CONSULTANT NARRATIVES

GEOTECHNICAL

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LGCI
Lahlaf Geotechnical Consulting, Inc.

December 14, 2020

Mr. Vladimir Lyubetsky
Principal
Drummey Rosane Anderson, Inc.
Howard Clock Building
260 Charles Street, Studio 300
Waltham, MA 02453
Phone: (617) 964-1700 x121
E-mail: vlyubetsky@draws.com

Re: **Preliminary Geotechnical Report**
Proposed Northeast Metropolitan Regional Vocational Technical High School
Wakefield, Massachusetts
LGCI Project No. 2025

Dear Mr. Lyubetsky:

Lahlaf Geotechnical Consulting, Inc. (LGCI) has completed a preliminary geotechnical study for the Proposed Northeast Metropolitan Regional Vocational Technical High School in Wakefield, Massachusetts. This report, submitted in pdf format, includes the results of our preliminary explorations and our preliminary recommendations.

The soil and rock samples from our explorations are currently stored at LGCI for further analysis, if requested. Unless notified otherwise, we will dispose of the soil samples after three months.

Thank you for choosing LGCI as your geotechnical engineer.

Very truly yours,

Lahlaf Geotechnical Consulting, Inc.

Abdelmadjid M. Lahlaf, Ph.D., P.E.
Principal Engineer

LGCI
Lahlaf Geotechnical Consulting, Inc.

PRELIMINARY GEOTECHNICAL REPORT
PROPOSED NORTHEAST METROPOLITAN REGIONAL VOCATIONAL TECHNICAL HIGH SCHOOL
WAKEFIELD, MASSACHUSETTS

LGCI Project No. 2025
December 14, 2020

Prepared for:

DRUMMEY ROSANE ANDERSON, INC.
Howard Clock Building
260 Charles Street, Studio 300
Waltham, MA 02453
Phone: (617) 964-1700

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Prepared for:

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Howard Clock Building
260 Charles Street, Studio 300
Waltham, MA 02453
Phone: (617) 964-1700

Prepared by:

LAHLAF GEOTECHNICAL CONSULTING, INC.
100 Chelmsford Road, Suite 2
Billerica, Massachusetts 01862
Phone: (978) 330-5912
Fax: (978) 330-5056

Abdelmadjid M. Lahlaf, Ph.D., P.E.
Principal Engineer

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1. PROJECT INFORMATION

1.1 Project Authorization

This geotechnical report presents the results of the preliminary subsurface explorations and a geotechnical evaluation performed by Lahlaf Geotechnical Consulting, Inc. (LGCI) for the proposed Northeast Metropolitan Regional Vocational Technical High School in Wakefield, Massachusetts. We performed our services in general accordance with the scope described in our proposal No. 20079 dated October 23, 2020. Mr. Vladimir Lyubetsky of Drummey Rosane Anderson (DRA) authorized our services by signing our proposal on December 14, 2020.

1.2 Purpose and Scope of Services

The purpose of our geotechnical services was to perform preliminary subsurface explorations at the site and to provide preliminary foundation design and construction recommendations. LGCI performed the following services:

- Performed a desk review that included reviewing available information about the site, including the geologic data available from the U.S. Geological Survey and our field observations from the site visit.
- Coordinated our preliminary test pit and boring locations with DRA and with the school staff.
- Marked the test pit and boring locations at the site and notified Dig Safe Systems Inc. (Dig Safe) and the Town of Wakefield for utility clearance.
- Engaged a drilling subcontractor to advance four (4) borings and to install two (2) groundwater observation wells at the site.
- Engaged an excavation subcontractor to excavate eighteen (18) test pits.
- Provided an LGCI geotechnical engineer at the site to coordinate and observe the test pits and borings, describe the soil samples, and prepare field logs.
- Submitted four (4) soil samples for laboratory testing.
- Prepared this preliminary geotechnical report containing the results of our preliminary subsurface explorations and our preliminary recommendations for foundation design and construction.

LGCI's scope of services does not include an environmental assessment for the presence or absence of wetlands or analytical testing for hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site, or mold in the soil or in any structure

at the site. Any statements regarding odors, colors, or unusual or suspicious items or conditions are strictly for the information of the client.

Our scope does not include reviewing drawings, preparing specifications, or performing field services. We will be pleased to perform these services for an additional fee. Recommendations for unsupported slopes, stormwater management, erosion control, pavement design, site specifics liquefaction analysis, slope stability analyses, and detailed cost or quantity estimates are not included in our scope of work. Our scope does not include environmental services.

LGCI previously prepared and submitted a report titled: "Preliminary Geotechnical Review Services," dated August 7, 2020. The present report includes the information contained in the previous report and supersedes it.

1.3 References

LGCI's understanding of the site is based on our observations at the site, and on the following drawings and reports:

- Drawing S1 titled: "Typical Details and General Notes, Northeast Metropolitan Regional Vocational Technical School," (1969 Structural Details) prepared by Korslund, LeNormand & Quann, Inc., dated June 2, 1969 and provided to us by DRA on July 30, 2020.

- Drawing S3 titled: "Foundation and First Floor Plan – Unit A, Northeast Metropolitan Regional Vocational Technical School," (First Floor Plan – Unit A) prepared by Korslund, LeNormand & Quann, Inc., dated June 2, 1969 and provided to us by DRA on July 30, 2020.

- Drawing S5 titled: "Foundation and First Floor Plan – Unit B, Northeast Metropolitan Regional Vocational Technical School," (First Floor Plan – Unit B) prepared by Korslund, LeNormand & Quann, Inc., dated June 2, 1969 and provided to us by DRA on July 30, 2020.

- Drawing S7 titled: "Foundation and First Floor Plan – Unit C, Northeast Metropolitan Regional Vocational Technical School," (First Floor Plan – Unit C) prepared by Korslund, LeNormand & Quann, Inc., dated June 2, 1969 and provided to us by Drummey Rosane Anderson, Inc. (DRA) on July 30, 2020.

- Drawing S9 titled: "Foundation and First Floor Plan – Unit D, Northeast Metropolitan Regional Vocational Technical School," (First Floor Plan – Unit D) prepared by Korslund, LeNormand & Quann, Inc., dated June 2, 1969 and provided to us by DRA on July 30, 2020.

- Drawing S12 titled: "Foundation and First Floor Plan – Unit E, Northeast Metropolitan Regional Vocational Technical School," (First Floor Plan – Unit E) prepared by Korslund, LeNormand & Quann, Inc., dated June 2, 1969 and provided to us by DRA on July 30, 2020.

- Drawing S14 titled: "Foundation and First Floor Plan – Unit F, Northeast Metropolitan Regional Vocational Technical School," (First Floor Plan – Unit F) prepared by Korslund, LeNormand & Quann, Inc., dated June 2, 1969 and provided to us by DRA on July 30, 2020.

- "Custom Soil Resource Report for Essex County, Massachusetts, Southern Part; and Middlesex County, Massachusetts," (Soil Survey Report) National Cooperative Soil Survey/National Resources Conservation Services, USDA (Map and soil description) printed November 15, 2019 https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx).

- "Surficial Materials Map of the Boston North, Massachusetts," prepared by Stone, B.D. and DiGiacomo-Cohen, M.L. for U.S. Geological Survey, 2018, Scientific Investigation Map 3402, Quadrangle 125 – Boston North.

- Drawings titled: "Northeast Metro Technical High School, Option C.3 Site Plan North," and "Northeast Metro Technical High School, Option C.3 Site Plan South," (Site Plans) prepared by Warner Larson Landscape Architects, Inc., dated October 22, 2020, and provided to LGCI by Nitsch Engineering, Inc., the project Civil engineer, via e-mail on December 9, 2020.

1.4 Site Description

Our understanding of the site is based on our observations at the site, and on the drawings listed in section 1.3.

The existing Northeast Metropolitan Regional Vocational Technical High School is located at 100 Hemlock Road, Wakefield, Massachusetts, as shown in Figure 1. The site is located north of Hemlock Road. The portion of the site south of Hemlock Road is wooded and vacant.

The site is bordered by the Wakefield High School on the western side, by private properties on the northern side, by a utility easement on the eastern side, and by Farm Street on the southern side.

The existing school consists of several interconnected buildings. The site includes an athletic practice field, and a small paved parking lot on the northern side; a small paved parking lot, a football field, and a baseball field on the western side; and a parking lot and a drop off loop on the southern side.

Based on the First Floor Plan (Unit A to F), the existing building is founded on conventional, shallow, spread, and continuous footings. Based on the 1969 Structural Details, the existing building footings were designed for allowable bearing capacities of 2 tons per square foot (tsf) for footings bearing on the natural soil or Structural Fill, and 15 tsf for footings bearing on bedrock.

Based on the historical topo maps included in Appendix A, the grades appear to have been cut on the western side of the site in what is currently the football field.

Based on the Site Plans, the existing grades vary at the site as described below.

- The grade drops from about El. 91 feet near at western end of the main access driveway (near the guard booth) to about El. 78 feet near the main entrance to the existing building. The grade continues dropping toward the southeastern corner of the existing building to about El. 75 feet then rises to about El. 90 feet near the northeastern corner of the building.

- The grade rises slightly to about El. 93 feet near the northwestern corner of the northern parking lot before it drops steeply to between about El. 58 feet and El. 62 feet at the northern practice field. The grade across the practice field continues dropping to about El. 58 feet near the northeastern corner of the field and gently rises to about El. 65 feet near the northwestern corner of the field.

- The driveway that loops around the building drops in elevation from about El. 93 feet near the northwestern corner of the site to about El. 80 feet on the southern side before it rises again to El. 85 feet where it joins the main driveway.

- On the western side, the site is terraced with tennis courts at about El. 102 feet, the football field at about El. 114 feet, and the baseball field at between El. 84 feet and El. 86 feet.

- The grades in the wooded area at the southern side of Hemlock Road are characterized by rolling terrain. The grade rises steeply from about El. 82 feet near the eastern side of Hemlock Road to over El. 110 feet over what appears to be a former rock cut. The grade rises to about El. 207 feet near the western side of the wooded area, with frequent local highs and lows within the area. Rock outcrops and surficial boulders are present throughout the entire extent of the wooded area.

1.5 Project Description

Our understanding of the proposed construction is based on our discussions with DRA and on the Site Plans listed in Section 1.3.

We understand that the Town of Wakefield is considering the existing high school located at 100 Hemlock Road, Wakefield, Massachusetts as the site for the proposed Northeast Metropolitan Regional Vocational Technical High School. We understand that Option C.3 has been selected for the proposed construction.

The proposed construction will include a new high school building, paved driveways and parking lots, and athletic fields. The proposed building will be constructed in the wooded area south of Hemlock Road. Based on the Site Plans, the proposed building will be somewhat rectangular in shape with a footprint of about 153,000 square feet. The proposed building will be accessible from Hemlock Road. We understand that the proposed building will have a ground floor with a finished floor elevation (FFE) at El. 140 feet and a main floor with an FFE at El. 155 feet.

The main parking lot will be in the general area of the current southern parking lot. Additional parking and a driveway loop will be provided around the proposed building. Based on the Site Plans, the proposed paved areas around the proposed building will range in grades between El. 93 feet near Hemlock Road and El. 165 feet near the eastern side of the proposed building. The driveway connecting to Farm Street drops in elevation from El. 165 feet to about El. 133 feet where it connects to Farm Street.

Athletic fields will also be provided, including one (1) combined soccer/baseball field, five (5) tennis courts, one (1) football field, and one (1) football field with a track and stands. The proposed athletic fields will be constructed within the area of the existing building after the latter has been demolished.

Based on the Site Plans, cuts up to 38 feet will be required to achieve the proposed ground floor elevation, and cuts up to 35 feet will be required to achieve the proposed main floor FFE and the grades in the proposed paved areas around the proposed building. Minor cuts and fills will be required to achieve the proposed athletic fields grades, except near the northern side of the proposed football field and track where cuts of up to 10 feet will be required.

1.6 Elevation Datum

We understand that the elevations shown in the Site Plans are referenced to the National American Vertical Datum of 1988 (NAVD 88).

2. SITE AND SUBSURFACE CONDITIONS

2.1 Surficial Geology

Based on the Surficial Geologic Map listed in Section 1.3, the natural soils in the general vicinity of the site mostly consist of the following:

- Thin Till – The thin till is described as non-sorted, non-stratified matrix of sand, some silt, and little clay that contains scattered pebbles, cobbles and boulders. The thin till is generally less than 10 to 15 feet thick.

- Coarse Deposits – The coarse deposits consist of sand, sand and gravel, and gravel deposits as described below.

  Sand Deposits – The sand deposits are comprised mostly of fine to coarse sand. Coarser layers may contain up to 25 percent gravel. Finer layers may contain very fine sand, silt, and clay.

  Sand and Gravel Deposits –The sand and gravel deposits occur as a mixture of gravel and sand within individual layers and as alternating layers of sand and gravel. The sand and gravel layers range between 25 and 50 percent gravel and 50 to 75 percent sand.

  Gravel Deposits – The gravel deposits are comprised of at least 50 percent gravel, cobbles, and boulders. Sand occurs within gravel beds and as separate layers within the gravel.

- Bedrock Outcrops – The Surficial Geologic Map indicated the presence of abundant rock outcrops on the western and southern sides of the site.

The Surficial Geologic Map of the site is shown in Figure 2.

2.2 Soil Survey Report

Based on the Soil Survey Report listed in Section 1.3, the soils at the site are classified primarily as follows:

- Charlton-Urban Land-Hollis Complex – Charlton soils are defined as well drained drumlin and ground moraines, and Hollis soils are defined as well drained ridges and hillslopes. Based on the Soil Survey Report, the Charlton soils are generally comprised of up to 5 inches of fine sandy loam, overlying up to 17 inches of sandy loam, overlying about up to 43 inches of gravelly sandy loam. The groundwater table is typically deeper than 80 inches. The Hollis soils are generally comprised of up to 14 inches of fine sandy loam, overlying unweathered bedrock. The groundwater table is typically deeper than 80 inches.

- Urban Land – Urban Land is defined as excavated and filled land.

- Rock Outcrop-Hollis Complex – Rock outcrops are defined as granite and gneiss. Hollis soils are defined as well drained, friable, shallow loamy basal till over granite and gneiss. Based on the Soil Survey Report, the Hollis soils are generally comprised of up to 14 inches of fine sandy loam, overlying unweathered bedrock. The groundwater table is typically deeper than 80 inches.

