Revised Hydrogeologic Report: Groundwater Mounding Analysis for Proposed Subsurface Disposal System

Site:
Proposed Cascade Development
115 Boston Post Road
Wayland, MA

Prepared For:

Cascade Development Associates, LLC
c/o Eden Management, Inc.

Prepared by:

GEOSPHERE ENVIRONMENTAL MANAGEMENT INC.

51 Portsmouth Avenue, Exeter, NH 03833
Phone: 603-773-0075 Fax: 603-773-0077
Web: www.geospherenh.com

Project No. 17205

January 19, 2021

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
1.0 INTRODUCTION 1
2.0 SITE DESCRIPTION 2
3.0 SITE TOPOGRAPHY 2
4.0 SUBSURFACE INVESTIGATION 2
5.0 GROUNDWATER FLOW 5
6.0 ESTIMATED SEASONAL HIGH GROUNDWATER CONDITIONS 5
7.0 SURFACE WATER MEASUREMENTS 6
8.0 NUMERICAL MODELING USING MODFLOW 6
9.0 PROPOSED MONITORING PLAN 9
10.0 CONCLUSIONS 10

TABLES

Table 1 Subsurface Characteristics and Elevation Data
Table 2 Permeability Test Results
Table 3 Lithology Summary – Soil Borings
Table 4 Groundwater Elevation Data

FIGURES

Figure 1 Locus Map
Figure 1A Site Information Coordinate Map
Figure 2 Aerial Site Plan
Figure 3 Site Plan
Figure 4 Observed Groundwater Contours 4/6/2018
Figure 5 Simulated Estimated Seasonal High Groundwater Elevations
Figure 6 Simulated Estimated Mound Height and Breakout (80% of 11,000 gpd)
Figure 7 Depth to Mound Below Ground Surface (80% of 11,000 gpd)
Figure 8 90-day Mounded Groundwater Elevation (80% of 11,000 gpd)
Figure 9 Simulated Estimated Mound Height and Breakout (80% of 13,200 gpd)
Figure 10 90-day Mounded Groundwater Elevation (80% of 13,200 gpd)
Figure A Effluent Discharge System Profile (Draft, OnSite Engineering)
Figure B Groundwater Discharge Permit Site Plan (DEI)

APPENDICES

Appendix A Test Pit and Percolation Test Logs (DEP Forms 11 and 12)
Appendix B Soil Boring / Well Construction Logs, TJ Ogden Well Driller's Log (2003)
Appendix C Geotechnical Testing Laboratory Permeability and Sieve Test Results
Appendix D Groundwater Model Summary
Appendix E Response to Town of Wayland Comments dated June 30, 2020

EXECUTIVE SUMMARY

This *Revised Hydrogeological Report: Groundwater Mounding Analysis for Proposed Subsurface Disposal System at Cascade Development in Wayland, MA* summarizes the results of hydrogeologic field investigations and two-dimensional groundwater mounding analyses conducted in support of a proposed subsurface domestic wastewater disposal system at Cascade Development, Wayland, Massachusetts.

1.0 INTRODUCTION

Geosphere Environmental Management, Inc. (GEOSPHERE) is pleased to submit this Hydrogeological Report on behalf of Cascade Development, to predict and assess the impacts of a proposed subsurface domestic wastewater disposal system associated with the redevelopment of the former Mahoney Garden Center property located 115 (technically 113 – 119) Boston Post Road, Wayland, Massachusetts. The property is currently occupied by the former buildings of the Garden Center and a separate residential dwelling. An apartment building with 97 bedrooms is proposed.

The design flow for the proposed disposal system is calculated at 10,670 gallons per day (gpd) in accordance with Massachusetts Environmental Code Title 5 (110 gallons per day per bedroom, 97 bedrooms).

This report summarizes the field investigation conducted to collect hydrogeological data in support of a two-dimensional groundwater computer model, developed and calibrated for the site. The hydrogeologic assessment included: an evaluation of subsurface information collected from test pit excavations (percolation rates, depths to refusal and mottling and/or groundwater); installation of groundwater monitoring wells and advancement of soil test borings; laboratory permeability testing and sieve analysis of selected soil samples from test borings, and establishing an estimated seasonal high groundwater elevation table (ESHGW) for the site.

Once these pertinent hydrogeologic parameters were identified, a 2-dimensional groundwater flow model was developed to predict potential impacts of the proposed subsurface wastewater disposal system (SSDS) on the ESHGW surface, and the effects in relation to the ground surface and nearby surface waters. This Hydrogeological Report was performed in accordance with 314 CMR 5.09, MassDEP's *Guidelines for the Design, Construction, Operations and Maintenance of Small Wastewater Treatment Systems with Land Disposal*, July 2018 edition (GUIDELINES), and GEOSPHERE's Scope of Work (Revised, April 29, 2020) submitted to MassDEP.

2.0 SITE DESCRIPTION

The 6.4 acre site lies south of Boston Post Road, east of the intersection with Pine Brook Road, see **Figure 1**. The site is bisected by Pine Brook, which flows west, toward the Sudbury River. The portion of the property that is subject to this hydrogeologic study abuts Boston Post Road (Route 20) and lies to the north of Pine Brook, see **Figure 1A** and **Figure 2**. The area of the property south of Pine Brook is undeveloped, and will remain so under the Cascade proposal.

The site is comprised of two adjoining lots, Wayland Assessor's Map 30, Lots 70 and 71. The easternmost parcel is a 1.265 acre lot (Map 30, Lot 70) currently occupied by a two-story wood framed private residence and two-story barn. The buildings are located in the northeastern part of the site. The western parcel is a 5.217 acre lot (Map 30, Lot 71) currently occupied by buildings that previously served as the garden center's retail showroom and green houses. Existing utilities at the site include publicly-supplied subsurface water lines, overhead electricity and subsurface natural gas. On-site septic leach fields served the former garden center and residence. An on-site irrigation well served the garden center since 2003.

A residential apartment building is planned for the site, with sanitary domestic wastewater to be disposed in a leach field located in the central-east portion of the site. The leach field will encompass approximately 10,066 square feet (0.23 acre) and will be located a minimum of 100 feet from Pine Brook's riverbank edge and associated wetland boundary, as shown on **Figure 3**. Pine Brook is classified as a MassDEP cold water fishery headwater which flows westerly toward the Sudbury River.

3.0 SITE TOPOGRAPHY

The site topography generally slopes gently from east to west. Ground elevations on site range between 180 and 148 feet NAVD88. Topography across the proposed leach field area also slopes from east to west, with an elevation change of approximately 10 feet, from 167 – 177 feet NAVD88 (see **Figure 3)**.

4.0 SUBSURFACE INVESTIGATION

4.1 Test Pit Excavations

In December 2016 and January 2017, Onsite Engineering of Franklin, MA and a representative from the Town of Wayland Board of Health supervised the excavation of a series of 23 exploratory test pits on site. These test pits were performed to obtain subsurface soil and hydrologic information; specifically, to measure soil percolation rates for the SSDS design. The locations of all test pits completed at the site are depicted on **Figure 3** (with the exception of Test Pit OSE-TP-1 which was placed within the footprint of an existing foundation).

In June 2020, Onsite Engineering and representatives from the Town of Wayland Board of Health, MassDEP, and GEOSPHERE supervised the excavation of an additional 5 exploratory test pits on site within the footprint of the proposed leaching fields. These test pits were

performed to obtain additional soil samples for testing, soil percolation rates, depths to mottling, and observations of boulders and groundwater, where present, and to modify the hydrogeologic model of the subject area.

The ground elevation, redoximorphic ("mottling") depth and elevation, and total depth of each of the test pits, and the depth/elevation of "refusal" are summarized in **Table 1**. Logs of 28 test pits (OSE-TP-1 through OSE-TP-23, and MDEP-1 through MDEP-5) are documented on MassDEP Form 11, which can be found in **Appendix A** of this report. Percolation test results including date completed, total depth, percolation test results, and permeability test results are documented on MassDEP Form 12, which can also be found in **Appendix A** of this report.

4.2 Soil Borings and Observation/Monitoring Well Installation

In order to gain more information about the subsurface soils, on November 29, 2017 GEOSPHERE supervised the advancement of nine (9) soil borings at the site. The location of the soil borings and subsequent monitoring wells were reviewed and approved by the Wayland Board of Health. Seven of these soil borings were converted into permanent groundwater monitoring wells. The borings were drilled and monitoring wells were installed by Crawford Drilling Services of Westminster, Massachusetts using direct push/GeoProbe equipment. As a result of difficulty advancing the GeoProbe equipment at B-3, Crawford returned to the site with a hollow stem auger drill rig to complete this borehole and monitoring well. The locations of the soil borings and wells completed on site are shown on **Figure 2** and **Figure 3**.

GEOSPHERE's on-site geologist visually characterized soil samples and selected nine representative samples to be submitted for sieve testing (particle size distribution analysis) and hydraulic permeability analysis by GeoTesting Express of Acton, MA. A summary of sample IDs, depths, and permeability test results can be found in **Table 2**. Lab reports for all soil samples submitted for permeability and grain size analysis can be found in **Appendix C**.

Refusal (the inability to advance augers or drilling rods) was encountered at depths of 12 to 22 feet below ground surface (bgs). Although refusal may have been the result of the drilling tools unable to advance deeper into the silt layer encountered on site, it was assumed to be the depth at which the upper surface of weathered bedrock (ledge) or dense glacial till overlying bedrock was encountered.

Five of the soil borings were completed as groundwater monitoring wells using 2-inch diameter PVC slotted screen and riser. Monitoring wells MW-1, MW-3, MW-4, MW-5 and MW-7 were installed in test borings B-1, B-3, B-4, B-5 and B-7, respectively.

4.3 Site Stratigraphy and Hydrogeologic Characterization

During monitoring well installation activities, soil samples were collected and visually characterized by a GEOSPHERE geologist. At the completion of the drilling program, boring logs and well installation diagrams were prepared based on the visual soil descriptions. Boring / Well Construction Logs can be found in **Appendix B**.

The subsurface materials encountered in the boreholes can be described as 7 to 20 ft. of very permeable sand and gravel deposits, below which, a layer of very compact, cohesive silt was encountered in the eastern portion of the site, at B-1, B-3, B-4, B-5 and B-6. Each of the borings was advanced until conditions became too dense for the equipment to advance, referred to here as 'refusal'. The thickness of the silt layer was never fully penetrated by the GeoProbe at any of the borings. That is, the base of the silt layer, which is assumed to be either a glacial till or weathered bedrock (ledge) was not encountered in any of the borings. However, without further testing or confirmation of the bedrock surface, it was assumed that the "refusal" elevation in all borings or test pits on site represents the top of weathered bedrock (ledge) or glacial till.

Based upon the shallow depths to refusal encountered in Test Pits OSE-10, -12, -13, -20, -21 and Boring B-2, it appears that weathered bedrock or glacial till penetrates or rises upward through areas of the silt in the area of the proposed leaching fields, to depths as shallow as 3.75 feet bgs in OSE-10 and 6 feet in OSE-22. As described below, permeability testing of representative samples of the silt layer confirmed a very low permeability/conductivity (i.e., low ability to transmit water). Given the marked difference between the permeability of the sand and gravel deposits and those of the silt deposits, the mounding model assumed that the materials located beneath the base of the sand and gravel layer (Model Layer 1) comprise a very low permeability layer (Model Layer 2) consistent with cohesive silt (or dense glacial till or competent bedrock).

A 2003 well drillers log, completed by TJ Ogden, Inc. when an irrigation well was installed at the garden center, in the area of OSE-TP-14, reports that silt was encountered to a depth of about 5 ft. bgs, and was underlain by bedrock at 20 feet bgs, see **Appendix B**.

Table 3 presents a summary of the lithologic data encountered during drilling, including total borehole depth, the thickness of sand and gravel deposits, and elevations of the ground surface and the bottom of the sand and gravel layer (Model Layer 1).

5.0 GROUNDWATER FLOW

Top of casing and ground elevations at monitoring wells were surveyed by Beals and Thomas, Inc. of Southborough, MA in feet relative to North American Vertical Datum of 1988 (NAVD88). Using these elevations, depth to groundwater measurements (from top of casing) were converted to groundwater elevation data.

In order to observe and record groundwater elevations at their highest, 14 measurements were conducted between April 2018 and May 2020, with 11 measurements conducted over the course of 24 weeks in the spring of 2020. As shown in **Table 4**, the highest groundwater elevations for 4 of the monitoring wells were observed in April 2020, and in April 2018 for the other 2 monitoring wells.

Based solely on the groundwater measurements collected on April 6, 2018, a Groundwater Contour Map was generated (see **Figure 4**). As shown on **Figure 4**, groundwater contours indicate groundwater flow in a westerly direction in the overburden aquifer under a relatively uniform hydraulic gradient of 0.04, measured between MW-3 and MW-7 (an elevation change of 19.18 feet over a distance of 520 feet).

6.0 ESTIMATED SEASONAL HIGH GROUNDWATER CONDITIONS

The depth to groundwater measurements and groundwater elevation calculations were integrated with data from soil borings and test pit observations to construct a two-dimensional, finite difference (MODFLOW) computer model, described in further detail below. Technical details of the groundwater model are included in **Appendix D.**

The highest groundwater elevations observed in each monitoring well, as well as the depths/elevations to mottling in each of the witnessed test pits conducted on site, were used to calibrate the model to simulate seasonal high groundwater table conditions (see **Table 1** and highlighted values in **Table 4**). A simulated Estimated Seasonal High Groundwater (ESHGW) Contour Map is presented as **Figure 5**. As shown in *Figure 5* of **Appendix D** and the *Summary Table* on page 8 of **Appendix D**, the elevations of ESHGW at 24 of the 28 test locations were conservatively over estimated (negative differential value). The differential values ranged from +0.94 feet to -5.33 feet, with a mean differential value of -1.42 feet, indicating the Model conservatively overestimates the ESHGW surface across the site. As a result, any modeled areas of breakout (where the mounded ESHGW surface rises above the ground surface as a result of the proposed discharge), especially areas of modeled breakout of less than one foot in height are, in reality, likely to be significantly less in height.

7.0 SURFACE WATER MEASUREMENTS

In January 2018, an elevation and location survey of Pine Brook was conducted by Beals & Thomas Engineers, in the area adjacent to the site. In addition to streambed elevations, surface water elevations (WS#1 – WS#13) were collected.

In November 2019, an additional three surface water elevations (WS#1 – WS#3) were collected by Doyle Engineering, Inc. to further evaluate seasonal levels of surface water in Pine Brook. The locations of the measurements are shown in **Figure 2** and **Figure 3**.

Table 1, **Figure 4** and **Figure 5** present the surface water elevation locations and measured elevation data. The surface water elevations were incorporated into the Groundwater Model as described in **Appendix D**.

8.0 NUMERICAL MODELING USING MODFLOW

A two-dimensional groundwater model was developed on the MODFLOW platform using the groundwater and subsurface data collected at the site. The model was designed to:

- Simulate an Estimated Seasonal High Groundwater (ESHGW) surface / elevation contours;
- Simulate the effects of the proposed subsurface disposal system's discharge on the ESHGW surface, by superimposing the mound created by 90 days of continuous discharge of 80% of the disposal system's design flow (i.e., "90-day mound height") onto the ESHGW surface, creating a 90-day simulated head groundwater contour;
- Evaluate the potential for breakout (simulated groundwater contours vs. current ground elevations);
- Assess the potential effects (mound height/discharge, and groundwater flux/contribution) of the proposed disposal system on Pine Brook.

Model Construction

As described above, and in **Appendix D**, the model simulated two lithologic units in the subsurface: Layer 1, representing the highly permeable sand and gravel deposits, and Layer 2, representing underlying low permeability (or low conductivity) materials (silt, till, or bedrock). The surficial layout of the model development is shown on *Figure 1* of **Appendix D**. Ground surface elevation, the leach field locations, the Pine Brook river bank, as well as surface water elevation/location data, and data point locations for all test pits and soil borings/monitoring wells are presented in *Figure 1*.

Based on the elevation data presented in **Table 1** and **Table 3** for the bottom of the sand and gravel layer (Layer 1), *Figure 2* of **Appendix D** presents the modeled elevation contours for the bottom of Layer 1. *Figure 3* of **Appendix D** presents a cross-section of the model, showing the rise in the elevation of Layer 2 in the area of the leach fields as a result of incorporating recorded refusal depths in five (5) of the test pits, and the top of the silt layer and/or refusal encountered in

the soil borings.

Simulated ESHGW

Based on the permeability test results summarized in **Table 2**, hydraulic conductivity values were selected and distributed as shown on *Figure 4* of **Appendix D**. As described in **Appendix D**, model calibration was performed to create an estimated seasonal high groundwater (ESHGW) surface that conservatively incorporate the observed ESHGW levels in monitoring wells, as well as mottled soil elevations and surface water elevations in Pine Brook. The residuals between the computed ESHGW values and the observed ESHGW values area presented in the *Summary Table*, and *Figure 5 and Figure 6* in **Appendix D**. **Figure 5**, attached, presents the simulated ESHGW elevations for the site in comparison to the observed elevations measured in the monitoring wells and the measured/surveyed surface water elevations.

Simulated Discharge Effects on Groundwater

Upon calibration of the groundwater model, a continuous discharge of 80% of the design flow (11,000 gallon per day, gpd) into the leach fields was simulated over 90 days. The size of the leaching field was determined by Onsite Engineering, based on the MassDEP *Guidelines for the Design, Construction, Operations and Maintenance of Small Wastewater Treatment Systems with Land Disposal*, July 2018 edition (GUIDELINES).

The leaching system is comprised of Infiltrator Standard high density plastic leaching chambers configured in continuously dosed perforated lateral chamber trenches. Based on the June 12, 2015 MassDEP Innovative/Alternative (I/A) technology approval for using standard chambers in a trench configuration for new construction, each chamber provides 6.53 square feet (SF) of leaching area per chamber Linear Foot (LF).

As noted in the soil information presented herein, the approved percolation test rate for the sand parent material observed in the witnessed test pits was 2 minutes per inch (MPI). As shown in Table 3 of the GUIDELINES, the maximum allowed Long Term Acceptance Rate (LTAR) for chambers with a less than 2 MPI perc rate is 3.0 gallons per day (gpd) per square foot (SF) of leaching. Furthermore, as required in the GUIDELINES, the proposed trenches are spaced with three times their effective width between them to account for the ability to install a future reserve area if required. As the Infiltrator Standard chamber has an effective width of 34-inches, the minimum separation between trenches, as shown on leaching field layout in the DEI site plan, is 102-inches, or 8.5-feet.

Based upon these design parameters, the effluent field was configured such that there are a total of 10 trenches, spaced at least 8.5-feet apart. As the system will be pressure dosed in accordance with the current edition of the MassDEP pressure dosing guidelines for septic system leaching fields, trenches of varied length are feasible for this leaching area. The following design parameters was used to complete the sizing of the field.

Cascade Effluent Disposal Area Schedule of Elevations										
	Trench Number									
	1	2	3	4	5	6	7	8	9	10
Trench Length (ft)	*56*	*56*	*56*	*60*	*68*	*68*	*68*	*68*	*68*	*68*
Estimated M-ESHGW Elev.	168.85	169.25	169.4	169.8	170.1	170.75	171.1	171.6	172.3	172.6
Bottom of Trench Elev.	173	173.5	174	174.25	174.5	175	175.5	176.25	176.35	176.75
Actual M-ESHGW Separation	4.15	4.25	4.6	4.45	4.4	4.25	4.4	4.65	4.05	4.15
Top of Trench (breakout) Elev.	174.25	174.75	175.25	175.5	175.75	176.25	176.75	177.5	177.6	178
Approximate Finish Grade	175.25	175.75	176.25	176.5	176.75	177.25	177.75	178.5	179.1	179.8

Based on the information presented above, there is a proposed total of 636 linear feet of chambers provided. Given the allowable loading rate of 6.53 SF/LF, that results in a leaching capacity of 4,153 SF. At the maximum allowed LTAR of 3 gpd/SF, the proposed leaching system provides an effective leaching capacity for up to 12,459 gpd, which exceeds the requested Title 5 design flow of 11,000 gpd. As a result, there is a factor of safety built into the capacity of the system and our analysis herein.

Based upon the resulting layout of the proposed leaching system as shown in the attached DEI site plan, the resultant mound generated by the even discharge of 8,800 gpd over the footprint of the leaching field is shown on **Figure 6.** As shown on **Figure 6**, the maximum height of the groundwater mound slightly exceeds 0.35 feet (max. = 0.36 feet) above existing groundwater elevations in the area beneath the leach fields, and the mound height at the top of the river bank of Pine Brook does not exceed 0.1 feet (max. = 0.07 feet [0.84 in.]). As simulated breakout of the mound is modeled to occur above the current ground surface only in areas beneath the leaching field footprint, the construction of the raised leaching bed (as shown in the attached site plan and cross section figures) eliminates the possibility of actual breakout under these modeled conditions.

Figure 7 presents conservative simulated contours of depth to the groundwater mound (below ground surface). The deeper depths located to the southeast of the leach fields are the result of a mound of topsoil on the ground surface at the site not shown on the LIDAR surface elevations depicted on *Figure 1* of **Appendix D**.

Figure 8 presents the 90-day mounded groundwater elevation contours which represents the simulated groundwater mound resulting from the simulated discharge superimposed onto the simulated ESHGW surface. Based upon the mounded estimated season high groundwater contours developed herein, the leaching system profile elevations detailed above were generated. This information was then used to complete the leaching field layout and grading, as shown in the attached **Figure B** - **Site Plan** (DEI) and in the attached cross-section: **Figure A – Effluent Disposal System Profile** (Onsite Engineering).

To further evaluate the effects of increased sanitary discharge into the subsurface on site, the groundwater model simulated the effect of a 90-day continuous discharge of 80% of 13,000 gpd (10,400 gpd), which represents the design flow for approximately 120 bedrooms (at 110 gallons per day per bedroom). The resultant mound heights, breakout heights, and 90-day mounded groundwater surface elevation contours are presented in **Figure 9** and **Figure 10**. The conservative model also predicts mound breakout at discrete locations underlying the leach

fields. Breakthrough of less than 0.47 ft. (< 6 inches) is predicted by the model; see **Figure 9**.

In both cases we believe the conservative ESHGW calibration is generating higher predicted groundwater elevations than we expect will occur.

Simulated Effects on Pine Brook

The groundwater model was used to predict Mass Balance effects from the proposed SSDS. To assess the changes in ambient groundwater flow in the vicinity of the leach fields, a water budget was calculated for a (rectangular) zone which occupies the majority of the site area northeast of and including Pine Brook (see *Table 1* in **Appendix D**).

The modeled volume of water discharged into Pine Brook is predicted to increase by 5% from 10,101 cubic feet per day (cfd) predicted under low estimated flow conditions, to 10,592 cfd with the addition of the proposed groundwater discharge.

9.0 PROPOSED MONITORING PLAN

The following is a list of proposed monitoring locations, frequency for monitoring, and water quality parameters designed to monitor the effects of the subsurface sanitary wastewater discharge on groundwater quality and surface water quality downgradient of the discharge.

Monitoring ID	**Location (see Figure 2 and Figure 3)**
MW-3	Existing Upgradient Monitoring Well
MW-5, MW-6	Existing Downgradient Monitoring Wells
SW-U	Proposed Upgradient Stream Sampling Location
SW-M	Proposed Mid-Stream Sampling Location

Water Quality Parameter	Frequency
Temperature	Monthly
pH	Monthly
Specific Conductance	Monthly
Water Levels	Monthly (Monitoring Wells)
Nitrate-Nitrogen	Quarterly
Total Nitrogen	Quarterly
Total Phosphurus	Quarterly
Orthophosphate	Quarterly

10.0 CONCLUSIONS

The conservative MODFLOW groundwater flow model simulation predicts that the modeled subsurface discharge of 8,800 gpd (80% of 11,000 gpd) over 90 days into the leach fields results in a maximum groundwater mounding effect of 0.36 ft. during ESHGW periods. Due to the shallow ambient groundwater table conditions at the site, as well as the conservative methods to simulate the estimated seasonal high groundwater surface (ESHGW), the two-dimensional model predicted groundwater would break-out at ground surface beneath the leach fields, only, with a maximum breakout height of 0.41 feet. Minimum separation between predicted groundwater mounding and ground surface elevation can be achieved through grading and elevated leach field construction (see attached **Figure B - Site Plan** and **Figure A – Effluent Disposal System Profile**).

The conservatively-simulated maximum mound effect at the boundary of the top of the riverbank at Pine Brook is less than 0.1 ft. (0.84 inches). The actual edges of the stream are located several feet laterally from the top of riverbank edge shown on the Figures. The modeled discharge effects on Pine Brook (up to a 5% increase in flow) are not considered to pose deleterious effects on stream flow, or biota, including trout.

Mass DEP personnel have indicated to GEOPSPHERE that temperature effects from domestic sanitary discharges into subsurface leach fields are not expected to raise ambient groundwater conditions outside the leach field footprint. Based upon the 100-foot separation distance of the leach fields to Pine Brook and its associated wetlands area, no deleterious temperature effects to the environment are anticipated.

TABLES

TABLE 1
Subsurface Characteristics and Elevation Data
Cascade Development
113-121 Boston Post Road - Wayland, MA

MONITORING WELLS

Monitoring Point ID	Date Installed	Ground Elevation	Y Coordinate (Mass. State Plane Feet)	X Coordinate (Mass. State Plane Feet)	Depth to Silt Layer or Refusal (ft)	Elevation of Top of Silt Layer or Refusal	Top of PVC Casing Elevation	Measured Depth to Groundwater on 4/6/2018 (ft btpvc)	Groundwater Elevation on 4/6/2018	Measured Depth to Groundwater on 4/28/2020 (ft btpvc)	Groundwater Elevation on 4/28/2020	(Max) Observed ESHGW Elevation
B-1/MW	11/29/2017	171.61	2956265.477	699144.4452	15.0	156.6	171.29	2.52	168.77	1.72	169.57	169.57
B-2	11/29/2017	175.7	2956255.458	699262.6962	14.0	161.7	-	-	-	-	-	-
B-3/MW	11/29/2017	177.32	2956051.3992	699265.7829	20.0	157.3	179.06	6.04	173.02	6.04	173.02	173.02
B-4/MW	11/29/2017	169.35	2956032.8306	699127.0892	10.0	159.4	171.68	3.98	167.70	3.57	168.11	168.11
B-5/MW	11/29/2017	171.25	2955893.7055	699173.2962	11.0	160.3	173.52	4.40	169.12	3.87	169.65	169.65
B-6/MW	11/29/2017	166.77	2956001.8683	699015.1444	7.0	159.8	168.47	3.38	165.09	3.05	165.42	165.42
B-7/MW	11/29/2017	157.86	2956139.5946	698789.6995	12	145.9	160.15	6.31	153.84	6.36	153.79	153.84
B-8	11/29/2017	157.6	2956235.1587	698781.6970	15	142.6	-	-	-	-	-	-
B-9	11/29/2017	171.2	2956194.7869	699156.7560	12	159.2	-	-	-	-	-	-

SURFACE WATER LOCATIONS

Surface Water Point ID	Date Surveyed	Streambed Elevation	Y Coordinate (Mass. State Plane Feet)	X Coordinate (Mass. State Plane Feet)	Surface Water Elevation
WS #1	Jan-18	144.8	2956109.1958	698685.3174	145.28
WS #2	Jan-18	147.36	2956100.5665	698753.1219	147.99
WS #3	Jan-18	154.68	2956076.5298	698816.6551	155.06
WS #4	Jan-18	157.36	2956070.0752	698895.8188	158.07
WS #5	Jan-18	160.12	2956052.4194	698960.3737	160.42
WS #6	Jan-18	163.39	2955938.2785	699006.0198	163.6
WS #7	Jan-18	165.23	2955898.1130	699043.1173	165.62
WS #8	Jan-18	166.84	2955855.1280	699112.3767	167.05
WS #9	Jan-18	167.64	2955862.6007	699163.8170	168.45
WS #10	Jan-18	168.81	2955848.0270	699192.6347	169.07
WS #11	Jan-18	170.19	2955827.8512	699247.5922	170.58
WS #12	Jan-18	172.38	2955796.7474	699309.2261	172.68
WS #13	Jan-18	174.15	2955761.903	699394.5205	174.88
1	Nov-19	-	2956101.813	698788.6385	151.32
2	Nov-19	-	2955996.21	698998.8976	162.17
3	Nov-19	-	2955861.246	699185.4789	168.21

