (RSK175)

1703684-01	Missing Ethene
	Missing Ethane
1703684-02	Missing Ethene
	Missing Ethane
1703684-03	Missing Ethene
	Missing Ethane

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703684

PROJECT COMPLETION CHECKLIST

All Reports:

1. Has Report been Paginated?	Yes	No	
2. Has Report been Digitally Signed?	Yes	No	
3. Has MCP/RPC Sheet been filled out?	Yes	No	N/A
4. Have PRM and Fax Sheet been removed from the Project?	Yes	No	
5. Is the correct Chain of Custody attached to the Report?	Yes	No	
6. Is the correct Cooler Receipt attached to the Report?	Yes	No	N/A

Contact Person: _____ EDD:_____

E-Mail: _____

1. Does e-mail address in Element match the COC/CSR?	Yes	No	
1a. If No, did you contact Customer Service?	Yes	No	N/A
2. Are their any CCs for the report?	Yes	No	
3a If Yes, did you include them?	Yes	No	N/A
4. Did you save a copy of the e-mail in the Work Order Folder?	Yes	No	

Client Connect: _____

1. Did you save Report in CORRECT ClientConnect Folder?	Yes	No	N/A
2. Did you save EDD in CORRECT ClientConnect Folder?	Yes	No	N/A

Fax:_____

1. Does fax number in Element match the COC?	Yes	No	
1a. Did you contact Customer Service?	Yes	No	N/A
2. Was the fax "rejected" for any reason?	Yes	No	
2a. Was the project re-faxed?	Yes	No	N/A
2b. Was Customer Service notified?	Yes	No	N/A

Updated to Faxed: Yes No N/A Initials:_____ Date:_____

ESS Laboratory

Division of Thielsch Engineering, Inc.

FAX

Date: _____

To: Julianne Marrion

Company: AECOM Environment - ENSR

Proiect Name: Orleans MA

ESS Work Order: 1703684

Fax: (978) 589-3100

Comments:

Our certified laboratory provides a full range of services, including the following:

- -Soil Characterization
- -Petroleum Fingerprinting
- -Priority Pollutant Analysis
- -Groundwater, Wastewater and Drinking Water Analyses
- -PCBs and Pesticides Analysis
- -Trace Metals (ICAP/Furnace) Analysis
- -Inorganic Analysis by Classic Methods, Flow Analyzer, and Ion Chromatography
- -Organics by GC/Mass Spectroscopy
- -Microbiology Analysis
- -Massachusetts EPH/VPH Analysis
- -Siloxanes
- -Field Screening and Sample Technician Services

Number of pages (including this cover): _____

Date: _____ Faxed: ____ Initials: _____ Time: _____

185 Frances Avenue, Cranston, RI 02910-2211 Tel: 401-461-7181 Fax: 401-461-4486 http://www.ESSLaboratory.com

CERTIFICATE OF ANALYSIS

Julianne Marrion
AECOM Environment - ENSR
9 Jonathan Bourne Dr
Pocasset, MA 02559

RE: Orleans MA (60476644 T10.1B)
ESS Laboratory Work Order Number: 1703729

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 1:27 pm, Apr 05, 2017

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 TNI and relative state standards, 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: 1703729

SAMPLE RECEIPT

The following samples were received on March 29, 2017 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
1703729-01	MW-1S (56-66)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703729-02	MW-1D (99-109)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703729-03	MW-3S (50-60)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703729-04	MW-3D (84-94)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703729-05	MW-5S (78-88)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703729-06	MW-5D (124-134)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703729-07	MW-9 (92-102)	Ground Water	200.7, 350.1, 353.2, 4500N, 9038, 9250
1703729-08	MW-13 (74-84)	Ground Water	200.7, 350.1, 353.2, 4500N, 8270D SIM, 9038, 9250
1703729-09	MW-11 (91-101)	Ground Water	200.7, 350.1, 353.2, 4500N, 8270D SIM, 9038, 9250
1703729-10	MW-12 (87-97)	Ground Water	200.7, 350.1, 353.2, 4500N, 8270D SIM, 9038, 9250

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703729

PROJECT NARRATIVE

No unusual observations noted.

End of Project Narrative.