- Charlton-Hollis-Rock Outcrop Complex – Charlton soils are defined as well drained, friable loamy eolian deposits over friable loamy basal till derived from granite and gneiss. Based on the Soil Survey Report, the Charlton soils are generally comprised of up to 5 inches of fine sandy loam, overlying up to 17 inches of sandy loam, overlying up to 43 inches of gravelly sandy loam. The groundwater table is typically deeper than 80 inches. Hollis soils are defined as well drained, friable, shallow loamy basal till over granite and gneiss. Based on the Soil Survey Report, the Hollis soils are generally comprised of up to 14 inches of fine sandy loam, overlying unweathered bedrock. The groundwater table is typically deeper than 80 inches. Rock outcrops are defined as granite and gneiss.

- Swansea Muck – Swansea Muck is defined in the Soil Survey Report as "highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits." Based on the Soil Survey Report, the Swansea Muck is generally comprised of up to 34 inches of muck, overlying about up to 45 inches of coarse sand. The groundwater table typically ranges between 0 and 6 inches.

- Ridgebury Fine Sandy Loam – Ridgebury soils are defined as poorly drained depressions, drumlins, drainageways, hills, and ground moraines. Based on the Soil Survey Report, the Ridgebury soils are generally comprised of up to 1 inch of moderately decomposed plant material, overlying up to 5 inches of fine sandy loam, overlying up to 4 inches of sandy loam, overlying up to 56 inches of gravelly sandy loam. The groundwater table typically ranges between 0 and 6 inches.

A copy of the Soil Survey Report and Map are included in Appendix B.

2.3 LGCI's Test Pits and Borings

2.3.1 General

LGCI coordinated our exploration locations with DRA and marked the exploration locations in the field by taping distances from the proposed building corners staked by Nitsch Engineering, Inc. (Nitsch), the project surveyor. LGCI notified Dig Safe for utility clearance prior to starting our explorations at the site.

Unless notified otherwise, we will dispose of the soil and rock samples obtained during our explorations after three months.

2.3.2 LGCI Explorations

2.3.2.1 Test Pits

LGCI engaged Northern Drill Service, Inc. (NDS) of Northborough, Massachusetts to excavate eighteen (18) test pits (TP-1 to TP-18) at the site on December 3 and 4, 2020. The test pits were excavated with a Komatsu PC-120 excavator. The test pits extended to depths ranging between 0.7 and 10.5 feet beneath the ground surface. To explore the subsurface conditions at greater depths, soil borings were also advanced at the site as described in Section 2.3.2.2.

An LGCI engineer observed and logged the test pits in the field.

Upon completion, the test pits excavations were backfilled with the excavated material and tamped with the excavator bucket.

2.3.2.2 Soil Borings

LGCI engaged NDS to advance four (4) borings (B-1-OW, B-2, B-3-OW, and B-4) on December 10 and 11, 2020. The borings were advanced with a Mobile B-48 track-mounted drill rig using drive and wash techniques with a 4-inch casing. The borings extended to depths ranging between 0.5 feet and 18 feet beneath the ground surface. Upon completion, the boreholes were backfilled with the soil cuttings. Two groundwater observation wells were installed in borings B-1-OW and B-3-OW.

NDS performed Standard Penetration Tests (SPT) during drilling and obtained split spoon samples in the borings with an automatic hammer at typical depth intervals of 2 feet or 5 feet as noted on the boring logs in general accordance with ASTM D-1586. Rock was cored in borings B-1-OW and B-3-OW.

An LGCI engineer observed and logged the borings in the field.

2.3.2.3 Test Pit and Soil Boring Logs and Locations

The test pit and boring locations are shown in Figure 3. Appendix C contains LGCI's test pits logs. Appendix D contains LGCI's boring logs, the groundwater observation well installation reports, and photographs of the rock cores. Tables 1 and 2 include summaries of LGCI's test pits and borings, respectively.

The ground surface elevations are not available at this time and are not included in the test pit and boring logs. Please note that our test pit and boring locations were located using taped measurements and were not surveyed. Accordingly, the locations shown in Figure 3 are approximate.

2.4 Subsurface Conditions

The subsurface description in this report is based on a limited number of test pits and borings and is intended to highlight the major soil strata encountered during our test pits and borings. The subsurface conditions are known only at the actual test pit and boring locations. Variations may occur and should be expected between test pit and boring locations. The test pit and boring logs represent conditions that we observed at the time of our test pits and borings and were edited, as appropriate, based on the results of the laboratory test data and inspection of the soil samples in the laboratory. The strata boundaries shown in our test pit and boring logs are based on our interpretations and the actual transitions may be gradual. Graphic soil symbols are for illustration only.

The soil strata encountered in the test pits and borings were as follows, starting at the ground surface.

Topsoil – Surficial topsoil (typical of organic forest mat) was encountered at the ground surface in all the test pits and borings. The topsoil extended to depths ranging between 0.2 and 2.0 feet beneath the ground surface. Refusal was encountered in this layer on apparent rock in test pits TP-7 and TP-14, and in boring B-2 at depths of 2.0, 0.7, and 0.5 feet beneath the ground surface, respectively.

Subsoil – A layer of subsoil was encountered beneath the surficial topsoil in all the test pits and borings except in test pits TP-7 and TP-14, and in boring B-2. The subsoil extended to depths ranging between 1.5 and 5.0 feet beneath the ground surface. Refusal was encountered in this layer on apparent rock in test pits TP-3 and TP-4, and in borings B-1-OW and B-3-OW at depths of 2.0, 1.5, 2.5, and 2.2 feet, respectively.

The samples in this layer were mostly described as silty sand. Three (3) samples were described as silt with sand and two (2) samples were described as sandy silt. The fines content in the subsoil ranged between 25 and 40 percent, and the gravel content ranged up to 30 percent. When described as silt, the sand content ranged between 5 and 40 percent. This layer contained traces of organic soil, roots, and wood. The subsoil also contained between 15 and 20 percent cobbles and boulders.

Sand and Gravel – A layer of sand was encountered beneath the subsoil in test pits TP-1, TP-5, TP-6, TP-8 to TP-10, TP-12, TP-13, and TP-15 to TP-18, and in boring B-4. Refusal was encountered in this layer on apparent rock at depths ranging between 2.7 and 10.5 feet beneath the ground surface.

The samples in this layer were mostly described as silty sand. Three (3) samples were described as well graded sand with silt and gravel and one (1) sample was described as poorly graded sand with silt and gravel. The fines content in the sand ranged between 5 and 30 percent, and the gravel content ranged between 15 and 35 percent. This layer contained up to 20 percent cobbles and boulders.

The SPT N-values in this layer were 11 and 34 bpf indicating mostly medium dense to dense sand.

Weathered Rock – Weathered rock was encountered beneath the subsoil in test pits TP-2 and TP-11 at depths of 2.5 and 2 feet beneath the ground surface, respectively. The samples in this layer were described as well graded gravel with silt and sand and silty gravel with sand.

Rock – Excavation refusal was encountered in all the test pits at depths ranging between 0.7 and 10.5 feet beneath the ground surface. Split spoon refusal was also encountered in all borings at depths ranging between 0.5 and 6.0 feet beneath the ground surface.

To confirm and characterize the rock, rock was cored in borings B-1-OW and B-3-OW. The rock generally consisted of hard to very hard, fresh to slightly weathered, sound to moderately fractured, medium-grained, gray, Rhyolite. The rock core recoveries ranged between 95 to 100 percent and the Rock Quality Designation (RQD) ranged between 51 and 92 percent.

2.5 Groundwater

Groundwater was encountered in test pits TP-1, TP-2, TP-8, TP-9, and TP-15 to TP-17, and in borings B-1-OW and B-4 at depths ranging between 0.8 feet and 10 feet beneath the ground surface as shown in Table 1 and 2 and in the test pit and boring logs.

One (1) groundwater level reading was obtained in groundwater observation wells B-1-OW and B-3-OW on December 11, 2020. The groundwater level readings ranged between 4.9 and 10 feet beneath ground surface as shown below.

	B-1-OW	B-3-OW
Date	**Depth / Elevation (ft.)**	**Depth / Elevation (ft.)**
12/11/2020	10.0	4.9

The groundwater information reported herein is based on observations made during or shortly after the completion of drilling and excavation, and may not represent the actual groundwater conditions. Furthermore, the drilling procedure introduced water into the boreholes; therefore, additional time may be required for the groundwater levels to stabilize. The groundwater information presented in this report only represents the conditions encountered at the time and location of the explorations. Seasonal fluctuation should be anticipated.

2.6 Laboratory Test Data

LGCI submitted four (4) soil samples collected from the test pits for grain-size analysis. The results of the grain-size analyses are provided in the test data sheets included in Appendix E and are summarized in the table below.

Grain-Size Analysis Test Results

Boring No.	Sample No.	Stratum	Sample depth (ft.)	Percent Gravel	Percent Sand	Percent Fines
TP-1	Grab	Subsoil	0.7 – 3.5	10.3	38.1	51.6
TP-5	Grab	Subsoil	0.5 – 3.5	18.9	45.2	35.9
TP-6	Grab	Subsoil	0.5 – 3.0	2.6	39.4	58.0
TP-9	Grab	Sand	1.9 – 6.2	23.2	54.3	22.5

3. EVALUATION AND RECOMMENDATIONS

3.1 General

Based on our understanding of the proposed construction, our observation of the test pits and borings, and the results of our laboratory testing, there are a few issues that we would like to highlight for consideration and discussion.

We anticipate that the major consideration during construction will be the removal of the subsoil and the blasting of rock.

3.1.1 Surficial Topsoil

The surficial topsoil and subsoil are not suitable to support the proposed building and paved areas and should be removed as described below.

- The surficial topsoil and subsoil should be entirely removed from within the proposed building footprint.

- In the proposed paved areas, we recommend entirely removing the surficial topsoil. We recommend removing the subsoil to the top of the natural sand, or to a minimum depth of 18 inches beneath the bottom of the proposed pavement, whichever occurs first. Where subsoil is encountered and extends to depths greater than 18 inches beneath the bottom of the proposed pavement, the subsoil deeper than 18 inches beneath the bottom of the proposed pavement may remain in place provided that it is improved in accordance with the recommendations in Section 4.1. The removal of the topsoil and subsoil should extend laterally 5 feet outside the limits of improvement areas.

3.1.2 Rock Blasting

Significant cuts are anticipated in order to achieve the proposed grades. Based on the test pits and borings, the majority of cuts will be in rock and will require rock blasting. To facilitate rock removal and the preparation of the subgrade of footings and slabs, we recommend that blasting extend to the bottom of the footings over the entire building footprint. Care should be exercised by the blasting contractor not to overblast. Overblasted and heaved rock should be removed and replaced with Structural Fill. Additional recommendations about rock blasting are provided in Section 4.5.

3.1.3 Shallow Foundations and Slabs-on-grade

- After the surficial topsoil and subsoil are entirely removed from within the proposed building footprint and from under the proposed retaining walls, if any, the proposed building and retaining walls, if any, may be supported on shallow footings bearing in Structural Fill placed directly on the natural sand and gravel or on top of rock. Due to the

susceptibility of the natural sand to disturbance, we recommend placing footings on a minimum of 6 inches of Structural Fill.

- The proposed slab may be designed as a slab-on-grade supported on Structural Fill placed directly on top of the natural sand.

3.1.4 Under-slab Drainage System

Based on the preliminary groundwater levels observed in the groundwater observation wells, we believe that an under-sab drainage system is required beneath the proposed slab-on-grade. Our recommendations for the under-slab drainage system are presented in Section 3.4.

3.1.5 Silt Content

The natural soil is silty. Silty soils are very susceptible to disturbance when exposed to moisture. Care should be exercised during construction to maintain a dry working subgrade and to provide working mats, e.g., crushed stone or concrete mud mats, to reduce the potential for disturbance of the foundation subgrade and to improve working conditions.

3.1.6 Reuse of Onsite Materials

The onsite materials are not suitable for reuse as Structural Fill. Additional recommendations for fill materials and reuse of onsite materials are presented in Sections 4.3 and 4.4, respectively.

The contractor may consider mobilizing a rock crusher to the site. Existing cobble and boulders and blasted rock can be processed by blending them with the natural soil and crushing them to produce a well graded material. Processed material obtained by crushing blasted rock, boulders, and soil should meet the gradation requirements of Ordinary Fill and Structural Fill. Material produced by the crushing operation should be well graded so as to reduce the potential for formation of honeycombs during its placement and compaction.

3.1.7 Additional Explorations

To further explore the thickness of the subsoil and characterize the rock, we recommend performing additional explorations, including soil borings and test pits during the next phase of the project. We recommend advancing at least ten (10) additional borings and excavating at least twelve (12) test pits. The borings should extend at least 20 feet into bedrock. We recommend installing at least two (2) additional groundwater observation wells in in two (2) borings (one each).

Our recommendations for footing design are presented in Section 3.2.1. Our estimates for settlement are presented in Section 3.2.2. Our concrete slab considerations are presented in

Section 3.3 and the lateral earth pressure recommendations are presented in Section 3.6. Section 4.1 provides recommendations for preparation of subgrades.

3.2 Foundation Recommendations

3.2.1 Footing Design

- For footings supported on a minimum of 6 inches of Structural Fill placed directly over the natural sand and gravel or on rock after removing the surficial topsoil and the subsoil, we recommend a net allowable bearing pressure of 4 kips per square foot (ksf).

- Footing subgrades should be prepared in accordance with the recommendations in Section 4.1.

- All foundations should be designed in accordance with *The Commonwealth of Massachusetts State Building Code 780 CMR, ninth Edition* (MSBC 9th Edition).

- Exterior footings and footings in unheated areas should be placed at a minimum depth of 4 feet below the final exterior grade to provide adequate frost protection. Interior footings in heated areas may be designed and constructed at a minimum depth of 2 feet below finished floor grades.

- Wall footings should be designed and constructed with continuous, longitudinal steel reinforcement for greater bending strength to span across small areas of loose or soft soils that may go undetected during construction.

- A representative of LGCI should be engaged to observe that the subgrade has been prepared in accordance with our recommendations.

3.2.2 Settlement Estimate

For footings designed using the net allowable bearing pressure recommended above, we anticipate that the settlement will be about 1 inch and that the differential settlement of the footings will be 3/4 inch or less, over 25 feet. Total and differential settlements of these magnitudes are usually considered tolerable for the anticipated construction. As the design progresses and the settlement estimates are refined, the tolerance of the proposed structure to the predicted total and differential settlements should be assessed by the structural engineer.

3.3 Concrete Slab Considerations

- Floor slabs can be constructed as slabs-on-grade bearing on a minimum of 12 inches of Structural Fill placed directly on top of the natural sand. The subgrade of the slabs should be prepared as described in Section 4.1.