TEST PITS

Test Pit ID	Date Installed	Ground Elevation	Y Coordinate (Mass. State Plane feet)	X Coordinate (Mass. State Plane feet)	Depth to Refusal (ft)	Refusal Elevation	Test Pit Depth (inches)	Test Pit Depth (ft)	Depth to Mottles (inches)	Observed ESHGW Elevation (Mottles)
OSE-TP 1	12/13/2016	-	-	-						
OSE-TP 2	12/13/2016	169.2	2956288.8242	699043.6544			108	9.00	38	166.0
OSE-TP 3	12/13/2016	164.2	2956254.7421	698887.7175			105	8.75	58	159.4
OSE-TP 4	12/13/2016	163	2956300.6732	698868.8230			106	8.83	55	158.4
OSE-TP 5	12/13/2016	159	2956269.4268	698716.1801			132	11.00	90	151.5
OSE-TP 6	12/13/2016	174.1	2956263.5567	699210.2769			108	9.00	39	170.9
OSE-TP 7	12/13/2016	169	2955999.0869	699108.9065			156	13.00	42	165.5
OSE-TP 8	12/13/2016	169	2956032.7831	699106.2188			120	10.00	34	166.2
OSE-TP 9	12/13/2016	170.7	2955990.4408	699189.0418			120	10.00	31	168.1
OSE-TP 10	12/13/2016	172.6	2956051.8904	699194.0570	3.75	168.85	45	3.75	Not Observed	-
OSE-TP 11	12/13/2016	171.9	2956035.3286	699198.1233			101	8.42	36	168.9
OSE-TP 12	12/13/2016	171.9	2956098.8513	699189.8760	*12.0	159.90	144	12.00	57	167.2
OSE-TP 13	12/13/2016	172.5	2956168.4763	699186.1268	10.42	162.08	125	10.42	54	168.0
OSE-TP 14	12/13/2016	169.7	2956110.4412	699123.8650			120	10.00	36	166.7
OSE-TP 15	12/13/2016	170.6	2956220.8622	699128.0425			120	10.00	60	165.6
OSE-TP 16	12/13/2016	177.3	2955993.0562	699277.8840			98	8.17	Not Observed	-
OSE-TP 17	1/12/2017	178.2	2955968.2462	699315.9860			137	11.42	57	173.5
OSE-TP 18	1/12/2017	175	2955963.3805	699255.1932			132	11.00	Not Observed	-
OSE-TP 19	1/12/2017	177	2956079.2441	699295.3133			120	10.00	42	173.5
OSE-TP 20	1/12/2017	168.8	2955963.2170	699097.3847			120	10.00	43	165.2
OSE-TP 21	1/12/2017	171	2955954.6637	699195.1384	7.00	164.00	84	7.00	36	168.0
OSE-TP 22	1/12/2017	172	2956011.5541	699214.2689	6.00	166.00	72	6.00	57	167.3
OSE-TP 23	1/12/2017	170	2955982.9862	699145.3471			96	8.00	36	167.0
MDEP - 1	6/16/2020	176.69	2956002.0896	699244.6151			84	7.00	Not Observed	-
MDEP - 2	6/16/2020	168.54	2956051.4820	699101.0544			101	8.42	34	165.7
MDEP - 3	6/16/2020	168.79	2956004.1908	699110.3752			90	7.50	31	166.2
MDEP - 4	6/16/2020	172.81	2956036.9763	699211.3145			90	7.50	25	170.7
MDEP - 5	6/16/2020	170.65	2956003.0219	699174.2657			86	7.17	Not Observed	-

Notes:
Elevations based on Survey by Beals & Thomas, Southborough, MA, or MassGIS LiDAR
Elevations in feet relative to NAVD88 datum
Depths are below ground surface
btoc = Below top of PVC casing
- = Data unavailable/not measured
* = Refusal listed as boulder or ledge
= Depth to Refusal/(assumed)Bedrock
> = No mottling observed (too shallow, or disturbed materials)

TABLE 2
Permeability Test Results
Cascade Development
115 Boston Post Road - Wayland, MA

Location ID	B1	B2	B3		B4		B5		B6	B7	B8	B9	MDEP-1	MDEP-4
Total Depth (ft)	17	14	22		14.5		18.5		13	12	18	12	7	7.5
Sand & Gravel Observed Depth	0 - 15 ft	0 - 14 ft	0 - 20 ft		0 - 10 ft		0 - 11 ft		0 - 7 ft	0 - 12 ft	0 - 15 ft	0 - 12 ft	0 - 7 ft	0 - 7.5 ft
Silt Observed Depth	15 - 17 ft	ne	20 - 22 ft		10 - 14.5 ft		11 - 18.5 ft		7 - 13 ft	ne	15 - 18 ft	ne	ne	ne
Well Installed?	Yes	No	Yes		Yes		Yes		No	No	No	No	No	No
Permeability Sample ID and Depth (ft)	**S1&S2 4-15 ft**	**Insufficient Volume**	**S20 0-5 ft**	**S6 5-10 ft**	**S12 5-10 ft**	**S13 10-14.5 ft**	**S9 5-10 ft**	**S10 11-18.5 ft**	**Insufficient Volume**	**Insufficient Volume**	**S16 5-13 ft**	**S19 5-12 ft**	**TP-1 0-7 ft**	**TP-4 0-7.5 ft**
Material Description from Boring Log	Silty Sand w/Gravel		Silty Sand w/Gravel	Silty Sand w/Gravel	Sand w/Gravel	Silt	Sand w/Gravel	Gravely Silt w/Sand			Sand w/Gravel	Sand w/Gravel		
Permeability Result (cm/sec)	1.8×10^{-2}		1.4×10^{-2}	1.1×10^{-1}	1.4×10^{-2}	2.4×10^{-6}	1.1×10^{-2}	9.6×10^{-7}			5.2×10^{-2}	3.8×10^{-2}	3.2×10^{-2}	2.9×10^{-2}
k (cm/sec)	0.018		0.014	0.11	0.014	0.0000024	0.011	0.00000096			0.052	0.038	0.032	0.029
(0.03281 ft/cm)*(86400 sec/day)	2835		2835	2835	2835	2835	2835	2835			2835	2835	2835	2835
k (ft/day)	51.0		39.7	311.9	39.7	0.0068	31.2	0.0027			147.4	107.7	90.7	82.2
Borehole Avg. k (ft/day)	51		176		40		31				147	108	91	82
Total Borehole Avg. k (ft/day) (9 samples)	91													

	Average Hydraulic Conductivity (K) of Sand & Gravel In Study Area (9 Samples*)	Average Hydraulic Conductivity (K) of Sand & Gravel in Leach Field Area (3 Samples**)	Average Hydraulic Conductivity (K) of Sand & Gravel in Surrounding Leach Field Area (5 Samples***)	Average Hydraulic Conductivity (K) of Silt Layer in Study Area (2 Samples****)	Hydraulic Conductivity (K) Value Used in MODFLOW Model for Sand & Gravel in Leach Field and Surrounding Area	Hydraulic Conductivity (K) Value Used Near Stream / B5 & B7 Area	Hydraulic Conductivity (K) Value Used Near Stream / B6 Area	Hydraulic Conductivity (K) Value Used in MODFLOW Model for Refusal Layer (Silt/Bedrock)
Permeability Result (cm/sec)	3.5×10^{-2}	2.5×10^{-2}	4.7×10^{-2}	1.7×10^{-6}	**Layer 1 - Zone 1**	**Layer 1 - Zone 3**	**Layer 1 - Zone 4**	**Layer 2**
k (cm/sec)	0.0353	0.025	0.0466	0.00000168				
(0.03281 ft/cm)*(86400 sec/day)	--	--	--	--	--	--	--	--
k (ft/day)	100	71	132	0.0048	**135**	**70**	**30**	**0.001**
Borehole Avg. k (ft/day)	--	--	--	--	--	--	--	--
Total Borehole Avg. k (ft/day) (9 samples)	--	--	--	--	--	--	--	--

Notes:
Sieve Analysis results for S-7, S-11, S-15 and S-17 included with permeability results in Appendix C.
Boring Samples Collected November 29-30, 2017
Test Pit Samples Collected June 16, 2020

* = Based on average K (ft/day) of samples S1&S2, S20, S6, S12, S9, S16, S19, TP-1, and TP-4
** = Based on average K (ft/day) of samples S12, TP-1, and TP-4
*** = Based on average K (ft/day) of samples S1&S2, S20, S6, S16, and S19
**** = Based on average K (ft/day) of samples S13, and S10

TABLE 3
Lithology Summary Table - Soil Borings
Cascade Development
115 Boston Post Road - Wayland, MA

Soil Boring ID	Total Borehole Depth (ft bgs)	Thickness of Topsoil, Fill and Sand & Gravel Layer) (ft)	Thickness of Silt Layer (ft) (if encountered)	Ground Elevation	Elevation of Bot. Sand & Gravel Layer / Top of Silt/Refusal Layer
B-1/MW	17	15	2	171.6	156.6
B-2	14	14	ne	175.7	161.7
B-3/MW	22	20	2	177.3	157.3
B-4/MW	14.5	10	4.5	169.4	159.4
B-5/MW	18.5	11	7.5	171.3	160.3
B-6/MW	13	7	6	166.8	159.8
B-7/MW	12	12	ne	157.9	145.9
B-8	18	15	3	157.6	142.6
B-9	12	12	ne	171.2	159.2
Irr. Well *	860	5	15		

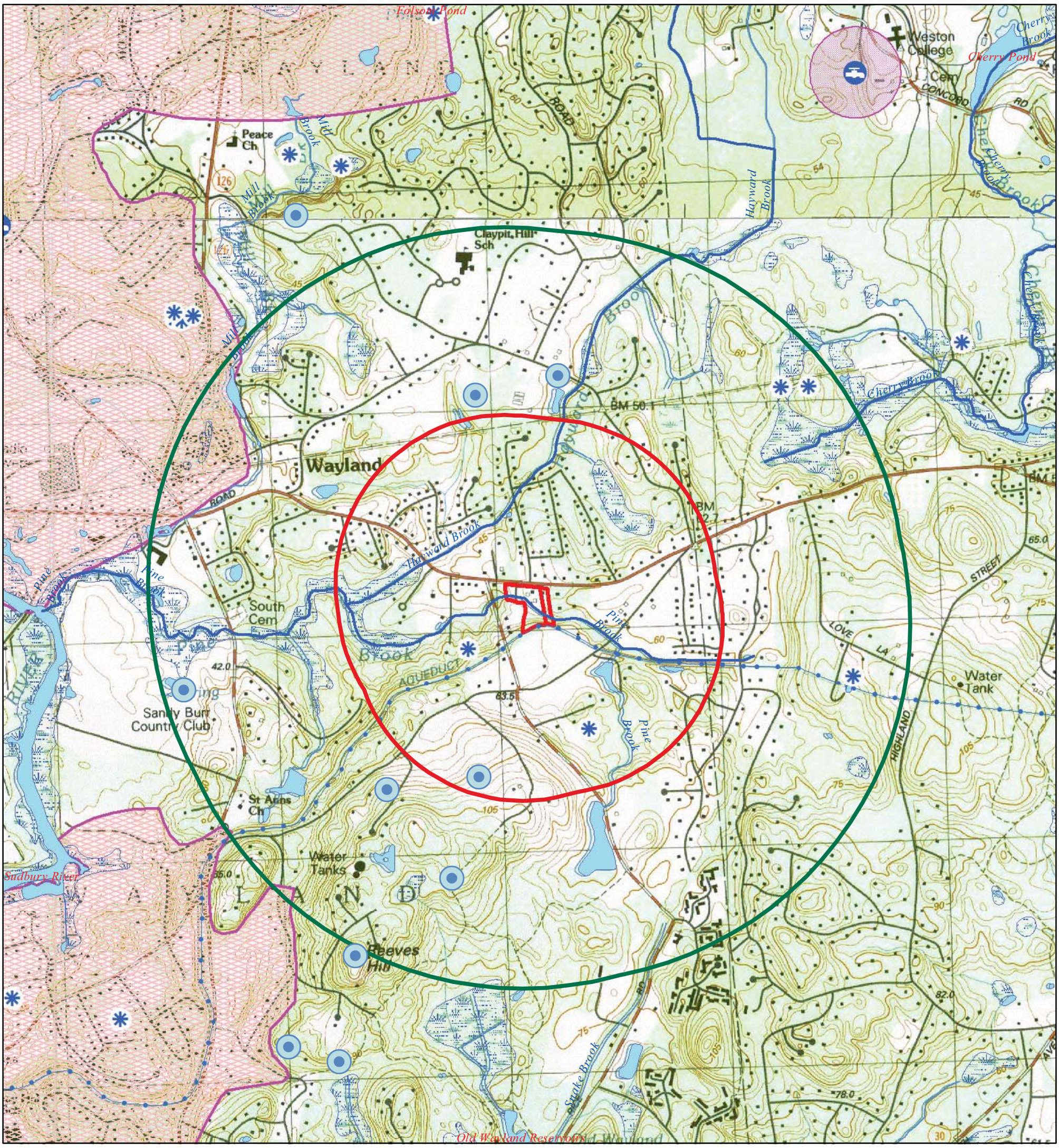
Notes:
bgs = below ground surface
Elevations in feet (ft) in reference to North American Vertical Datum of 1988 (NAVD88)
ne = Refusal (assumed to be bedrock/ledge) encountered. Silt not encountered.
Elevations based on survey by Beals and Thomas, or MassGIS LiDAR.
* = Information from Well Completion Report of Bedrock Irrigation Well installed by T.J. Ogden in January 2003

TABLE 4
Groundwater Elevation Data
Cascade Development
113-121 Boston Post Road - Wayland, MA

			Date of Measurement													
			4/6/2018	11/11/2019	3/6/2020	3/13/2020	3/20/2020	3/27/2020	3/30/2020	4/2/2020	4/5/2020	4/8/2020	4/10/2020	4/15/2020	4/28/2020	5/17/2020
Monitoring Well ID	**Ground Elevation**	**Top of PVC Elevation**	**Groundwater Elevation**													
MW-1	171.61	171.29	168.77	166.13	166.13	168.34	168.54	168.58	168.79	168.94	169.14	169.09	169.43	169.52	**169.57**	169.43
MW-3	177.32	179.06	**173.02**	168.8	168.8	171.44	171.4	171.92	172.1	172.24	172.76	172.82	173.02	172.95	172.96	172.31
MW-4	169.35	171.68	167.7	166	166	166.87	167.07	167.25	167.72	167.3	167.82	167.52	167.87	167.71	**168.11**	167.27
MW-5	171.25	173.52	169.12	167.92	167.92	168.39	168.55	168.81	169.19	168.85	169.31	169.03	169.27	169.28	**169.65**	168.84
MW-6	166.77	168.47	165.09	163.98	163.98	164.57	164.79	164.83	165.23	164.85	165.17	164.88	165.21	165.07	**165.42**	164.76
MW-7	157.86	160.15	**153.84**	152.96	152.96	152.75	153.1	153.26	153.65	153.22	153.64	153.23	153.52	153.39	153.79	152.93

Notes:
Elevation in feet above vertical datum (NAVD88)
Depth to groundwater measurements from top of PVC riser collected on date shown, and converted to elevation by subtracting from PVC elevation
Shaded Value = Highest measured groundwater elevation = Observed Estimated Seasonal High Groundwater (ESHGW) Elevation

FIGURES



Legend

- 2,500 Foot Property Radius
- 1 Mile Property Radius
- EPA/RCRA-regulated Hazardous Wazste Site
- MA-regulated Hazardous Waste Site
- MA and EPA/RCRA-regulated Hazardous Waste Site
- Private Wells (Mass. EEA Data Portal)
- Community Groundwater Source
- NHESP Certified Vernal Pools
- MA DFW Coldwater Fisheries Resources
- Other Stream
- Aqueduct
- Pond/Lake
- Wetland
- DEP Approved Zone II
- IWPA
- Property Boundary

0 1,500 3,000 4,500 6,000 Feet

N W E S

GEOSPHERE ENVIRONMENTAL MANAGEMENT INC.

FIGURE 1

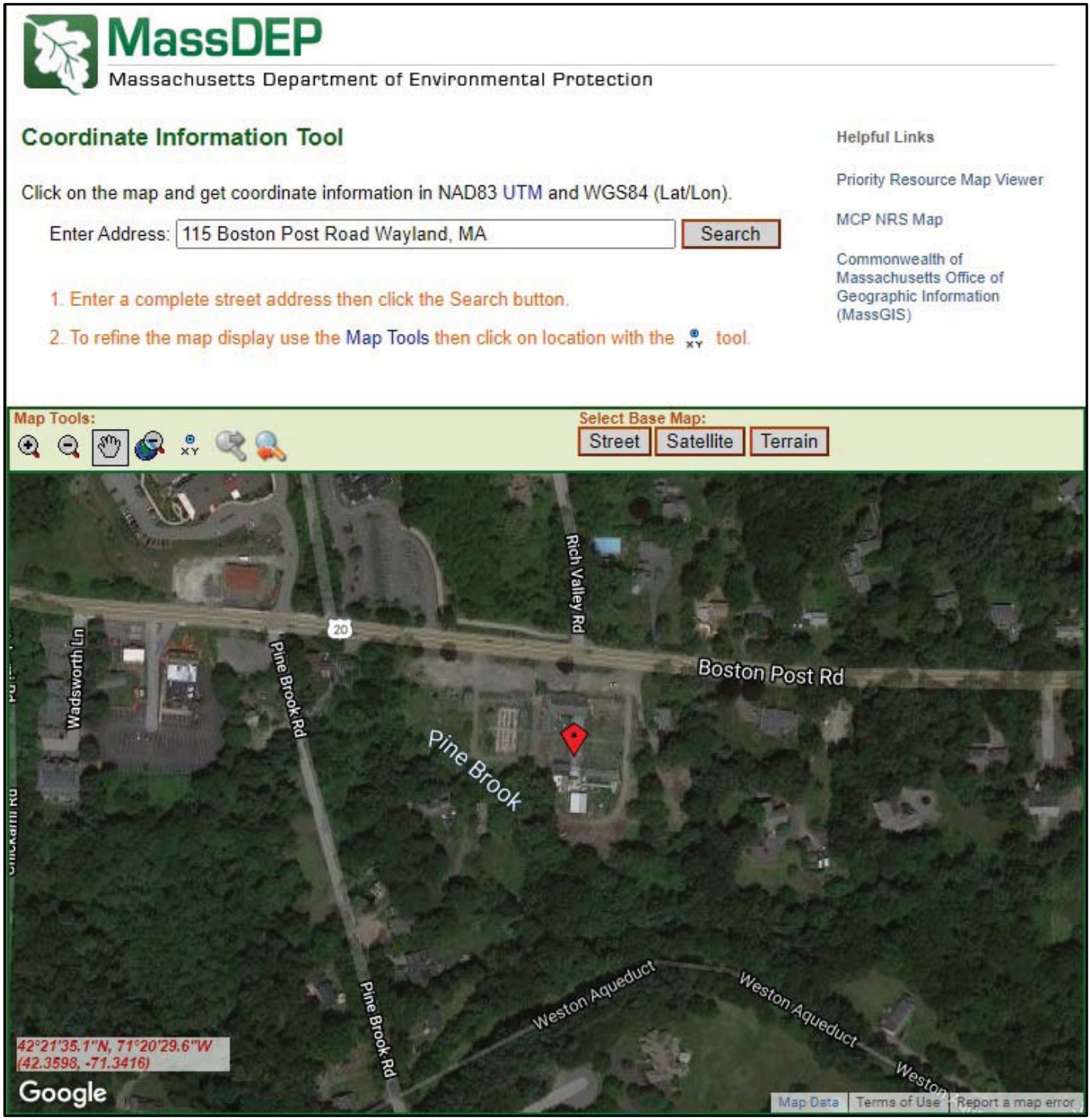
SITE LOCUS

Cascade Wayland
115 Boston Post Road
Wayland, MA

CREATED BY:	CHECKED BY:	PROJECT:
Matt Krapf 12/21/2020	Dave Niemeyer 12/21/2020	17205.1\FIGURES\ 2020_Report

Data Source: MassGIS (Bureau of Geogrpahic Information). Massachusetts EEA Data Portal.

FIGURE 1A
BRP WP 83 – SITE INFORMATION COORDINATE MAP



PROPOSED DISCHARGE LOCATION NARRATIVE:

The property is located at 115 Boston Post Road in Wayland, MA, on the southern side of Boston Post Road. The proposed discharge location is approximately 265 – 355 feet south of the center line of Boston Post Road, and greater than 100 feet north of Pine Brook.

Legend

- Borehole
- Monitoring Well
- OnSite Test Pits
- Stream Surface Survey - Jan. 2018
- Stream Surface Survey - Nov. 2019
- Irrigation Well (Approx.)
- River_Bank
- Wetland Boundary
- Revised 2020 Leachfield
- OnSite/MDEP Test Pits - June 2020
- Property Boundary

0 40 80 160 240 320 400 Feet

N W E S

GEOSPHERE ENVIRONMENTAL MANAGEMENT INC.

FIGURE 2

AERIAL SITE PLAN

Cascade Wayland
115 Boston Post Road
Wayland, MA

CREATED BY:	CHECKED BY:	PROJECT:
Matt Krapf 12/21/2020	Dave Niemeyer 12/21/2020	17205.1\FIGURES\ 2020_Report

Data Source: MassGIS (Bureau of Geogrpahic Information).
Imagery Date: 2019.

Legend

- Borehole
- Monitoring Well
- OnSite Test Pits
- Stream Survey Location - Jan. 2018
- Proposed Surface Water Quality Monitoring Location
- Stream Surface Survey - Nov. 2019
- Irrigation Well (Approx.)
- Suface Topography (1-ft interval)
- River_Bank
- Wetland Boundary
- Revised 2020 Leachfield
- OnSite/MDEP Test Pits - June 2020
- Existing Buildings
- Property Boundary

0 40 80 160 240 320 400 Feet

N W E S

GEOSPHERE ENVIRONMENTAL MANAGEMENT INC.

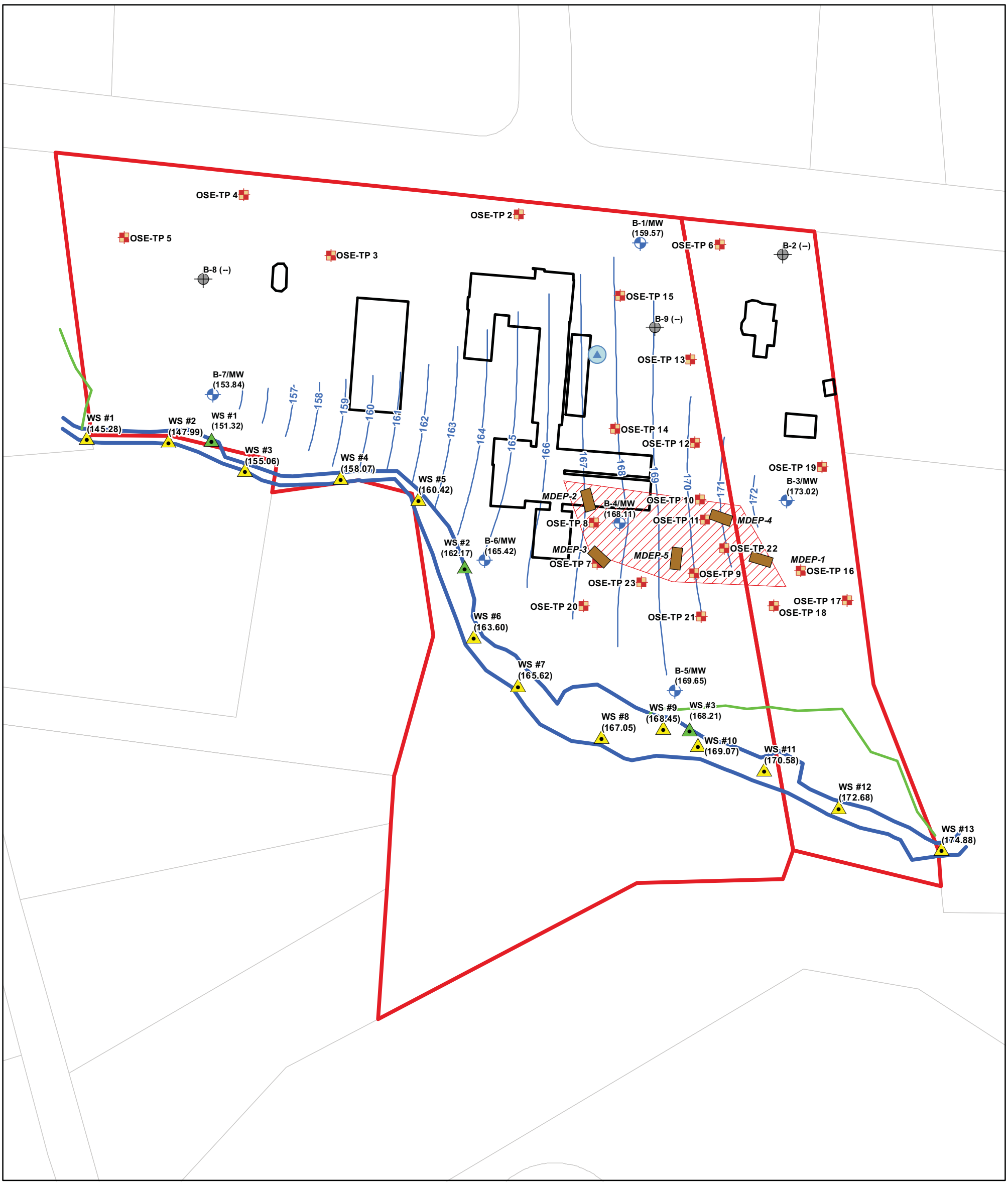
FIGURE 3

SITE PLAN

Cascade Wayland
115 Boston Post Road
Wayland, MA

CREATED BY:	CHECKED BY:	PROJECT:
Matt Krapf 12/16/2020	Dave Niemeyer 12/16/2020	17205.1\FIGURES\ 2020_Report

Data Source: MassGIS (Bureau of Geogrpahic Information). Imagery Date: 2019. Ground elevation survey: Beals & Thomas, Southborough, MA. Elevations relative to North American Vertical Datum, 1988.



Legend

- Borehole
- Monitoring Well (GW Elev. 4/6/2018)
- OnSite Test Pits
- Stream Survey Location - Jan. 2018
- Stream Surface Survey - Nov. 2019
- Irrigation Well (Approx.)
- Groundwater Elevevation Contours (1-ft Interval) (GEOSPHERE - April 6, 2018)
- River_Bank
- Wetland Boundary
- Revised 2020 Leachfield
- OnSite/MDEP Test Pits - June 2020
- Existing Buildings
- Property Boundary

0 40 80 160 240 320 400 Feet

N W E S

GEOSPHERE ENVIRONMENTAL MANAGEMENT INC.

FIGURE 4

OBSERVED GROUNDWATER CONTOURS APRIL 6, 2018

Cascade Wayland
115 Boston Post Road

CREATED BY:	CHECKED BY:	PROJECT:
Matt Krapf 12/21/2020	Dave Niemeyer 12/21/2020	17205.1\FIGURES\ 2020_Report

Data Source: MassGIS (Bureau of Geogrpahic Information).
Elevations relative to North American Vertical Datum, 1988.

Legend

- Borehole
- Monitoring Well (GW Elev. 4/6/2018)
- OnSite Test Pits
- Stream Survey Location - Jan. 2018
- Irrigation Well (Approx.)
- Stream Surface Survey - Nov. 2019
- ESHGW Contours (2-ft. Interval)
- River_Bank
- Wetland Boundary
- Revised 2020 Leachfield
- On Site/MDEP Test Pits - June 2020
- Existing Buildings
- Property Boundary

0 40 80 160 240 320 400 Feet

N
W E
S

GEOSPHERE ENVIRONMENTAL MANAGEMENT INC.

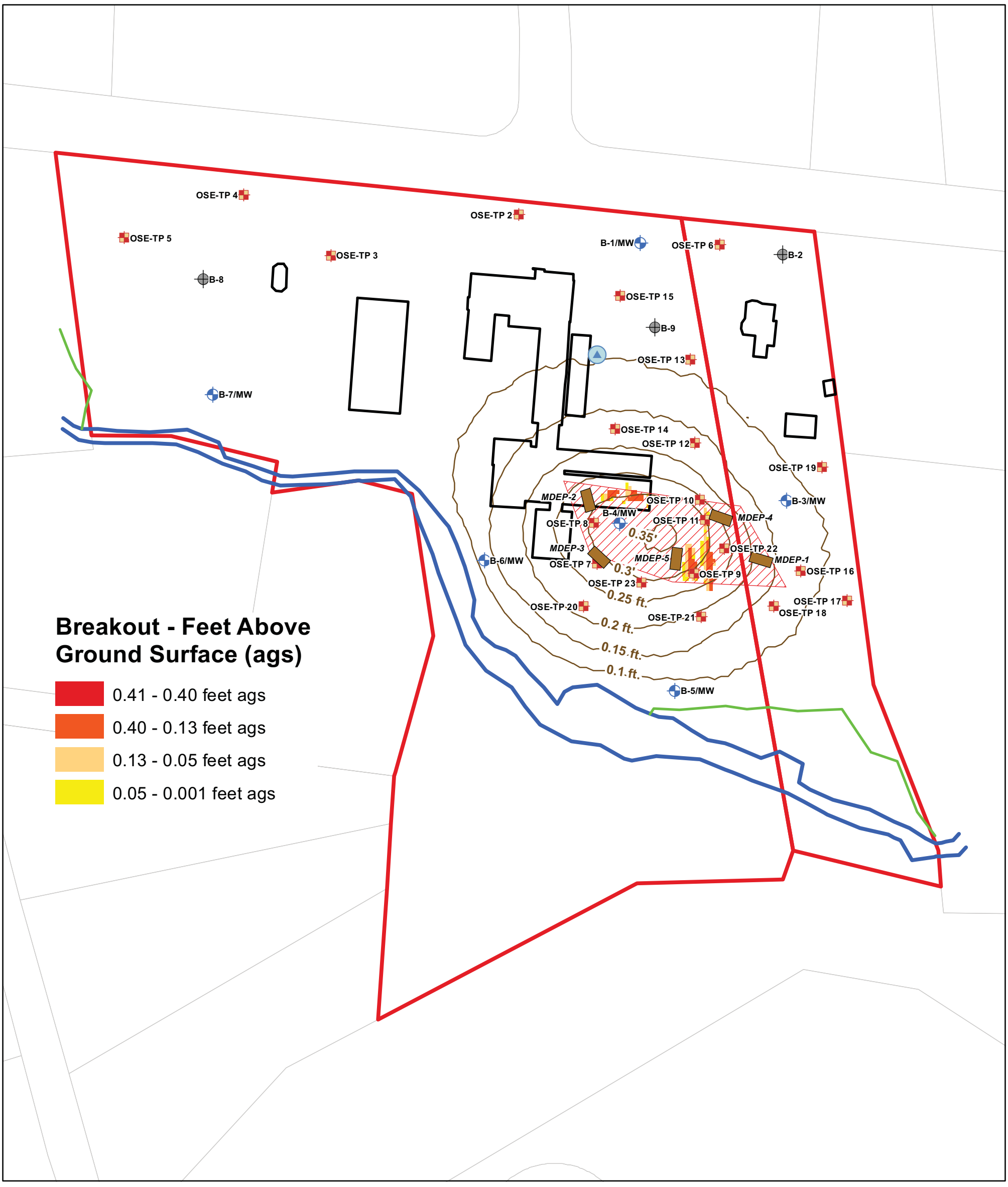
FIGURE 5

SIMULATED ESTIMATED SEASONAL HIGH GROUNDWATER ELEVATION

Cascade Wayland
115 Boston Post Road
Wayland, MA

CREATED BY:	CHECKED BY:	PROJECT:
Matt Krapf 12/21/2020	Dave Niemeyer 12/21/2020	17205.1\FIGURES\ 2020_Report

Data Source: MassGIS (Bureau of Geogrpahic Information).
Elevations relative to North American Vertical Datum, 1988.