DATA USABILITY LINKS

To ensure you are viewing the most current version of the documents below, please clear your internet cookies for www.ESSLaboratory.com. Consult your IT Support personnel for information on how to clear your internet cookies.

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: 1703729

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
8015C - 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: MW-1S (56-66)
Date Sampled: 03/29/17 10:30
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-01
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	04/01/17 16:07	10	10	CC73134
Manganese	**0.454** (0.020)		200.7		1	KJK	04/01/17 16:07	10	10	CC73134

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-1S (56-66)
Date Sampled: 03/29/17 10:30
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-01
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
Ammonia as N	**0.11** (0.10)		350.1		1	EEM	04/04/17 12:46	mg/L	CD70303
Chloride	**15.0** (3.0)		9250		1	EEM	04/03/17 14:22	mg/L	CD70309
Nitrate as N	**2.56** (0.110)		353.2		5	JLK	03/30/17 22:08	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/30/17 21:09	mg/L	CC73051
Sulfate	**5.4** (5.0)		9038		1	EEM	04/03/17 16:45	mg/L	CD70311
Total Nitrogen	**4.26** (0.30)		4500N		5	JLK	04/04/17 18:29	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-1D (99-109)
Date Sampled: 03/29/17 10:10
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-02
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	04/01/17 16:11	10	10	CC73134
Manganese	**0.059** (0.020)		200.7		1	KJK	04/01/17 16:11	10	10	CC73134

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-1D (99-109)
Date Sampled: 03/29/17 10:10
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-02
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
Ammonia as N	**0.43** (0.10)		350.1		1	EEM	04/04/17 12:54	mg/L	CD70303
Chloride	**30.7** (3.0)		9250		1	EEM	04/03/17 14:24	mg/L	CD70309
Nitrate as N	**4.12** (0.210)		353.2		10	JLK	03/30/17 22:09	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/30/17 21:10	mg/L	CC73051
Sulfate	**8.2** (5.0)		9038		1	EEM	04/03/17 16:45	mg/L	CD70311
Total Nitrogen	**4.86** (0.40)		4500N		10	JLK	04/04/17 18:30	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-3S (50-60)
Date Sampled: 03/29/17 12:15
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-03
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**1.27** (0.100)		200.7		1	KJK	04/01/17 16:15	10	10	CC73134
Manganese	**0.669** (0.020)		200.7		1	KJK	04/01/17 16:15	10	10	CC73134

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-3S (50-60)
Date Sampled: 03/29/17 12:15
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-03
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
Ammonia as N	ND (0.10)		350.1		1	EEM	04/04/17 12:55	mg/L	CD70303
Chloride	**774** (30.0)		9250		10	EEM	04/03/17 14:43	mg/L	CD70309
Nitrate as N	**0.299** (0.030)		353.2		1	JLK	03/30/17 21:53	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/30/17 21:11	mg/L	CC73051
Sulfate	ND (5.0)		9038		1	EEM	04/03/17 16:45	mg/L	CD70311
Total Nitrogen	**0.75** (0.22)		4500N		1	JLK	04/04/17 18:30	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-3D (84-94)
Date Sampled: 03/29/17 12:34
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-04
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**34.5** (0.100)		200.7		1	KJK	04/01/17 16:20	10	10	CC73134
Manganese	**2.78** (0.020)		200.7		1	KJK	04/01/17 16:20	10	10	CC73134

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-3D (84-94)
Date Sampled: 03/29/17 12:34
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-04
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
Ammonia as N	**4.36** (0.10)		350.1		1	EEM	04/04/17 12:56	mg/L	CD70303
Chloride	**147** (15.0)		9250		5	EEM	04/03/17 14:44	mg/L	CD70309
Nitrate as N	ND (0.030)		353.2		1	JLK	03/30/17 21:54	mg/L	[CALC]
Nitrite as N	**0.043** (0.010)		353.2		1	JLK	03/30/17 21:12	mg/L	CC73051
Sulfate	**18.1** (5.0)		9038		1	EEM	04/03/17 16:45	mg/L	CD70311
Total Nitrogen	**5.35** (0.42)		4500N		2	JLK	04/04/17 18:47	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-5S (78-88)
Date Sampled: 03/29/17 15:45
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-05
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.120** (0.100)		200.7		1	KJK	04/01/17 16:36	10	10	CC73134
Manganese	**0.075** (0.020)		200.7		1	KJK	04/01/17 16:36	10	10	CC73134