- To reduce the potential for dampness in the proposed floor slabs, the project architect may consider placing a vapor barrier beneath the floor slabs. The vapor barrier should be protected from puncture during construction of the slabs.

- For the design of the floor slabs bearing on the materials described above, we recommend using a modulus of subgrade reaction, k_{s1}, of 100 tons per cubic foot (tcf). Please note that the values of k_{s1} are for a 1 x 1 square foot area. These values should be adjusted for larger areas using the following expression:

$$Modulus\ of\ Subgrade\,\mathrm{Re}\,action\,(k_s) = k_{s1} * \left(\frac{B+1}{2B}\right)^2$$

where:

k_s = Coefficient of vertical subgrade reaction for loaded area,
k_{s1} = Coefficient of vertical subgrade reaction for 1 x 1 square foot area, and
B = Width of area loaded, in feet.

Please note that cracking of slabs-on-grade can occur as a result of heaving or compression of the underlying soil, but also as a result of concrete curing stresses. To reduce the potential for cracking, the precautions listed below should be closely followed for construction of all slabs-on-grade:

- Construction joints should be provided between the floor slab and the walls and columns in accordance with the American Concrete Institute (ACI) requirements, or other applicable code.

- Backfill in interior utility trenches should be properly compacted.

- In order for the movement of exterior slabs not to be transmitted to the building foundation or superstructure, exterior slabs should be isolated from the building superstructure.

3.4 Under-Slab Drains

Based on the current groundwater levels observed in the explorations, we anticipate that under-slab drainage systems will be required under the proposed building. This recommendation will be revised after additional groundwater data is collected from the groundwater observation wells.

The under-slab drainage system should consist of 1) a minimum of 12 inches of ¾-inch crushed stone placed below the slab, and 2) 6-inch-diameter slotted PVC pipes installed with their inverts at least 18 inches below the bottom of the slab. The pipes should be installed in trenches placed at 15 to 20 apart. The trenches should be at least 18 inches wide and 12 inches deep (below the

bottom of the 12 inches of crushed stone) to allow placing crushed stone around the PVC pipe. The slotted PVC pipes should connect to a 6-inch solid PVC header pipe that collects and channels the collected water out of the building.

A non-woven geotextile fabric should be installed between the crushed stone and the underlying soil or rock for separation. The slots on the PVC pipes should be placed facing downward to allow for entry of water at the bottom of the pipe. Clean-outs should be included at the end of the perforated pipes.

If possible, the water from the under-slab drainage system should be channeled to flow by gravity to a discharge area or to the City storm drainage system. If gravity drainage is not possible, groundwater from the under-slab drainage system should be collected in a sump pump pit and discharged using a sump pump. If the water from the drainage system is channeled to the City storm drainage system, the owner should apply for a discharge permit and should perform analytical tests as required by the permits.

3.5 Seismic Design

In accordance with Section 1613 of MSBC 9th Edition and International Building Code (2015 IBC) and based on the boring data, the seismic criteria for the site are as follows:

- Site Class: C
- Spectral Response Acceleration at short period (Ss): 0.232g
- Spectral Response Acceleration at 1 sec. (S_1): 0.072g
- Site Coefficient Fa (Table 1613.5.3(1)): 1.2
- Site Coefficient Fv (Table 1613.5.3(2): 1.7
- Adjusted spectral response S_{MS}: 0.278 g
- Adjusted spectral responses S_{M1}: 0.122 g

Based on the boring information, we believe the site soils are not susceptible to liquefaction.

3.6 Lateral Pressures for Wall Design

3.6.1 Lateral Earth Pressures

Lateral earth pressures recommended for design of below-ground building walls such as the wall separating the ground floor (FFE of El. 140 feet) and the main floor (FFE of El. 155 feet), and site retaining walls, if any, are provided below.

Coefficient of Active Earth Pressure, K_A:	0.33 (see note below)
Coefficient of At-Rest Earth Pressure, K_o:	0.50
Coefficient of Passive Earth Pressure, K_p:	3.0
Total Unit Weight γ:	125 pcf

Note: The values in the table are based on a friction angle for the backfill of 30 degrees and neglecting friction between the backfill and the wall. The design active and passive coefficients are based on horizontal surfaces (non-sloping backfill) on both the active and passive sides, and a vertical wall face.

- Exterior walls of below-ground spaces, and retaining walls braced at the top to restrain movement/rotation, should be designed using the "at-rest" pressure coefficient.

- We recommend placing free-draining material within the 3 feet immediately behind the retaining wall. We recommend providing weep holes in site walls to promote drainage where possible, or a pipe should be placed at the base of the wall to collect the groundwater. Groundwater collected by the wall drains should be discharged in a lower area if gravity flow is possible.

- Passive earth pressures should only be used at the toe of the wall where special measures or provisions are taken to prevent disturbance or future removal of the soil on the passive side of the wall, or in areas where the wall design includes a key. In any case, the passive pressures should be neglected in the top 2 feet.

- Where a permanent vertical uniform load will be applied on the active side immediately adjacent to the wall, a horizontal surcharge load equal to half of the uniform vertical load should be applied over the height of the wall. At a minimum, a temporary construction surcharge of 100 psf should be applied uniformly over the height of the wall.

- We recommend using an ultimate friction factor of 0.50 between the natural sand and the bottom of the wall. Below-ground walls should be designed for minimum factors of safety of 1.5 for sliding and 2.0 for overturning.

3.6.2 Seismic Pressures

In accordance with MSBC 9th Edition, Section 1610, a lateral earthquake force equal to $0.100*(S_s)*(F_a)*\gamma*H^2$ should be included in the design of walls (for horizontal backfill), where S_s is the maximum considered earthquake spectral response acceleration (defined in Section 3.5), F_a is the site coefficient (defined in Section 3.5), γ is the total unit weight of the soil backfill, and H is the height of the wall.

The earthquake force should be distributed as an inverted triangle over the height of the wall. In accordance with MSBC 9th Edition, Section 1610.2, a load factor of 1.43 shall be applied to the earthquake force for wall strength design.

Temporary surcharges should not be included when designing for earthquake loads. Surcharge loads applied for extended periods of time shall be included in the total static lateral soil pressure and their earthquake lateral force shall be computed and added to the force determined above.

3.6.3 Perimeter and Wall Drains

- We recommend that free-draining material be placed within 3 feet of the below-ground spaces such as the wall separating the ground floor and the main floor. To reduce the potential for dampness in belowground spaces, perimeter walls of the proposed below-ground spaces, if any, should be damp-proofed.

- We recommend that drains be provided behind walls of below-ground spaces, and behind site retaining walls. The drains should consist of 6-inch perforated PVC pipes installed with the slots facing down. Perimeter drains should be installed at the bottom of the wall in 18 inches of crushed stone wrapped in a geotextile fabric for separation and filtration. Site retaining walls may be designed with weep holes discharging near the bottom of the face of the walls.

- Groundwater collected by the wall drains could be discharged in a lower area if gravity flow is possible. Alternatively, it should be discharged into the street drains. A permit would be required for discharge into street drains.

3.7 Pavement Considerations

3.7.1 General

The subsurface conditions encountered at the site are generally suitable to support the proposed driveway, after preparation of the subgrade as described in Section 4.1.

- We recommend entirely removing the topsoil from within the footprint of the proposed paved areas.

- The subsoil should be removed in accordance with the recommendations in Sections 3.1.1 and 4.1.

- Cobbles and boulders should be removed to at least 18 inches below the bottom of the pavement.

3.7.2 Exterior Slabs

- Exterior slabs such as sidewalks/walkways and surface pads should be placed on a minimum of 12 inches of Structural Fill with less than 5 percent fines.

- To reduce the potential for heave caused by surface water penetrating under the concrete panels of the proposed sidewalks/walkways, the joints between the concrete sections should be sealed with a waterproof compound. The exterior slabs should be sloped away from the building or other vertical surfaces to promote flow of water. To the extent possible, roof leaders should not discharge onto exterior slab surfaces.

- Based on the groundwater levels measured during our explorations, we do not believe that sidewalk drains are needed. LGCI will update this recommendation after additional explorations are performed and groundwater observation wells are installed at the site.

3.7.3 Pavement Sections

The proposed driveways and parking areas should be constructed with minimum asphalt and subbase thicknesses in accordance with the recommendations and details prepared by the project civil engineer. At a minimum, the following typical pavement sections should be used.

A typical, minimum, standard-duty pavement section that could be used for parking areas is as follows:

1.5"	Asphalt "Top Course"
2.0"	Asphalt "Base Course"
8"	Processed Gravel for Sub-Base (MassDOT M1.03.1)

A typical, minimum, heavy-duty pavement section that could be used for driveways and areas of heavy truck traffic is as follows:

2.0"	Asphalt "Top Course"
2.5"	Asphalt "Base Course"
12"	Processed Gravel for Sub-Base (MassDOT M1.03.1)

The pavement sections shown above represent minimum thicknesses representative of typical local construction practices for similar use. Periodic maintenance should be anticipated.

Pavement material types and construction procedures should conform to specifications of the “Standard Specifications for Highways and Bridges,” prepared by the Commonwealth of Massachusetts Department of Public Works and dated 1988 (with the latest Supplemental Specifications).

4. CONSTRUCTION CONSIDERATIONS

4.1 Subgrade Preparation

- The topsoil, subsoil, organic materials, abandoned utilities, if any, and other below-ground structures, if any, should be entirely removed from within the footprint of the proposed building and site structures, including site retaining walls, and exterior stairs, if any, before the start of foundation work.

- Tree stumps, root balls, and roots larger than ½ inch in diameter should be removed and the cavities filled with suitable material and compacted per Section 4.3 of this report.

- Topsoil, root balls, organic material, and other deleterious material should be entirely removed from within the proposed paved areas.

- The site contractor should note that the surficial materials at the site may contain large boulders.

- Cobbles and boulders should be removed at least 6 inches from beneath footings, and 24 inches beneath the bottom of proposed slabs, 24 inches beneath the bottom of the asphalt in paved areas, and 24 inches beneath the base material of the turf in the proposed athletic fields. The resulting excavations should be backfilled with compacted Structural Fill within the proposed building and with Ordinary Fill under the subbase of paved areas and under the base material in athletic fields.

- The base material of athletic fields should conform to the gradation and placement requirements of the landscape architect or the manufacturer/installer of synthetic turf.

- Due to the high susceptibility of the natural sand and gravel for disturbance under foot and vehicular traffic, we recommend placing a minimum of 6 inches of Structural Fill at the bottom of the excavation or 4 inches of lean concrete to serve as a working mat.

- The bottom of the excavation resulting from the removal of the topsoil and subsoil in areas where the excavation terminates in the natural sand and gravel should be compacted with a dynamic vibratory compactor imparting a minimum of 40 kips of force to the subgrade.

- The base of the footing excavations in granular soil should be compacted with a dynamic vibratory compactor weighing at least 200 pounds and imparting a minimum of 4 kips of force to the subgrade before placing the required 6 inches of Structural Fill.

- The subgrade of the slabs should be compacted using a vibratory roller compactor imparting a minimum of 10 kips of force to the subgrade before placing Structural Fill.

- Where soft zones are revealed during the preparation of the subgrade, the soft materials or buried organic soil should be removed and replaced with Structural Fill within the building footprint and with Ordinary Fill beneath the subbase of paved areas.

- The subgrade in rock should be prepared in accordance with the recommendations is Section 4.5.

- To reduce the potential of increasing lateral pressures on the retaining walls, fill placed within 3 feet of the walls, if any, should be compacted using a small plate compactor imparting a maximum dynamic effort of 4 kips. The fill within 3 feet of the walls should be placed in maximum 8-inch loose lifts.

- After the surficial topsoil is entirely removed and after the subsoil is removed from within the proposed paved areas in accordance with the recommendations in Section 3.1.1, the existing subsoil deeper than 18 inches beneath the bottom of the proposed pavement should be improved by compacting the exposed surface with at least eight (8) passes (4 passes in each direction) of a vibratory roller compactor imparting a dynamic effort of at least 40 kips. Where soft zones of soil are observed, the soft soil should be removed, and the grade should be restored using Ordinary Fill to the bottom of the proposed subbase layer. If pumping of the subsoil deeper than 18 inches beneath the bottom of the proposed grade is observed, the compactor should be switched to static mode and the soft material should be removed and replaced with Ordinary Fill.

- After the topsoil is removed from within the proposed athletic fields, the exposed subsoil or natural soil should be proofrolled with a loaded rubber tire truck or with a large vibratory roller compactor imparting a minimum dynamic effort of 40 kips. Where soft zones are indicated by the proofrolling, the soft zones should be removed and the grades should be restored using Ordinary Fill to the bottom of the base material of the proposed turf designed by the landscape architect or the manufacturer/installer of synthetic turf, if any. The preparation of the subgrade before the placement of the turf subbase should follow the recommendations of the landscape architect.

- Fill placed within the footprint of the proposed building should meet the gradation and compaction requirements of Structural Fill shown in Section 4.3.

- Fill placed under the subbase of paved areas, should meet the gradation and compaction requirements of Ordinary Fill shown in Section 4.3.

- Fill placed in the top 12 inches beneath exterior slabs should consist of Structural Fill with less than 5 percent fines.

- When crushed stone is required in the drawings or it is used for the convenience of the contractor, it should be wrapped in a geotextile fabric for separation. The geotextile fabric

should not be used under retaining walls as it promotes a plane of sliding such as under retaining wall footings.

- An LGCI geotechnical representative should observe the subgrades of footings and slabs prior to fill and concrete placement to verify that the exposed bearing materials are suitable for the design soil bearing pressure. If soft or loose pockets are encountered in the footing excavations, the soft or loose materials should be removed, and the bottom of the footing should be placed at a lower elevation on firm soil, or the resulting excavation should be backfilled with Structural Fill or crushed stone wrapped in geotextile for separation. The LGCI representative should also observe the improvement of the existing subsoil if any, and/or fill within the proposed paved areas.

4.2 Subgrade Protection

The site soils are frost susceptible. If construction takes place during freezing weather, special measures should be taken to prevent the subgrade from freezing. Such measures should include the use of heat blankets or excavating the final six inches of soil just before pouring concrete. Footings should be backfilled as soon as possible after footing construction. Soil used as backfill should be free of frozen material, as should the ground on which it is placed. Filling operations should be halted during freezing weather.

Materials with high fines contents are typically difficult to handle when wet as they are sensitive to moisture content variations. Subgrade support capacities may deteriorate when such soils become wet and/or disturbed. The contractor should keep exposed subgrades properly drained and free of ponded water. Subgrades should be protected from machine and foot traffic to reduce disturbance.

4.3 Fill Materials

Structural Fill and Ordinary Fill should consist of inert, hard, durable sand and gravel, free from organic matter, clay, surface coatings and deleterious materials, and should conform to the gradation requirements shown below.