Legend

- Borehole
- Monitoring Well
- OnSite Test Pit
- Irrigation Well (Approx.)
- 90-Day Mound Height (0.05 ft. Interval)
- River_Bank
- Wetland Boundary
- Revised 2020 Leachfield
- OnSite/MDEP Test Pits - June 2020
- Existing Buildings
- Property Boundary

0 40 80 160 240 320 400 Feet

N
W E
S

GEOSPHERE ENVIRONMENTAL MANAGEMENT INC.

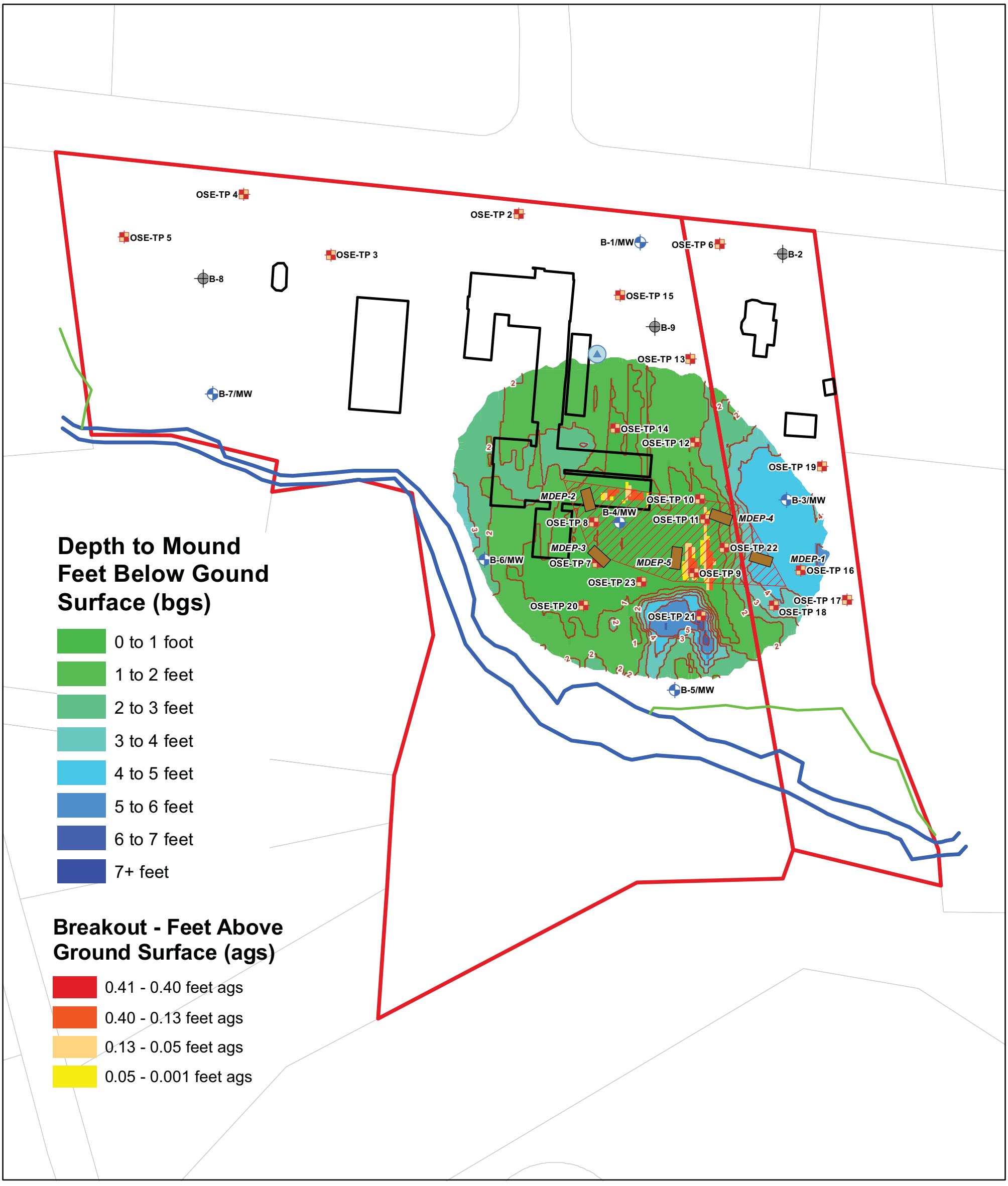
FIGURE 6

SIMULATED EST. MOUND HEIGHT AND BREAKOUT
(80% of Design Flow of 11,000 gpd)

Cascade Wayland
115 Boston Post Road
Wayland, MA

CREATED BY:	CHECKED BY:	PROJECT:
Matt Krapf 12/21/2020	Dave Niemeyer 12/21/2020	17205.1\FIGURES\ 2020_Report

Data Source: MassGIS (Bureau of Geogrpahic Information).
Elevations relative to North American Vertical Datum, 1988.



Legend

- Borehole
- Monitoring Well
- OnSite Test Pits
- Irrigation Well (Approx.)
- Depth to Mound Contours (feet bgs)
- River_Bank
- Wetland Boundary
- Revised 2020 Leachfield
- OnSite/MDEP Test Pits - June 2020
- Existing Buildings
- Property Boundary

0 40 80 160 240 320 400 Feet

N
W E
S

GEOSPHERE
ENVIRONMENTAL MANAGEMENT INC.

FIGURE 7

DEPTH TO MOUND
BELOW GROUND SURFACE (bgs)
(80% of Design Flow of 11,000 gpd)

Cascade Wayland
115 Boston Post Road
Wayland, MA

CREATED BY:	CHECKED BY:	PROJECT:
Matt Krapf 12/21/2020	Dave Niemeyer 12/21/2020	17205.1\FIGURES\ 2020_Report

Data Source: MassGIS (Bureau of Geogrpahic Information).
Elevations relative to North American Vertical Datum, 1988.

Legend

- Borehole
- Monitoring Well (GW Elev. 4/6/2018)
- OnSite Test Pits
- Stream Survey Location - Jan. 2018
- Stream Surface Survey - Nov. 2019
- Irrigation Well (Approx.)
- 90-Day Mounded Groundwater Elevation Contours (2-ft. Interval) (80% of Design Flow - 11,000 gpd)
- River_Bank
- Wetland Boundary
- Revised 2020 Leachfield
- OnSite/MDEP Test Pits - June 2020
- Existing Buildings
- Property Boundary

0 40 80 160 240 320 400 Feet

N
W E
S

GEOSPHERE ENVIRONMENTAL MANAGEMENT INC.

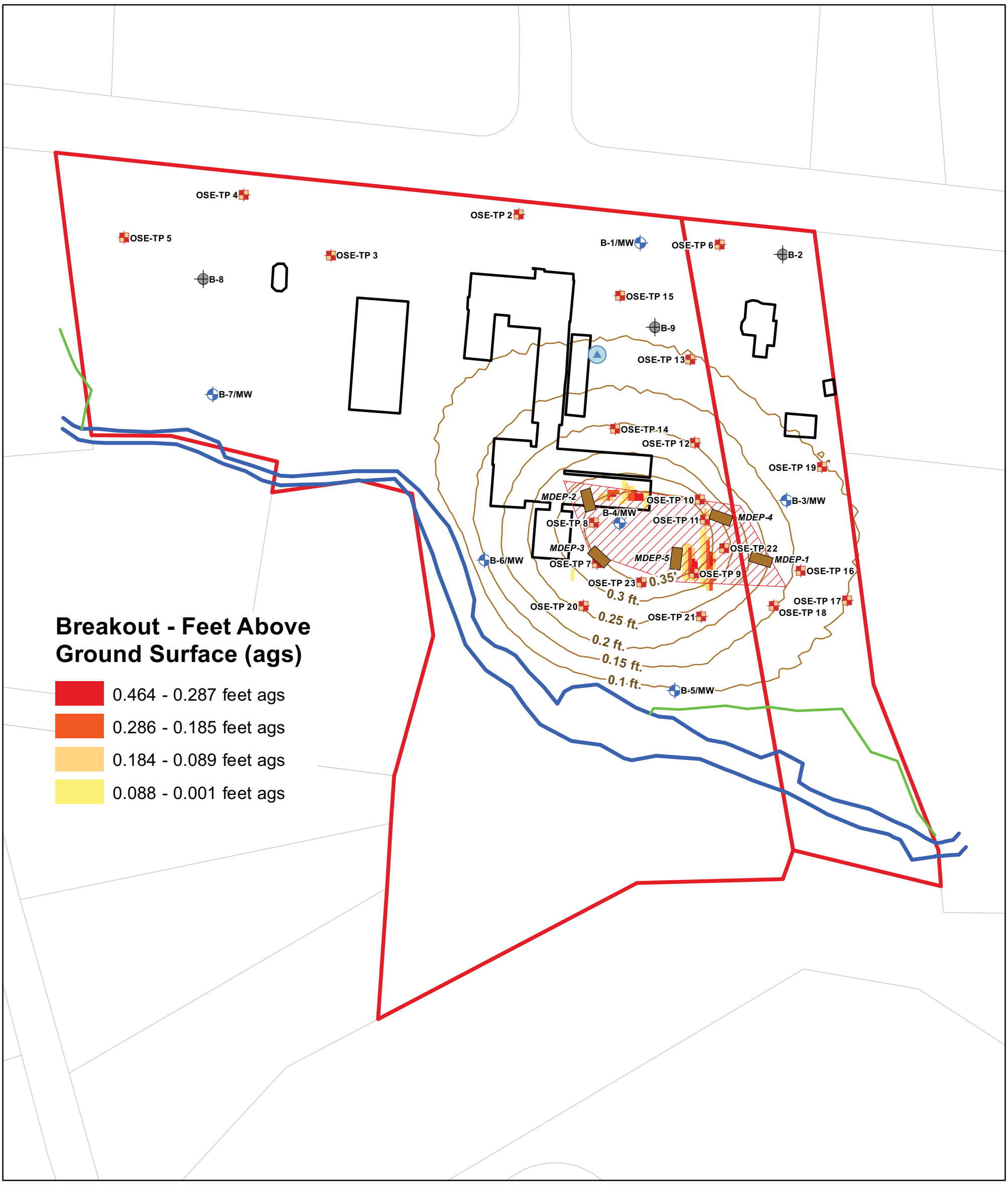
FIGURE 8

90-DAY MOUNDED GROUNDWATER ELEVATION
(80% of Design Flow of 11,000 Gallons Per Day)

Cascade Wayland
115 Boston Post Road
Wayland, MA

CREATED BY:	CHECKED BY:	PROJECT:
Matt Krapf 12/21/2020	Dave Niemeyer 12/21/2020	17205.1\FIGURES\ 2020_Report

Data Source: MassGIS (Bureau of Geogrpahic Information).
Elevations relative to North American Vertical Datum, 1988.



Legend

- Borehole
- Monitoring Well
- OnSite Test Pits
- Irrigation Well (Approx.)
- 90-Day Mound Height (0.05 ft. Interval)
- River_Bank
- Wetland Boundary
- Revised 2020 Leachfield
- OnSite/MDEP Test Pits - June 2020
- Existing Buildings
- Property Boundary

0 40 80 160 240 320 400 Feet

N W E S

GEOSPHERE ENVIRONMENTAL MANAGEMENT INC.

FIGURE 9

SIMULATED EST. MOUND HEIGHT AND BREAKOUT
(80% of Design Flow of 13,200 gpd)

Cascade Wayland
115 Boston Post Road
Wayland, MA

CREATED BY:	CHECKED BY:	PROJECT:
Matt Krapf 12/21/2020	Dave Niemeyer 12/21/2020	17205.1\FIGURES\ 2020_Report

Data Source: MassGIS (Bureau of Geogrpahic Information). Elevations relative to North American Vertical Datum, 1988.

Legend

- Irrigation Well (Approx.)
- Borehole
- Monitoring Well (GW Elev. 4/6/2018)
- OnSite Test Pits
- Stream Survey Location - Jan. 2018
- Stream Surface Survey - Nov. 2019
- 90-Day Mounded Groundwater Elevation Contours (2-ft. Interval) (80% of Design Flow - 13,200 gpd)
- River_Bank
- Wetland Boundary
- Revised 2020 Leachfield
- OnSite/MDEP Test Pits - June 2020
- Existing Buildings
- Property Boundary

0 40 80 160 240 320 400 Feet

N
W E
S

GEOSPHERE ENVIRONMENTAL MANAGEMENT INC.

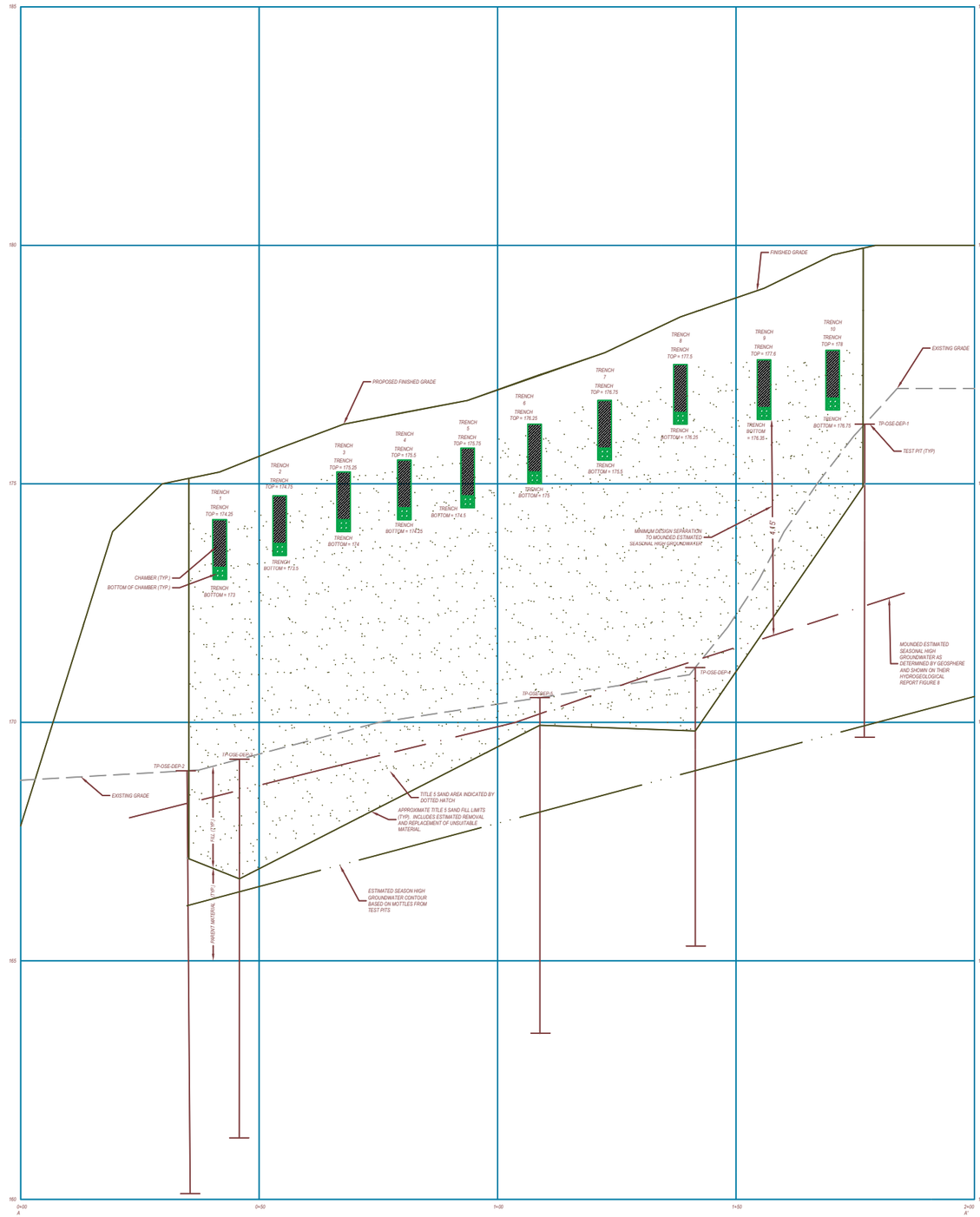
FIGURE 10

90-DAY MOUNDED GROUNDWATER ELEVATION
(80% of Design Flow of 13,200 Gallons Per Day)

Cascade Wayland
115 Boston Post Road
Wayland, MA

CREATED BY:	CHECKED BY:	PROJECT:
Matt Krapf 12/22/2020	Dave Niemeyer 12/22/2020	17205.1\FIGURES\ 2020_Report

Data Source: MassGIS (Bureau of Geogrpahic Information).
Elevations relative to North American Vertical Datum, 1988.



EFFLUENT DISPOSAL SYSTEM PROFILE

SCALE: 1" = 10' HORIZONTAL
1"=1' VERTICAL

10 0 5 10 20
SCALE: 1 INCH = 10 FEET

ONSITE ENGINEERING INC.
Water, Wastewater and Stormwater Specialists
279 East Central Street
Franklin, MA 02038
508-553-0616
www.onsite-eng.com

CASCADE WAYLAND
WAYLAND, MASSACHUSETTS

EFFLUENT DISPOSAL SYSTEM
CROSS SECTION A-A

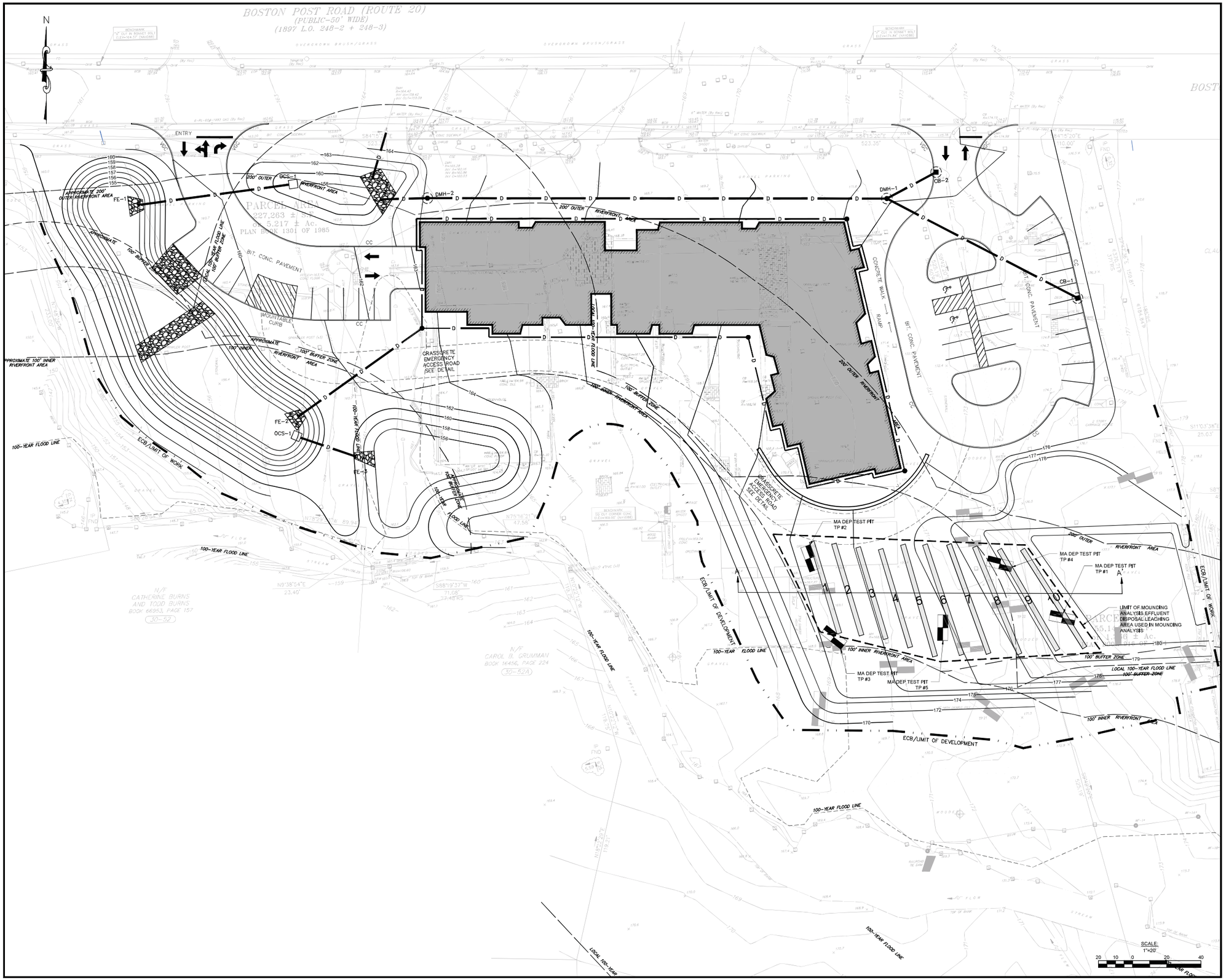
DRAFT REVIEW SUBMITTAL NOT FOR CONSTRUCTION

REV	DATE	DESCRIPTION

PROJECT NO.:
DATE: JANUARY 2021
SCALE: NONE
SHEET: 1 OF 1

DRAWN BY: PRR DESIGNED BY: PRR
CHECKED BY: DCF APPROVED BY: DCF

Fig. A



dei
SITE DESIGN
CIVIL ENGINEERING
LAND PLANNING

DESIGN • ENGINEERING • INNOVATION
14 Spring St. 1st Floor
Waltham, MA 02451
781.850.2731
www.doyleeng.com

No.	Description	Date

DWG ISSUE & REVISION HISTORY

Stamp

Key Plan

Project Title:

CASCADE
IN
WAYLAND

Drawing Title:

GROUNDWATER
DISCHARGE PERMIT
SITE PLAN

Project No.: 160012 Scale: 1"=20'
Drawn By: SJ
Checked By: WAD
Approved By: WAD
Date: JANUARY 14, 2020

Drawing No.

FIGURE B

Appendix A

Test Pit and Percolation Test Logs
Massachusetts DEP Forms 11 and 12

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

DEP has provided this form for use by on-site professionals and local Boards of Health. Other forms may be used, but the information must be substantially the same as provided here. Before using this form, check with your local Board of Health to determine the form they use.

A. Facility Information

1. Facility Information

Mahoney's Garden Center, LLC
Owner Name

115 Boston Post Road Map/Lot: Map 30, Lot 071
Street Address

Wayland MA 01778
City/Town State Zip Code

B. Site Information

1. (Check one) New Construction ☒ Upgrade ☐ Repair ☐

2. Published Soil Survey available? Yes ☒ No ☐ If yes: _____ _____ __
Year Published Publication Scale Soil Map Unit

Haven Urban Land Complex (MassGIS) _____
Soil Name Soil limitations

3. Surficial Geological Report available? Yes ☐ No ☒ If yes: _____ _____ _____
Year Published Publication Scale Map Unit

_____ _____
Geologic Material Landform

4. Flood Rate Insurance Map:

Above the 500 year flood boundary? Yes ☒ No ☐ Within the 100 year flood boundary? Yes ☐ No ☒

Within the 500 year flood boundary? Yes ☐ No ☒ Within a Velocity Zone? Yes ☐ No ☒

5. Wetland Area: National Wetland Inventory Map _____ _____
Map Unit Name

Wetlands Conservancy Program Map _____ _____
Map Unit Name

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

6. Current Water Resource Conditions (USGS) December 2016 (Month/Year) Range: Above Normal ☐ Normal ☐ Below Normal ☒

7. Other references reviewed: _____

C. On-Site Review

(*minimum of two holes required at every proposed primary and reserved disposal area)*

Deep Observation Hole Number: December 13, 2016 (Date) AM (Time) Sunny 30s F (Weather)

1. Location

   Ground Elevation at Surface of Hole Varies

   Location (Identify on Plan) See Plan

2. Land Use: Nursery (e.g. woodland, agricultural field, vacant lot, etc.) None (Surface Stones) 3-8% (Slope (%))

   Disturbed (Vegetation) Moraine (Landform) _____ (Position on landscape (attach sheet))

3. Distances from: Open Water Body > 100 feet Drainage Way > 100 feet Possible Wet Area > 100 feet

   Property Line >10 feet Drinking Water Well > 100 feet Other _____

4. Parent Material: Ice Contact Outwash Unsuitable Materials Present: Yes ☒ No ☐

   If Yes: Disturbed Soil☐ Fill Material☒ Impervious Layer(s) ☐ Weathered/Fractured Rock☐ Bedrock ☒

5. Groundwater Observed: Yes ☒ No ☐

   If Yes: Depth Weeping from Pit Varies Depth Standing Water in Hole Varies

   Estimated Depth to High Groundwater: Varies (see Testpits) (inches) _____ (elevation)

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-1

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			

Additional Notes Excavation within buried foundation

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-2

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-42	Fill		38”								
42-60	C_1	2.5 Y 7/6				Very Fine Sand			Single Grain	Loose	
60-108	C_2	2.5 Y 6/6				Sandy Loam			Massive	Friable	

Additional Notes Water Weeping @ 78”, ESHGW = 38”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-3

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-22	Fill										
22-33	A	10 YR 3/2				Sandy Loam			Massive	Friable	
33-105	C_1	2.5 Y 6/6	58”			Loamy Sand			Single Grain	Loose	

Additional Notes Water Weeping @ 74”, ESHGW=58”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-4

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-50	Fill										
50-57	A	10 YR 3/2	55”			Sandy Loam			Massive	Friable	
57-72	C_1	2.5 Y 6/3				Coarse Sand			Single Grain	Loose	
72-106	C_2	2.5 Y 6/3				Very Fine Loamy Sand			Single Grain	Loose	

Additional Notes Water Weeping @ 72”, ESHGW=55”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-5

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-90	Fill										
90-101	A	10 YR 3/2	90”			Sandy Loam			Massive	Friable	
101-132	C	2.5 Y 5/6				Very Fine Loamy Sand			Single Grain	Loose	

Additional Notes Water Standing @ 112”, ESHGW=90”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-6

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-13	Fill										
13-24	A	10 YR 3/2				Sandy Loam			Massive	Friable	
24-48	Bw	10 YR 5/6	39”			Sandy Loam			Massive	Friable	
48-108	C_1	2.5 Y 6/6				Sandy Loam			Massive	Friable	

Additional Notes ESHGW=39”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method used:
   - ☒ Depth observed standing water in observation hole A. Varies (inches) B. _ (inches)
   - ☒ Depth weeping from side of observation hole A. Varies (inches) B. _ (inches)
   - ☒ Depth to soil redoximorphic features (mottles) A. Varies (inches) B. _ (inches)
   - ☐ Groundwater adjustment (USGS methodology) A. _____ (inches) B. _____ (inches)

2. Index Well Number _____ Reading Date _____ Index Well Level _____

   Adjustment Factor _____ Adjusted Groundwater Level _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system? Yes ☐ No ☐

   b. If yes, at what depth was it observed? Upper boundary: Varies (inches) Lower boundary: Varies (inches)

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

_____ Signature of Soil Evaluator

_____ Date

Raymond Willis, P.E., SE2612 — Typed or Printed Name of Soil Evaluator/License Number

May 1996 — *Date of Soil Evaluator Exam

Darren MacCaughey — Name of Board of Health Witness

Town of Wayland — Board of Health

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Use this sheet for field diagrams:

See Attached Plans

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

DEP has provided this form for use by on-site professionals and local Boards of Health. Other forms may be used, but the information must be substantially the same as provided here. Before using this form, check with your local Board of Health to determine the form they use.