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-5S (78-88)
Date Sampled: 03/29/17 15:45
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-05
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
Ammonia as N	ND (0.10)		350.1		1	EEM	04/04/17 12:56	mg/L	CD70303
Chloride	**64.4** (3.0)		9250		1	EEM	04/03/17 14:27	mg/L	CD70309
Nitrate as N	**18.6** (0.410)		353.2		20	JLK	03/30/17 22:10	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/30/17 21:13	mg/L	CC73051
Sulfate	**49.0** (25.0)		9038		5	EEM	04/03/17 16:45	mg/L	CD70311
Total Nitrogen	**18.9** (0.60)		4500N		20	JLK	04/04/17 18:32	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-5D (124-134)
Date Sampled: 03/29/17 16:17
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-06
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**0.608** (0.100)		200.7		1	KJK	04/01/17 16:40	10	10	CC73134
Manganese	**0.584** (0.020)		200.7		1	KJK	04/01/17 16:40	10	10	CC73134

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-5D (124-134)
Date Sampled: 03/29/17 16:17
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-06
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
Ammonia as N	**14.0** (1.00)		350.1		10	EEM	04/04/17 13:12	mg/L	CD70303
Chloride	**70.1** (3.0)		9250		1	EEM	04/03/17 14:28	mg/L	CD70309
Nitrate as N	**0.058** (0.030)		353.2		1	JLK	03/30/17 21:56	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/30/17 21:14	mg/L	CC73051
Sulfate	**23.8** (5.0)		9038		1	EEM	04/03/17 16:45	mg/L	CD70311
Total Nitrogen	**16.0** (1.02)		4500N		5	JLK	04/04/17 18:47	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-9 (92-102)
Date Sampled: 03/29/17 14:57
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-07
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest

All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	04/01/17 16:45	10	10	CC73134
Manganese	**0.052** (0.020)		200.7		1	KJK	04/01/17 16:45	10	10	CC73134

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-9 (92-102)
Date Sampled: 03/29/17 14:57
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-07
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
Ammonia as N	ND (0.10)		350.1		1	EEM	04/04/17 12:58	mg/L	CD70303
Chloride	**60.8** (3.0)		9250		1	EEM	04/03/17 14:29	mg/L	CD70309
Nitrate as N	**6.37** (0.210)		353.2		10	JLK	03/30/17 22:13	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/30/17 21:17	mg/L	CC73051
Sulfate	**34.6** (10.0)		9038		2	EEM	04/03/17 16:45	mg/L	CD70311
Total Nitrogen	**6.65** (0.40)		4500N		10	JLK	04/04/17 18:33	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-13 (74-84)
Date Sampled: 03/29/17 13:40
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-08
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	**6.67** (0.100)		200.7		1	KJK	04/01/17 16:57	10	10	CC73134
Manganese	**0.447** (0.020)		200.7		1	KJK	04/01/17 16:57	10	10	CC73134

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-13 (74-84)
Date Sampled: 03/29/17 13:40
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-08
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 3/30/17 17:20

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	03/31/17 22:12	C7C0505	CC72972

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	50 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-13 (74-84)
Date Sampled: 03/29/17 13:40
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-08
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
Ammonia as N	**0.11** (0.10)		350.1		1	EEM	04/04/17 12:59	mg/L	CD70303
Chloride	**127** (15.0)		9250		5	EEM	04/03/17 14:49	mg/L	CD70309
Nitrate as N	**1.18** (0.050)		353.2		2	JLK	03/30/17 22:14	mg/L	[CALC]
Nitrite as N	**0.013** (0.010)		353.2		1	JLK	03/30/17 21:18	mg/L	CC73051
Sulfate	**22.5** (5.0)		9038		1	EEM	04/03/17 16:45	mg/L	CD70311
Total Nitrogen	**1.58** (0.24)		4500N		2	JLK	04/04/17 18:34	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-11 (91-101)
Date Sampled: 03/29/17 16:25
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-09
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	04/01/17 16:53	10	10	CC73134
Manganese	**0.501** (0.020)		200.7		1	KJK	04/01/17 16:53	10	10	CC73134