4.3.1 Structural Fill

The Structural Fill should have a plasticity index of less than 6 and should meet the gradation requirements shown below. Structural Fill should be compacted in maximum 9-inch loose lifts to at least 95 percent of the Modified Proctor maximum dry density (ASTM D1557), with moisture contents within ±2 percentage points of optimum moisture content.

Sieve Size Percent	Passing by Weight
3 inches	100
1 ½ inch	80-100
½ inch	50-100
No. 4	30-85
No. 20	15-60
No. 60	5-35
No. 200*	0-10

* 0 – 5 Under sidewalks, unheated slabs, exterior stairs, ramps, and pads, and walkways

4.3.2 Ordinary Fill

Ordinary Fill should have a plasticity index of less than 6 and should meet the gradation requirements shown below. Ordinary Fill should be compacted in maximum 9-inch loose lifts to at least 95 percent of the Modified Proctor maximum dry density (ASTM D1557), with moisture contents within ±2 percentage points of optimum moisture content.

Sieve Size Percent	Passing by Weight
6 inches	100
1 inch	50-100
No. 4	20-100
No. 20	10-70
No. 60	5-45
No. 200	0-20

4.4 Reuse of Onsite Materials

Based on our field observations and the results of the grain-size analyses, we anticipate that the natural soils at the site may not be used as Structural Fill.

The contractor should avoid mixing the existing soils with suitable imported material. Should reusable materials be encountered during excavation, they should be excavated and stockpiled separately for compliance testing.

Soils with 20 percent or greater fines content are generally very sensitive to moisture content variations and are susceptible to frost. Such soils are very difficult to compact at moisture contents that are much higher or much lower than the optimum moisture content determined from the laboratory compaction test. Therefore, strict moisture control should be implemented during compaction of onsite soils with fines contents of 20 percent or greater. The contractor should be prepared to remove and replace such soils if pumping occurs.

The contractor may consider mobilizing a rock crusher to the site. Boulders and blasted rock can be processed with the natural soil and crushed to produce granular fill that is lower in fines if blended with a sufficient proportion of rock. Processed material obtained by crushing blasted rock, boulders, and soil should meet the gradation requirements of Ordinary Fill and Structural Fill. Material produced by the crushing operation should be well graded so as to reduce the potential for formation of honeycombs during its placement and compaction. The site contractor should be prepared to produce batches of material processed using different blending ratios at the start of the earthwork operations. LGCI will review the results of grain-size analyses performed on the processed material and provide an opinion about the blending ratio to maintain throughout construction.

All materials to be used as fill, including blended materials, should first be tested for compliance with the applicable gradation specifications.

4.5 Rock Blasting Considerations

4.5.1 Rock Removal

Deep rock cuts will be required to achieve the proposed FFE of the proposed building and the proposed grades of the paved areas.

Minor rock cuts (less than one foot) over short distances may be achieved using hoe-rams or using other non-blasting techniques. For the majority of the cuts, we anticipate that rock blasting will be required.

- Rock should be cut to at least 12 inches beneath footings and at a minimum of 24 inches beneath the bottom of the proposed slabs. To facilitate rock excavation and backfilling, we recommend that the blasting extend to the 12 inches beneath the bottom of footings under the entire building footprint.

- The rock should be cut laterally at least one foot beyond each side of the footing. For retaining wall footings, the rock should be cut laterally at least 3 feet from the outside face of the wall to allow for placement of the formwork.

- The rock surface should be cut as level as possible. The surface of rock should not be steeper than 12H:1V.

- Structural Fill should not be placed directly on rock surface that are fractured. The fractures should be covered with a geotextile fabric for separation before placing Structural Fill on the fractured rock.

- Rock should be cut at least 18 inches beneath the bottom of paved areas, and 18 inches beneath the ground surface of athletic fields.

- Under utility pipes, manholes, and catch basins, rock should be cut a minimum of 12 inches beneath the pipe or structure.

- Laterally, rock should be cut a minimum of 12 inches outside utility structures and a minimum of 18 inches on each side of utility pipes.

- To reduce overblasting and the potential for heaved rock, drill holes for blasting should not extend more than 2 feet beneath the minimum depths shown above.

- Rock blasting should be controlled to reduce vibrations and airblast overpressure to below thresholds established in the Earth Moving Specifications.

- Pre-splitting or controlled blasting may be desirable to reduce the amount of over-blast.

- To reduce the potential for blasted rock intended for crushing and mixing with organic soil, we recommend that the topsoil, roots, tree stumps, and vegetation be removed before blasting. The remainder of the overburden soils and excavatable weathered rock should not be removed before blasting.

- To help obtain information about the top of the rock for rock quantity estimating purposes, we recommend that the Earth Moving Specifications include a requirement for the contractor to perform rock probes at the site in a grid pattern before the start of blasting. The results of the probes should include at a minimum the ground surface elevation and the elevation of the top of the rock. The probes should extend at least 10 feet beyond the perceived top of rock to make sure that the perceived top of rock is not a boulder.

4.5.2 Ground Vibration Monitoring

Rock blasting operations will generate ground vibrations that may result in minor cracks and cosmetic damage to nearby structures. To protect the adjacent structures from potential damage, construction blasting should be carefully controlled and monitored. We recommend monitoring vibrations at the ground surface and at nearby structures before and during the rock blasting operations.

4.5.3 Public Notification

The human perception threshold to vibration is very low, i.e., people are far more sensitive to vibrations than are the structures they occupy. Various studies have indicated that the sound effects are noticeable at peak particle velocity (PPV) values of 0.02 inches per second (ips) and complaints and claims of damage are likely at PPV values of 0.2 to 0.3 ips. These vibration intensities are well below the intensities that would cause structural damage to buildings. For these reasons, we recommend that the owner implement a proactive program

of public notification and education of neighbors on the physical characteristics of blasting effects before the start of blasting.

4.5.4 Pre-Construction Condition Survey

We recommend that the Owner perform a pre-construction condition survey of structures located within 250 feet of the nearest blasting operation to document the existing conditions of the structures. The Owner may also consider using crack monitoring gauges to monitor large cracks identified during the pre-construction surveys.

4.6 Groundwater Control Procedures

Based on the groundwater levels encountered in our explorations, we anticipate that groundwater control procedures will be needed during removal of the subsoil and after rock blasting. We anticipate that filtered sump pumps installed in pits located at least three feet below the bottom of the excavation may be sufficient to handle surface runoff that may enter the excavation. The contractor should be prepared to install multiple deep sump pumps to maintain a dry subgrade. Also, where deep trenches are required for utilities, multiple sump pumps would be required to maintain a dry excavation subgrade.

The contractor should be permitted to employ whatever commonly accepted means and practices as necessary to maintain the groundwater level below the bottom of the excavation, and to maintain a dry excavation during wet weather. Groundwater levels should be maintained at a minimum of 1-foot below the bottom of excavations during construction. Placement of reinforcing steel or concrete in standing water should not be permitted.

Proper permits should be obtained from authorities having jurisdiction over the work. At a minimum, the water collected from excavations should be filtered for fines in sedimentation basins before being discharged. The sedimentation basins could be constructed of hay bales wrapped in a geotextile fabric.

To reduce the potential for sinkholes developing over sump pump pits after the sump pumps are removed, the crushed stone placed in the sump pump pits should be wrapped in a geotextile for separation. Alternatively, the crushed stone should be entirely removed after the sump pump is no longer in use and the sump pump pit should be restored with suitable backfill.

4.7 Temporary Excavations

All excavations to receive human traffic should be constructed in accordance with the OSHA guidelines.

The site soils should generally be considered Type “C” and should have a maximum allowable slope of 1.5 Horizontal to 1 Vertical (1.5H:1V) for excavations less than 20 feet deep. Deeper excavations, if needed, should have shoring designed by a professional engineer.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of the excavation sides and bottom and to protect existing structures.

5. RECOMMENDATIONS FOR FUTURE WORK

As part of our current scope, LGCI will prepare Earth Moving specifications.

We recommend engaging LGCI to perform the following services:

- Perform additional explorations during the next phase of the project and revise our geotechnical report accordingly.
- Prepare Earth Moving Specifications and review the geotechnical aspect of foundation drawings.
- Review the geotechnical aspects of contractor submittals and requests for information (RFIs).
- Provide a field representative during construction to observe the subgrade of foundations and slabs.

6. REPORT LIMITATIONS

Our analysis and recommendations are based on project information provided to us at the time of this report. If changes to the type, size, and location of the proposed structures or to the site grading are made, the recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the conclusions and recommendations modified in writing by LGCI. LGCI cannot accept responsibility for designs based on our recommendations unless we are engaged to review the final plans and specifications to determine whether any changes in the project affect the validity of our recommendations and whether our recommendations have been properly implemented in the design.

It is not part of our scope to perform a more detailed site history; therefore, we have not explored for or researched the locations of buried utilities or other structures in the area of the proposed construction. Our scope did not include environmental services or services related to moisture, mold, or other biological contaminants in or around the site.

The recommendations in this report are based in part on the data obtained from the subsurface explorations. The nature and extent of variations between explorations may not become evident until construction. If variations from anticipated conditions are encountered, it may be necessary to revise the recommendations in this report. We cannot accept responsibility for designs based on recommendations in this report unless we are engaged to 1) make site visits during construction to check that the subsurface conditions exposed during construction are in general conformance with our design assumptions and 2) ascertain that, in general, the work is being performed in compliance with the contract documents.

Our report has been prepared in accordance with generally accepted engineering practices and in accordance with the terms and conditions set forth in our agreement. No other warranty, expressed or implied, is made. This report has been prepared for the exclusive use of Drummey Rosane Anderson, Inc. for the specific application to the Proposed Northeast Metropolitan Regional Technical Vocational High School in Wakefield, Massachusetts as conceived at this time.

7. REFERENCES

In addition to the references included in the text of the report, we used the following references:

The Commonwealth of Massachusetts (2015), "The Massachusetts State Building Code, Ninth Edition," comprised of the International Building Code (IBC-2015) and 780 CMR: Massachusetts Amendments to IBC-2015.

The Department of Labor, Occupational Safety and Health Administration (1989), "Occupational Safety and Health Standards - Excavations; Final Rule," 20 CFR Part 1926, Subpart P.

USGS Wakefield, MA topographic map from http://mapserver.mytopo.com.

Table 1 - Summary of LGCI's Test Pits
Proposed Northeast Metro Regional Vocational Technical High School
Wakefield, Massachusetts
LGCI Project No. 2025

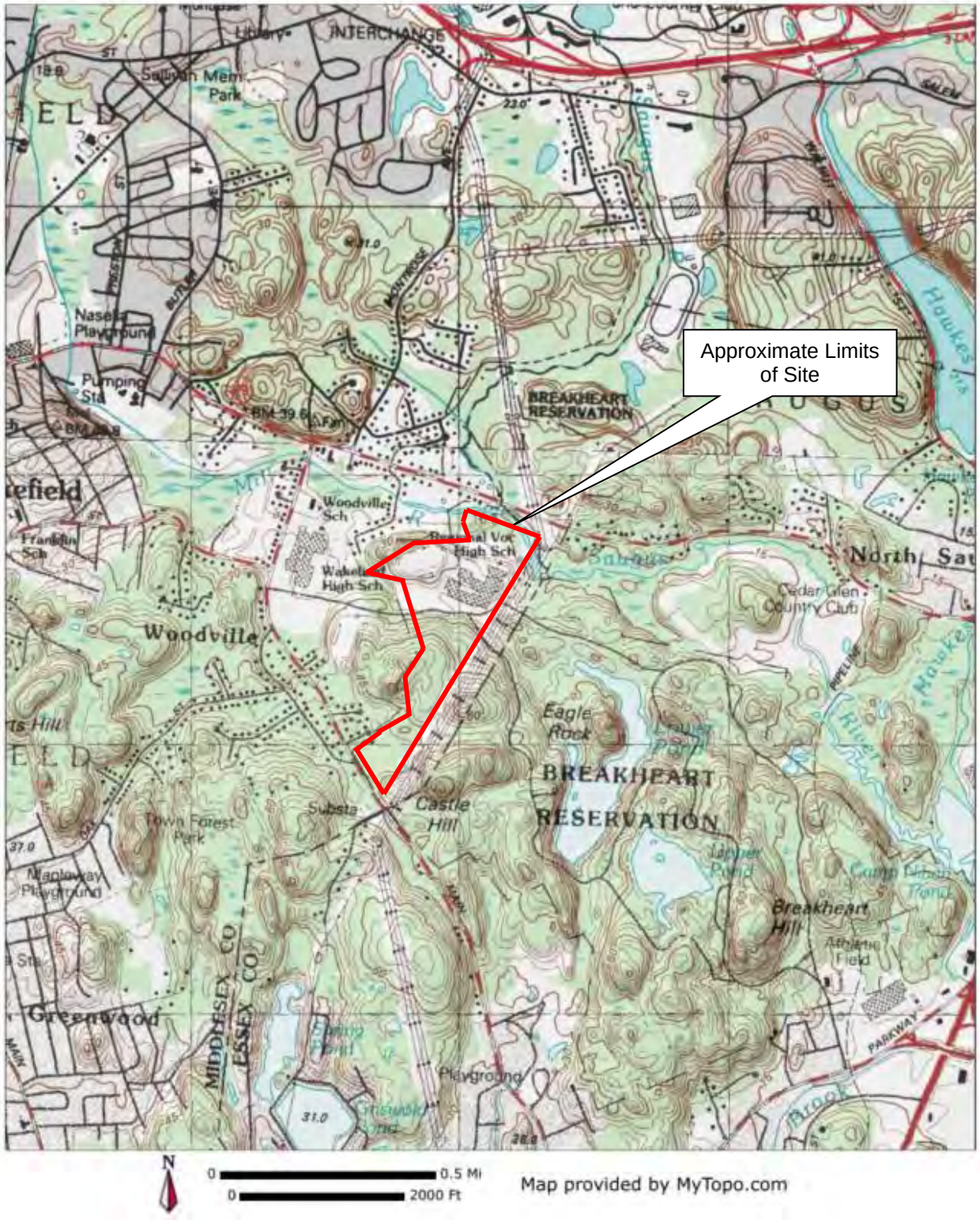
Test Pit No.	Groundwater[1] Depth (ft.)	Bottom of Topsoil Depth (ft.)	Bottom of Subsoil Depth (ft.)	Bottom of Sand and Gravel Depth (ft.)	Top of Weathered Rock Depth (ft.)	Bottom of Test Pit Depth (ft.)
TP-1	2.0	0.7	3.5	9.0[4]	-	9.0
TP-2	4.0	0.8	3.5	-	3.5[5]	4.3
TP-3	-	1.0	2.0[3]	-	-	2.0
TP-4	-	0.5	1.5[3]	-	-	1.5
TP-5	-	0.5	3.5	5.0[4]	-	5.0
TP-6	-	0.5	3.0	4.5[4]	-	4.5
TP-7	-	2.0[2]	-	-	-	2.0
TP-8	2.0	1.0	3.0	9.0[4]	-	9.0
TP-9	3.6	0.4	1.9	6.2[4]	-	6.2
TP-10	-	0.3	2.1	2.7[4]	-	2.7
TP-11	-	0.5	2.0	-	2.0[5]	3.2
TP-12	-	1.0	4.0	7.0[4]	-	7.0
TP-13	-	0.4	2.3	4.8[4]	-	4.8
TP-14	-	0.7[2]	-	-	-	0.7
TP-15	2.5	0.5	4.0	5.0[4]	-	5.0
TP-16	3.5	1.0	5.0	10.5[4]	-	10.5
TP-17	1.5	0.2	1.9	3.1[4]	-	3.1
TP-18	-	0.3	2.8	3.9[4]	-	3.9

1. Groundwater is based on the level measured durring excavation.
2. Test pit terminated in the topsoil layer on apparent rock.
3. Test pit terminated in the subsoil layer on apparent rock.
4. Test pit terminated in the sand layer on apparent rock or in cobbles and boulders.
5. Test pit terminated in the weathered rock.
6. "-" means groundwater or layer was not encountered.