A. Facility Information

1. Facility Information

Mahoney's Garden Center, LLC
Owner Name

115 Boston Post Road Map/Lot: Map 30, Lot 071
Street Address

Wayland MA 01778
City/Town State Zip Code

B. Site Information

1. (Check one) New Construction ☒ Upgrade ☐ Repair ☐

2. Published Soil Survey available? Yes ☒ No ☐ If yes: _____ _____ __
Year Published Publication Scale Soil Map Unit

Haven Urban Land Complex (MassGIS) _____
Soil Name Soil limitations

3. Surficial Geological Report available? Yes ☐ No ☒ If yes: _____ _____ _____
Year Published Publication Scale Map Unit

_____ _____
Geologic Material Landform

4. Flood Rate Insurance Map:

Above the 500 year flood boundary? Yes ☒ No ☐ Within the 100 year flood boundary? Yes ☐ No ☒

Within the 500 year flood boundary? Yes ☐ No ☒ Within a Velocity Zone? Yes ☐ No ☒

5. Wetland Area: National Wetland Inventory Map _____ _____
Map Unit Name

Wetlands Conservancy Program Map _____ _____
Map Unit Name

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

6. Current Water Resource Conditions (USGS) January 2017 (Month/Year) Range: Above Normal ☐ Normal ☐ Below Normal ☒

7. Other references reviewed: _____

C. On-Site Review

(*minimum of two holes required at every proposed primary and reserved disposal area)*

Deep Observation Hole Number: January 12, 2017 (Date) AM (Time) Overcast-Sunny 50s F (Weather)

1. Location

   Ground Elevation at Surface of Hole Varies

   Location (Identify on Plan) See Plan

2. Land Use: Nursery (e.g. woodland, agricultural field, vacant lot, etc.) None (Surface Stones) 3-8% (Slope (%))

   Disturbed (Vegetation) Moraine (Landform) _____ (Position on landscape (attach sheet))

3. Distances from: Open Water Body > 100 feet Drainage Way > 100 feet Possible Wet Area > 100 feet

   Property Line >10 feet Drinking Water Well > 100 feet Other _____

4. Parent Material: Ice Contact Outwash Unsuitable Materials Present: Yes ☒ No ☐

   If Yes: Disturbed Soil ☐ Fill Material ☒ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☒

5. Groundwater Observed: Yes ☒ No ☐

   If Yes: Depth Weeping from Pit Varies Depth Standing Water in Hole Varies

   Estimated Depth to High Groundwater: Varies (see Testpits) (inches) _____ (elevation)

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-7

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-24	Fill										
24-36	C_1	2.5 Y 7/6				Coarse Sand &Gravel		>5%	Single Grain	Loose	Gravel
36-156	C_2	2.5 Y 7/4	42”			Coarse Sand &Gravel		>5%	Single Grain	Loose	Gravel

Additional Notes Water Standing @ 53”, ESHGW @ 42”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-8

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-44	Fill		34”								
44-66	C_1	2.5 Y 7/4				Coarse Sand & Gravel		>5%	Single Grain	Loose	Gravel
66-120	C_2	2.5 Y 6/4				Medium Sand			Single Grain	Loose	

Additional Notes Water Standing @ 54”, ESHGW = 34”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-9

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12	Fill										
12-24	C_1	2.5 Y 7/6				Medium Sand			Single Grain	Loose	
24-120	C_2	2.5 Y 7/4	31”			Coarse Sand & Gravel		>5%	Single Grain	Loose	Gravel

Additional Notes Water Standing @ 53”, ESHGW=31”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-10

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-25	Fill										
25-45	C_1	2.5 Y 7/4				Coarse Sand & Gravel			Single Grain	Loose	
45	R										

Additional Notes No Water, No Mottles

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-11

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-15	Fill										
15-55	C_1	10 YR 5/6	36”			Loamy Sand			Single Grain	Loose	
55-101	C_2	2.5 Y 6/4				Coarse Sand & Gravel		>5%	Single Grain	Loose	Gravel, Caving

Additional Notes Water Standing @ 60”, ESHGW=36”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-12

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-32	Fill										
32-82	C_1	2.5 Y 6/6	57”			Sandy Loam			Single Grain	Loose	
82-144	C_2	2.5 Y 6/6				Sandy Loam		>5%	Single Grain	Loose	Gravel
144	R										Rock or Large Boulder

Additional Notes Water Weeping @ 77”, ESHGW=57”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-13

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-34	Fill										
34-54	C_1	2.5 Y 7/4	54”			Very Fine Loamy Sand			Single Grain	Loose	
54-125	C_2	2.5 Y 6/6				Sandy Loam			Massive	Friable	
125	R										

Additional Notes Water Weeping @ 96”, ESHGW=54”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-14

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-30	Fill										
30-120	C_1	2.5 Y 7/4	36”			Very Fine Loamy Sand			Single Grain	Loose	

Additional Notes Water Standing @ 58”, ESHGW=36”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-15

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-65	Fill		60”								
65-72	C_1	2.5 Y 7/4				Very Fine Loamy Sand			Single Grain	Loose	
72-120	C_2	2.5 Y 6/4				Coarse Sand & Gravel		>5%	Single Grain	Loose	Gravel

Additional Notes Water Standing @ 65”, ESHGW=60”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-16

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-39	Fill										
39-98	C_1	2.5 Y 6/6				Sandy Loam			Massive	Friable	

Additional Notes No water, west side of hole has 57" of fill.

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method used:
   - ☒ Depth observed standing water in observation hole A. Varies (inches) B. _ (inches)
   - ☒ Depth weeping from side of observation hole A. Varies (inches) B. _ (inches)
   - ☒ Depth to soil redoximorphic features (mottles) A. Varies (inches) B. _ (inches)
   - ☐ Groundwater adjustment (USGS methodology) A. _____ (inches) B. _____ (inches)

2. Index Well Number _____ Reading Date _____ Index Well Level _____

   Adjustment Factor _____ Adjusted Groundwater Level _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system? Yes ☒ No ☐

   b. If yes, at what depth was it observed? Upper boundary: Varies (inches) Lower boundary: Varies (inches)

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

_____ Signature of Soil Evaluator

_____ Date

Raymond Willis, P.E.; SE2612
Typed or Printed Name of Soil Evaluator/License Number

May 1996
*Date of Soil Evaluator Exam

Darren MacCaughey
Name of Board of Health Witness

Town of Wayland
Board of Health

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Use this sheet for field diagrams:

See Attached Plans

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

DEP has provided this form for use by on-site professionals and local Boards of Health. Other forms may be used, but the information must be substantially the same as provided here. Before using this form, check with your local Board of Health to determine the form they use.

A. Facility Information

1. Facility Information

Mahoney's Garden Center, LLC
Owner Name

115 Boston Post Road Map/Lot: Map 30, Lot 071
Street Address

Wayland MA 01778
City/Town State Zip Code

B. Site Information

1. (Check one) New Construction ☒ Upgrade ☐ Repair ☐

2. Published Soil Survey available? Yes ☒ No ☐ If yes: _____ _____ __
Year Published Publication Scale Soil Map Unit

Haven Urban Land Complex (MassGIS) _____
Soil Name Soil limitations

3. Surficial Geological Report available? Yes ☐ No ☒ If yes: _____ _____ _____
Year Published Publication Scale Map Unit

_____ _____
Geologic Material Landform

4. Flood Rate Insurance Map:

Above the 500 year flood boundary? Yes ☒ No ☐ Within the 100 year flood boundary? Yes ☐ No ☒

Within the 500 year flood boundary? Yes ☐ No ☒ Within a Velocity Zone? Yes ☐ No ☒

5. Wetland Area: National Wetland Inventory Map _____ _____
Map Unit Name

Wetlands Conservancy Program Map _____ _____
Map Unit Name

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

6. Current Water Resource Conditions (USGS) November 2017 (Month/Year) Range: Above Normal ☐ Normal ☒ Below Normal ☐

7. Other references reviewed: _____

C. On-Site Review

(*minimum of two holes required at every proposed primary and reserved disposal area)*

Deep Observation Hole Number: November 13, 2017 (Date) AM (Time) Overcast 50s F (Weather)

1. Location

   Ground Elevation at Surface of Hole Varies

   Location (Identify on Plan) See Plan

2. Land Use: Nursery (e.g. woodland, agricultural field, vacant lot, etc.) None (Surface Stones) 3-8% (Slope (%))

   Disturbed (Vegetation) Moraine (Landform) _____ (Position on landscape (attach sheet))

3. Distances from: Open Water Body > 100 feet Drainage Way > 100 feet Possible Wet Area > 100 feet

   Property Line >10 feet Drinking Water Well > 100 feet Other _____

4. Parent Material: Ice Contact Outwash Unsuitable Materials Present: Yes ☒ No ☐

   If Yes: Disturbed Soil ☐ Fill Material ☒ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock ☒

5. Groundwater Observed: Yes ☒ No ☐

   If Yes: Depth Weeping from Pit Varies Depth Standing Water in Hole Varies

   Estimated Depth to High Groundwater: Varies (see Testpits) (inches) _____ (elevation)

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-17

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12	Fill/A	10 YR 3/2				Sandy Loam			Massive	Friable	
12-24	Bw	10 YR 5/6				Sandy Loam			Massive	Friable	
24-57	C_1	2.5 Y 7/4	57”	10 YR 5/8		Loamy Sand			Massive	Friable	
57-137	C_2	2.5 Y 4/1				Sandy Loam			Massive	Friable	

Additional Notes Water Standing @ 132”, ESHGW @ 57”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-18

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-29	Fill										
29-35	A	10 YR 3/2				Sandy Loam			Massive	Friable	
35-50	Bw	10 TR 5/6				Sandy Loam			Massive	Friable	
50-132	C_1	2.5 Y 6/4				Medium-Coarse Sand & Gravel		>5%	Single Grain	Loose	Boulder

Additional Notes No water, no mottles

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-19

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-25	Fill										
25-32	A	10 YR 3/2				Sandy Loam			Massive	Friable	
32-46	Bw	10 YR 5/6	42”	10 YR 5/8		Sandy Loam			Massive	Friable	
46-82	C_1	2.5 Y 6/4				Very Fine Sand			Single Grain	Loose	
82-120	C_2	2.5 Y 4/1				Sandy Loam			Massive	Friable	

Additional Notes No water, ESHGW=42”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-20

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-21	Fill										
21-43	C_1	2.5 Y 7/6				Coarse Sand & Gravel			Single Grain	Loose	
43-120	C_2	2.5 Y 7/4	43”	10 YR 5/8		Coarse Sand & Gravel			Single Grain	Loose	

Additional Notes Water @ 43”, Mottles @ 43”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-21

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-3	A	10 YR 3/2				Sandy Loam					
3-84	C_1	2.5 Y 7/4	36”	10 YR 5/8		Coarse Sand & Gravel		>5%	Single Grain	Loose	
84	R										

Additional Notes Water Standing @ 72”, ESHGW=36”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-22

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-10	A	10 YR 3/2				Sandy Loam					
10-24	Bw	10 YR 5/6	57”			Sandy Loam			Single Grain	Loose	
24-72	C_1	2.5 Y 7/4				Coase Sand & Gravel		>5%	Single Grain	Loose	
72	R										

Additional Notes No water, excavated to depth of 107” to the east.

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Deep Observation Hole Number: OSE-TP-23

Depth (In.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-24	Fill										
24-62	C_1	2.5 Y 7/6	36”	10 YR 5/8		Coarse Sand & Gravel			Single Grain	Loose	
62-96	C_2	2.5 Y 7/4				Coarse Sand & Gravel			Single Grain	Loose	

Additional Notes Water Weeping @ 55”, ESHGW=36”

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method used:
   - ☒ Depth observed standing water in observation hole A. Varies (inches) B. _ (inches)
   - ☒ Depth weeping from side of observation hole A. Varies (inches) B. _ (inches)
   - ☒ Depth to soil redoximorphic features (mottles) A. Varies (inches) B. _ (inches)
   - ☐ Groundwater adjustment (USGS methodology) A. _____ (inches) B. _____ (inches)

2. Index Well Number _____ Reading Date _____ Index Well Level _____

   Adjustment Factor _____ Adjusted Groundwater Level _____

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system? Yes ☒ No ☐

   b. If yes, at what depth was it observed? Upper boundary: Varies (inches) Lower boundary: Varies (inches)

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

_____ Signature of Soil Evaluator

_____ Date

Raymond Willis, P.E.; SE2612
Typed or Printed Name of Soil Evaluator/License Number

May 1996
*Date of Soil Evaluator Exam

Darren MacCaughey
Name of Board of Health Witness

Town of Wayland
Board of Health

Commonwealth of Massachusetts
City/Town of Brookfield, Massachusetts

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Use this sheet for field diagrams:

See Attached Plans

Commonwealth of Massachusetts
City/Town of Wayland

Percolation Test

Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Site Information

Mahoney's Nursery
Owner Name

115 Boston Post Road
Street Address or Lot #

Wayland	MA	01778
City/Town	State	Zip Code

Contact Person (if different from Owner) | Telephone Number

B. Test Results

	1/12/2017 AM	1/12/2017 PM
	Date / Time	Date / Time
Observation Hole #	OSE-TP-9	OSE-TP-11
Depth of Perc	24"-52"	17"-35"
Start Pre-Soak	11:59 AM	12:04 PM
End Pre-Soak		12:22 PM
Time at 12”		12:22 PM
Time at 9”		12:26 PM
Time at 6”		12:33 PM @ 5.5"
Time (9”-6”)		7 minutes
Rate (Min./Inch)	<2 mpi	2 mpi
	Test Passed: ☒ Test Failed: ☐	Test Passed: ☒ Test Failed: ☐

Raymond Willis, P.E.
Test Performed By:

Darren MacCaughey
Witnessed By:

Comments:

TP-9 - 24 gallons passed in less than 15 minutes

Commonwealth of Massachusetts
City/Town of Wayland

Percolation Test

Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Site Information

Mahoney's Nursery
Owner Name

115 Boston Post Road
Street Address or Lot #

Wayland	MA	01778
City/Town	State	Zip Code

Contact Person (if different from Owner) | Telephone Number

B. Test Results

	1/12/2017 AM	1/12/2017 PM
	Date / Time	Date / Time
Observation Hole #	OSE-TP-12	OSE-TP-14
Depth of Perc	53"-71"	30"-48"
Start Pre-Soak	11:29 AM	2:45 PM
End Pre-Soak	11:44 AM	3:02 PM
Time at 12”	11:44 AM	3:02 PM
Time at 9”	12:11 PM	3:24 PM
Time at 6”	12:50 PM	4:00 PM
Time (9”-6”)	39 minutes	36 minutes
Rate (Min./Inch)	13 mpi	12 mpi
	Test Passed: ☒ Test Failed: ☐	Test Passed: ☒ Test Failed: ☐

Raymond Willis, P.E.
Test Performed By:

Darren MacCaughey
Witnessed By:

Comments:

Commonwealth of Massachusetts
City/Town of Wayland

Percolation Test

Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Site Information

Mahoney's Nursery
Owner Name

115 Boston Post Road
Street Address or Lot #

Wayland	MA	01778
City/Town	State	Zip Code

Contact Person (if different from Owner) | Telephone Number

B. Test Results

	Date	Time	Date	Time
	1/12/2017	AM		
Observation Hole #	OSE-TP-16			
Depth of Perc	46"-64"			
Start Pre-Soak	2:22 PM			
End Pre-Soak	2:37 PM			
Time at 12”	2:37 PM			
Time at 9”	3:15 PM @ 8.75"			
Time at 6”	4:02 PM @ 5.75"			
Time (9”-6”)	47 minutes			
Rate (Min./Inch)	16 mpi			

Test Passed: ☒ Test Failed: ☐ | Test Passed: ☐ Test Failed: ☐

Raymond Willis, P.E.
Test Performed By:

Darren MacCaughey
Witnessed By:

Comments:

Commonwealth of Massachusetts
City/Town of Wayland

Percolation Test

Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Site Information

Mahoney's Nursery
Owner Name

115 Boston Post Road
Street Address or Lot #

Wayland	MA	01778
City/Town	State	Zip Code

Contact Person (if different from Owner) | Telephone Number

B. Test Results

	12/13/2016 AM	12/13/2016 PM
	Date / Time	Date / Time
Observation Hole #	OSE-TP-3	OSE-TP-6
Depth of Perc	40"-58"	51"-69"
Start Pre-Soak	9:59 AM	1:43 PM
End Pre-Soak	10:15 AM	1:59 PM
Time at 12”	10:15 AM	1:59 PM
Time at 9”	10:23 AM	2:25 PM
Time at 6”	10:34 AM	2:57 PM
Time (9”-6”)	11 minutes	32 minutes
Rate (Min./Inch)	4 mpi	11 mpi
	Test Passed: ☒ Test Failed: ☐	Test Passed: ☒ Test Failed: ☐

Raymond Willis, P.E.
Test Performed By:

Darren MacCaughey
Witnessed By:

Comments:

Commonwealth of Massachusetts
City/Town of Wayland

Percolation Test

Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Site Information

Mahoney's Nursery
Owner Name

115 Boston Post Road
Street Address or Lot #

Wayland	MA	01778
City/Town	State	Zip Code

Contact Person (if different from Owner) | Telephone Number

B. Test Results

	Date	Time	Date	Time
	11/13/2017	AM		
Observation Hole #	OSE-TP-17			
Depth of Perc	60"-78"			
Start Pre-Soak	10:32 AM			
End Pre-Soak	10:47 AM			
Time at 12”	10:47 AM			
Time at 9”	12:02 PM			
Time at 6”	1:40 PM			
Time (9”-6”)	98 minutes			
Rate (Min./Inch)	33 mpi			

Test Passed: ☒ Test Failed: ☐

Test Passed: ☐ Test Failed: ☐

Raymond Willis, P.E.
Test Performed By:

Darren MacCaughey
Witnessed By:

Comments:

Commonwealth of Massachusetts
City/Town of Wayland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Mahoney's Garden Center, LLC
Owner Name

115 Boston Post Road
Street Address

30/071
Map/Lot #

Wayland
City

MA
State

01778
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: MassGIS (Source) 624 (Soil Map Unit)

   Haven Urban Land Complex
   Soil Name

   Soil Limitations

   Ice Contact Outwash
   Soil Parent material

   Plain
   Landform

3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: Year Published/Source Map Unit

   Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: Wetland Type

7. Current Water Resource Conditions (USGS): July 2020 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Wayland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: MDEP-1 (Hole #) | 6/16/2020 (Date) | AM (Time) | 70's Sunny (Weather) | 42d21'33" (Latitude) | 71d20'26" (Longitude:)

1. Land Use: Commercial (e.g., woodland, agricultural field, vacant lot, etc.) | Trees light underbrush (Vegetation) | Few (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 3-8 (Slope (%))

   Description of Location:

2. Soil Parent Material: Ice Contact Outwash | Plain (Landform) | (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body > 100 feet | Drainage Way > 10 feet | Wetlands > 50 feet | Property Line > 10 feet | Drinking Water Well > 100 feet | Other ____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 70" Depth Weeping from Pit 70" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-15	Ap	Sandy Loam	10 YR 3/2						Massive	Friable	
15-36	Bw	Sandy Loam	10 YR 6/6						Massive	Friable	
36-84	C1	Sand & Gravel	2.5 Y 5/4				35%	35%	Single Grain	Loose	

Additional Notes:
Did not excavate further than 84 inches due to caving of hole on a slope; did not encounter bedrock

Commonwealth of Massachusetts
City/Town of Wayland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: MDEP-2 (Hole #) | 6/16/202 0 | AM (Time) | 70's Sunny (Weather) | 42d21'34" (Latitude) | 71d20'28" (Longitude:)

1. Land Use: Commercial (e.g., woodland, agricultural field, vacant lot, etc.) | None (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 0-3 (Slope (%))

Description of Location: Area behind abandoned green house

2. Soil Parent Material: Ice Contract Outwash | Plain (Landform) | _____ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body > 100 feet | Drainage Way > 10 feet | Wetlands > 50 feet | Property Line > 10 feet | Drinking Water Well > 100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 43" Depth Weeping from Pit 51" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-22	Fill										
22-38	C1	Sandy Loam	10 YR 6/4	34"	10 YR 5/8	> 5%					Material only on north side of hole
38-101	C2	Sand & Gravel	2.5 Y 5/4				30%	20%	Single Grain	Loose	Caving

Additional Notes:

Commonwealth of Massachusetts
City/Town of Wayland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: MDEP-3 (Hole #) | 6/16/2020 (Date) | AM (Time) | 70's Sunny (Weather) | 41d21'33" (Latitude) | 71d20'28" (Longitude:)

1. Land Use: Commercial (e.g., woodland, agricultural field, vacant lot, etc.) | None (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 0-3 (Slope (%))

   Description of Location: _____

2. Soil Parent Material: Ice Contact Outwash | Plain (Landform) | _____ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body > 100 feet | Drainage Way > 10 feet | Wetlands > 50 feet | Property Line > 10 feet | Drinking Water Well > 100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 47" Depth Weeping from Pit 51" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-30	Fill										
30-38	C1	Very Fine Sandy Loam	10 YR 6/3	31"	10 YR 6/3	5-10%			Massive	Friable	
38-90	C2	Sand & Gravel	2.5 Y 5/4				35%	35%	Single Grain	Loose	Caving

Additional Notes:

Commonwealth of Massachusetts
City/Town of Wayland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: MDEP-4 (Hole #) | 6/16/202 0 | AM (Time) | 70's Sunny (Weather) | 42d21'33" (Latitude) | 71d20'27" (Longitude:)

1. Land Use: Commercial (e.g., woodland, agricultural field, vacant lot, etc.) | None (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 0-3 (Slope (%))

Description of Location: Area behind abandoned green house

2. Soil Parent Material: Ice Contract Outwash | Plain (Landform) | _____ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body > 100 feet | Drainage Way > 10 feet | Wetlands > 50 feet | Property Line > 10 feet | Drinking Water Well > 100 feet | Other _____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 51" Depth Weeping from Pit 51" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-16	Fill										
16-33	C1	Fine Sandy Loam	10 YR 5/3	25"	10 YR 5/8	25%			Massive	Friable	
33-90	C2	Sand & Gravel	10 YR 4/3				35%	35%	Single Grain	Loose	Caving

Additional Notes:

Commonwealth of Massachusetts
City/Town of Wayland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: MDEP-5 (Hole #) | 6/16/2020 (Date) | PM (Time) | 70's Sunny (Weather) | 42d21'33" (Latitude) | 71d20'26" (Longitude:)

1. Land Use: Commercial (e.g., woodland, agricultural field, vacant lot, etc.) | None (Vegetation) | None (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 0-3 (Slope (%))

   Description of Location:

2. Soil Parent Material: Ice Contact Outwash | Plain (Landform) | (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body > 100 feet | Drainage Way > 10 feet | Wetlands > 50 feet | Property Line > 10 feet | Drinking Water Well > 100 feet | Other ____ feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☒ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 42" Depth Weeping from Pit 42" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-7	Fill										
7-20	Bw	Sandy Loam	10 YR 4/4						Massive	Friable	
20-23	C1	Sandy Loam	10 YR 5/4						Massive	Friable	
23-86	C2	Sand & Gravel	10 YR 4/4				35%	35%	Single Grain	Loose	Caving

Additional Notes:

Commonwealth of Massachusetts
City/Town of Wayland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole #MDEP-1	Obs. Hole #MDEP-2
☐ Depth observed standing water in observation hole	70 inches	51 inches
☐ Depth weeping from side of observation hole	70 inches	43 inches
☐ Depth to soil redoximorphic features (mottles)	_____ inches	34 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Wayland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole #MDEP-3	Obs. Hole #MDEP-4
☐ Depth observed standing water in observation hole	51 inches	51 inches
☐ Depth weeping from side of observation hole	47 inches	51 inches
☐ Depth to soil redoximorphic features (mottles)	_____ inches	26 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Wayland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole #MDEP-5	Obs. Hole #_____
☐ Depth observed standing water in observation hole	42 inches	_____ inches
☐ Depth weeping from side of observation hole	42 inches	_____ inches
☐ Depth to soil redoximorphic features (mottles)	_____ inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c – [S_r \times (OW_c – OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Wayland

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature of Soil Evaluator	7/28/2020 Date
Raymond Willis, P.E./SE2612 Typed or Printed Name of Soil Evaluator / License #	6/30/2022 Expiration Date of License
Joe Cerutti, Tenzin Lama Name of Approving Authority Witness	MassDEP Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Commonwealth of Massachusetts
City/Town of Wayland

Percolation Test

Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A. Site Information

Mahoney's Garden Center, LLC
Owner Name

115 Boston Post Road
Street Address or Lot #

Wayland	MA	01778
City/Town	State	Zip Code

Contact Person (if different from Owner) | Telephone Number

B. Test Results

	6/16/2020 Date / AM Time	6/16/2020 Date / PM Time
Observation Hole #	MDEP-4	MDEP-3
Depth of Perc	30"-48"	16"-34"
Start Pre-Soak	11:22 AM	12:25 PM
End Pre-Soak	11:37 AM	12:40 PM
Time at 12”	11:37 AM	12:40 PM
Time at 9”	11:41 AM	12:42 PM
Time at 6”	11:46 AM	12:45 PM
Time (9”-6”)	5 minutes	3 minutes
Rate (Min./Inch)	<2 min/inch	<2 min/inch
	Test Passed: ☒ Test Failed: ☐	Test Passed: ☒ Test Failed: ☐

Raymond Willis, P.E.
Test Performed By:

Joe Cerutti, Tenzin Lama, MassDEP
Board of Health Witness

Comments:

Appendix B

Soil Boring/Monitoring Well Construction Logs
TJ Ogden Well Driller's Log – Irrigation Well (2003)

GEOSPHERE
ENVIRONMENTAL MANAGEMENT INC.
51 Portsmouth Ave.
Exeter, NH 03833
(603)773-0075

Log of Borehole/MW: B-1/MW

Project No.: 17205

Site: Mahoney Garden Center Borehole Location: B-1/MW

Address: 115 Boston Post Road

Client: Eden Management Geologist: MK/LB

SUBSURFACE PROFILE			SAMPLE					
Depth (ft / m)	Symbol	Description	Core ID	Sample ID	Pen (ft)	Rec (ft)	Well Data	Comments
0 / 0		Ground Surface						
		Silty Sand with Gravel Light to dark brown fine to coarse Sand (40-50%), Gravel (20-40%), Fines (10-20%). Loose, dry. (0'-15')	B1-1		60"	41"		4" diameter flush mount road box -Concrete 0-1' -Silica sand backfill 1'-3' -Bentonite seal 3'-5'
			B1-2	S1	60"	18"		
			B1-3	S2	60"	14"		-Screen 6'-16' -Silica sand filter pack 5'-16'
		Silt Tan fines, dense, non-plastic, non-cohesive, wet. (15'-17')	B1-4		24"	13"		Well set at 16'
		End of Boring/Refusal = 17'						End of Boring/Refusal at 17'

Drill Date: 11/29/2017 Borehole Diameter: 2.5" Ground Elevation: 0

Drill Method: Geoprobe Sampler Diameter: 2" Depth to GW: 5.54' btpvc

Driller: Crawford Drilling Services Well Casing Diameter: 2" PVC Date of Static GW Level: 12/12/2017

GEOSPHERE ENVIRONMENTAL MANAGEMENT INC.
51 Portsmouth Ave.
Exeter, NH 03833
(603)773-0075

Log of Borehole/MW: B-2

Project No.: 17205

Site: Mahoney Garden Center Borehole Location: B-2

Address: 115 Boston Post Road

Client: Eden Management Geologist: MK/LB

SUBSURFACE PROFILE			SAMPLE					
Depth (ft / m)	Symbol	Description	Core ID	Sample ID	Pen (ft)	Rec (ft)	Well Data	Comments
0 / 0		Ground Surface						
		Topsoil/Organics (0'-1')						
2		***Sandy Silt with Gravel*** Light brown to gray Fines (60%), fine Sand (15-25%), and Gravel (10-15%). Wet at 14'. (1'-14')	B2-1	S4 2'-5'	60"	39"		No well set.
4								
6 / 2			B2-2	S3 5'-7'	60"	44"		
8				S5-2 5'-9'				
10			B2-3	S5 9'-14'	48"	32"		
12 / 4								
14		***End of Boring/Refusal at 14'***						End of Boring/Refusal at 14'
16								
18								
20 / 6								

Drill Date: 11/29/2017 Borehole Diameter: 2.5" Ground Elevation: 0

Drill Method: Geoprobe Sampler Diameter: 2" Depth to GW: N/A

Driller: Crawford Drilling Services Well Casing Diameter: N/A Date of Static GW Level: N/A

GEOSPHERE ENVIRONMENTAL MANAGEMENT INC.
51 Portsmouth Ave.
Exeter, NH 03833
(603)773-0075

Log of Borehole/MW: B-3/MW

Project No.: 17205

Site: Mahoney Garden Center Borehole Location: B-3/MW

Address: 115 Boston Post Road

Client: Eden Management Geologist: MK/LB

SUBSURFACE PROFILE			SAMPLE					
Depth (ft / m)	Symbol	Description	Core ID	Sample ID	Pen (ft)	Rec (ft)	Well Data	Comments
		Ground Surface						4" diameter riser stick-up 1.8' ags
0		***Silty Sand with Gravel*** Brown to dark brown fine to coarse Sand (50-60%), Gravel (25-30%), Fines (15-20%). Loose 0'-5', compact to very compact 5'-20'. Moist at 9', wet at 11'. (0'-20')	B3-1	S20 0'-5'	60"	40"		-Concrete seal 0-3'
2								-Bentonite seal 3'-4'
6 (2 m)			B3-2	S6 5'-10'	60"	47"		-Silica sand filter pack 4'-13' Screen 3'-13'
12 (4 m)			B3-3	S7 10'-14'	60"	38"		Well set at 13'
16			B3-4	S8 14'-22'	60"	13"		
20 (6 m)		***Silt*** Gray fines (90%), Gravel (10%). Very compact. Wet. (20'-22')	B3-5		24"	12"		
22		***End of Boring/Refusal = 22'***						End of Boring/Refusal at 22'
24								

Drill Date: 11/29/2017 Borehole Diameter: 2.5" Ground Elevation: 0

Drill Method: Geoprobe Sampler Diameter: 2" Depth to GW: 11.24' btpvc

Driller: Crawford Drilling Services Well Casing Diameter: 2" PVC Date of Static GW Level: 12/12/2017

GEOSPHERE
ENVIRONMENTAL MANAGEMENT INC.
51 Portsmouth Ave.
Exeter, NH 03833
(603)773-0075