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-11 (91-101)
Date Sampled: 03/29/17 16:25
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-09
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 3/30/17 17:20

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	03/31/17 22:49	C7C0505	CC72972

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	56 %		15-115

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-11 (91-101)
Date Sampled: 03/29/17 16:25
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-09
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
Ammonia as N	ND (0.10)		350.1		1	EEM	04/04/17 13:36	mg/L	CD70426
Chloride	**30.9** (3.0)		9250		1	EEM	04/03/17 14:35	mg/L	CD70309
Nitrate as N	**0.239** (0.030)		353.2		1	JLK	03/30/17 22:01	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/30/17 21:19	mg/L	CC73051
Sulfate	**12.1** (5.0)		9038		1	EEM	04/03/17 16:45	mg/L	CD70311
Total Nitrogen	**0.54** (0.22)		4500N		1	JLK	04/04/17 18:35	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12 (87-97)
Date Sampled: 03/29/17 15:10
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-10
Sample Matrix: Ground Water
Units: mg/L

Extraction Method: 200.7/6010BNoDigest
All methods used are in accordance with 40 CFR 136.

Dissolved Metals

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyst	Analyzed	I/V	F/V	Batch
Iron	ND (0.100)		200.7		1	KJK	04/01/17 17:01	10	10	CC73134
Manganese	**0.080** (0.020)		200.7		1	KJK	04/01/17 17:01	10	10	CC73134

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12 (87-97)
Date Sampled: 03/29/17 15:10
Percent Solids: N/A
Initial Volume: 500
Final Volume: 0.5
Extraction Method: 3535A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-10
Sample Matrix: Ground Water
Units: ug/L
Analyst: VSC
Prepared: 3/30/17 17:20

All methods used are in accordance with 40 CFR 136.

8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution

Analyte	Results (MRL)	MDL	Method	Limit	DF	Analyzed	Sequence	Batch
1,4-Dioxane	ND (0.250)		8270D SIM		1	03/31/17 23:25	C7C0505	CC72972

	%Recovery	Qualifier	Limits
Surrogate: 1,4-Dioxane-d8	*53 %*		*15-115*

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA
Client Sample ID: MW-12 (87-97)
Date Sampled: 03/29/17 15:10
Percent Solids: N/A

ESS Laboratory Work Order: 1703729
ESS Laboratory Sample ID: 1703729-10
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
Ammonia as N	ND (0.10)		350.1		1	EEM	04/04/17 13:35	mg/L	CD70426
Chloride	**43.2** (3.0)		9250		1	EEM	04/03/17 14:36	mg/L	CD70309
Nitrate as N	**0.142** (0.030)		353.2		1	JLK	03/30/17 22:03	mg/L	[CALC]
Nitrite as N	ND (0.010)		353.2		1	JLK	03/30/17 21:20	mg/L	CC73051
Sulfate	**8.3** (5.0)		9038		1	EEM	04/03/17 16:45	mg/L	CD70311
Total Nitrogen	**0.46** (0.22)		4500N		1	JLK	04/04/17 18:37	mg/L	[CALC]

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703729

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Dissolved Metals										
Batch CC73134 - 200.7/6010BNoDigest										
Blank										
Iron	ND	0.100	mg/L							
Manganese	ND	0.020	mg/L							
LCS										
Iron	2.51		mg/L	2.500		101	80-120			
Manganese	0.514		mg/L	0.5000		103	80-120			
8270D(SIM) Semi-Volatile Organic Compounds w/ Isotope Dilution										
Batch CC72972 - 3535A										
Blank										
1,4-Dioxane	ND	0.250	ug/L							
Surrogate: 1,4-Dioxane-d8	*2.46*		ug/L	*5.000*		*49*	*15-115*			
LCS										
1,4-Dioxane	11.1	0.250	ug/L	10.00		111	40-140			
Surrogate: 1,4-Dioxane-d8	*2.86*		ug/L	*5.000*		*57*	*15-115*			
LCS Dup										
1,4-Dioxane	11.4	0.250	ug/L	10.00		114	40-140	2	20	
Surrogate: 1,4-Dioxane-d8	*3.04*		ug/L	*5.000*		*61*	*15-115*			
Classical Chemistry										
Batch CC73051 - [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							
LCS										
Nitrate as N	ND		mg/L							
Nitrite as N	0.254		mg/L	0.2497		102	90-110			
Nitrite as N	0.254		mg/L	0.2497		102	90-110			
Batch CC73052 - [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	0.522		mg/L							
Nitrate/Nitrite as N	0.522		mg/L	0.5000		104	90-110			
Nitrate/Nitrite as N	0.522		mg/L	0.5000		104	90-110			
Total Nitrogen	0.522		mg/L							
Batch CD70303 - General Preparation										
Blank										