Table 2 - Summary of LGCI's Borings
Proposed Northeast Metro Regional Vocational Technical High School
Wakefield, Massachusetts
LGCI Project No. 2025

Boring No.	Groundwater[1] Depth (ft.)	Bottom of Topsoil Depth (ft.)	Bottom of Subsoil Depth (ft.)	Bottom of Sand and Gravel Depth (ft.)	Depth to Refusal/Top of Rock Depth (ft.)	Bottom of Boring Depth (ft.)
B-1-OW	10.0	0.3	2.5	-	2.5	14.0
B-2	-	0.5[2]	-	-	0.5	0.5
B-3-OW	-	0.3	2.2	-	2.2	18.0
B-4	0.8	0.3	2.6	6.0	6.0	8.0

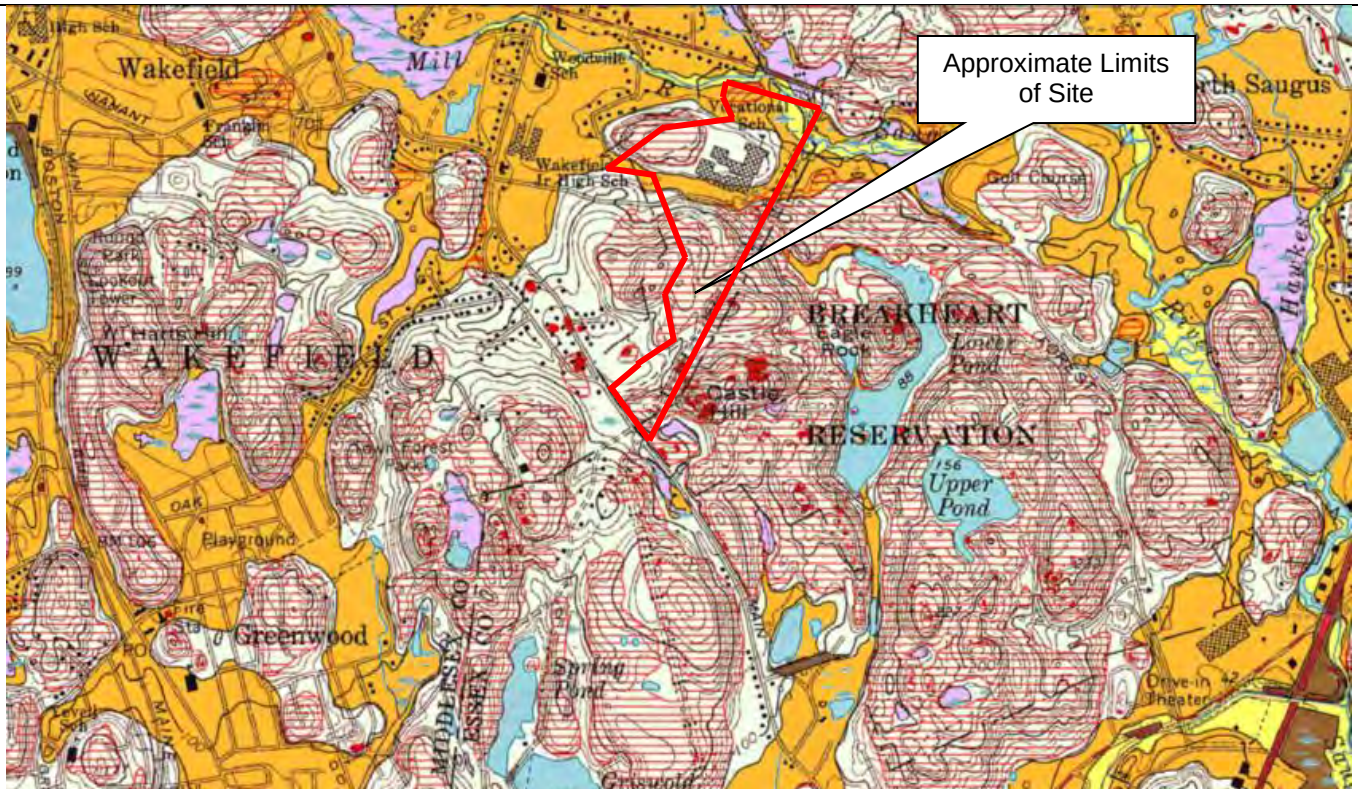
1. Groundwater is based on level measured at the end of drilling.
2. Split Spoon refusal in the topsoil layer.
3. "-" means groundwater or layer was not encountered.



Contour Intervals: 10 feet

Figure based on USGS topographic map of Wakefield, MA obtained from www.mytopo.com

Client:	Project:		
Drummey Rosane Anderson, Inc.	Prop. Northeast Metro Regional Vocational Techical H.S.	Figure 1 – Site Location Map	
LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Wakefield, MA	LGCI Project No.: 2025	Date: Dec. 2020



Thin till—Nonsorted, nonstratified matrix of sand, some silt, and little clay containing scattered pebble, cobble, and boulder clasts; large surface boulders are common; unit was mapped where till is generally less than 10 to 15 ft thick including areas of shallow bedrock. Predominantly consists of upper till of the last glaciation; loose to moderately compact, generally sandy, commonly stony. Two facies are present in some places: a looser, coarser grained ablation facies, melted out from supraglacial position; and an underlying more compact, finer grained lodgement facies deposited subglacially. In general, both ablation and lodgement facies of upper till derived from fine-grained bedrock are finer grained, more compact, less stony and have fewer surface boulders than upper till derived from coarse-grained crystalline rocks. Across Massachusetts, fine-grained bedrock sources include the red Mesozoic sedimentary rocks of the Connecticut Valley lowland, marble in the western river valleys, and fine-grained schists in upland areas

Coarse deposits consist of *gravel deposits*, *sand and gravel deposits*, and *sand deposits*, not differentiated in this report. *Gravel deposits* are composed of at least 50 percent gravel-size clasts; cobbles and boulders predominate; minor amounts of sand occur within gravel beds, and sand comprises a few separate layers. Gravel layers generally are poorly sorted, and bedding commonly is distorted and faulted due to postdepositional collapse related to melting of ice. *Sand and gravel deposits* occur as mixtures of gravel and sand within individual layers and as layers of sand alternating with layers of gravel. Sand and gravel layers generally range between 25 and 50 percent gravel particles and between 50 and 75 percent sand particles. Layers are well sorted to poorly sorted; bedding may be distorted and faulted due to postdepositional collapse. *Sand deposits* are composed mainly of very coarse to fine sand, commonly in well-sorted layers. Coarser layers may contain up to 25 percent gravel particles, generally granules and pebbles; finer layers may contain some very fine sand, silt, and clay

Bedrock outcrops and areas of abundant outcrop or shallow bedrock—Solid color shows extent of individual bedrock outcrops; horizontal-line pattern indicates areas of shallow bedrock or areas where small outcrops are too numerous to map individually; in areas of shallow bedrock, surficial materials are less than 5 to 10 ft thick. These units were not mapped consistently among all quadrangles; see note at beginning of appendix 1 for information on bedrock outcrop mapping by quadrangle

Figure based on map titled: "Surficial Materials Map of the Boston North, Massachusetts," prepared by Stone, B.D. and DiGiacomo-Cohen, M.L. for U.S. Geological Survey, 2018, Scientific Investigation Map 3402, Quadrangle 125 – Boston North.

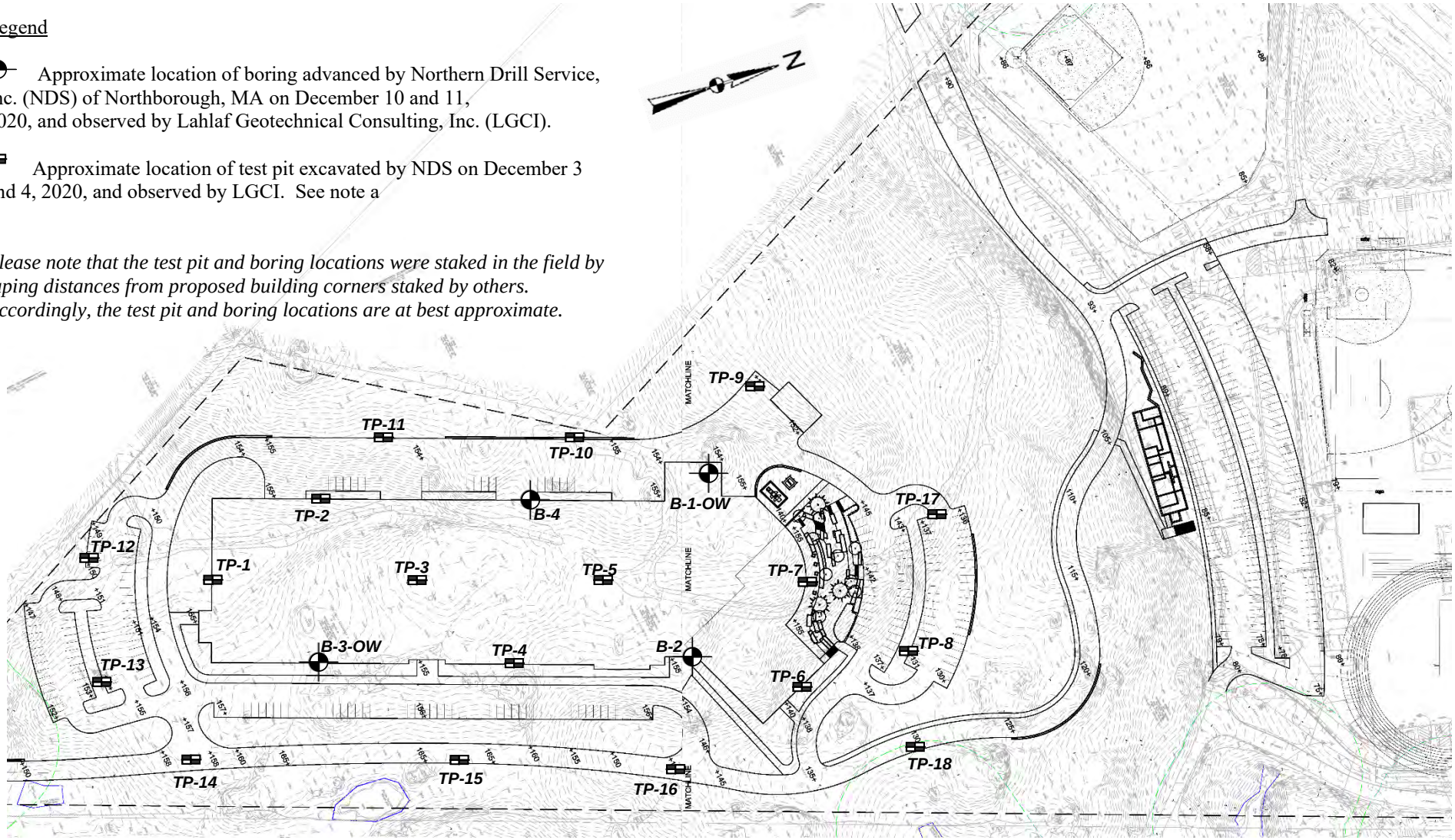
Client:	Project:		
Drummey Rosane Anderson, Inc.	Prop. Northeast Metro Regional Vocational Techical H.S.	Figure 2 – Surficial Geologic Map	
LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Wakefield, MA	LGCI Project No.: 2025	Date: Dec. 2020

Legend

Approximate location of boring advanced by Northern Drill Service, Inc. (NDS) of Northborough, MA on December 10 and 11, 2020, and observed by Lahlaf Geotechnical Consulting, Inc. (LGCI).

Approximate location of test pit excavated by NDS on December 3 and 4, 2020, and observed by LGCI. See note a

Please note that the test pit and boring locations were staked in the field by taping distances from proposed building corners staked by others. Accordingly, the test pit and boring locations are at best approximate.



Approximate Scale (ft.)