Log of Borehole/MW: B-4/MW

Project No.: 17205

Site: Mahoney Garden Center Borehole Location: B-4/MW

Address: 115 Boston Post Road

Client: Eden Management Geologist: MK/LB

SUBSURFACE PROFILE			SAMPLE					
Depth (ft / m)	Symbol	Description	Core ID	Sample ID	Pen (ft)	Rec (ft)	Well Data	Comments
-3 / -1		Ground Surface						4" diameter riser stick-up 2.3' ags
1		***Well graded Sand with Gravel*** Brown fine to coarse sand (50-60%), Gravel (40-50%). Loose & dry 0-3', to compact, wet at 6'. (0'-10')	B4-1	S21 1.5'-2.5'	60"	24"		-Concrete seal 0'-1' -Bentonite seal 1'-1.5' -Sand backfill 1.5'-2.5'
3								
5			B4-2	S12 5'-10'	60"	20"		-Native fill 2.5'-14.5' Well screen 4.5'-14.5'
7 / 2								
9								
11		***Silt*** Brown/gray fines (90%), Gravel (10%). Very compact, cohesive, non-plastic, wet. (10'-14.5')	B4-3	S13 1 0'-14.5	12"	9"		
13 / 4								Well set at 14.5'
15		***End of Boring/Refusal at 14.5'***						

Drill Date: 11/29/2017 Borehole Diameter: 2.5" Ground Elevation: 0

Drill Method: Geoprobe Sampler Diameter: 2" Depth to GW: 6.87' btpvc

Driller: Crawford Drilling Services Well Casing Diameter: 2" PVC Date of Static GW Level: 12/12/2017

GEOSPHERE ENVIRONMENTAL MANAGEMENT INC.
51 Portsmouth Ave.
Exeter, NH 03833
(603)773-0075

Log of Borehole/MW: B-5/MW

Project No.: 17205

Site: Mahoney Garden Center Borehole Location: B-5/MW

Address: 115 Boston Post Road

Client: Eden Management Geologist: MK/LB

SUBSURFACE PROFILE			SAMPLE					
Depth (ft / m)	Symbol	Description	Core ID	Sample ID	Pen (ft)	Rec (ft)	Well Data	Comments
-2								4" diameter riser stick-up 2.25' ags
0		Ground Surface						
0–10		***Well graded Sand with Gravel*** Brown to gray fine to coarse Sand (50-60%) and Gravel (40-50%). Wet at 3'. (0'-10')	B5-1	S9 5'-10'	120"	41"		-Concrete seal -Bentonite seal 0.5'-1' -Silica sand filter pack 1'-15' Screen 2'-15'
10–11		***Poorly graded Sand*** Brown/orange medium Sand (90%) and Gravel (10%). Wet. (10'-11')		S9-2 10'-11'				
11–18.5		***Gravelly Silt with Sand*** Tan fines (50%), Sand (20%) and Gravel (30%). Very compact, non-cohesive, non-plastic, wet. (11'-18.5')	B5-2	S10/ S11 11'-18.5'	60"	34"		Well set at 15'
16–18.5			B5-3		30"	24"		
18–20		***End of Boring/Refusal at 18.5'***						End of Boring/Refusal at 18.5'

Drill Date: 11/29/2017 Borehole Diameter: 2.5" Ground Elevation: 0

Drill Method: Geoprobe Sampler Diameter: 2" Depth to GW: 5.77' btpvc

Driller: Crawford Drilling Services Well Casing Diameter: 2" PVC Date of Static GW Level: 12/12/2017

GEOSPHERE ENVIRONMENTAL MANAGEMENT INC.
51 Portsmouth Ave.
Exeter, NH 03833
(603)773-0075

Log of Borehole/MW: B-6/MW

Project No.: 17205

Site: Mahoney Garden Center Borehole Location: B-6/MW

Address: 115 Boston Post Road

Client: Eden Management Geologist: MK/LB

SUBSURFACE PROFILE			SAMPLE					
Depth (ft / m)	Symbol	Description	Core ID	Sample ID	Pen (ft)	Rec (ft)	Well Data	Comments
-2								4" diameter riser stick-up 1.6' ags
0		Ground Surface						
0		***Well graded Sand with Gravel*** Tan fine to medium Sand (50-60%) and Gravel (40-50%). Moist at 5', wet at 7' (0'-7')						-Concrete seal 0'-1'
2			B6-1		60"	13"		-Bentonite seal 1'-2'
4								-Silica sand filter pack 2'-13'
6 (2)				S14 5'-7'				
8		***Silt*** Fines (100%) gray, wet, very compact. (7'-13')	B6-2		60"	21"		Screen 3'-13'
10				S14-2 7'-13'				
12			B6-3		24"	5"		Well set at 13'
4		***End of Boring/Refusal at 13'***						End of Boring/Refusal at 13'
14								
16								
18								
20 (6)								

Drill Date: 11/29/2017 Borehole Diameter: 2.5" Ground Elevation: 0

Drill Method: Geoprobe Sampler Diameter: 2" Depth to GW: 4.90' btpvc

Driller: Crawford Drilling Services Well Casing Diameter: 2" PVC Date of Static GW Level: 12/12/2017

GEOSPHERE
ENVIRONMENTAL MANAGEMENT INC.
51 Portsmouth Ave.
Exeter, NH 03833
(603)773-0075

Log of Borehole/MW: B-7/MW

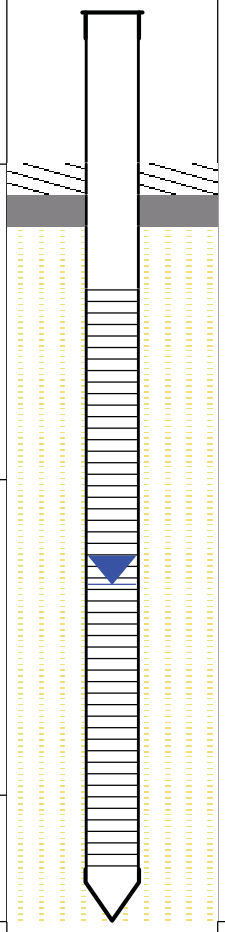
Project No.: 17205

Site: Mahoney Garden Center Borehole Location: B-7/MW

Address: 115 Boston Post Road

Client: Eden Management Geologist: MK/LB

SUBSURFACE PROFILE			SAMPLE					
Depth (ft / m)	Symbol	Description	Core ID	Sample ID	Pen (ft)	Rec (ft)	Well Data	Comments
-3 / -1		Ground Surface						4" diameter riser stick up 2.4'
1 / 3		***Fill*** (no sample collected) (0'-5')	B7-1		60"	6"		-Concrete seal 0'-0.5' -Bentonite seal 0.5'-1' -Silica sand filter pack 1'-12'
5 / 7 / 9 / 11 (2)		***Silty Gravel with Sand*** Light brown Fines (20%), medium to coarse Sand (40%) and Gravel (50%). Very compact, dry. (5'-12')	B7-2	S15	60"	27"		Screen 2'-12'
			B7-3		24"	No Rec.		Well set at 12'
13 / 15 / 17 (4)		***End of Boring/Refusal at 12'***						End of boring/Refusal at 12'



Drill Date: 11/29/2017 Borehole Diameter: 7" Ground Elevation: 0

Drill Method: Geoprobe/Auger Sampler Diameter: 2" Depth to GW: 6.66

Driller: Crawford Drilling Services Well Casing Diameter: N/A Date of Static GW Level: 12/12/2017

GEOSPHERE
ENVIRONMENTAL MANAGEMENT INC.
51 Portsmouth Ave.
Exeter, NH 03833
(603)773-0075

Log of Borehole/MW: B-8

Project No.: 17205

Site: Mahoney Garden Center Borehole Location: B-8

Address: 115 Boston Post Road

Client: Eden Management Geologist: MK/LB

SUBSURFACE PROFILE			SAMPLE					
Depth (ft / m)	Symbol	Description	Core ID	Sample ID	Pen (ft)	Rec (ft)	Well Data	Comments
0 / 0		Ground Surface						
		Fill (no sample collected) Moist at 4'. (0'-4')	B8-1		60"	22"		No well set.
		Well graded Sand with Gravel Light brown medium to coarse Sand (50-60%), and Gravel (40-50%). Moist at 7', wet at 13', mottling at 12'. Very compact 5-15'. (4'-15')	B8-2	S16 5'-13'	60"	32"		
			B8-3		60"	24"		
		Silty Sand with Gravel Dark brown fines (50-60%), Sand (25-30%), and Gravel (25%). Very compact, wet. (15'-18')	B8-4	S17 13'-18'	36"	24"		
		End of Boring/Refusal at 18'						

Drill Date: 11/29/2017 Borehole Diameter: 2.5" Ground Elevation: 0

Drill Method: Hollow Stem Auger Sampler Diameter: 2" Depth to GW: N/A

Driller: Crawford Drilling Services Well Casing Diameter: N/A Date of Static GW Level: N/A

GEOSPHERE ENVIRONMENTAL MANAGEMENT INC.
51 Portsmouth Ave.
Exeter, NH 03833
(603)773-0075

Log of Borehole/MW: B-9

Project No.: 17205

Site: Mahoney Garden Center Borehole Location: B9

Address: 115 Boston Post Road

Client: Eden Management Geologist: MK/LB

SUBSURFACE PROFILE			SAMPLE					
Depth (ft / m)	Symbol	Description	Core ID	Sample ID	Pen (ft)	Rec (ft)	Well Data	Comments
0 / 0		Ground Surface						
0–12		***Well graded Sand with Gravel*** Gray/brown to dark brown fine to medium Sand (60-80%), Gravel (20-40%). Trace fines. Moist at 4', mottling at 4'. (0'-12')	B9-1	S18 2'-5'	60"	19"		No well set.
			B9-2	S19 5'-12'	60"	6"		
			B9-3		24"	12"		
12		***End of boring/refusal at 12'***						Refusal at 12'

Drill Date: 11/29/2017 Borehole Diameter: 2.5" Ground Elevation: 0

Drill Method: Geoprobe/Auger Sampler Diameter: 2" Depth to GW: N/A

Driller: Crawford Drilling Services Well Casing Diameter: N/A Date of Static GW Level: N/A

Massachusetts Department of Environmental Management
Office of Water Resources

112669

TYPE OR PRINT ONLY

Well Completion Report

1. WELL LOCATION GPS (OPTIONAL) LATITUDE _____ LONGITUDE _____

Address at Well Location: 115 Boston Post Rd. Property Owner: Mahoney's

Subdivision Name: _____ Mailing Address: _____

City/Town: Wayland City/Town: _____

Assessors Map _____ Assessors Lot #: _____ NOTE: Assessors Map and Lot # mandatory if no street address available

Board of Health permit obtained: Yes ☑ Not Required ☐ Permit Number _____ Date Issued _____

RECEIVED FEB 10 2003 BOARD OF HEALTH WAYLAND

2. WORK PERFORMED
☑ New Well ☐ Abandon
☐ Deepen ☐ Recondition
☐ Replace ☐ Other _____

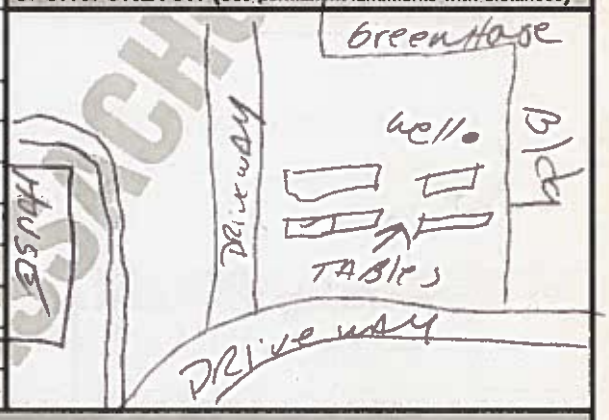
3. PROPOSED USE
☐ Domestic ☑ Irrigation
☐ Monitoring ☐ Municipal
☐ Industrial ☐ Other _____

4. DRILLING METHOD
☐ Cable ☐ Auger
☐ Air Hammer ☐ Direct Push
☑ Mud Rotary ☐ Other _____

5. WELL LOG

From (ft)	To (ft)	WATER	Permeability High	Permeability Low	Clay	Silt	Sand	Gravel	Cobbles	Boulders	Other	Rock Type
0	5		✓					✓				
5	20				✓							
20	30											MED Grey
30	860										DRY Gray	

6. SITE SKETCH (Use permanent landmarks with distances)



7. WELL CONSTRUCTION
Total Depth Drilled 860
Date Drilling Complete 1/15/03

8. CASING

From (ft)	To (ft)	Casing Type and Material	Size O.D. (in)	Well Seal Type
0	30	17/b #40 steel	6	Drive shoe

9. SCREEN

From (ft)	To (ft)	Slot Size	Screen Type and Material	Screen Diameter

10. FILTER PACK / GROUT / ABANDONMENT MATERIAL

From (ft)	To (ft)	Material Description	Purpose

11. ADDITIONAL WELL INFORMATION
Developed? ☑ Yes ☐ No
Fracture Enhancement? ☐ Yes ☐ No
Method Airflow
Disinfected? ☑ Yes ☐ No

12. WELL TEST DATA (PRODUCTION WELLS)

Date	Method	Yield (GPM)	Time Pumped (hrs & min)	Drawdown to (Ft. BGS)	Time (hrs & min)	Recovery to (Ft. BGS)
1/15/03	Airlift	7	2	860	24	10

13. STATIC WATER LEVEL (ALL WELLS)

Date Measured	Depth Below Ground Surface (FT)
1/16/03	10

14. PERMANENT PUMP (IF AVAILABLE)
Pump Description _____ Horsepower _____
Pump Intake Depth _____ (ft) Nominal Pump Capacity _____ (gpm)

15. NAME/ADDRESS OF PUMP INSTALLATION COMPANY

16. COMMENTS

17. WELL DRILLER'S STATEMENT
This well was drilled and/or abandoned under my supervision, according to applicable rules and regulations, and this report is complete and correct to the best of my knowledge.

Driller: Marc Reid Supervising Driller Signature: Tom [signature] Registration #: 8415
Firm: T J O'Brien Co Inc Date: 1/16/03 Rig Permit #: 338

NOTE: Well Completion Reports must be filed by the registered well driller within 30 days of well completion.

BOARD OF HEALTH COPY

Appendix C

Geotechnical Testing Laboratory Permeability Test Results

Client:	Geosphere Env. Management		
Project Name:	Wayland		
Project Location:	---		
GTX #:	307448		
Start Date:	01/15/18	Tested By:	eec
End Date:	01/15/18	Checked By:	emm
Boring #:	---		
Sample #:	S12		
Depth:	---		
Visual Description:	Moist, olive brown sand with silt and gravel		

Permeability of Granular Soils (Constant Head) by ASTM D2434

Sample Type: Remolded

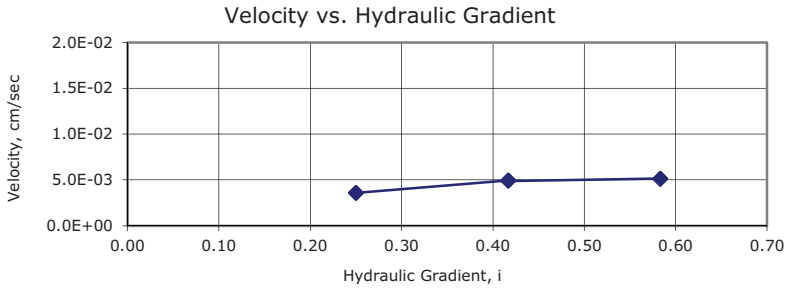
Sample Information:

Maximum Dry Density:	--- pcf
Optimum Moisture Content:	--- %
Compaction Test Method:	---
Classification (ASTM D2487):	---
Assumed Specific Gravity:	2.65

Sample Preparation / Test Setup: Test specimen compacted with moderate effort at air-dried moisture content. Material >3/8-inch screened out of sample prior to testing.

Parameter	Initial	Final
Height, in	1.20	1.20
Diameter, in	4.00	4.00
Area, in^2	12.6	12.6
Volume, in^3	15.1	15.1
Mass, g	419	506
Bulk Density, pcf	105.9	127.8
Moisture Content, %	0.5	19.8
Dry Density, pcf	105.3	106.7
Degree of Saturation, %	---	95.4
Void Ratio, e	---	0.55

Date	Reading #	Volume of Flow, cc	Time of Flow, sec	Flow Rate, cc/sec	Gradient	Permeability, cm/sec	Temp., °C	Correction Factor	Permeability @ 20 °C, cm/sec
1/15	1	2.9	10	0.29	0.25	1.4E-02	14.2	1.163	1.7E-02
1/15	2	2.9	10	0.29	0.25	1.4E-02	14.2	1.163	1.7E-02
1/15	3	2.9	10	0.29	0.25	1.4E-02	14.2	1.163	1.7E-02
1/15	4	4.0	10	0.40	0.42	1.2E-02	14.2	1.163	1.4E-02
1/15	5	4.0	10	0.40	0.42	1.2E-02	14.2	1.163	1.4E-02
1/15	6	4.0	10	0.40	0.42	1.2E-02	14.2	1.163	1.4E-02
1/15	7	4.2	10	0.42	0.58	8.8E-03	14.2	1.163	1.0E-02
1/15	8	4.1	10	0.41	0.58	8.8E-03	14.2	1.163	1.0E-02
1/15	9	4.2	10	0.42	0.58	8.8E-03	14.2	1.163	1.0E-02



PERMEABILITY @ 20 °C = 1.4×10^{-2} cm/sec

Note: This standard has been withdrawn by ASTM with no replacement.

Client:	Geosphere Env. Management		
Project Name:	Wayland		
Project Location:	---		
GTX #:	307448		
Start Date:	01/11/18	Tested By:	eec
End Date:	01/12/18	Checked By:	emm
Boring #:	---		
Sample #:	S6		
Depth:	---		
Visual Description:	Moist, gray silty sand with gravel		

Permeability of Granular Soils (Constant Head) by ASTM D2434

Sample Type: Remolded

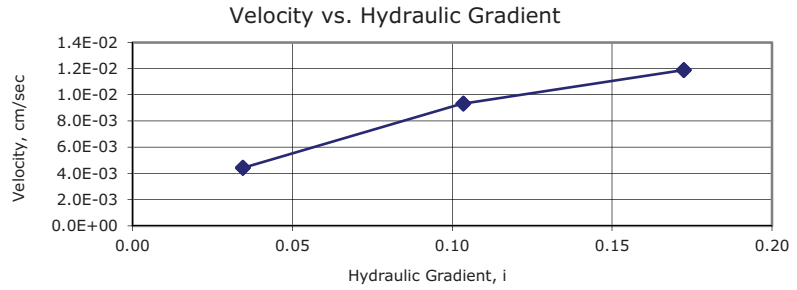
Sample Information:

Maximum Dry Density:	--- pcf
Optimum Moisture Content:	--- %
Compaction Test Method:	---
Classification (ASTM D2487):	---
Assumed Specific Gravity:	2.65

Sample Preparation / Test Setup: Test specimen compacted with moderate effort at air-dried moisture content. Material >3/8-inch screened out of sample prior to testing.

Parameter	Initial	Final
Height, in	3.00	2.90
Diameter, in	4.00	4.00
Area, in^2	12.6	12.6
Volume, in^3	37.7	36.4
Mass, g	934.0	1180.0
Bulk Density, pcf	94.4	123.4
Moisture Content, %	0.6	24.6
Dry Density, pcf	93.8	99.0
Degree of Saturation, %	---	97.2
Void Ratio, e	---	0.67

Date	Reading #	Volume of Flow, cc	Time of Flow, sec	Flow Rate, cc/sec	Gradient	Permeability, cm/sec	Temp., °C	Correction Factor	Permeability @ 20 °C, cm/sec
1/12	1	3.6	10	0.36	0.03	1.3E-01	13.9	1.173	1.5E-01
1/12	2	3.6	10	0.36	0.03	1.3E-01	13.9	1.173	1.5E-01
1/12	3	3.6	10	0.36	0.03	1.3E-01	13.9	1.173	1.5E-01
1/12	4	7.6	10	0.76	0.10	9.0E-02	13.9	1.173	1.1E-01
1/12	5	7.6	10	0.76	0.10	9.0E-02	13.9	1.173	1.1E-01
1/12	6	7.6	10	0.76	0.10	9.0E-02	13.9	1.173	1.1E-01
1/12	7	9.6	10	0.96	0.17	6.9E-02	13.9	1.173	8.1E-02
1/12	8	9.7	10	0.97	0.17	6.9E-02	13.9	1.173	8.1E-02
1/12	9	9.6	10	0.96	0.17	6.9E-02	13.9	1.173	8.1E-02



PERMEABILITY @ 20 °C = 1.1×10^{-1} cm/sec

Note: This standard has been withdrawn by ASTM with no replacement.

Client:	Geosphere Env. Management		
Project Name:	Wayland		
Project Location:	---		
GTX #:	307448		
Start Date:	01/11/18	Tested By:	eec
End Date:	01/12/18	Checked By:	emm
Boring #:	---		
Sample #:	S9		
Depth:	---		
Visual Description:	Moist, gray silty sand with gravel		

Permeability of Granular Soils (Constant Head) by ASTM D2434

Sample Type: Remolded

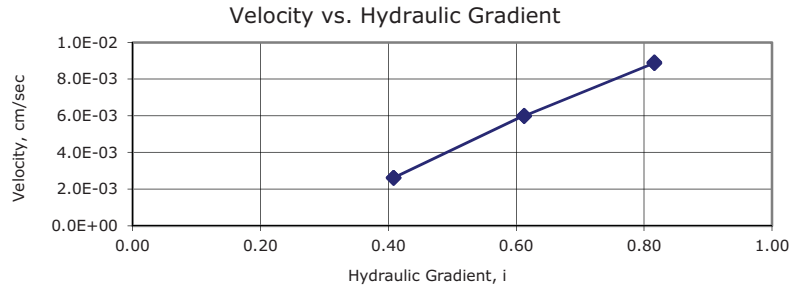
Sample Information:

Maximum Dry Density:	--- pcf
Optimum Moisture Content:	--- %
Compaction Test Method:	---
Classification (ASTM D2487):	---
Assumed Specific Gravity:	2.65

Sample Preparation / Test Setup: Test specimen compacted with moderate effort at air-dried moisture content. Material >3/8-inch screened out of sample prior to testing.

Parameter	Initial	Final
Height, in	1.00	0.98
Diameter, in	4.00	4.00
Area, in^2	12.6	12.6
Volume, in^3	12.6	12.3
Mass, g	325.9	410.0
Bulk Density, pcf	98.8	126.8
Moisture Content, %	0.2	21.8
Dry Density, pcf	98.6	104.1
Degree of Saturation, %	---	98.1
Void Ratio, e	---	0.59

Date	Reading #	Volume of Flow, cc	Time of Flow, sec	Flow Rate, cc/sec	Gradient	Permeability, cm/sec	Temp., °C	Correction Factor	Permeability @ 20 °C, cm/sec
1/11	1	2.1	10	0.21	0.41	6.4E-03	13.7	1.179	7.6E-03
1/11	2	2.1	10	0.21	0.41	6.4E-03	13.7	1.179	7.5E-03
1/11	3	2.1	10	0.21	0.41	6.4E-03	13.7	1.179	7.6E-03
1/11	4	4.9	10	0.49	0.61	9.8E-03	13.7	1.179	1.2E-02
1/11	5	4.9	10	0.49	0.61	9.8E-03	13.7	1.179	1.2E-02
1/11	6	4.8	10	0.48	0.61	9.8E-03	13.7	1.179	1.2E-02
1/11	7	7.2	10	0.72	0.82	1.1E-02	13.7	1.179	1.3E-02
1/11	8	7.2	10	0.72	0.82	1.1E-02	13.7	1.179	1.3E-02
1/11	9	7.2	10	0.72	0.82	1.1E-02	13.7	1.179	1.3E-02



PERMEABILITY @ 20 °C = 1.1×10^{-2} cm/sec

Note: This standard has been withdrawn by ASTM with no replacement.

Client:	Geosphere Env. Management		
Project Name:	Wayland		
Project Location:	---		
GTX #:	307448		
Start Date:	01/12/18	Tested By:	eec
End Date:	01/12/18	Checked By:	emm
Boring #:	---		
Sample #:	S-16		
Depth:	---		
Visual Description:	Moist, gray silty gravel with sand		

Permeability of Granular Soils (Constant Head) by ASTM D2434

Sample Type: Remolded

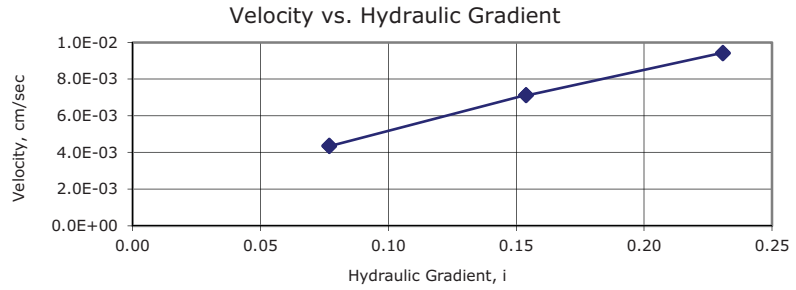
Sample Information:

Maximum Dry Density:	--- pcf
Optimum Moisture Content:	--- %
Compaction Test Method:	---
Classification (ASTM D2487):	---
Assumed Specific Gravity:	2.65

Sample Preparation / Test Setup: Test specimen compacted with moderate effort at air-dried moisture content. Material >3/8-inch screened out of sample prior to testing.

Parameter	Initial	Final
Height, in	2.80	2.60
Diameter, in	4.00	4.00
Area, in^2	12.6	12.6
Volume, in^3	35.2	32.7
Mass, g	902.0	1100.0
Bulk Density, pcf	97.7	128.3
Moisture Content, %	0.5	20.9
Dry Density, pcf	97.1	106.0
Degree of Saturation, %	---	99.1
Void Ratio, e	---	0.56

Date	Reading #	Volume of Flow, cc	Time of Flow, sec	Flow Rate, cc/sec	Gradient	Permeability, cm/sec	Temp., °C	Correction Factor	Permeability @ 20 °C, cm/sec
1/12	1	3.5	10	0.35	0.08	5.6E-02	17.0	1.079	6.1E-02
1/12	2	3.6	10	0.36	0.08	5.7E-02	17.0	1.079	6.1E-02
1/12	3	3.5	10	0.35	0.08	5.7E-02	17.0	1.079	6.1E-02
1/12	4	5.8	10	0.58	0.15	4.6E-02	17.0	1.079	5.0E-02
1/12	5	5.8	10	0.58	0.15	4.6E-02	17.0	1.079	5.0E-02
1/12	6	5.8	10	0.58	0.15	4.6E-02	17.0	1.079	5.0E-02
1/12	7	7.6	10	0.76	0.23	4.1E-02	17.0	1.079	4.4E-02
1/12	8	7.6	10	0.76	0.23	4.1E-02	17.0	1.079	4.4E-02
1/12	9	7.6	10	0.76	0.23	4.1E-02	17.0	1.079	4.4E-02



PERMEABILITY @ 20 °C = 5.2×10^{-2} cm/sec

Note: This standard has been withdrawn by ASTM with no replacement.

Client:	Geosphere Env. Management		
Project Name:	Wayland		
Project Location:	---		
GTX #:	307448		
Start Date:	01/11/18	Tested By:	eec
End Date:	01/12/18	Checked By:	emm
Boring #:	---		
Sample #:	S20		
Depth:	---		
Visual Description:	Moist, dark brown silty sand with gravel		

Permeability of Granular Soils (Constant Head) by ASTM D2434

Sample Type: Remolded

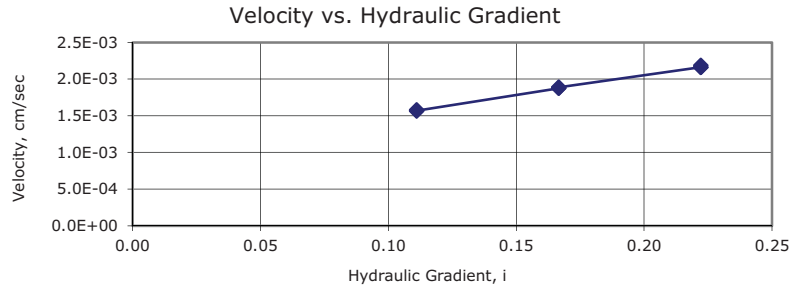
Sample Information:

Maximum Dry Density:	--- pcf
Optimum Moisture Content:	--- %
Compaction Test Method:	---
Classification (ASTM D2487):	---
Assumed Specific Gravity:	2.65

Sample Preparation / Test Setup: Test specimen compacted with moderate effort at air-dried moisture content. Material >3/8-inch screened out of sample prior to testing.

Parameter	Initial	Final
Height, in	3.70	3.60
Diameter, in	4.00	4.00
Area, in^2	12.6	12.6
Volume, in^3	46.5	45.2
Mass, g	1100	1420
Bulk Density, pcf	90.1	119.6
Moisture Content, %	0.9	27.5
Dry Density, pcf	89.3	93.8
Degree of Saturation, %	---	95.5
Void Ratio, e	---	0.76

Date	Reading #	Volume of Flow, cc	Time of Flow, sec	Flow Rate, cc/sec	Gradient	Permeability, cm/sec	Temp., °C	Correction Factor	Permeability @ 20 °C, cm/sec
1/10	1	1.3	10	0.13	0.11	1.4E-02	13.6	1.183	1.7E-02
1/10	2	1.3	10	0.13	0.11	1.4E-02	13.6	1.183	1.7E-02
1/10	3	1.3	10	0.13	0.11	1.4E-02	13.6	1.183	1.7E-02
1/10	4	1.5	10	0.15	0.17	1.1E-02	13.6	1.183	1.3E-02
1/10	5	1.5	10	0.15	0.17	1.1E-02	13.6	1.183	1.3E-02
1/10	6	1.5	10	0.15	0.17	1.1E-02	13.6	1.183	1.3E-02
1/10	7	1.8	10	0.18	0.22	9.7E-03	13.6	1.183	1.1E-02
1/10	8	1.8	10	0.18	0.22	9.7E-03	13.6	1.183	1.1E-02
1/10	9	1.8	10	0.18	0.22	9.8E-03	13.6	1.183	1.2E-02



PERMEABILITY @ 20 °C = 1.4×10^{-2} cm/sec

Note: This standard has been withdrawn by ASTM with no replacement.