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703729

Quality Control Data

Analyte	Result	MRL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Qualifier
Classical Chemistry										
Batch CD70303 - General Preparation										
Ammonia as N	ND	0.10	mg/L							
LCS										
Ammonia as N	0.10	0.10	mg/L	0.09994		98	80-120			
LCS										
Ammonia as N	1.03	0.10	mg/L	0.9994		103	80-120			
Batch CD70309 - General Preparation										
Blank										
Chloride	ND	3.0	mg/L							
LCS										
Chloride	31.2		mg/L	30.00		104	90-110			
Batch CD70311 - General Preparation										
Blank										
Sulfate	ND	5.0	mg/L							
LCS										
Sulfate	9.6	5.0	mg/L	9.988		96	85-115			
Batch CD70351 - 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	15.9	2.00	mg/L	18.80		85	80-120			
Total Nitrogen	15.9	2.00	mg/L							
Batch CD70426 - NH4 Prep										
Blank										
Ammonia as N	ND	0.10	mg/L							
LCS										
Ammonia as N	0.09	0.10	mg/L	0.09994		93	80-120			
LCS										
Ammonia as N	0.98	0.10	mg/L	0.9994		98	80-120			

CERTIFICATE OF ANALYSIS

Client Name: AECOM Environment - ENSR
Client Project ID: Orleans MA

ESS Laboratory Work Order: 1703729

Notes and Definitions

U	Analyte included in the analysis, but not detected
D	Diluted.
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: 1703729

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/dwp/partners/labCert.shtml

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.dep.pa.gov/Business/OtherPrograms/Labs/Pages/Laboratory-Accreditation-Program.aspx

ESS Laboratory

Division of Thielsch Engineering, Inc.
185 Frances Avenue, Cranston RI 02910
Tel. (401) 461-7181 Fax (401) 461-4486
www.esslaboratory.com

CHAIN OF CUSTODY

ESS Lab # 1703729

Turn Time: Rush
Regulatory State:
Is this project for any of the following?: ○CT RCP ○MA MCP ○RGP

Reporting Limits:
Electonic Deliverables: ☐ Limit Checker ☐ Standard Excel ☐ Other (Please Specify →)

Company Name: Julianne Mamon
Contact Person: AECOM
City: Pocasset
State: MA
Telephone Number:
FAX Number:
Project #:
Project Name: Onians LF
Address: 9 Jonathan Bourne Dr
Zip Code: 02559
PO #:
Email Address: Julianne.Mamon@aecom.com

Analysis: TN, Ammonia | NO2, NO3, SO4, Cl | Diss Metals | 1,4 Dioxane

ESS Lab ID	Collection Date	Collection Time	Sample Type	Sample Matrix	Sample ID	TN, Ammonia	NO2, NO3, SO4, Cl	Diss Metals	1,4 Dioxane
1	03/29/17	1030	G	GW	MW-1S (56-66)	X	X	X	
2	03/29/17	1010	G	GW	MW-1D (99-109)	X	X	X	
3	03/29/17	1215	G	GW	MW-3S (50-60)	X	X	X	
4	03/29/17	1234	G	GW	MW-3D (84-94)	X	X	X	
5	03/29/17	1545	G	GW	MW-5S (78-88)	X	X	X	
6	03/29/17	1607	G	GW	MW-5D (124-134)	X	X	X	
7	03/29/17	1457	G	GW	MW-9 (92-102)	X	X	X	
8	03/29/17	1340	G	GW	MW-13 (74-84)	X	X	X	X
9	03/29/17	1625	G	GW	MW-11 (91-101)	X	X	X	X
10	03/29/17	1510	G	GW	MW-12 (87-97)	X	X	X	X
					Container Type	P	P	P	AG
					Container Volume	6	5	3	6
					Preservation Code	3	1	1	1
					Number of Containers per Sample	1	1	1	2