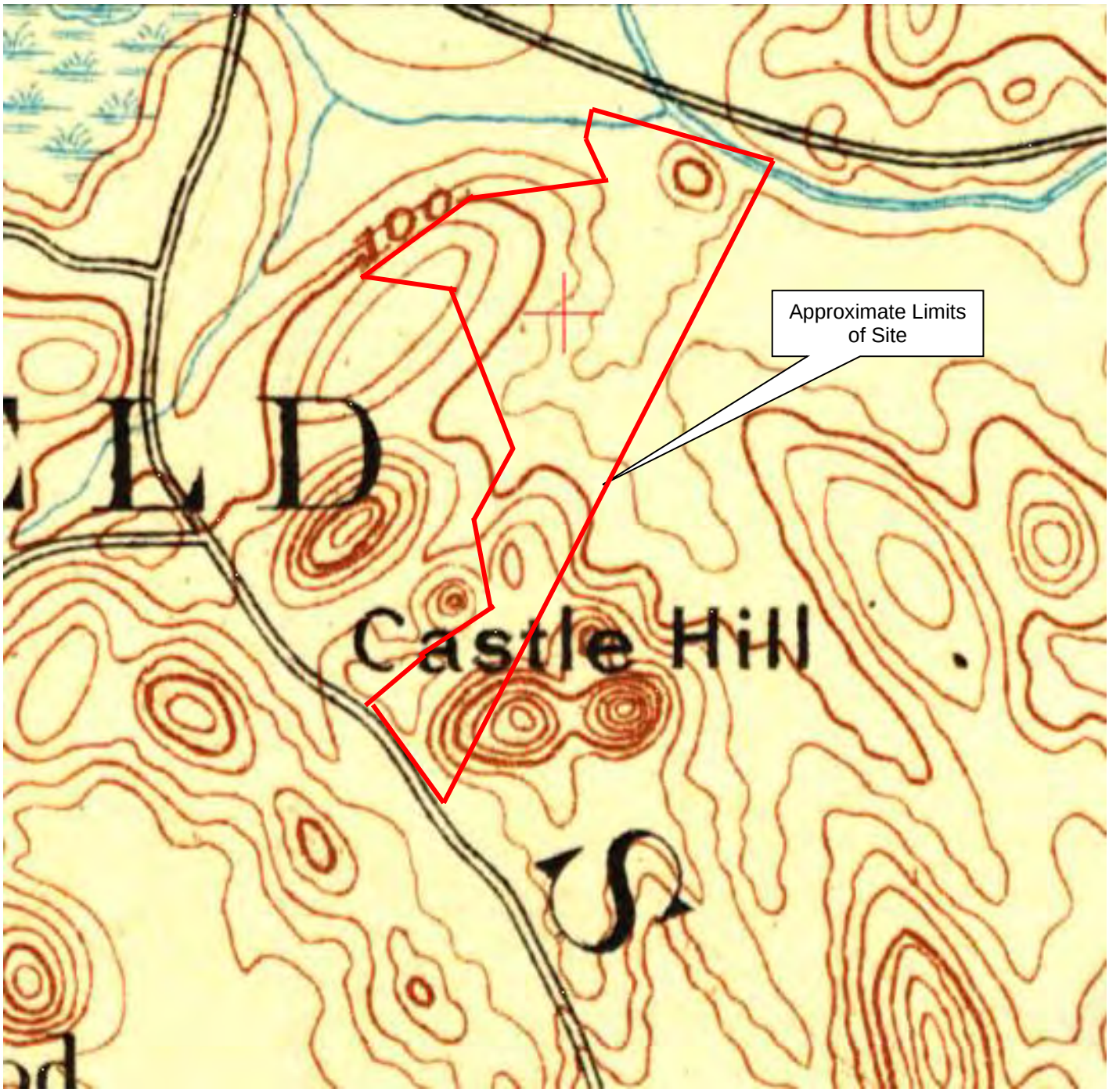
0 30' 60' 150'

Note

Figure based on drawing titled: "Northeast Metro Technical High School, Option C.3 Site Plan North", and "Northeast Metro Technical High School, Option C.3 Site Plan South" prepared by Warner Larson Landscape Architects, Inc., dated October 22, 2020, and provided to LGCI by Nitsch Engineering, Inc., via e-mail on December 9, 2020.

Client: Drummey Rosane Anderson, Inc.	Project: Proposed Northeast Metro Regional Vocational Technical High School	Figure 3 – Test Pit and Boring Location Plan	
LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Wakefield, MA	LGCI Project No.: 2025	Date: Dec. 2020

APPENDIX A – Historical Topo Maps

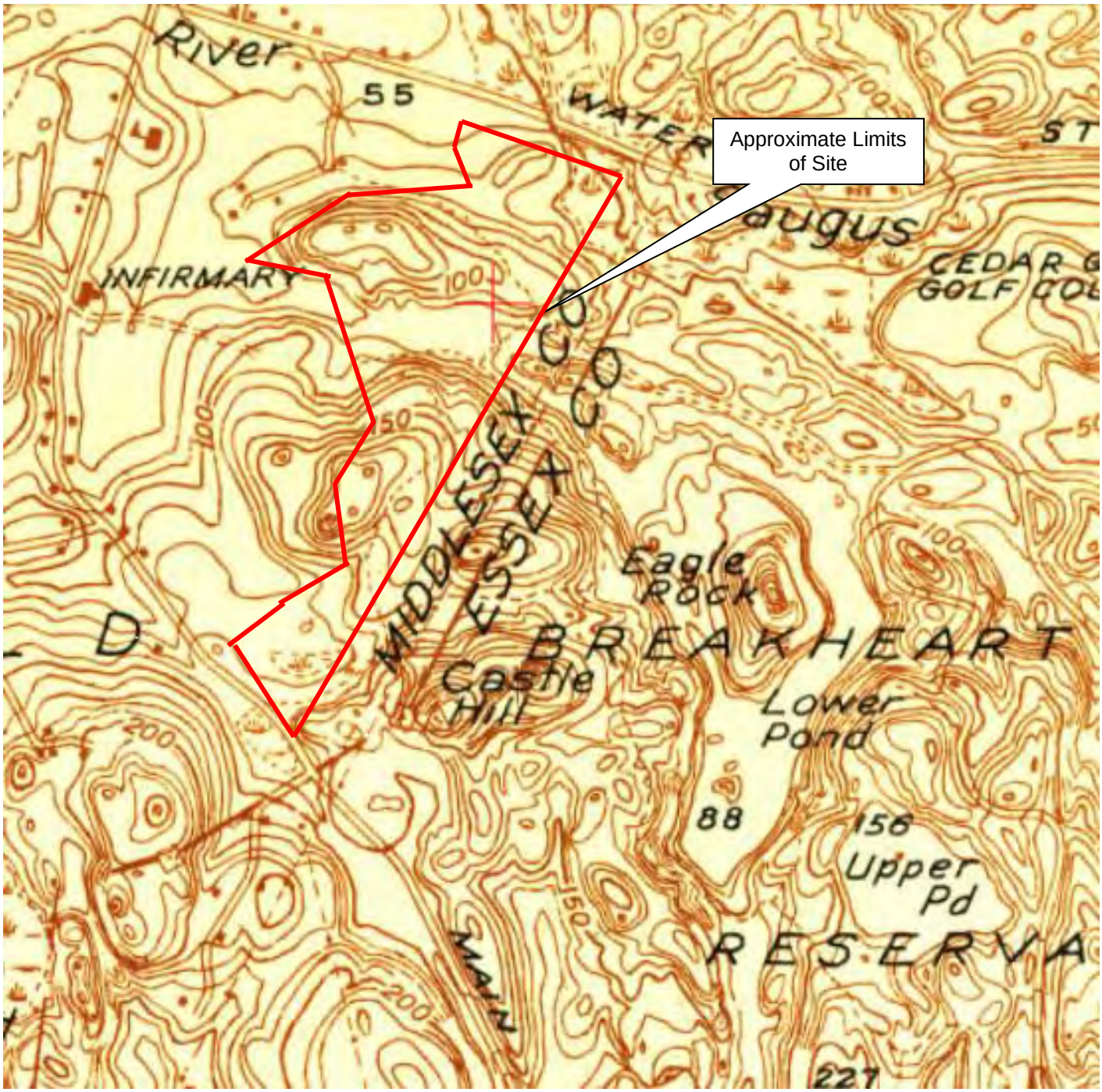


Contour Intervals: 20 feet

Figure based on USGS topographic map of Wakefield, MA obtained from https://livingatlas.arcgis.com/topoexplorer/index.html

Client:	Project:	
Drummey Rosane Anderson, Inc.	Proposed Northeast Metropolitan Regional Vocational High School	Figure A1 – 1893 Historical Topo Map

LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Wakefield, MA	LGCI Project No.: 2025	Date: August 2020

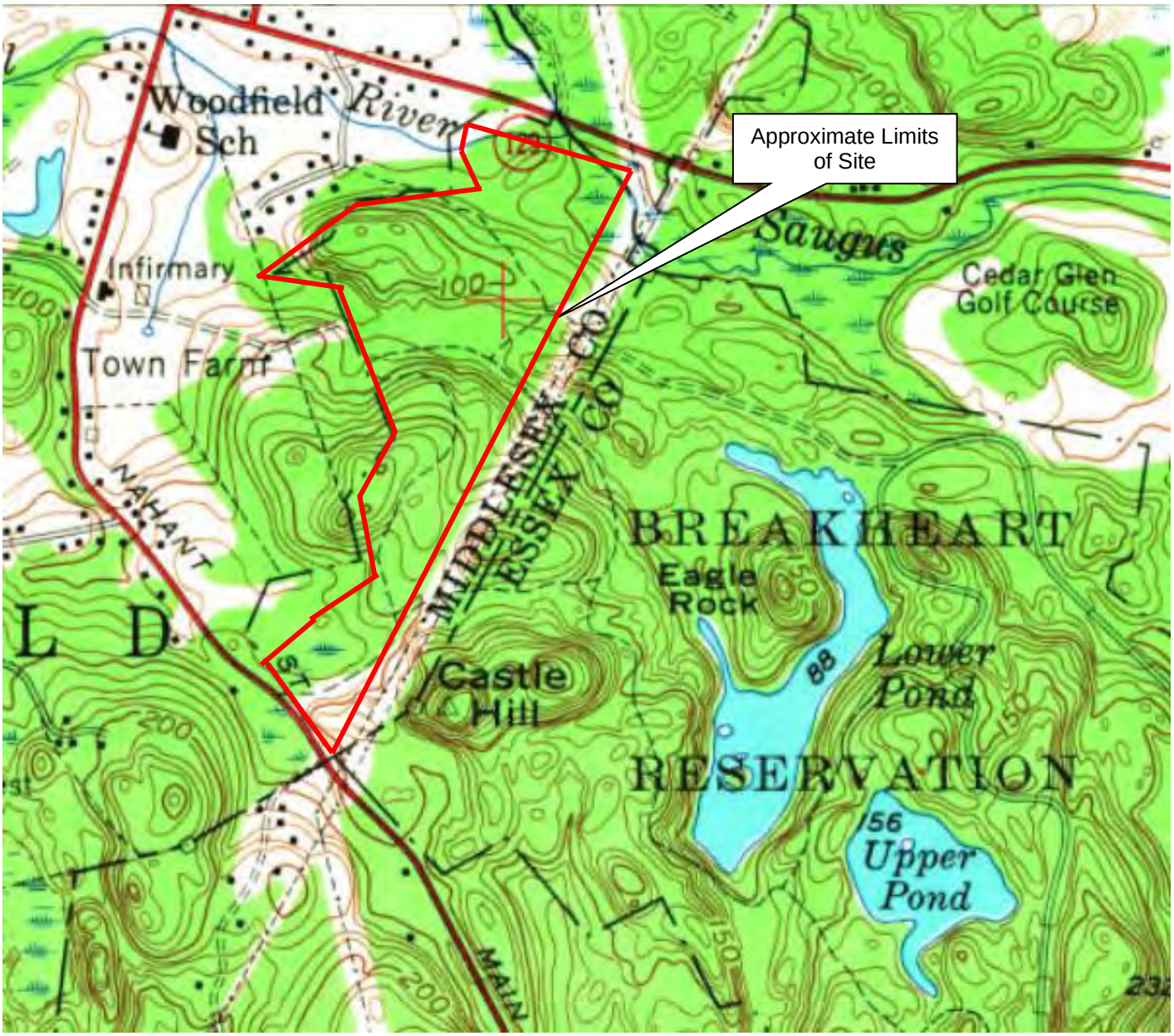


Contour Intervals: 10 feet

Figure based on USGS topographic map of Wakefield, MA obtained from https://livingatlas.arcgis.com/topoexplorer/index.html

Client:	Project:	
Drummey Rosane Anderson, Inc.	Proposed Northeast Metropolitan Regional Vocational High School	Figure A2 – 1943 Historical Topo Map

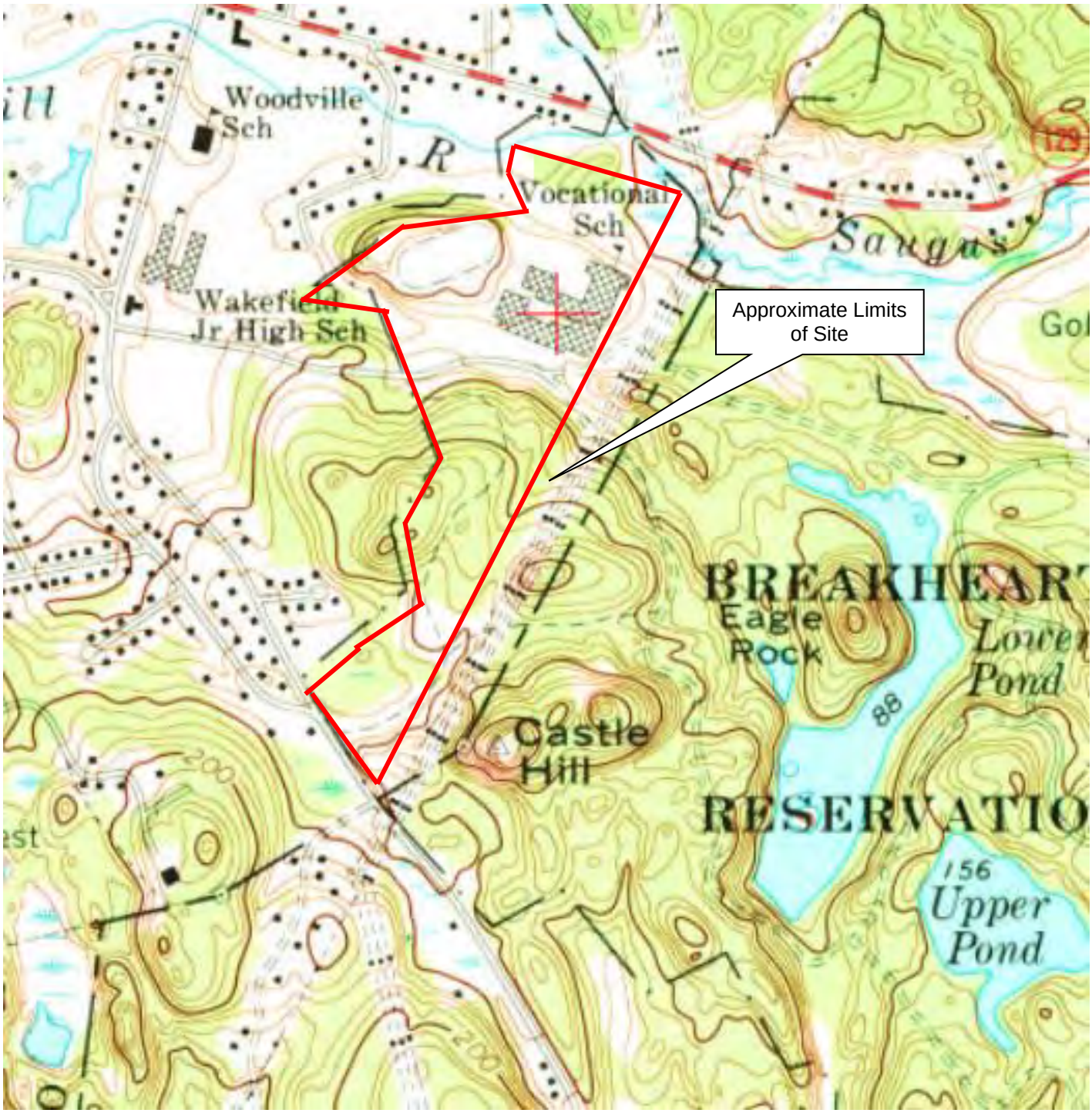
	Project Location:	LGCI Project No.:	Date:
LGCI Lahlaf Geotechnical Consulting, Inc.	Wakefield, MA	2025	August 2020