Client:	Geosphere Env. Management		
Project Name:	Wayland		
Project Location:	---		
GTX #:	307448		
Start Date:	01/15/18	Tested By:	eec
End Date:	01/16/18	Checked By:	emm
Boring #:	---		
Sample #:	S1/S2		
Depth:	---		
Visual Description:	Moist, olive gray sand with silt and gravel		

Permeability of Granular Soils (Constant Head) by ASTM D2434

Sample Type: Remolded

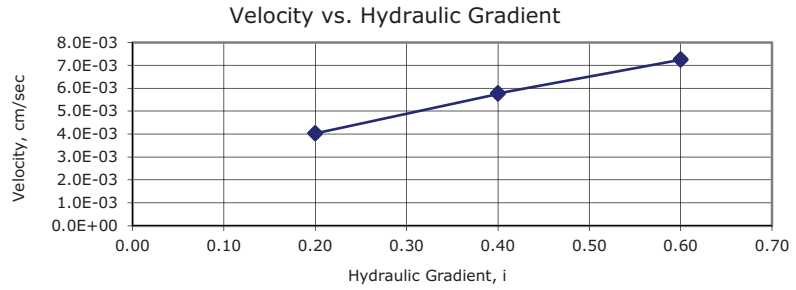
Sample Information:

Maximum Dry Density:	--- pcf
Optimum Moisture Content:	--- %
Compaction Test Method:	---
Classification (ASTM D2487):	---
Assumed Specific Gravity:	2.65

Sample Preparation / Test Setup: Test specimen compacted with moderate effort at air-dried moisture content. Material >3/8-inch screened out of sample prior to testing.

Parameter	Initial	Final
Height, in	1.10	1.00
Diameter, in	4.00	4.00
Area, in^2	12.6	12.6
Volume, in^3	13.8	12.6
Mass, g	380.0	436.0
Bulk Density, pcf	104.7	132.2
Moisture Content, %	0.3	17.8
Dry Density, pcf	104.4	112.2
Degree of Saturation, %	---	99.4
Void Ratio, e	---	0.47

Date	Reading #	Volume of Flow, cc	Time of Flow, sec	Flow Rate, cc/sec	Gradient	Permeability, cm/sec	Temp., °C	Correction Factor	Permeability @ 20 °C, cm/sec
1/15	1	3.3	10	0.33	0.20	2.0E-02	14.2	1.163	2.3E-02
1/15	2	3.3	10	0.33	0.20	2.0E-02	14.2	1.163	2.4E-02
1/15	3	3.3	10	0.33	0.20	2.0E-02	14.2	1.163	2.3E-02
1/15	4	4.7	10	0.47	0.40	1.4E-02	14.2	1.163	1.7E-02
1/15	5	4.7	10	0.47	0.40	1.4E-02	14.2	1.163	1.7E-02
1/15	6	4.7	10	0.47	0.40	1.4E-02	14.2	1.163	1.7E-02
1/15	7	5.9	10	0.59	0.60	1.2E-02	14.2	1.163	1.4E-02
1/15	8	5.9	10	0.59	0.60	1.2E-02	14.2	1.163	1.4E-02
1/15	9	5.9	10	0.59	0.60	1.2E-02	14.2	1.163	1.4E-02



PERMEABILITY @ 20 °C = 1.8×10^{-2} cm/sec

Note: This standard has been withdrawn by ASTM with no replacement.

Client:	Geosphere Env. Management		
Project Name:	Wayland		
Project Location:	---		
GTX #:	307448		
Start Date:	01/15/18	Tested By:	eec
End Date:	01/16/18	Checked By:	emm
Boring #:	---		
Sample #:	S19		
Depth:	---		
Visual Description:	Moist, olive brown sand with silt and gravel		

Permeability of Granular Soils (Constant Head) by ASTM D2434

Sample Type: Remolded

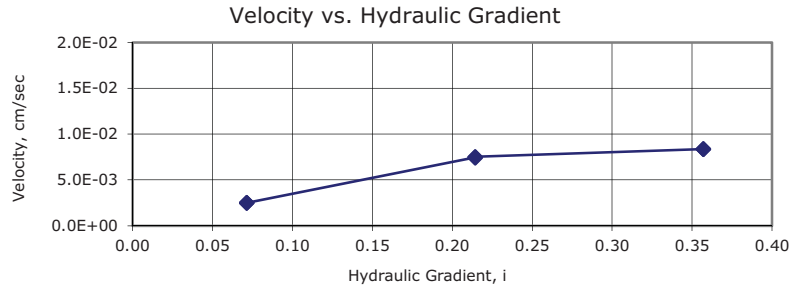
Sample Information:

Maximum Dry Density:	--- pcf
Optimum Moisture Content:	--- %
Compaction Test Method:	---
Classification (ASTM D2487):	---
Assumed Specific Gravity:	2.65

Sample Preparation / Test Setup: Test specimen compacted with moderate effort at air-dried moisture content. Material >3/8-inch screened out of sample prior to testing.

Parameter	Initial	Final
Height, in	1.50	1.40
Diameter, in	4.00	4.00
Area, in^2	12.6	12.6
Volume, in^3	18.8	17.6
Mass, g	451.0	565.0
Bulk Density, pcf	91.1	122.3
Moisture Content, %	0.5	25.4
Dry Density, pcf	90.7	97.6
Degree of Saturation, %	---	96.7
Void Ratio, e	---	0.70

Date	Reading #	Volume of Flow, cc	Time of Flow, sec	Flow Rate, cc/sec	Gradient	Permeability, cm/sec	Temp., °C	Correction Factor	Permeability @ 20 °C, cm/sec
1/15	1	2.0	10	0.20	0.07	3.5E-02	12.7	1.214	4.2E-02
1/15	2	2.1	10	0.21	0.07	3.5E-02	12.7	1.214	4.3E-02
1/15	3	2.0	10	0.20	0.07	3.5E-02	12.7	1.214	4.2E-02
1/15	4	6.1	10	0.61	0.21	3.5E-02	12.7	1.214	4.2E-02
1/15	5	6.0	10	0.60	0.21	3.5E-02	12.7	1.214	4.2E-02
1/15	6	6.1	10	0.61	0.21	3.5E-02	12.7	1.214	4.3E-02
1/15	7	6.8	10	0.68	0.36	2.3E-02	12.7	1.214	2.8E-02
1/15	8	6.8	10	0.68	0.36	2.3E-02	12.7	1.214	2.9E-02
1/15	9	6.8	10	0.68	0.36	2.3E-02	12.7	1.214	2.8E-02



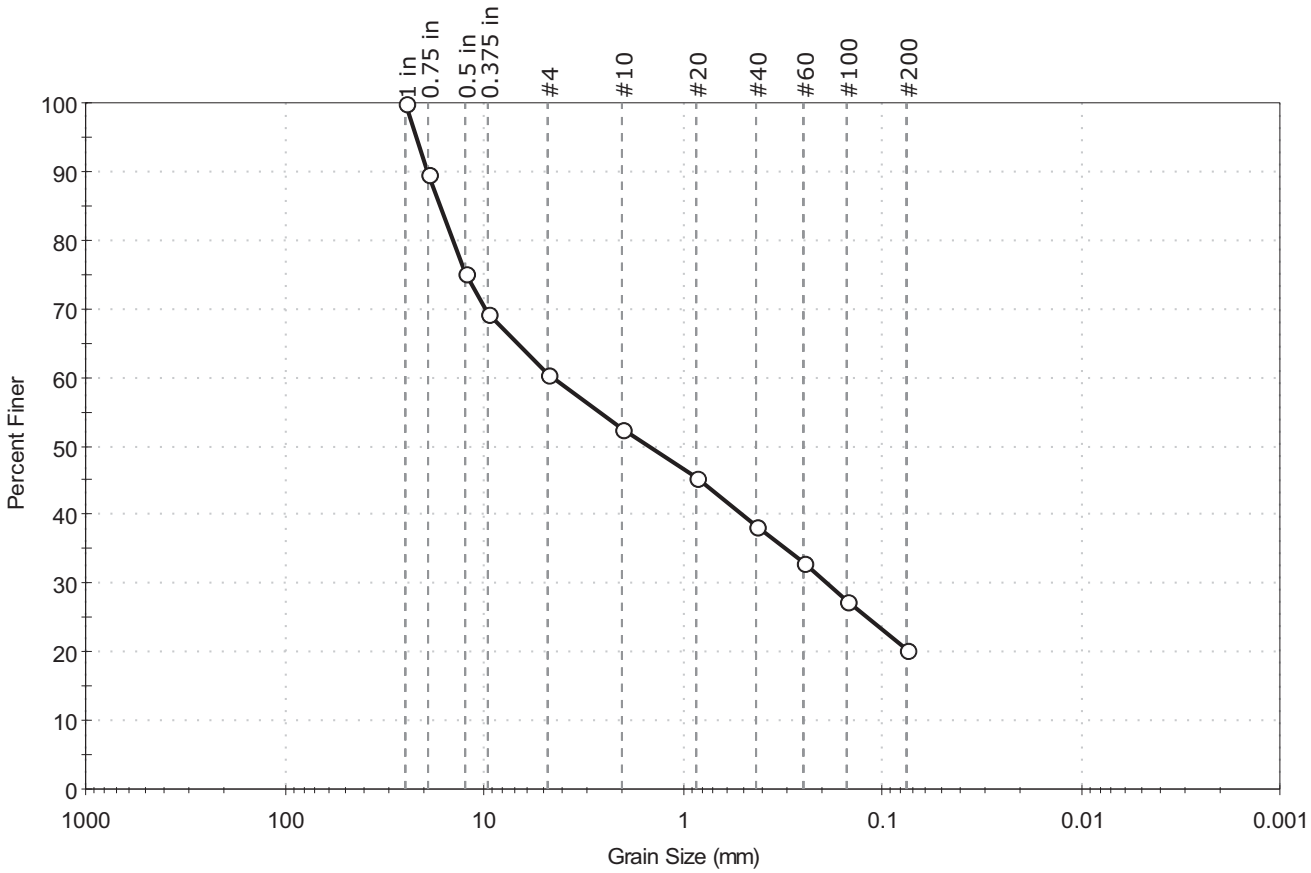
PERMEABILITY @ 20 °C =

3.8×10^{-2} cm/sec

Note: This standard has been withdrawn by ASTM with no replacement.

Client:	Geosphere Env. Management				
Project:	Wayland				
Location:				Project No:	GTX-307448
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	S1/S2	Test Date:	01/05/18	Checked By:	emm
Depth :	---	Test Id:	438665		
Test Comment:	---				
Visual Description:	Moist, greenish gray silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	39.6	40.0	20.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	90		
0.5 in	12.50	75		
0.375 in	9.50	69		
#4	4.75	60		
#10	2.00	52		
#20	0.85	45		
#40	0.42	38		
#60	0.25	33		
#100	0.15	27		
#200	0.075	20		

Coefficients

D_{85} = 16.6118 mm D_{30} = 0.1885 mm

D_{60} = 4.5508 mm D_{15} = N/A

D_{50} = 1.4844 mm D_{10} = N/A

C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

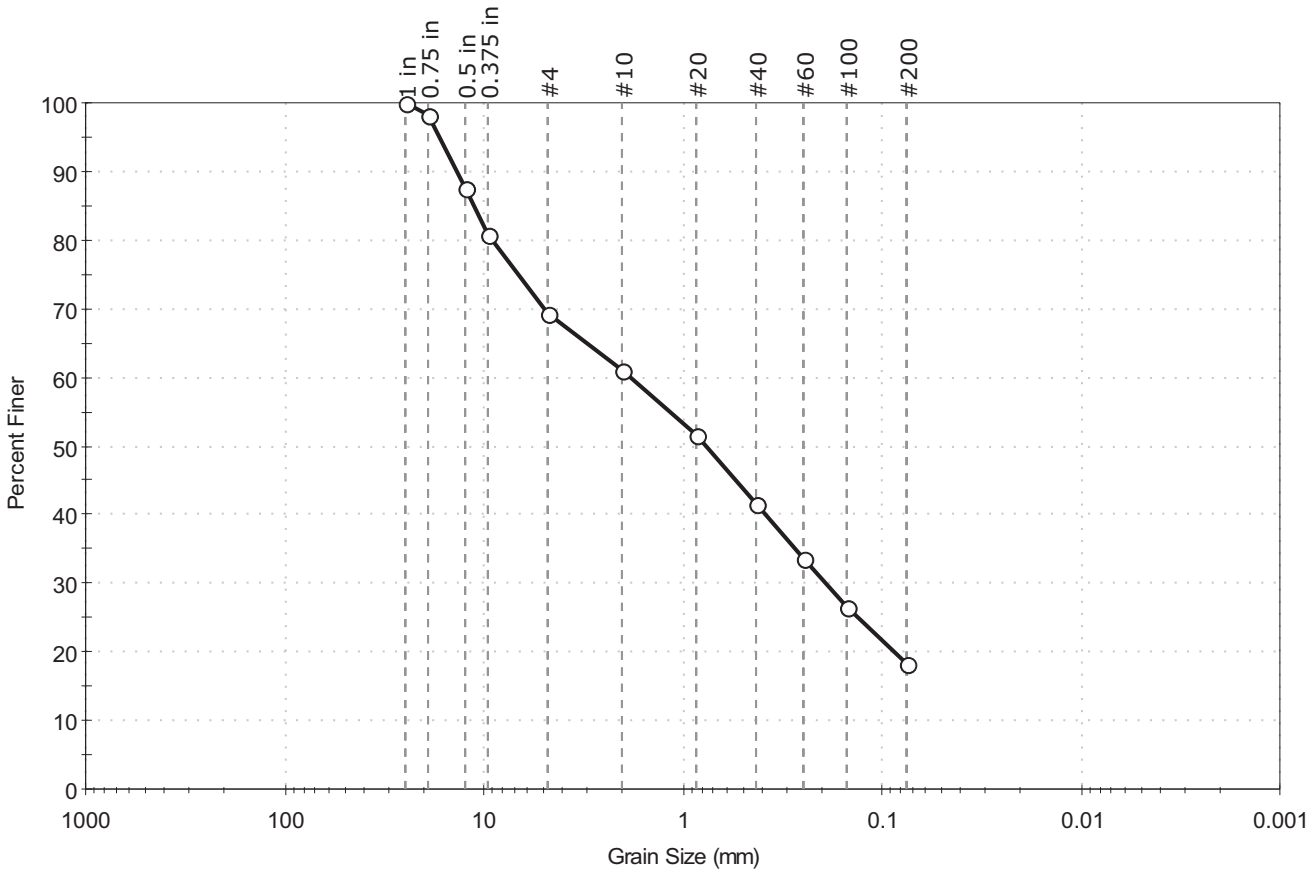
Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

printed 1/12/2018 8:24:00 AM

Client:	Geosphere Env. Management				
Project:	Wayland				
Location:				Project No:	GTX-307448
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	S7	Test Date:	01/03/18	Checked By:	emm
Depth :	---	Test Id:	438666		
Test Comment:	---				
Visual Description:	Moist, gray silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	30.5	51.1	18.4

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	98		
0.5 in	12.50	88		
0.375 in	9.50	81		
#4	4.75	69		
#10	2.00	61		
#20	0.85	52		
#40	0.42	42		
#60	0.25	34		
#100	0.15	26		
#200	0.075	18		

Coefficients

D_{85} = 11.2567 mm	D_{30} = 0.1935 mm
D_{60} = 1.8251 mm	D_{15} = N/A
D_{50} = 0.7553 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

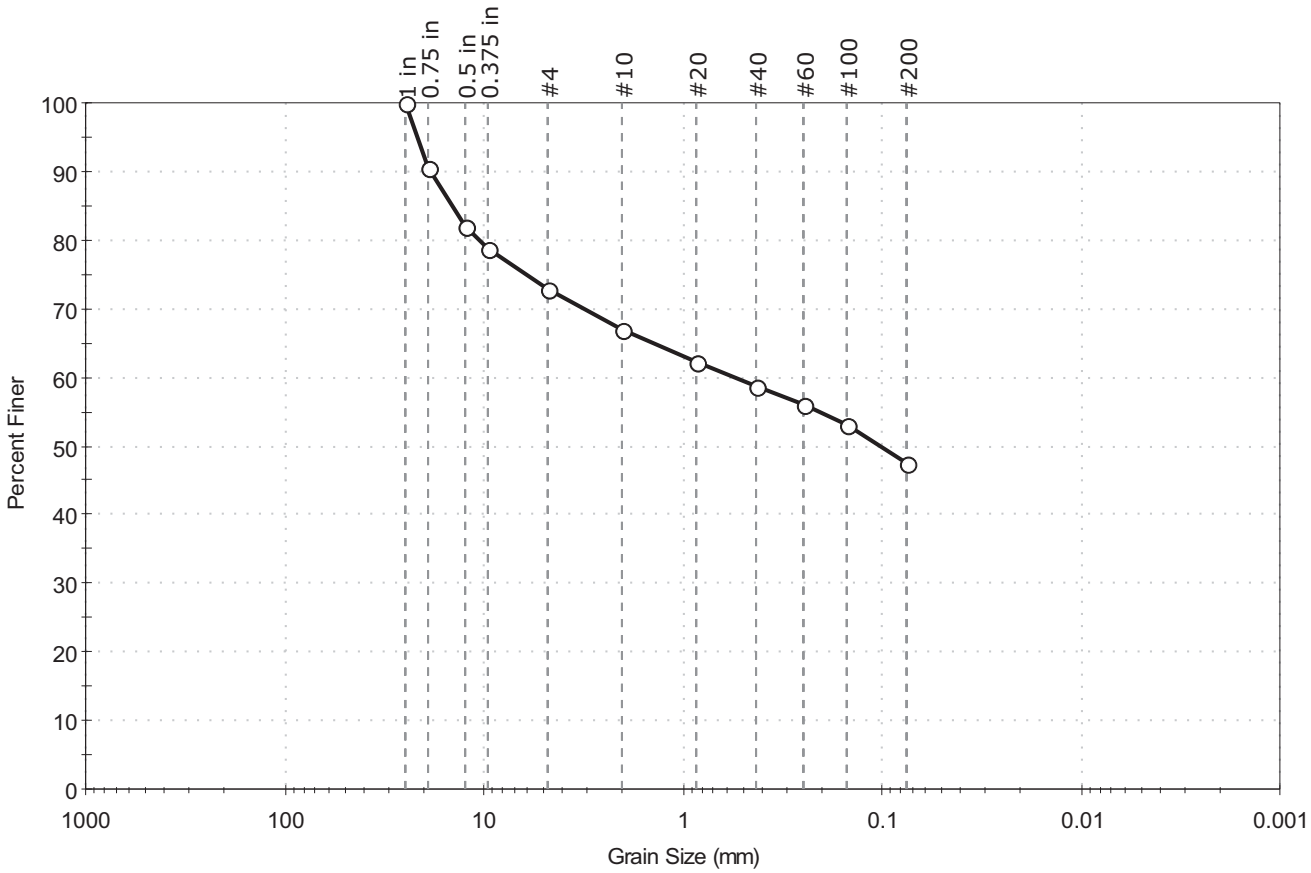
Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

printed 1/12/2018 8:24:01 AM

Client:	Geosphere Env. Management				
Project:	Wayland				
Location:				Project No:	GTX-307448
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	S11	Test Date:	01/03/18	Checked By:	emm
Depth :	---	Test Id:	438667		
Test Comment:	---				
Visual Description:	Moist, brown clayey gravel with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	27.0	25.4	47.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	91		
0.5 in	12.50	82		
0.375 in	9.50	79		
#4	4.75	73		
#10	2.00	67		
#20	0.85	62		
#40	0.42	59		
#60	0.25	56		
#100	0.15	53		
#200	0.075	48		

Coefficients

D_{85} = 14.4990 mm D_{30} = N/A
D_{60} = 0.5494 mm D_{15} = N/A
D_{50} = 0.1021 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

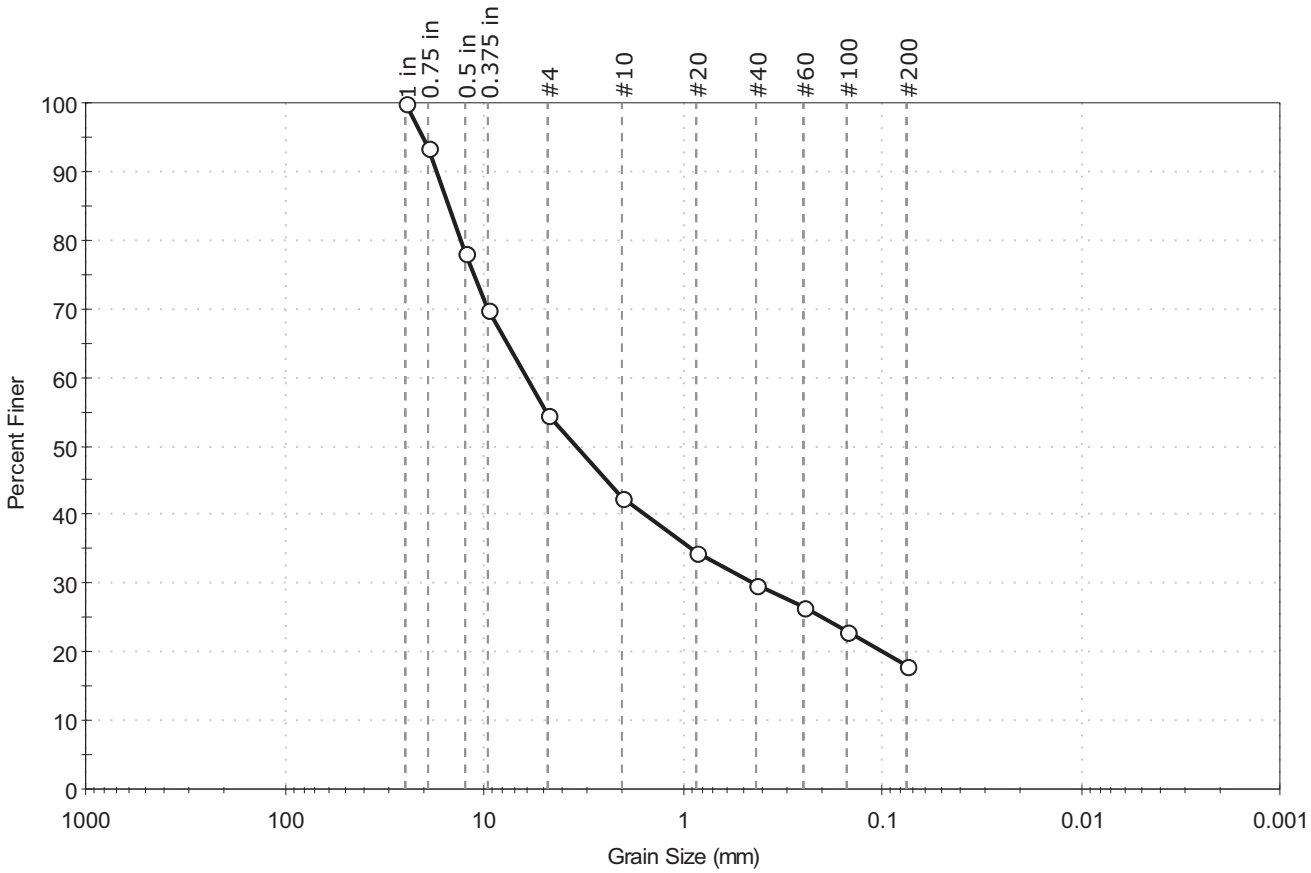
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client:	Geosphere Env. Management				
Project:	Wayland				
Location:				Project No:	GTX-307448
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	S15	Test Date:	01/03/18	Checked By:	emm
Depth :	---	Test Id:	438668		
Test Comment:	---				
Visual Description:	Moist, gray silty gravel with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	45.4	36.7	17.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	93		
0.5 in	12.50	78		
0.375 in	9.50	70		
#4	4.75	55		
#10	2.00	43		
#20	0.85	34		
#40	0.42	30		
#60	0.25	26		
#100	0.15	23		
#200	0.075	18		

Coefficients

D_{85} = 15.0857 mm	D_{30} = 0.4425 mm
D_{60} = 6.0615 mm	D_{15} = N/A
D_{50} = 3.4205 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

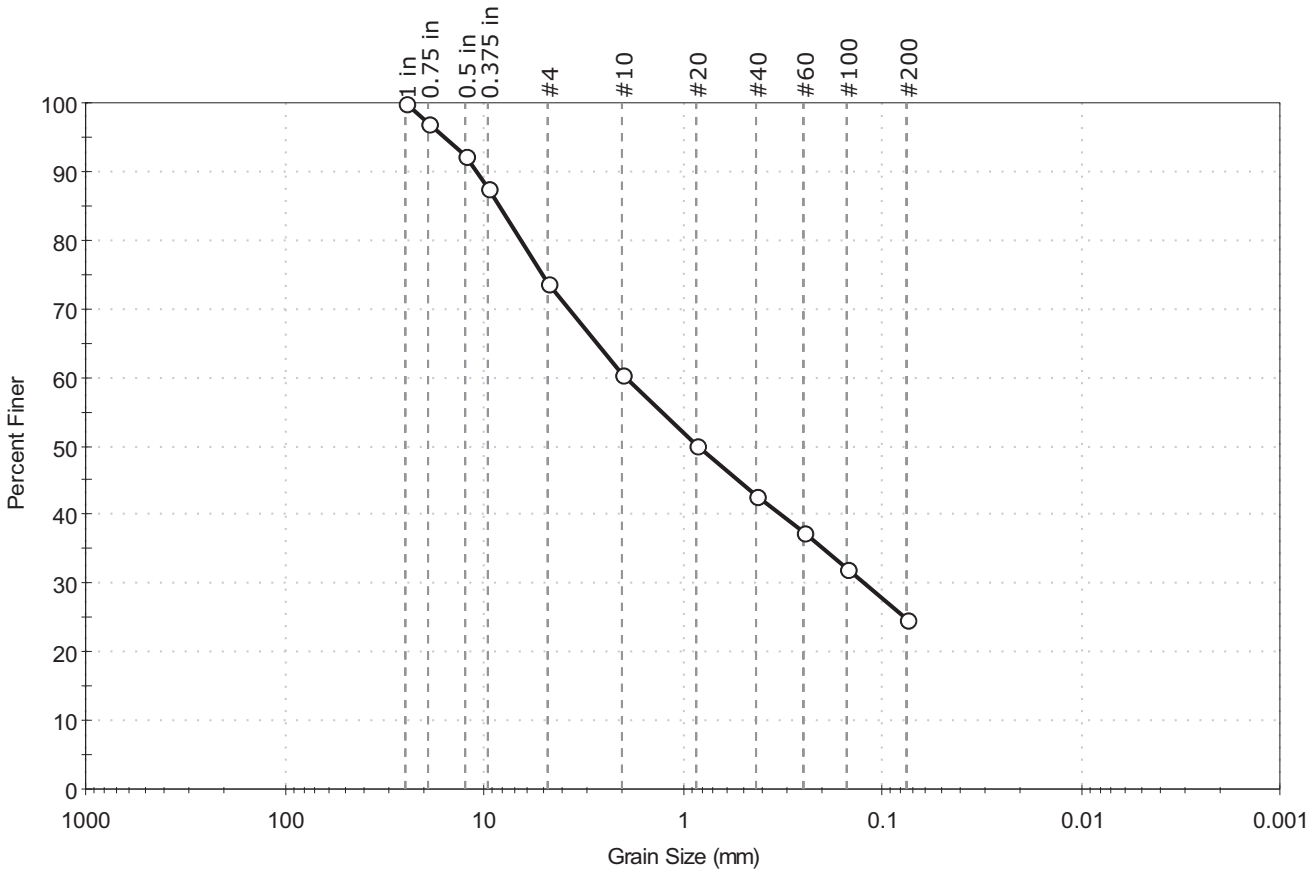
Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

Client:	Geosphere Env. Management				
Project:	Wayland				
Location:				Project No:	GTX-307448
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	S17	Test Date:	01/03/18	Checked By:	emm
Depth :	---	Test Id:	438669		
Test Comment:	---				
Visual Description:	Moist, dark brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	26.1	49.2	24.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 in	25.00	100		
0.75 in	19.00	97		
0.5 in	12.50	92		
0.375 in	9.50	88		
#4	4.75	74		
#10	2.00	60		
#20	0.85	50		
#40	0.42	43		
#60	0.25	38		
#100	0.15	32		
#200	0.075	25		

Coefficients

D_{85} = 8.3075 mm	D_{30} = 0.1229 mm
D_{60} = 1.9333 mm	D_{15} = N/A
D_{50} = 0.8355 mm	D_{10} = N/A
C_u = N/A	C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