Container Type: AC-Air Cassette AG-Amber Glass B-BOD Bottle C-Cubitainer G - Glass O-Other P-Poly S-Sterile V-Vial

Container Volume: 1-100 mL 2-2.5 gal 3-250 mL 4-300 mL 5-500 mL 6-1L 7-VOA 8-2 oz 9-4 oz 10-8 oz 11-Other*

Preservation Code: 1-Non Preserved 2-HCl 3-H2SO4 4-HNO3 5-NaOH 6-Methanol 7-Na2S2O3 8-ZnAce, NaOH 9-NH4Cl 10-DI H2O 11-Ascorbic Acid 12-Other*

Laboratory Use Only

Cooler Present: ✓
Seals Intact: NA
Cooler Temperature: 5.2 °C ICE IR 15/13 3/29/17 2011

Sampled by: BKM

Comments: Please specify "Other" preservative and containers types in this space

Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)
[signature] 03/29/17 1910	[signature] 3/29/17 1910	[signature] 3/29/17 2001	[signature] 3/29/17 1954
Relinquished by: (Signature, Date & Time)	Received By: (Signature, Date & Time)	Relinquished By: (Signature, Date & Time)	Received By: (Signature, Date & Time)

Appendix B

Survey Data

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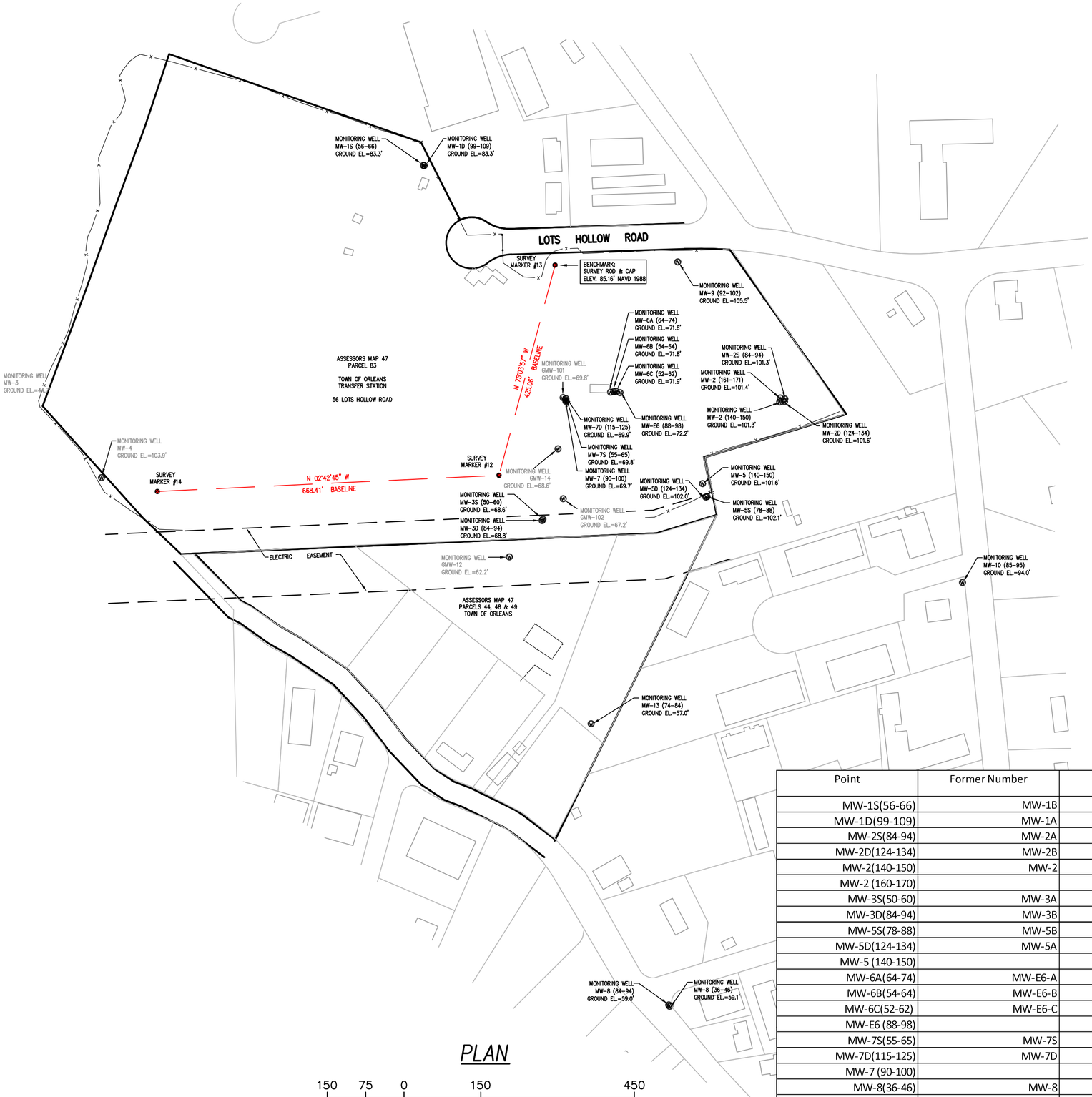