Contour Intervals: 10 feet

Figure based on USGS topographic map of Wakefield, MA obtained from https://livingatlas.arcgis.com/topoexplorer/index.html

Client:	Project:		
Drummey Rosane Anderson, Inc.	Proposed Northeast Metropolitan Regional Vocational High School	Figure A3 – 1956 Historical Topo Map	
LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Wakefield, MA	LGCI Project No.: 2025	Date: August 2020



Contour Intervals: 10 feet

Figure based on USGS topographic map of Wakefield, MA obtained from https://livingatlas.arcgis.com/topoexplorer/index.html

Client:	Project:		
Drummey Rosane Anderson, Inc.	Proposed Northeast Metropolitan Regional Vocational High School	Figure A4 – 1971 Historical Topo Map	
LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Wakefield, MA	LGCI Project No.: 2025	Date: August 2020

Contour Intervals: 3 meters

Figure based on USGS topographic map of Wakefield, MA obtained from https://livingatlas.arcgis.com/topoexplorer/index.html

Client:	Project:	
Drummey Rosane Anderson, Inc.	Proposed Northeast Metropolitan Regional Vocational High School	Figure A5 – 1985 Historical Topo Map

LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Wakefield, MA	LGCI Project No.: 2025	Date: August 2020

APPENDIX B – Excerpts of Soil Survey Report

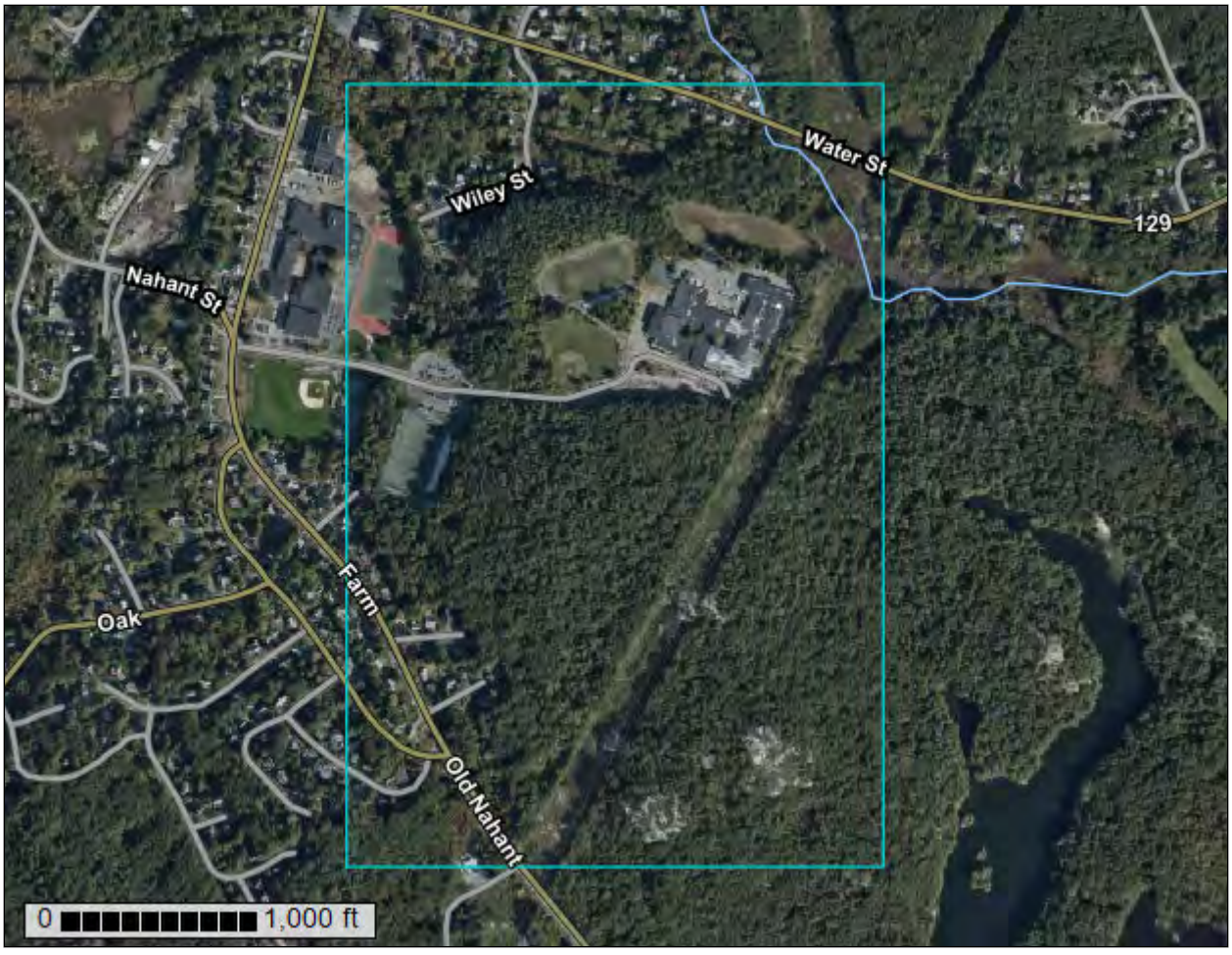
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Essex County, Massachusetts, Southern Part; and Middlesex County, Massachusetts



August 3, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:15,800 to 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Essex County, Massachusetts, Southern Part
Survey Area Data: Version 17, Jun 9, 2020

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 20, Jun 9, 2020

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

MAP LEGEND

MAP INFORMATION

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Sep 13, 2019—Oct 5, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	13.4	5.3%
102E	Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes	1.2	0.5%
105D	Rock outcrop-Hollis complex, 3 to 25 percent slopes	39.7	15.7%
242B	Hinckley gravelly fine sandy loam, 3 to 8 percent slopes	1.7	0.7%
616A	Fluvaquents, frequently flooded, 0 to 3 percent slopes	4.7	1.8%
Subtotals for Soil Survey Area		**60.6**	**24.0%**
Totals for Area of Interest		**252.2**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
51A	Swansea muck, 0 to 1 percent slopes	4.6	1.8%
52A	Freetown muck, 0 to 1 percent slopes	10.0	4.0%
53A	Freetown muck, ponded, 0 to 1 percent slopes	3.8	1.5%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	6.8	2.7%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	8.3	3.3%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	3.0	1.2%
104C	Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes	4.6	1.8%
104D	Hollis-Rock outcrop-Charlton complex, 15 to 25 percent slopes	6.4	2.6%
105E	Rock outcrop-Hollis complex, 3 to 35 percent slopes	58.2	23.1%
253B	Hinckley loamy sand, 3 to 8 percent slopes	2.9	1.2%
602	Urban land	11.7	4.6%
631C	Charlton-Urban land-Hollis complex, 3 to 15 percent slopes, rocky	39.8	15.8%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
655	Udorthents, wet substratum	15.7	6.2%
656	Udorthents-Urban land complex	15.7	6.2%
Subtotals for Soil Survey Area		**191.6**	**76.0%**
Totals for Area of Interest		**252.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Essex County, Massachusetts, Southern Part

102C—Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w69g
Elevation: 0 to 1,540 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Chatfield, extremely stony, and similar soils: 39 percent
Hollis, extremely stony, and similar soils: 26 percent
Rock outcrop: 17 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chatfield, Extremely Stony

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 2 inches: fine sandy loam
Bw - 2 to 30 inches: gravelly fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 41 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands

Hydric soil rating: No

Description of Hollis, Extremely Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Nose slope, crest, side slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: gravelly fine sandy loam
Bw - 7 to 16 inches: gravelly fine sandy loam
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Parent material: Igneous and metamorphic rock

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Charlton, extremely stony
Percent of map unit: 12 percent
Landform: Hills, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Sutton, extremely stony
Percent of map unit: 3 percent
Landform: Ground moraines, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Paxton, extremely stony
Percent of map unit: 2 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Leicester, extremely stony
Percent of map unit: 1 percent
Landform: Depressions, drainageways, hills, ground moraines
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: Yes

102E—Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes

Map Unit Setting
National map unit symbol: 2w69h
Elevation: 0 to 1,540 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Chatfield, extremely stony, and similar soils: 35 percent
Hollis, extremely stony, and similar soils: 30 percent
Rock outcrop: 20 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chatfield, Extremely Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Convex, linear
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 2 inches: fine sandy loam
Bw - 2 to 30 inches: gravelly fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 41 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Hollis, Extremely Stony

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, nose slope, crest
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: gravelly fine sandy loam
Bw - 7 to 16 inches: gravelly fine sandy loam
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Hills, ridges
Parent material: Igneous and metamorphic rock

Typical profile

R - 0 to 79 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water capacity: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 7 percent
Landform: Hills, ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope

Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Leicester, extremely stony

Percent of map unit: 4 percent
Landform: Depressions, drainageways, hills, ground moraines
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Concave
Hydric soil rating: Yes

Sutton, extremely stony

Percent of map unit: 2 percent
Landform: Hills, ground moraines
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Paxton, extremely stony

Percent of map unit: 2 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

105D—Rock outcrop-Hollis complex, 3 to 25 percent slopes

Map Unit Setting

National map unit symbol: vkcq
Elevation: 0 to 280 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Rock outcrop: 65 percent
Hollis and similar soils: 20 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rock Outcrop

Setting

Parent material: Granite

Properties and qualities

Slope: 25 to 35 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: Unranked

Description of Hollis

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable, shallow loamy basal till derived from granite and gneiss over granite

Typical profile

O - 0 to 2 inches: muck
H2 - 2 to 4 inches: fine sandy loam
H3 - 4 to 17 inches: gravelly fine sandy loam
H4 - 17 to 19 inches: unweathered bedrock

Properties and qualities

Slope: 25 to 35 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Minor Components

Chatfield

Percent of map unit: 15 percent
Hydric soil rating: No

242B—Hinckley gravelly fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vk5l
Elevation: 0 to 1,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Flood plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable sandy and gravelly glaciofluvial deposits derived from granite and gneiss

Typical profile

H1 - 0 to 8 inches: gravelly fine sandy loam
H2 - 8 to 17 inches: gravelly loamy sand
H3 - 17 to 60 inches: stratified cobbly coarse sand to very gravelly loamy fine sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Windsor
Percent of map unit: 10 percent
Hydric soil rating: No

Sudbury
Percent of map unit: 3 percent
Hydric soil rating: No

Wareham
Percent of map unit: 1 percent
Landform: Terraces
Hydric soil rating: Yes

Swansea
Percent of map unit: 1 percent
Landform: Bogs
Hydric soil rating: Yes

616A—Fluvaquents, frequently flooded, 0 to 3 percent slopes

Map Unit Setting
National map unit symbol: vk56
Elevation: 0 to 100 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Fluvaquents and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fluvaquents

Setting
Landform: Alluvial flats
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable loamy alluvium over friable sandy eolian deposits

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Depth to water table: About 0 to 12 inches
Frequency of flooding: NoneFrequent

Frequency of ponding: None

Minor Components

Swansea

Percent of map unit: 10 percent
Landform: Bogs
Hydric soil rating: Yes

Unnamed soils

Percent of map unit: 5 percent
Hydric soil rating: No

Middlesex County, Massachusetts

51A—Swansea muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2trl2
Elevation: 0 to 1,140 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Swansea and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Swansea

Setting

Landform: Swamps, bogs
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits

Typical profile

Oa1 - 0 to 24 inches: muck
Oa2 - 24 to 34 inches: muck
Cg - 34 to 79 inches: coarse sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water capacity: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Freetown

Percent of map unit: 10 percent
Landform: Bogs, swamps

Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

52A—Freetown muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2q9
Elevation: 0 to 1,110 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Freetown and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Freetown

Setting

Landform: Depressions, depressions, bogs, marshes, kettles, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water capacity: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 5 percent
Landform: Kettles, depressions, depressions, marshes, swamps, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

53A—Freetown muck, ponded, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2qc
Elevation: 0 to 1,140 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Freetown, ponded, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Freetown, Ponded

Setting

Landform: Marshes, kettles, swamps, bogs, depressions, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water capacity: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Whitman, ponded

Percent of map unit: 5 percent
Landform: Depressions on ground moraines
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea, ponded

Percent of map unit: 5 percent
Landform: Kettles, depressions, depressions, marshes, swamps, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

71B—Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w69c
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Ridgebury, extremely stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ridgebury, Extremely Stony

Setting

Landform: Depressions, drumlins, drainageways, hills, ground moraines
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope

Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 6 inches: fine sandy loam
Bw - 6 to 10 inches: sandy loam
Bg - 10 to 19 inches: gravelly sandy loam
Cd - 19 to 66 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 15 to 35 inches to densic material
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY009CT - Wet Till Depressions
Hydric soil rating: Yes

Minor Components

Woodbridge, extremely stony

Percent of map unit: 10 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Footslope, summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Whitman, extremely stony

Percent of map unit: 8 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Paxton, extremely stony

Percent of map unit: 2 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Shoulder, summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex

Across-slope shape: Convex, linear
Hydric soil rating: No

103B—Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 98yc
Elevation: 0 to 1,490 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Charlton and similar soils: 50 percent
Hollis and similar soils: 25 percent
Rock outcrop: 15 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Charlton

Setting

Landform: Ground moraines, drumlins
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable loamy eolian deposits over friable loamy basal till derived from granite and gneiss

Typical profile

H1 - 0 to 5 inches: fine sandy loam
H2 - 5 to 22 inches: sandy loam
H3 - 22 to 65 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: A
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Hollis

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable, shallow loamy basal till over granite and gneiss

Typical profile

H1 - 0 to 2 inches: fine sandy loam
H2 - 2 to 14 inches: fine sandy loam
H3 - 14 to 18 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 8 to 20 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Ledges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Granite and gneiss