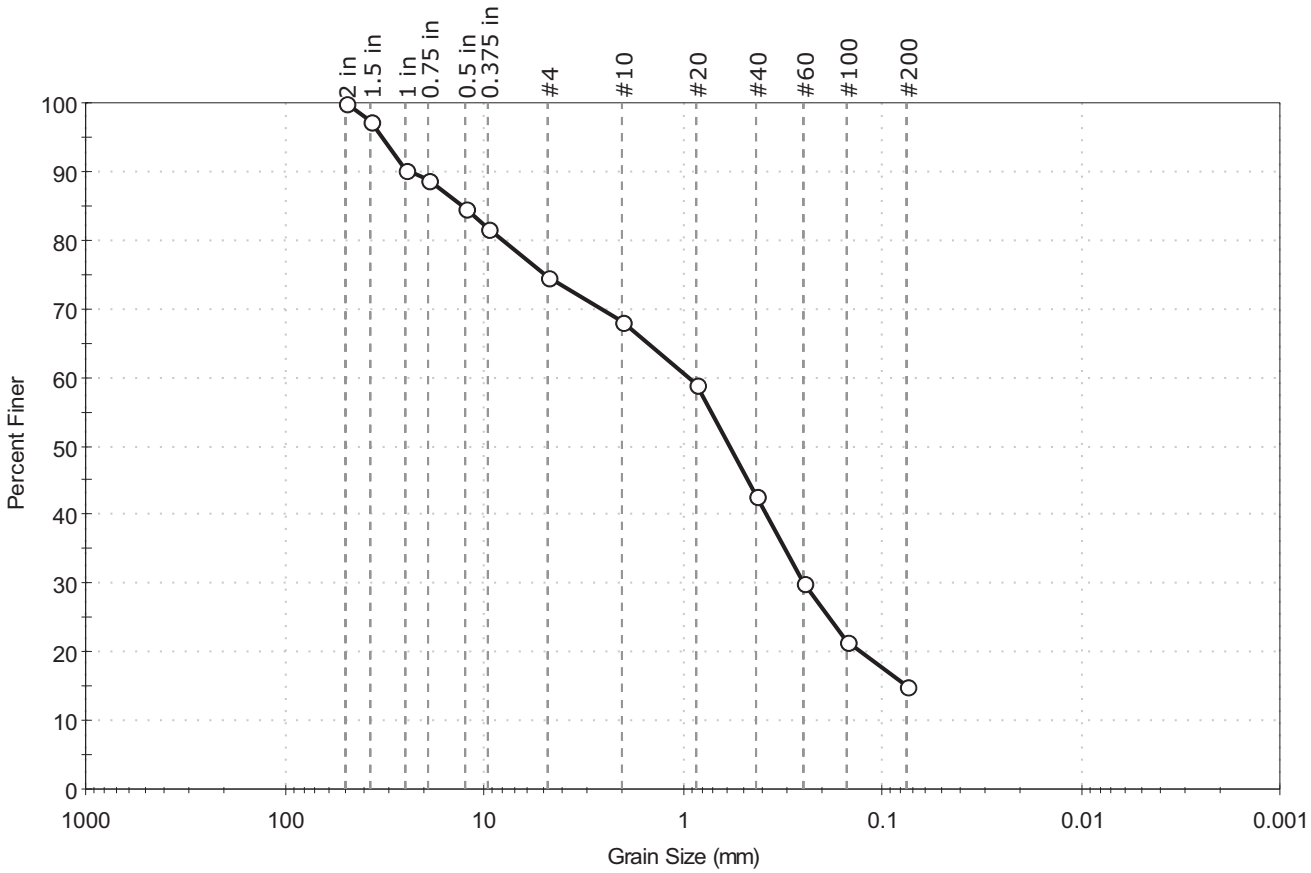
Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

printed 1/12/2018 8:24:04 AM

Client:	Geosphere Env. Management				
Project:	Wayland				
Location:				Project No:	GTX-307448
Boring ID:	---	Sample Type:	bag	Tested By:	jbr
Sample ID:	S20	Test Date:	01/05/18	Checked By:	emm
Depth :	---	Test Id:	438670		
Test Comment:	---				
Visual Description:	Moist, dark brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	25.2	59.8	15.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
2 in	50.00	100		
1.5 in	37.50	97		
1 in	25.00	90		
0.75 in	19.00	89		
0.5 in	12.50	85		
0.375 in	9.50	82		
#4	4.75	75		
#10	2.00	68		
#20	0.85	59		
#40	0.42	43		
#60	0.25	30		
#100	0.15	22		
#200	0.075	15		

Coefficients

D_{85} = 13.0232 mm D_{30} = 0.2499 mm
D_{60} = 0.9285 mm D_{15} = 0.0753 mm
D_{50} = 0.5772 mm D_{10} = N/A
C_u = N/A C_c = N/A

Classification

ASTM N/A

AASHTO Stone Fragments, Gravel and Sand (A-1-b (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

printed 1/12/2018 8:24:04 AM

Client:	Geosphere Env. Management		
Project Name:	Wayland		
Project Location:	---		
GTX #:	307448		
Start Date:	12/28/2017	Tested By:	eec/trm
End Date:	1/9/2018	Checked By:	emm
Boring #:	---		
Sample #:	S-10		
Depth:	---		
Visual Description:	Moist, grayish brown silt with sand		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type: Remolded

Permeant Fluid: De-aired Distilled water

Orientation: Vertical

Cell #: ---

Sample Preparation: Test specimen compacted with moderate effort at as-received moisture content. Material >3/8-inch removed from sample prior to testing. Trimmings moisture content = 22.6%

Assumed Specific Gravity: 2.70

Parameter	Initial	Final
Height, in	2.55	2.35
Diameter, in	2.96	2.80
Area, in^2	6.88	6.16
Volume, in^3	17.5	14.5
Mass, g	512.7	498.4
Bulk Density, pcf	111.1	130.9
Moisture Content, %	22.6	19.2
Dry Density, pcf	90.6	109.8
Degree of Saturation, %	71	97

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.68	Increased Cell Pressure, psi:	95.90	Cell Pressure Increment, psi:	5.22
Sample Pressure, psi:	85.08	Corresponding Sample Pressure, psi:	90.17	Sample Pressure Increment, psi:	5.09
				B Coefficient:	0.98

FLOW DATA

Date	Trial #	Pressure, psi Cell	Pressure, psi Sample	Manometer Readings Z_1	Manometer Readings Z_2	Manometer Readings Z_1-Z_2	Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
1/3	1	90.7	85.1	11.5	10.5	1.0	38	24.3	9.0E-07	19.7	1.008	9.1E-07
1/3	2	90.7	85.1	11.5	10.5	1.0	35	24.3	9.8E-07	19.7	1.008	9.8E-07
1/3	3	90.7	85.1	11.5	10.5	1.0	34	24.3	1.0E-06	19.7	1.008	1.0E-06
1/3	4	90.7	85.1	11.5	10.5	1.0	36	24.3	9.5E-07	19.7	1.008	9.6E-07

PERMEABILITY AT 20° C: 9.6 x 10^{-7} cm/sec (@ 5 psi effective stress)

Client:	Geosphere Env. Management		
Project Name:	Wayland		
Project Location:	---		
GTX #:	307448		
Start Date:	12/27/2017	Tested By:	eec/trm
End Date:	1/8/2018	Checked By:	emm
Boring #:	---		
Sample #:	S-13		
Depth:	---		
Visual Description:	Moist, pale brown silt		

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter by ASTM D5084

Constant Volume

Sample Type: Remolded

Permeant Fluid: De-aired Distilled water

Orientation: Vertical

Cell #: ---

Sample Preparation: Test specimen compacted with moderate effort at as-received moisture content. Material >3/8-inch removed from sample prior to testing. Trimmings moisture content = 17.6%

Assumed Specific Gravity: 2.70

Parameter	Initial	Final
Height, in	2.10	2.08
Diameter, in	2.81	2.79
Area, in^2	6.20	6.11
Volume, in^3	13.0	12.7
Mass, g	461.7	458.3
Bulk Density, pcf	134.8	137.0
Moisture Content, %	16.4	15.5
Dry Density, pcf	115.8	118.6
Degree of Saturation, %	97	99

B COEFFICIENT DETERMINATION

Cell Pressure, psi:	90.32	Increased Cell Pressure, psi:	95.00	Cell Pressure Increment, psi:	4.68
Sample Pressure, psi:	84.73	Corresponding Sample Pressure, psi:	89.32	Sample Pressure Increment, psi:	4.59
				B Coefficient:	0.98

FLOW DATA

Date	Trial #	Pressure, psi Cell	Pressure, psi Sample	Manometer Readings Z_1	Manometer Readings Z_2	Manometer Readings Z_1-Z_2	Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp, °C	R_t	Permeability K @ 20 °C, cm/sec
	1	90.3	84.7	23.0	18.0	5.0	34	54.9	2.4E-06	19.7	1.008	2.4E-06
1/0	2	90.3	84.7	23.0	18.0	5.0	36	54.9	2.3E-06	19.7	1.008	2.3E-06
1/0	3	90.3	84.7	23.0	18.0	5.0	33	54.9	2.5E-06	19.7	1.008	2.5E-06
1/0	4	90.3	84.7	23.0	18.0	5.0	36	54.9	2.3E-06	19.7	1.008	2.3E-06

PERMEABILITY AT 20° C: 2.4 x 10^{-6} cm/sec (@ 5 psi effective stress)

GeoTesting Express
a subsidiary of Geocomp Corporation

SOIL CHAIN OF CUSTODY & TEST REQUEST

CLIENT	
Company: GEOSPHERE	
Address: 51 PORTSMOUTH AVE	
City, State, Zip: EXETER, NH 03833	
Contact: DAVID NIEMEYER	E-mail: dniemeyer@
Phone: 603-773-0075 x12	Fax: geosphere nh.com

PROJECT	
Project Name: WAYLAND	
Address:	Client Project #: 17205
City, State, Zip:	
On-site Contact:	E-mail:
Phone:	Fax:

GeoTesting Express, Inc.
1145 Massachusetts Avenue
Boxborough, MA 01719
800 434 1062 Toll Free
978 635 0266 Fax

2662 Holcomb Bridge Road, Suite 310
Alpharetta, GA 30022
770 645 6575 Tel
770 645 6570 Fax

www.geotesting.com

INVOICE (complete if different from client)	
Company:	
Address:	
City, State, Zip:	
Contact:	E-mail:
Phone:	Fax:

GENERAL	
Purchase Order #: 17205	GTX Sales Order #:
Shipped By:	Date Shipped:
Mode of Shipment:	Requested Turnaround:
Send Results To:	☒ CLIENT OFFICE ☐ PROJECT OFFICE
Send Results Via:	☒ E-MAIL ☐ FAX ☐ VERBAL ☐ HARD COPY

SOIL *please include boring # and depth if known	Sample ID	Atterberg Limits (ASTM D 4318)	California Bearing Ratio (ASTM D 1883) *specify conditions below	USCS – Classification (ASTM D 2487)	Density (ASTM D 2937)	Direct Shear (ASTM D 3080) *specify conditions below	Direct Simple Shear (ASTM D 6528) *specify conditions below	Electrical Resistivity (ASTM G 57)	Grain Size (ASTM D 422) Sieve Only / Sieve & Hydrometer please circle one	Incremental Consolidation (ASTM D 2435)	Moisture Content (ASTM D 2216)	Organic Content (ASTM D 2974)	Permeability/ Hydraulic Conductivity (Fixed Wall – ASTM D 2434) (Flexible Wall – ASTM D 5084) please circle one	Ph (ASTM D 4972)	Proctor Compaction (Standard – ASTM D 698) (Modified – ASTM D 1557) please circle one	Specific Gravity (ASTM D 854)	Triaxial Shear (UU – ASTM D 2850) (CU – ASTM D 4767) (CD – US COE EM1110) *specify conditions below please circle one	Unconfined Compression (ASTM D 2166)	Other:	Other:
1	Combine S1																			
2	S2			X					X				X							
3	S3																			
4	S4																			
5	S5																			
6	S6												X							
7	S7			X					X											

*Specify Test Conditions (Undisturbed or Remolded, Density and moisture, Test Normal Loads, Test Confining Stresses, etc.):
Desired Tests: 1) Permeability, moderate compaction (PRIORITY); Sieve (no hydrometer)
Call to discuss need for Atterberg Limits, Hydrometer for classification, and compositing.

AUTHORIZE BY SIGNING AND DATING:
SIGNATURE: [signature] PRINT NAME: DAVID NIEMEYER DATE: 12/21/17

P1/3

Relinquished By: Matthew W. Kropp	DATE: 12/13/17 2:41pm	Received By: [signature]	DATE: 12/13/17
	TIME:		TIME: 2:40PM
Relinquished By:	DATE:	Received By:	DATE:
	TIME:		TIME:

a subsidiary of Geocomp Corporation

SOIL CHAIN OF CUSTODY & TEST REQUEST

CLIENT	
Company: GEOSPHERE	
Address: 51 PORTSMOUTH AVE	
City, State, Zip: EXETER, NH 03833	
Contact: DAVID NIEHEYER	E-mail: dniehever@
Phone: 603-773-0075 x12	Fax: geosphere nh.com

PROJECT	
Project Name: WAYLAND	
Address:	Client Project #: 17205
City, State, Zip:	
On-site Contact:	E-mail:
Phone:	Fax:

GeoTesting Express, Inc.
1145 Massachusetts Avenue
Boxborough, MA 01719
800 434 1062 Toll Free
978 635 0266 Fax

2662 Holcomb Bridge Road, Suite 310
Alpharetta, GA 30022
770 645 6575 Tel
770 645 6570 Fax

www.geotesting.com

INVOICE (complete if different from client)	
Company:	
Address:	
City, State, Zip:	
Contact:	E-mail:
Phone:	Fax:

GENERAL	
Purchase Order #: 17205	GTX Sales Order #:
Shipped By:	Date Shipped:
Mode of Shipment:	Requested Turnaround:
Send Results To:	☒ CLIENT OFFICE ☐ PROJECT OFFICE
Send Results Via:	☒ E-MAIL ☐ FAX ☐ VERBAL ☐ HARD COPY

SOIL *please include boring # and depth if known	Sample ID	Atterberg Limits (ASTM D 4318)	California Bearing Ratio (ASTM D 1883) *specify conditions below	USCS – Classification (ASTM D 2487)	Density (ASTM D 2937)	Direct Shear (ASTM D 3080) *specify conditions below	Direct Simple Shear (ASTM D 6528) *specify conditions below	Electrical Resistivity (ASTM G 57)	Grain Size (ASTM D 422) Sieve Only / Sieve & Hydrometer please circle one	Incremental Consolidation (ASTM D 2435)	Moisture Content (ASTM D 2216)	Organic Content (ASTM D 2974)	Permeability/ Hydraulic Conductivity (Fixed Wall - ASTM D 2434) (Flexible Wall – ASTM D 5084) please circle one	Ph (ASTM D 4972)	Proctor Compaction (Standard – ASTM D 698) (Modified – ASTM D 1557) please circle one	Specific Gravity (ASTM D 854)	Triaxial Shear (UU – ASTM D 2850) (CU – ASTM D 4767) (CD – US COE EM1110) *specify conditions below please circle one	Unconfined Compression (ASTM D 2166)	Other:	Other:
1	S8																			
2	S9												X							
3	S10												X							
4	S11			X					X											
5	S12												X							
6	S13												X (fw)							
7	S14																			

*Specify Test Conditions (Undisturbed or Remolded, Density and moisture, Test Normal Loads, Test Confining Stresses, etc.):
Desired Tests: 1) Permeability, moderate compaction (Phoenix); Sieve (no hydrometer)
Call to discuss need for Atterberg Limits, Hydrometer for classification, and compositing.

AUTHORIZE BY SIGNING AND DATING:

SIGNATURE: _____ PRINT NAME: _____ DATE: _____

P2/3

Relinquished By: Matthew W. Kropf	DATE: 12/13/17 TIME: 2:41 pm	Received By:	DATE: 12/13/17 TIME: 2:40
Relinquished By:	DATE: TIME:	Received By:	DATE: TIME:

GeoTesting express
a subsidiary of Geocomp Corporation

SOIL CHAIN OF CUSTODY & TEST REQUEST

CLIENT	
Company: GEOSPHERE	
Address: 51 Portsmouth Ave	
City, State, Zip: Exeter, NH 03833	
Contact: David Niemeyer	E-mail: dniemeyer@
Phone: 603-773-0075 x12	Fax: geosphere nh.com

PROJECT	
Project Name: WAYLAND	
Address:	Client Project #: 17205
City, State, Zip:	
On-site Contact:	E-mail:
Phone:	Fax:

GeoTesting Express, Inc.
1145 Massachusetts Avenue
Boxborough, MA 01719
800 434 1062 Toll Free
978 635 0266 Fax

2662 Holcomb Bridge Road, Suite 310
Alpharetta, GA 30022
770 645 6575 Tel
770 645 6570 Fax

www.geotesting.com

INVOICE (complete if different from client)	
Company:	
Address:	
City, State, Zip:	
Contact:	E-mail:
Phone:	Fax:

GENERAL	
Purchase Order #: 17205	GTX Sales Order #:
Shipped By:	Date Shipped:
Mode of Shipment:	Requested Turnaround:
Send Results To: ☒ CLIENT OFFICE	☐ PROJECT OFFICE
Send Results Via: ☒ E-MAIL ☐ FAX	☐ VERBAL ☐ HARD COPY

SOIL *please include boring # and depth if known	Sample ID	Atterberg Limits (ASTM D 4318)	California Bearing Ratio (ASTM D 1883) *specify conditions below	USCS – Classification (ASTM D 2487)	Density (ASTM D 2937)	Direct Shear (ASTM D 3080) *specify conditions below	Direct Simple Shear (ASTM D 6528) *specify conditions below	Electrical Resistivity (ASTM G 57)	Grain Size (ASTM D 422) (Sieve Only / Sieve & Hydrometer) please circle one	Incremental Consolidation (ASTM D 2435)	Moisture Content (ASTM D 2216)	Organic Content (ASTM D 2974)	Permeability/ Hydraulic Conductivity (Fixed Wall - ASTM D 2434) (Flexible Wall – ASTM D 5084) please circle one	Ph (ASTM D 4972)	Proctor Compaction (Standard – ASTM D 698) (Modified – ASTM D 1557) please circle one	Specific Gravity (ASTM D 854)	Triaxial Shear (UU – ASTM D 2850) (CU – ASTM D 4767) (CD – US COE EM1110) *specify conditions below please circle one	Unconfined Compression (ASTM D 2166)	Other:	Other:
1	S15			X					X											
2	S16												X							
3	S17			X					X											
4	S19												X							
5	S20			X					X				X							
6																				
7																				

*Specify Test Conditions (Undisturbed or Remolded, Density and moisture, Test Normal Loads, Test Confining Stresses, etc.):
Desired Tests: 1) Permeability, moderate compaction (PRIORITY); Sieve (no hydrometer)
Call to discuss need for Atterberg Limits, Hydrometer for classification, and compositing.

AUTHORIZE BY SIGNING AND DATING:

SIGNATURE: _____ PRINT NAME: _____ DATE: _____

P3/3

Relinquished By: Matthew W. Kerff	DATE: 12/13/17	Received By:	DATE: 12/13/17
	TIME: 2:40 pm		TIME: 2:40
Relinquished By:	DATE:	Received By:	DATE:
	TIME:		TIME:

Appendix D

Groundwater Model Summary Report
J. Matthew Davis & Associates, LLC

ADDENDUM TO:

HYDROGEOLOGICAL REPORT:
113-119 Boston Post Road in Wayland Massachusetts
Wayland, MA.

J. Matthew Davis & Associates, LLC
2 Maple St
Durham, NH

Submitted to:

Geosphere Environmental Management, Inc.
Exeter, NH

December 2020

INTRODUCTION

This report summarizes the groundwater model development, calibration, and simulation results for proposed leachfields at 113-121 Boston Post Road in Wayland Massachusetts (the "Site"). The primary objective of the groundwater model is to:

- Synthesize hydrogeologic data available for the Site. These data were provided by Geosphere Environmental Management, Inc (GEOSPHERE) and obtained from Mass GIS.
- Using the data and standard groundwater modeling techniques, the following have been provided to GEOSHERE in digital form (shapefiles):
    - Calibrated Estimated Seasonal High Ground Water (ESHGW) elevations
    - Simulated 90-day mound height due to infiltration in leach fields superimposed on ESHGW, and
    - Calculation of 90-day mound height relative to ESHGW elevations and the current ground surface elevations.

The current model is a revision of a model previously developed and provided to GEOSPHERE in June 2018. The differences are noted herein.

DATA SYNTHESIS

The following data sets were utilized in the development of the groundwater model:

- Surface elevations from the 2010 FEMA LiDAR survey (tile 19_03064692) were obtained from the Mass GIS "Oliver" tool, imported into GIS and converted to feet. The ground surface elevations obtained are consistent with surface elevations provided by GEOSPHERE.

- The elevations of the bottom of the sand and gravel layer (Model Layer 1) were revised using additional information provided by GEOSPHERE that included data from five test pits where refusal was recorded (see GEOSPHERE's Table 1), in addition to revised borehole data where the incidence of refusal and/or the top of the silt layer was assumed to represent the top elevation of a low permeable layer (Model Layer 2).
- GEOSPHERE provided updated ESHGW target values that included more water level measurements, along with the estimates from Test Pits (soil mottling).
- Surface water location and elevations provided as both GIS shapefiles (locations) and tabulated survey elevations (water surface elevations), as well as surface water elevations shown on a map of the site.
- Updated permeability data from boreholes and test pits.

MODEL DEVELOPMENT

To meet the stated objectives, a MODFLOW model was developed using Groundwater Vistas (version 5.51). The overall model set up is illustrated in Figure 1. The finite difference grid has an overall 6 foot spacing of rows and columns. In the vicinity of the leach fields, the row and column spacings are reduced to approximately 3 feet by 3 feet. The overall model grid size is 155 rows by 217 columns. Two model layers were initially set up – one representing the overlying sand and gravel and the lower representing a low conductivity silt layer.

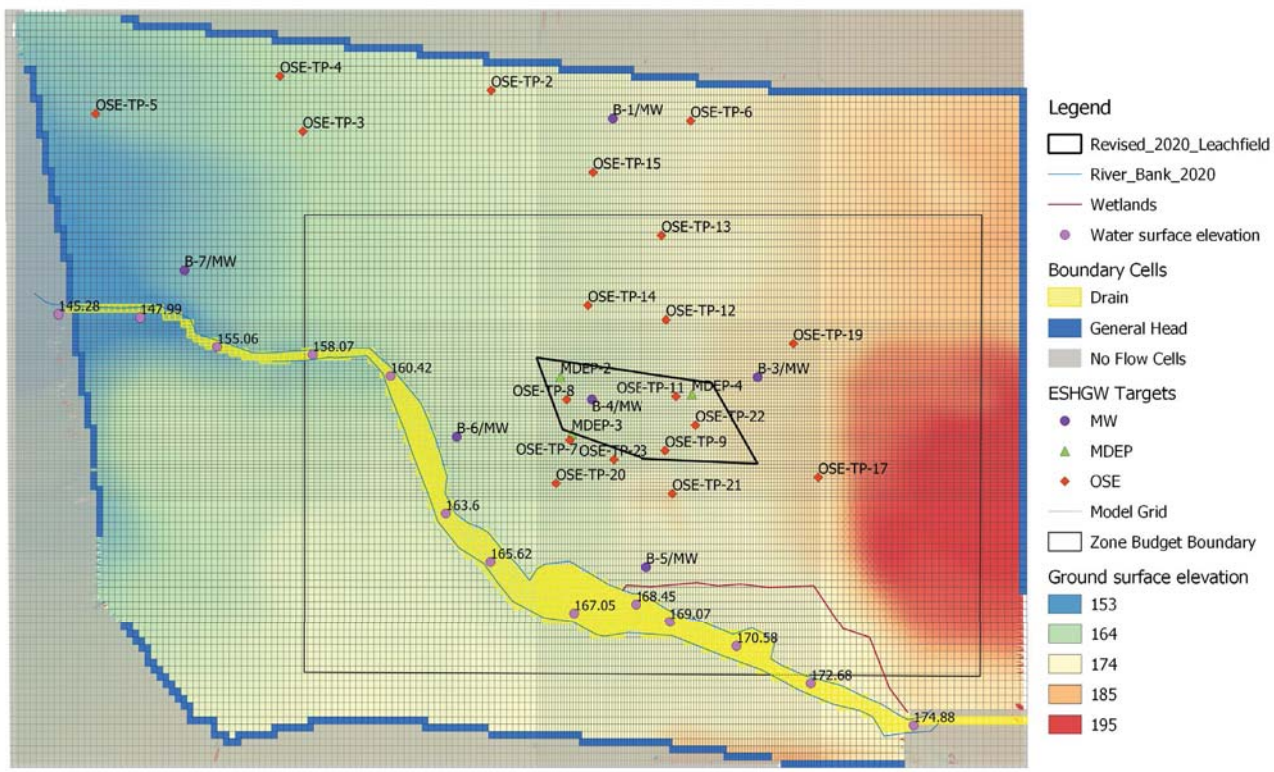


Figure 1. Overview of groundwater model setup. Borings and test pits without target heads not shown.

The top of Layer 1 is set to the ground surface elevation, as determined by LIDAR, and the bottom is interpolated from observations from 9 boreholes and 4 test pits (Figure 2). The most

significant change from the previous model was the increase in elevation near OSE-TP-11 (Figure 3).

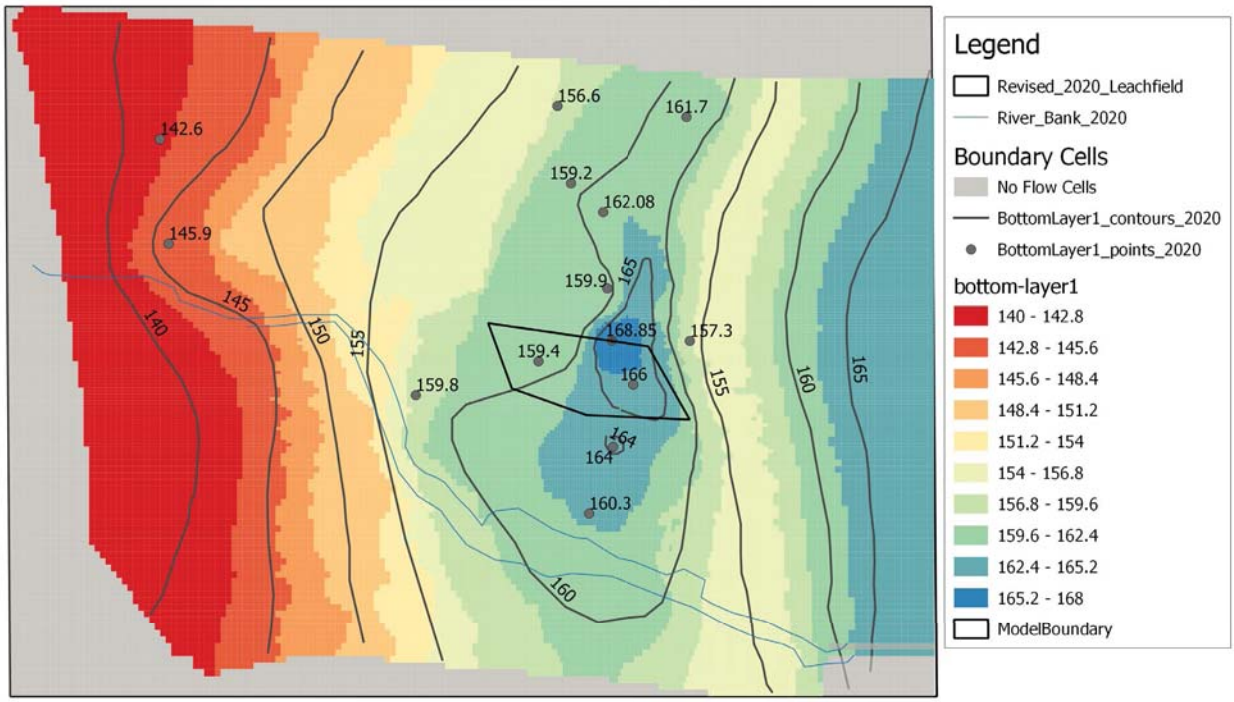


Figure 2. Bottom of Layer 1 interpolated from borehole observations. Adjusted in vicinity of B-7 to facilitate model convergence.

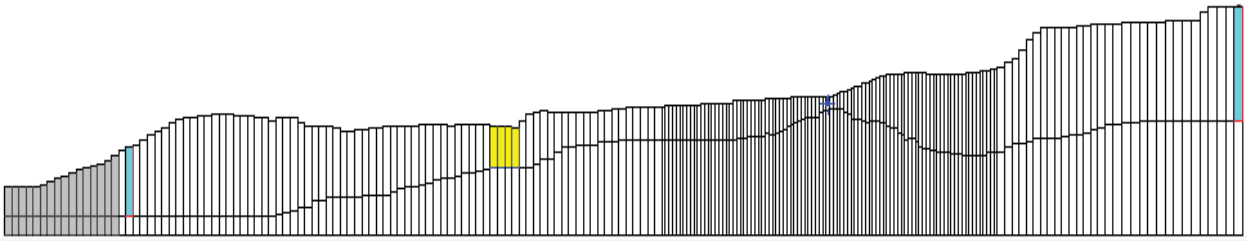


Figure 3. East-west cross section through model row 73 (including OSE TP-11) showing ground elevations and elevation of silt/clay layer (bottom of Layer 1).