MASS. COORD. SYSTEM NAD 1983 MAINLAND ZONE

PLAN

150 75 0 150 450

1 inch = 150 ft.

Point	Former Number	Northing	Easting	Elevation (Top of Casing)	Elevation (Ground)
MW-1S(56-66)	MW-1B	2746376.912	1065411.951	85.18	83.3
MW-1D(99-109)	MW-1A	2746378.251	1065412.230	85.11	83.3
MW-2S(84-94)	MW-2A	2747083.146	1065868.116	101.49	101.3
MW-2D(124-134)	MW-2B	2747082.250	1065873.604	101.42	101.6
MW-2(140-150)	MW-2	2747072.948	1065874.231	102.80	101.3
MW-2 (160-170)		2747074.158	1065866.368	102.90	101.4
MW-3S(50-60)	MW-3A	2746610.267	1066103.468	70.32	68.6
MW-3D(84-94)	MW-3B	2746608.706	1066105.838	69.74	68.8
MW-5S(78-88)	MW-5B	2746930.990	1066059.285	103.91	102.1
MW-5D(124-134)	MW-5A	2746928.574	1066059.990	103.89	102.0
MW-5 (140-150)		2746922.228	1066033.688	103.60	101.7
MW-6A(64-74)	MW-E6-A	2746742.487	1065854.917	71.22	71.6
MW-6B(54-64)	MW-E6-B	2746749.138	1065854.084	71.40	71.8
MW-6C(52-62)	MW-E6-C	2746753.180	1065853.573	71.55	71.9
MW-E6 (88-98)		2746761.475	1065855.516	71.91	72.1
MW-7S(55-65)	MW-7S	2746655.371	1065870.865	71.64	69.8
MW-7D(115-125)	MW-7D	2746655.063	1065867.382	71.66	69.9
MW-7 (90-100)		2746655.240	1065873.239	71.44	69.7
MW-8(36-46)	MW-8	2746858.117	1067055.206	58.80	59.1
MW-8 (84-94)		2746856.254	1067052.383	58.80	59.2
MW-9(92-102)	MW-9	2746873.731	1065600.504	107.32	105.5
MW-10(85-95)	MW-10	2747430.262	1066227.000	93.69	94.0
MW-13 (74-84)		2746704.616	1066502.895	59.27	57.0
SM-14	SM-14	2745856.991	1066048.918		102.64
SM-12	SM-12	2746524.645	1066017.283		82.35
SM-13	SM-13	2746634.195	1065606.584		85.16

COASTAL engineering co.
260 Cranberry Hwy, Orleans, MA 02653
508.255.6511 P 508.255.6700 F

NO.	DATE	REVISION	BY

SEAL

PROJECT: AECOM — 56 LOT'S HOLLOW ROAD AND VICINITY — ORLEANS, MA

SHEET TITLE: WELL PLAN OF LAND

SCALE: AS NOTED

DRAWING FILE: C18470-00.dwg

DATE: REV 5/4/2017 ~~2/17/2017~~

DRAWN BY: BPM

CHECKED BY:

SKC-5A

1 OF 1 SHEETS

PROJECT NO. C17470.00

F:\SDSKPROJ\C18000\C18470\C18470-00.dwg May 04, 2017 - 8:21am