Based on groundwater observations, the flow is generally east to west and the surface water feature running through the site is expected to be hydraulically connected to the groundwater. For the purposes of this analysis the stream is expected to serve as the primary sink and is modeled using the Drain Package (DRN). As shown in Figure 1, the drain cells occupy the entire region bounded by the River Bank polygon. While the actual surface expression of the stream may not extend from one bank to another, the drain cell head values are used to represent both the free water surface and the adjacent hyporheic zone up to the riverbank. The heads in the drain cells were set by piecewise linear interpolation based on the water surface elevations shown in Figure 1. After comparing the drain cell head values obtained from interpolation of the original water surface measurements with three additional measurements near the monitoring wells MW-5, MW-6, and MW-7 (November, 2019), the heads in all drain cells were increased by 0.25 feet so

that all drain cell heads were equal to or greater than the observed values. While the difference between the interpolated drain cell heads and the elevations measured in November 2019 is most likely due to approximating the locations from a map and linear interpolation, the additional 0.25 feet of head in the drain cells helps with the calibration of seasonal high observations in the MW wells and is consistent with seasonal high conditions. The hydraulic conductivity of the drain cells was set to 2 ft/day and is the lower value of the values used in the previous model that ranged from 2 to 25 ft/day. A python script was written to ensure that the hydraulic conductivity value was honored as the cell conductance terms in MODFLOW are based on both hydraulic conductivity and cell size. In the context of the MODFLOW River Package, the conductance values used would equate to river cell conductances with a riverbed thickness of 1ft.

Because of the limited amount of information available, the limited model objectives, and the appearance of significant east-to-west groundwater flow through the site, the seasonal high groundwater condition was established using the General Head Boundary (GHB) package along the model perimeter. Heads along the boundaries were assigned to mimic the observed or inferred natural gradient. While use of such a boundary condition has the potential to bias the model, results the boundary appears to be far enough from the infiltration area as to have a negligible impact on the mounding calculations.

The hydraulic conductivity of Layer 1 was represented initially by three zones and, during calibration, a fourth zone in the vicinity of B-6/MW was added (Zone 4). Zone 2 represents Layer 2 and is set to a value of 1.0E-3 ft/day and acts essentially as a no-flow layer. The conductivity values assigned to the zones in Layer 1 were guided by the permeability data and then adjusted during calibration with a goal of matching the observed water levels in the boreholes.

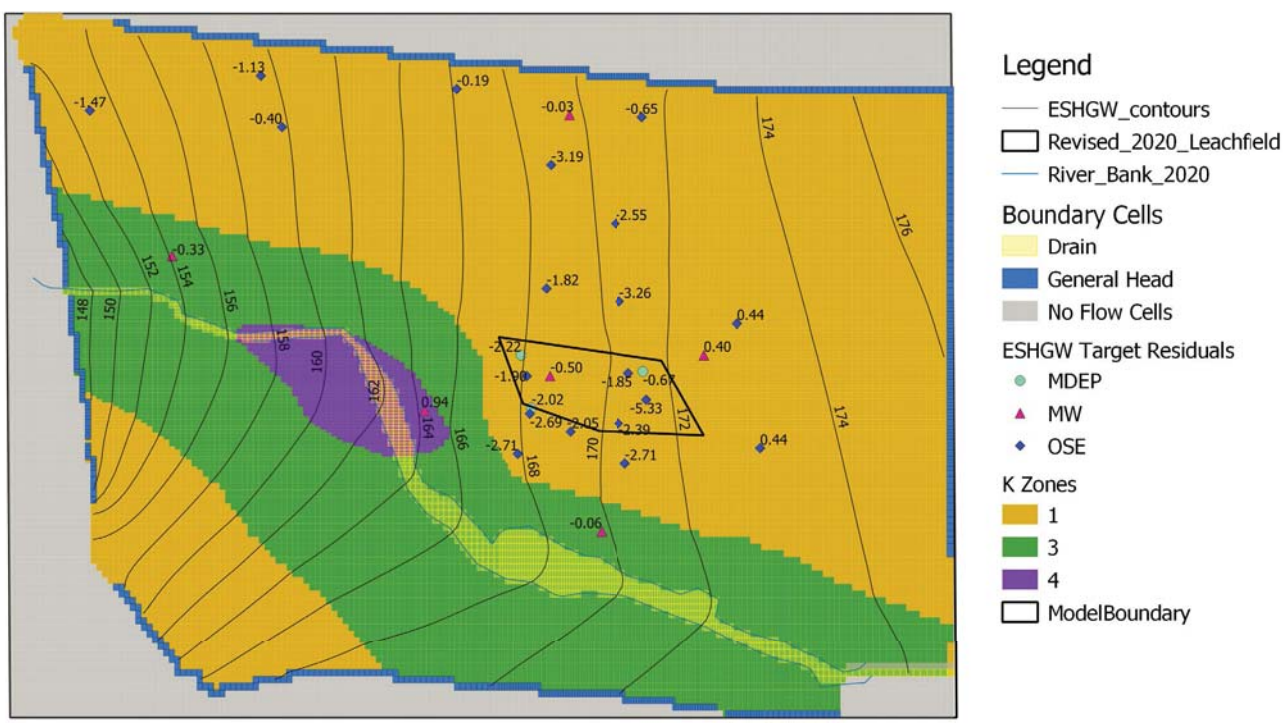


Figure 4. Hydraulic conductivity zones along with ESHGW calibration and residuals.

MODEL CALIBRATION

A steady state groundwater model was developed to simulate the estimated seasonal high ground water (ESHGW) elevations. The calibration targets included both the ESHGW ("mottling") elevations observed in the test pits (coded as OSE and MDEP targets) and six seasonal high ground water level observations (coded as MW targets). Trial-and-error calibration was conducted with an emphasis on honoring the observed water level values. The results of the calibration are shown in Figures 5 and 6.

The objective of the calibration is to obtain a simulated ESHGW that represents the highest (most conservative) set of conditions. The two types of observations (test pits and observed water levels) differ significantly, with the observed water levels being higher than the nearby test pit observations. For calibrating the ESHGW surface, greater emphasis was placed on the observed seasonal-high water table values which are determined as the maximum observed water table elevation in the MW wells during the spring of 2020. For the MW wells, the calibrated ESHGW has a mean residual of 0.07 ft (positive residuals coincide with observed values that are greater than computed) with four of the six computed values exceeding the observed value. By focusing the calibration to honor the observed water levels, the computed ESHGW in the vicinity of the leach field is significantly higher than the mottling elevations in the test pits, by approximately two feet (Figure 5). While the reason for the difference in the test pit data and the observed head data is unclear, it seems most prudent to weigh observed values of ESHGW more than those inferred from soil mottling.

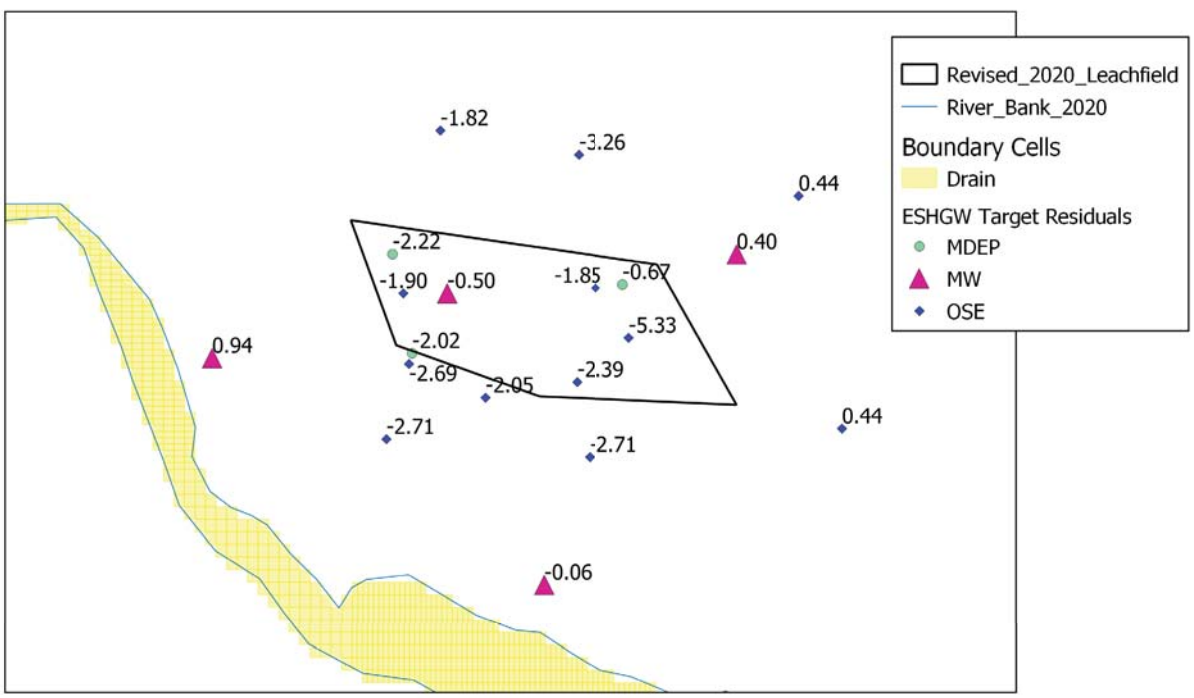


Figure 5. Map of ESGW residuals in vicinity of leach field. Negative values coincide with ESHGW that are greater than observed.

As illustrated in Figure 6, most of the model (computed) values exceed the observed values (24 of the 28) and the MW wells fall more closely along the 1:1 line.

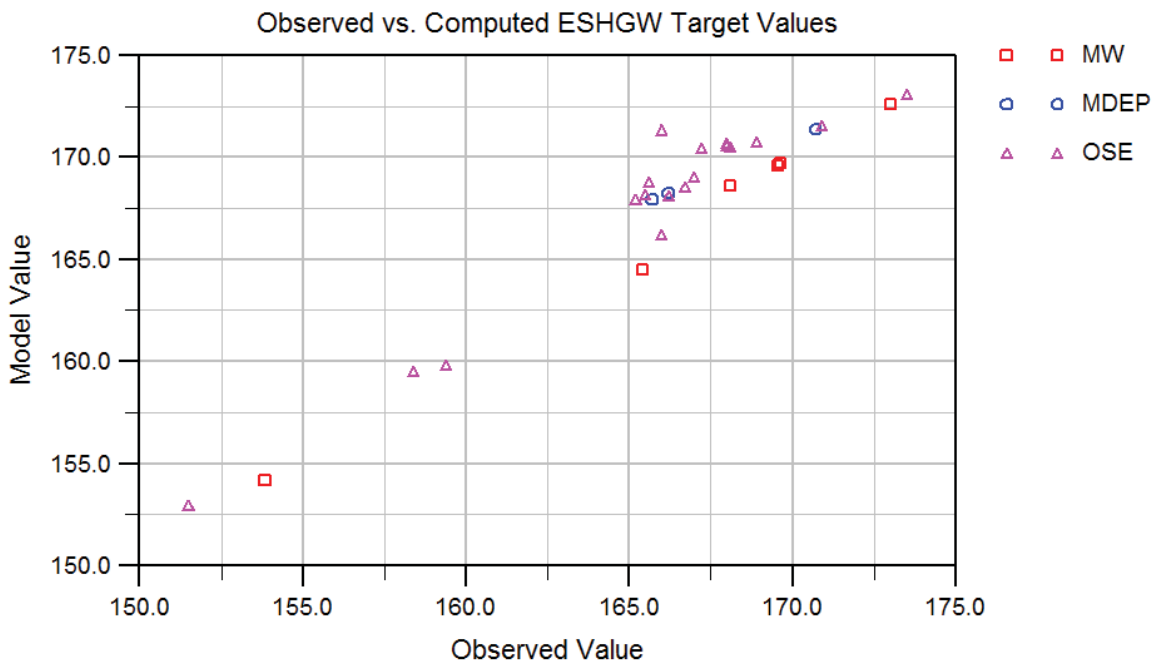


Figure 6. Comparison of simulated ESHGW surface with observations.

It was found that the general head boundary along the perimeter of the model is sufficient to match the heads and ambient recharge is not necessary to simulate the ESHGW surface. Calibrated hydraulic conductivities in the Layer 1 zones (Figure 1) are 135 ft/day for Zone 1, 70 ft/day for Zone 3, and 30 ft/day for Zone 4. While the Zone 1 conductivity is higher than the mean value of all sand and gravel samples, it is well within the range of those observed and several studies have found that the effective hydraulic conductivity of a ground water model is often higher than measurements obtained with a permeameter[1].

TRANSIENT SIMULATION

To simulate the effects of infiltration, a 90-day transient stress period was added to the steady stress period (representing ESHGW conditions) and the MODFLOW Recharge Package was used to simulate infiltration over the leach field. Based on guidance from GEOSPHERE, the model was executed using a steady flow rate of 8,800 gpd applied uniformly over the area of the leach field, which is 80% of the design flow 11,000 gpd. The transient simulation has one stress period of 90-day duration, 10 time steps, and a time-step multiplier of 1.2. The initial heads were set to the calibrated ESHGW heads and mound height was computed as the change in head over the 90-

[1] For example, see Niemann, W.L., and C.W. Rovey II, 2008, A systematic field-based testing program of hydraulic conductivity and dispersivity over a range in scale, Hydrogeology Journal, 17, 307-320 and Schulze-Makuch, D., et al., 1999, Scale dependency of hydraulic conductivity in heterogeneous media, Ground Water, 37: 904-919.

day simulation. Results of the mounding simulation were provided as shapefiles to GEOSPHERE.

To assess the changes in flows in the vicinity of the infiltration basins, a MODFLOW Zone Budget was calculated for the rectangular region surrounding the leach field (Figure 1). Analysis of the mass balance illustrates the effect of the boundary condition on the model (Table 1). Without infiltration, the groundwater flow in the steady-state ESHGW model is from the northeast and south, with a net outflow of 10,101 cubic feet per day (cfd) to the stream. Under stressed conditions, the flow rates after 90 days approach steady state conditions and show that stream discharge increases by 5%, representing about 50% of the infiltrated water. The mounding from the infiltration results in decreased ambient flow from the east and north, reducing flow into the polygon from that direction by 2% and 14%, respectively.

Table 1. Comparison of fluxes through rectangular Zone Budget region shown in Figure 1.

	ESHGW			90 day w/ infiltration			Difference
Description	Inflow	Outflow	Net (cfd]	Inflow	Outflow	Net (cfd)	Relative
West	-	15,452	(15,452)	-	15,895	(15,895)	3%
East	8,687	-	8,687	8,548	-	8,548	-2%
North	3,002	29	2,973	2,630	63	2,567	-14%
South	13,978	84	13,894	14,260	68	14,192	2%
Infiltration			-	1,178		1,178	n/a
Stream	-	10,101	(10,101)	-	10,592	(10,592)	5%

SUMMARY TABLE OF ESHGW VALUES.

Location Name	Observed [elevation, ft]	Computed [elevation, ft]	Residual [ft]
B-1/MW	169.57	169.60	-0.03
B-3/MW	173.02	172.62	0.40
B-4/MW	168.11	168.61	-0.50
B-5/MW	169.65	169.71	-0.06
B-6/MW	165.42	164.48	0.94
B-7/MW	153.84	154.17	-0.33
MDEP-2	165.70	167.92	-2.22
MDEP-3	166.20	168.22	-2.02
MDEP-4	170.70	171.37	-0.67
OSE-TP-12	167.20	170.46	-3.26
OSE-TP-13	168.00	170.55	-2.55
OSE-TP-14	166.70	168.52	-1.82
OSE-TP-17	173.50	173.06	0.44
OSE-TP-19	173.50	173.06	0.44
OSE-TP-20	165.20	167.91	-2.71
OSE-TP-21	168.00	170.70	-2.70
OSE-TP-22	166.00	171.33	-5.33
OSE-TP-23	167.00	169.05	-2.05
OSE-TP-2	166.00	166.19	-0.19
OSE-TP-3	159.40	159.80	-0.40
OSE-TP-4	158.40	159.53	-1.13
OSE-TP-5	151.50	152.97	-1.47
OSE-TP-7	165.50	168.19	-2.69
OSE-TP-8	166.20	168.10	-1.90
OSE-TP-9	168.10	170.49	-2.39
OSE-TP-6	170.90	171.55	-0.65
OSE-TP-11	168.90	170.75	-1.85
OSE-TP-15	165.60	168.79	-3.19

Appendix E

Response to Town of Wayland Comments, dated June 30, 2020

ADDENDUM TO HYDROGEOLOGIC REPORT

Response to Comments issued to MADEP by the
Town of Wayland on June 30, 2020

The enclosed are responses to comments to the *Revised Scope of Work – Hydrogeological Assessment for Groundwater Discharge Permit, Cascade Wayland, 115 Boston Post Road* (Geosphere, April 29, 2020) provided by the Town of Wayland on June 30, 2020. Comments (C) have not been altered. Responses (R) are provided in blue text.

Conservation

1. C. The additional test pits conducted on June 22, 2020 were done after an 8-week period of no measurable precipitation and are not representative of normal groundwater elevations. R. MA DEP approved and provided direct oversight of the additional 5 test pits conducted in June 2020. While precipitation conditions may not have been "normal", average, or near "seasonal high" conditions, the observations that are logged during these test pits include documentation of redoximorphic (i.e., redox, mottling) features that provide key evidence of seasonal high groundwater elevation/depth at that location, regardless of precipitation conditions. All depths/elevations of MA DEP or Town-witnessed redox features were incorporated into the hydrogeologic model to provide an accurate depiction of the estimated seasonal high groundwater (ESHGW) surface/groundwater contour.
2. C. No information on the proposed technology for the wastewater treatment system was provided. R. Information on the wastewater treatment system will be provided as part of the groundwater discharge permit application process. We envision providing a tertiary level treatment system with disinfection capabilities. The design and specification of the treatment system is not typically submitted during the hydrogeological site assessment and permitting process.
3. C. The selected (representative) soil samples collected during the drilling include S1 and S2 from bore hole 1, which is not located in the vicinity of the leach fields or in the direction of the stream from the leach fields. How is this considered representative? Soil samples from bore holes 6 and 7 should have been used since this is the direction of groundwater flow. R. Nine (9) borings were conducted across the entire property, not just where the leach fields were anticipated, or in the direction of groundwater flow, as these exact features were not yet fully known. Data from the borings, including geologist-logged lithologic observations and soil testing (permeability, sieve), and data from the six (6) monitoring wells installed, particularly groundwater depth/elevations over time, were used to construct a conceptual model of the property's subsurface conditions. While soil testing was not conducted in all soil samples, or from every boring, we believe the data provided an accurate representation of the two lithologic units encountered (the sand and gravel deposits, and the underlying silt deposits) to construct a conceptual model for the entire property.
4. C. All site-specific data should include temperature, nutrients, TSS, etc. in both groundwater and Pine Brook samples. R. See Hydrogeological Report for the proposed monitoring plan.
5. C. The model simulation included the design flow over a period of 180 days. Did this 180-day period include periods of high groundwater and during the seasonal spawning of trout (October)? R. The previous (2018) and the newly revised 2020 model simulated a constant flow of 80% of the design flow over 90 days, per MADEP guidelines. Seasonal high estimates of groundwater elevations and surface water elevations were incorporated into the Revised Model

simulation. An estimate of the increase in groundwater flux into Pine Brook using January 2018 and November 2019 measured surface water elevations is provided (see Hydrogeological Report).

2018 Hydrogeologic Model:

1. C. The model uses the groundwater data for April 2018. Why wasn't groundwater date from April 2019 used? (April 2018 – 5.69 inches vs. April 2019 6.29 inches) R. The models comply with DEP regulations and guidance. The 2018 model utilized the highest measured groundwater elevations available at the time (April 2018). The newly revised 2020 model utilizes the highest of 14 measured groundwater elevations over the course of 14 months, which purposely included bi-weekly measurements during the spring of 2020, to document the highest observed groundwater conditions and further refine ESHGW conditions.
2. C. The simulated ESHGW is a foot higher near B-4 and 1-5 feet higher than ground surface elevation along the western boundary. This was discounted as an error although no soil samples were used from the bore holes drilled along the western boundary. Instead of discounting this as an error, this information needs further investigation. R. As described in both model simulations, the object of the model was to simulate ESHGW conditions in the area immediately surrounding the proposed leach fields. The lack of data along with the inherent assumptions/construct of the model boundary (i.e., the insertion of constant head boundaries which are not real) will inherently create differences from the observed conditions. The conservative nature of the model (i.e., by simulating an ESHGW surface that is likely to be higher, rather than lower in elevation than directly measured ESHGW conditions) is designed to provide a conservative estimate of the worst-case conditions under constant mounding of the design flow onto the ESHGW surface beneath the leach fields and proximate to the adjacent stream.
3. C. The groundwater mounding simulation has similar results when superimposed on the ESHGW and again, needs further investigation. It's concerning that the model predicts breakout at LF1 and at 'discrete locations' southwest of the leach fields along Pine Brook. Note this states the model was done over a continuous 90- day period but the scope of work states 180-day period. I disagree with the statement 'we believe the conservative ESHGW calibration is generating higher predicted groundwater elevation than we expect will occur'. I believe this results are concerning. R. . The Scope of Work inadvertently referenced 180 days. MA DEP Guidance requires the model simulate 90 days of continuous discharge.
4. C. The particle tracking exercise performed to model the potential interaction with Pine Brook is depicted on Figure 6 in Appendix D. This figure shows that most particles pass through Pine Brook and exit along the western boundary. This simulation is not realistic, especially given the high groundwater elevation in this area. The particles would most likely discharge to Pine Brook. R. Correct. This was the result of the 2018 model not incorporating estimated seasonal high surface water elevations in Pine Brook into the model. As a result, the groundwater flow was modeled to flow beneath the brook. We have since incorporated surface water elevations into the revised 2020 model, and the assumption that groundwater will be in direct connection with the surface water in the brook.

Town Engineer

C. Page 1, last paragraph. Consideration should be given to the recently obtained test pit data given the very shallow level at which the groundwater was encountered. R. Test pit data from the recently installed test pits in June 2020 was indeed considered and incorporated into the model. The depths to mottling recorded in these (and other) test pits are consistently shallower than any observed groundwater depths.

C. Page 2, second paragraph. The proponent identified "tertiary treatment" as being used to treat the effluent from the development. Tertiary treatment is very generic term and does not inherently provide a single anticipated effluent quality. The proponent should identify the technology and effluent pollutant levels based upon the technology provided. R. Information on the wastewater treatment system will be submitted to Mass. DEP for approval as part of the groundwater discharge permit application process. We envision providing a tertiary level treatment system with disinfection capabilities. The design and specification of the treatment system is not typically submitted during the hydrogeological site assessment and permitting process.

C. Page 2, Task 1, Was the footprint of the leaching field modified/increased for the increased flow? The leaching field footprint was modified based upon the approved area determined in the field during the completion of the MassDEP witnessed test pits and the increase in flow to 11,000 gpd of Title 5 sewage. The size of the field and leaching trenches was determined using MassDEP approved loading rates for the perc test results obtained, as defined in the Guidelines for the Design, Construction, Operation, and Maintenance of Small Wastewater Treatment Facilities with Land Disposal, current edition.

C. Page 2, Task 1, third bullet. Question as to the use of LiDAR data for surface elevations. The site is accessible and has had several surveys performed. While LiDAR can be useful over large undeveloped tracks of land, the existing space contains buildings and other features that may provide less accurate information than actual survey. R. LiDAR is better suited to a digital model. The LiDAR elevations were compared to the surveyed elevations and the discrepancies were deemed to be within an acceptable level of error.

C. Page 2, Task 1, fourth bullet. The proponent is suggesting that their revisions to the model will include impacts from the "storm water detention features". Detention of stormwater should not impact the GW level. Of note, over the several iterations of the project that has been reviewed by the Town, none appears to have presented a scenario that adequately addresses the stormwater from the development. Iterations including detention ponds, infiltration basins, direct discharge, and other combinations have been proposed. Given that the small size of the site and the projects immediate proximity to a cold-water fishery, it is imperative any groundwater/surface water modeling and pollutant modeling should include the proposed impacts from (sic) the stormwater management system. This should be a clear part of the analysis including a formal developed system as opposed to a simple "estimation". R. We agree that storm water detention features should not impact the groundwater level, and therefore, they have not been incorporated into the hydrogeologic model. See Hydrogeological Report for the proposed monitoring plan.

C. Page 2, Task 1, sixth bullet. How will this be performed? It should ensure that it is not simply hydraulic, but pollutant as well. Pollutants to be considered should be temperature and pathogens, as well, given the proximity of the project to the cold-water fishery. R. A Site Plan was submitted to MA DEP with the Scope of Work, but the Site Plans have since been revised.

C. Page 2, Task 1A. Was a site plan provided? R. A Site Plan was submitted to MA DEP with the Scope of Work, but the Site Plans have since been revised (see Hydrogeological Report).

C. Page 2, Task 2. "The proposed discharge….". This should include any proposed infiltration that might be considered relative to the stormwater management system. R. IBID.

C. Page 3, Item g. Use of "septic system" R. The term septic system has been replaced with proposed subsurface disposal system, leaching fields, wastewater treatment system/plant, where appropriate.

C. Page 3, Item g. What "water quality analysis parameters" are being considered. R. See Hydrogeological Report for the proposed monitoring plan.

Health Department

C. An updated site plan that shows the new outline/layout of the leaching area (and WWTF), any stormwater infiltration or detention area(s) and locations of all test holes, percolation tests, monitoring wells and respective logs. Due to ledge being encountered on the site in several deep test holes and in locations of attempted monitoring well locations, this information will be important for ensuring leaching and stormwater can meet design and regulation requirements. Test holes where ledge was encountered should be included/mapped and clearly identified on the site plan for understanding of the soils and refusal areas for site development/stormwater. R. Observations of "refusal" in test pits, where "ledge" or "boulders" were assumed/observed, have been incorporated into the model (see Table 1) and provide the transition elevation between Layer 1 (sand and gravel) and Layer 2 (dense silt/clay or ledge). See figures in Appendix D showing revised elevations of Layer 1 base.

C. Provide results of monitoring well readings/dates, measurements, and digital recordings. R. See Hydrogeological Report.

C. Provide information on how often piezometer/staff gauges and groundwater data will/is be collected. R. See Hydrogeological Report for the proposed monitoring plan.

C. Indicate what type of wastewater treatment/technology will be provided. Information on the wastewater treatment system will be provided as part of the groundwater discharge permit application process. We envision providing a tertiary level treatment system with disinfection capabilities. The design and specification of the treatment system is not typically submitted during the hydrogeological site assessment and permitting process.

C. Provide the input parameters for the groundwater model (modflow) and especially the seasonal high groundwater elevation selected. R. See Hydrogeological Report.

C. Provide temperature readings in Pine Brook (including frequency and duration), this should done at regular intervals and especially during spawning season. R. See Hydrogeological Report for the proposed monitoring plan.

C. The Wayland Board of Health has Local Wastewater Treatment Facility Regulations which I have attached a copy of. We have particular concern/interest in the SOW and the hydrogeo due to the following: encountering of ledge in some test holes during soil testing, large, expected flows, and close proximity of the leaching area to Pine Brook (greater then 10,0000 gpd). I have outlined specific sections of the regulations that would apply to this project for your consideration/inclusion in the Revised Scope of Work for the hydrogeo, although the full copy of the regulation is also attached. R. We believe the Hydrogeological Report has addressed these concerns.

- 4.10 Environmental Compatibility, the plans for the proposed system or facility shall consider all aspects of public health and environmental quality protection. Efforts shall be taken to preserve water supply, private property, wetlands, wildlife habitat, recreational sites, historic sites, and natural beauty. The design shall be prepared to have the least possible adverse

impact on the public health and the environment. The project proposal shall include evidence that the wastewater system or facility will result in the least adverse impact on the public health or the environment as compared with other possible wastewater management alternatives for the project.

- 4.20 General discharge and treatment requirements, no discharge from a SWWTP shall result in degradation of ground or surface waters in a manner inconsistent with their proposed use. There shall be compliance with all applicable water quality standards. The existing characteristics of the receiving waters must be considered to ensure compliance. There shall be no discharge into any wetland, stagnant waters, lakes, or streams.
- 4.30 Hydrogeological Investigation, the applicant shall submit a hydrogeological survey report, prepared by a qualified geotechnical engineer or hydrogeologist, to show the impact of the subsurface discharge of the SWWTP on ground water. The report shall include a determination of the flow direction, contaminant levels, extent of wastewater discharge plume, ground and surface waters affected and any interaction with water supply, public or private. This analysis shall be performed for the SWWTP design plan and for any other viable wastewater treatment or disposal strategy for the project to be served.
- 4.40 Wetlands and Flood Plains, no portion of the SWWTP shall be within 100 feet of wetlands or the 100-year flood plain. No portion of the subsurface disposal works for a SWWTP shall be located less than 200 from a wetland or the 100-year flood plain. No component of the treatment plant, except for underground piping, shall be constructed less than two (2) feet above the high-water level in any area subject to flooding. Such distances are considered “minimum” and may be increased by the Wayland Board of Health fi site specific conditions warrant.
- 4.50 General Siting and Design Requirements, SWWTP design shall include attenuation of odor or noise problems, and shall satisfactorily address the general aesthetic appearance, to both protect the operator and to satisfy neighborhood environmental requirements.
- 4.51 Distances (Please see attached regulations, page 5)
- 7.00 Groundwater Monitoring, we would like to be involved with what will be proposed for monitoring wells (number of wells and locations).
- 8.20 Groundwater Monitor Wells, we would like to be involved with providing input on frequency of groundwater monitoring.

R. Cascade Development does not seek the Wayland Board of Health’s approval of the enclosed Hydrogeolgocial Report, as revised. In accordance with 314 CMR 5.00, small wastewater treatment systems with land disposal of greater than 10,000 gpd fall under the jurisdiction of MA DEP. Following MA DEP’s approval of the enclosed Hydrogeological Report, Cascade Development intends to submit to MA DEP an application for a Groundwater Discharge Permit in accordance with 314 CMR 5.00. All treatment system design submissions will comply with MA DEP requirements.