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s

Minor Components

Canton

Percent of map unit: 2 percent
Landform: Hills
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Head slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Woodbridge

Percent of map unit: 2 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, toeslope, summit
Landform position (three-dimensional): Head slope, base slope, nose slope
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Scituate

Percent of map unit: 2 percent
Landform: Hillslopes, depressions
Landform position (two-dimensional): Toeslope, summit
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Narragansett

Percent of map unit: 2 percent
Landform: Ridges, hills
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Unnamed

Percent of map unit: 1 percent

Montauk

Percent of map unit: 1 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Head slope, nose slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

103C—Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2wzp1
Elevation: 0 to 1,390 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Charlton, extremely stony, and similar soils: 50 percent
Hollis, extremely stony, and similar soils: 20 percent
Rock outcrop: 10 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Charlton, Extremely Stony

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: fine sandy loam
Bw - 4 to 27 inches: gravelly fine sandy loam
C - 27 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Hollis, Extremely Stony

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: gravelly fine sandy loam
Bw - 7 to 16 inches: gravelly fine sandy loam
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Hills, ridges
Parent material: Igneous and metamorphic rock

Typical profile

R - 0 to 79 inches: bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water capacity: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Woodbridge, extremely stony

Percent of map unit: 8 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Canton, extremely stony

Percent of map unit: 5 percent
Landform: Moraines, ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Chatfield, extremely stony

Percent of map unit: 5 percent
Landform: Hills, ridges
Landform position (two-dimensional): Summit, backslope, shoulder
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Ridgebury, extremely stony

Percent of map unit: 2 percent
Landform: Hills, ground moraines, depressions, drumlins, drainageways
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

104C—Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w69p
Elevation: 0 to 1,270 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hollis, extremely stony, and similar soils: 35 percent
Charlton, extremely stony, and similar soils: 25 percent
Rock outcrop: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hollis, Extremely Stony

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: gravelly fine sandy loam
Bw - 7 to 16 inches: gravelly fine sandy loam
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Charlton, Extremely Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Summit, backslope, shoulder
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: fine sandy loam
Bw - 4 to 27 inches: gravelly fine sandy loam
C - 27 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Hills, ridges
Parent material: Igneous and metamorphic rock

Typical profile

R - 0 to 79 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water capacity: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Canton, extremely stony

Percent of map unit: 7 percent
Landform: Hills, moraines, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Chatfield, extremely stony

Percent of map unit: 6 percent
Landform: Hills, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Montauk, extremely stony

Percent of map unit: 1 percent
Landform: Recessionial moraines, hills, drumlins, ground moraines
Landform position (two-dimensional): Summit, backslope, shoulder
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Scituate, extremely stony

Percent of map unit: 1 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Footslope, backslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

104D—Hollis-Rock outcrop-Charlton complex, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 98yh
Elevation: 0 to 1,530 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hollis and similar soils: 35 percent
Rock outcrop: 30 percent
Charlton and similar soils: 20 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hollis

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Crest, head slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable, shallow loamy basal till over granite and gneiss

Typical profile

H1 - 0 to 2 inches: fine sandy loam
H2 - 2 to 14 inches: fine sandy loam
H3 - 14 to 18 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 25 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 8 to 20 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Parent material: Granite and gneiss

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s

Description of Charlton

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable loamy eolian deposits over friable loamy basal till derived from granite and gneiss

Typical profile

H1 - 0 to 5 inches: fine sandy loam
H2 - 5 to 22 inches: sandy loam
H3 - 22 to 65 inches: gravelly sandy loam

Properties and qualities

Slope: 15 to 25 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Canton

Percent of map unit: 10 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, summit

Landform position (three-dimensional): Head slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Montauk

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Nose slope, head slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Unnamed

Percent of map unit: 2 percent

105E—Rock outcrop-Hollis complex, 3 to 35 percent slopes

Map Unit Setting

National map unit symbol: 98yj
Elevation: 0 to 2,100 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Rock outcrop: 50 percent
Hollis and similar soils: 45 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rock Outcrop

Setting

Landform: Ledges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Granite and gneiss

Properties and qualities

Slope: 5 to 20 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8s

Description of Hollis

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable, shallow loamy basal till over granite and gneiss

Typical profile

H1 - 0 to 2 inches: fine sandy loam
H2 - 2 to 14 inches: fine sandy loam
H3 - 14 to 18 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 35 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 8 to 20 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Minor Components

Whitman

Percent of map unit: 3 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea

Percent of map unit: 1 percent
Landform: Bogs, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Unnamed

Percent of map unit: 1 percent

253B—Hinckley loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2svm8
Elevation: 0 to 1,430 feet
Mean annual precipitation: 36 to 53 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Outwash terraces, outwash deltas, outwash plains, eskers, moraines, kame terraces, kames
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Nose slope, side slope, base slope, crest, riser, tread
Down-slope shape: Linear, convex, concave
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 8 percent
Landform: Moraines, outwash terraces, outwash deltas, kame terraces, outwash plains, kames, eskers
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Nose slope, side slope, base slope, crest, riser, tread
Down-slope shape: Linear, convex, concave
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Kame terraces, outwash plains, moraines, outwash terraces, outwash deltas
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope, base slope, head slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Agawam

Percent of map unit: 2 percent
Landform: Outwash deltas, kame terraces, outwash plains, kames, eskers, moraines, outwash terraces
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Nose slope, side slope, base slope, crest, riser, tread
Down-slope shape: Linear, convex, concave
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

602—Urban land

Map Unit Setting

National map unit symbol: 9950
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Minor Components

Rock outcrop

Percent of map unit: 5 percent
Landform: Ledges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave

Udorthents, wet substratum

Percent of map unit: 5 percent
Hydric soil rating: No

Udorthents, loamy

Percent of map unit: 5 percent
Hydric soil rating: No

631C—Charlton-Urban land-Hollis complex, 3 to 15 percent slopes, rocky

Map Unit Setting

National map unit symbol: vr1g
Elevation: 0 to 1,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Charlton and similar soils: 45 percent
Urban land: 35 percent
Hollis and similar soils: 10 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Charlton

Setting

Landform: Drumlins, ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable loamy eolian deposits over friable loamy basal till derived from granite and gneiss

Typical profile

H1 - 0 to 5 inches: fine sandy loam
H2 - 5 to 22 inches: sandy loam
H3 - 22 to 65 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Description of Hollis

Setting

Landform: Ridges, hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable, shallow loamy basal till over granite and gneiss

Typical profile

H1 - 0 to 2 inches: fine sandy loam
H2 - 2 to 14 inches: fine sandy loam
H3 - 14 to 18 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 8 to 20 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Minor Components

Canton

Percent of map unit: 4 percent
Landform: Hills
Landform position (two-dimensional): Backslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Udorthents, loamy

Percent of map unit: 2 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 2 percent
Landform: Ledges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave

Scituate

Percent of map unit: 1 percent
Landform: Depressions, hillslopes
Landform position (two-dimensional): Toeslope, summit
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Montauk

Percent of map unit: 1 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Nose slope, head slope
Down-slope shape: Convex

Across-slope shape: Convex
Hydric soil rating: No

655—Udorthents, wet substratum

Map Unit Setting

National map unit symbol: vr1n
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, wet substratum, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Wet Substratum

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Minor Components

Urban land

Percent of map unit: 8 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear

Freetown

Percent of map unit: 4 percent
Landform: Depressions, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave

Hydric soil rating: Yes

Swansea

Percent of map unit: 3 percent
Landform: Bogs, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

656—Udorthents-Urban land complex

Map Unit Setting

National map unit symbol: 995k
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 45 percent
Urban land: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land

Minor Components

Canton

Percent of map unit: 10 percent
Landform: Hills
Landform position (two-dimensional): Backslope, toeslope
Landform position (three-dimensional): Side slope, base slope
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Plains, terraces
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Paxton

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

APPENDIX C – LGCI's Test Pit Logs

LGCI
Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Road, Suite 2
Billerica, MA 01862
Telephone: (978) 330-5912
Fax: (978) 330-5056

TEST PIT LOG

TP-1

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/3/20 **DATE COMPLETED:** 12/3/20
TEST PIT LOCATION: Southern side of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 9 ft.
GROUNDWATER LEVELS:
▽ **DURING EXCAVATION:** 2.0 ft.
▼ **AT END OF EXCAVATION:** -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 40's / Sunny
TEST PIT DIMENSIONS: 13.0' x 4.5'
LOGGED BY: SD **CHECKED BY:** TG

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.7	0 ft. - 0.7 ft.: Topsoil
2.5		E		Subsoil	3.5	0.7 ft. - 3.5 ft.: Sandy SILT (ML), 35-40% fine sand, 10-15% fine subrounded gravel, trace of organic soil, trace of roots, trace of wood, slightly plastic fines, 5-10% boulders, brown, wet (subsoil) ▽
5.0		E		Sand and Gravel		3.5 ft. - 9 ft.: Silty SAND with Gravel (SM), fine to coarse, 15-20% fines, 30-35% fine to coarse subrounded gravel, 15-20% cobbles, light brown, wet
7.5		D	1		9.0	REMARK 1: Refusal on apparent rock at depth of 9.0'.
						Bottom of test pit at 9.0 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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TEST PIT LOG

TP-2

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/4/20 **DATE COMPLETED:** 12/4/20
TEST PIT LOCATION: Along western side of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 4.3 ft.
GROUNDWATER LEVELS:
▽ **DURING EXCAVATION:** 4.0 ft.
▼ **AT END OF EXCAVATION:** -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 50's / Sunny
TEST PIT DIMENSIONS: 10.0' x 5.0'
LOGGED BY: TG **CHECKED BY:** SD

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.8	0 ft. - 0.8 ft.: Topsoil
2.5		E		Subsoil	3.5	0.8 ft. - 3.5 ft.: SILT with Sand (ML), slightly plastic, 5-10% fine sand, trace of organic soil, trace of roots, 15-20% cobbles and boulders, brown, moist
		M D	1	Weathered Rock	4.3	3.5 ft. - 4.3 ft.: Well Graded GRAVEL with Silt and Sand (GW-GM), fine to coarse, subangular, 5-10% fines, 10-15% fine to coarse sand, wet (weathered rock) ▽ REMARK 1: Refusal on apparent rock at depth of 4.3'. Bottom of test pit at 4.3 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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TEST PIT LOG

TP-3

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/3/20 **DATE COMPLETED:** 12/3/20
TEST PIT LOCATION: Within proposed building footprint
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 2 ft.
GROUNDWATER LEVELS:
DURING EXCAVATION: Not encountered
AT END OF EXCAVATION: -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 40's / Sunny
TEST PIT DIMENSIONS: 13.0' x 3.5'
LOGGED BY: SD **CHECKED BY:** TG

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	1.0	0 ft. - 1 ft.: Topsoil
		D	1	Subsoil	2.0	1 ft. - 2 ft.: Silty SAND (SM), fine to medium, trace coarse, 30-35% fines, 10-15% coarse subrounded gravel, trace of organic soil, trace of roots, trace of wood, brown, wet REMARK 1: Refusal on apparent rock at depth of 2.0'. Bottom of test pit at 2.0 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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TEST PIT LOG

TP-4

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/3/20 **DATE COMPLETED:** 12/3/20
TEST PIT LOCATION: Along eastern side of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 1.5 ft.
GROUNDWATER LEVELS:
DURING EXCAVATION: Not encountered
AT END OF EXCAVATION: -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 40's / Sunny
TEST PIT DIMENSIONS: 12.0' x 4.0'
LOGGED BY: SD **CHECKED BY:** TG

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.5	0 ft. - 0.5 ft.: Topsoil
		D	1	Subsoil	1.5	0.5 ft. - 1.5 ft.: Silty SAND (SM), fine to medium, trace coarse, 30-35% fines, ~10% fine to coarse subrounded gravel, trace of organic soil, trace of roots, 15-20% cobbles, brown, moist (subsoil) REMARK 1: Refusal on apparent rock at depth of 1.5'. Bottom of test pit at 1.5 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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TEST PIT LOG

TP-5

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/3/20 **DATE COMPLETED:** 12/3/20
TEST PIT LOCATION: Within proposed building footprint
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 5 ft.
GROUNDWATER LEVELS:
DURING EXCAVATION: Not encountered
AT END OF EXCAVATION: -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 40's / Sunny
TEST PIT DIMENSIONS: 11.0' x 6.0'
LOGGED BY: SD **CHECKED BY:** TG

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.5	0 ft. - 0.5 ft.: Topsoil
2.5		E		Subsoil	3.5	0.5 ft. - 3.5 ft.: Silty SAND with Gravel (SM), fine to coarse, 35-40% fines, 15-20% fine to coarse subrounded gravel, trace of organic soil, trace of roots, 25-30% cobbles and boulders, light brown, wet (subsoil)
5.0		D	1	Sand and Gravel	5.0	3.5 ft. - 5 ft.: Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 10-15% fines, 30-35% fine to coarse subrounded gravel, 45-50% cobbles and boulders, gray, wet

REMARK 1: Refusal on apparent rock at depth of 5.0'.
Bottom of test pit at 5.0 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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TEST PIT LOG

TP-6

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/3/20 **DATE COMPLETED:** 12/3/20
TEST PIT LOCATION: Near NE corner of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 4.5 ft.
GROUNDWATER LEVELS:
DURING EXCAVATION: Not encountered
AT END OF EXCAVATION: -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 40's / Sunny
TEST PIT DIMENSIONS: 7.5' x 5.0'
LOGGED BY: SD **CHECKED BY:** TG

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.5	0 ft. - 0.5 ft.: Topsoil
2.5		E		Subsoil	3.0	0.5 ft. - 3 ft.: Sandy SILT (ML), 35-40% fine sand, 0-5% fine subrounded gravel, trace of organic soil, trace of roots, 0-5% cobbles, brown, wet
		D	1	Sand and Gravel	4.5	3 ft. - 4.5 ft.: Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 10-15% fines, 20-25% fine to coarse subrounded gravel, gray, wet

REMARK 1: Refusal on apparent rock at depth of 4.5'.
Bottom of test pit at 4.5 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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TEST PIT LOG

TP-7

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/3/20 **DATE COMPLETED:** 12/3/20
TEST PIT LOCATION: Along northern side of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 2 ft.
GROUNDWATER LEVELS:
DURING EXCAVATION: Not encountered
AT END OF EXCAVATION: -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 40's / Sunny
TEST PIT DIMENSIONS: 11.0' x 5.0'
LOGGED BY: SD **CHECKED BY:** TG

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil		0 ft. - 2 ft.: Topsoil
		D	1		2.0	REMARK 1: Refusal on apparent rock at depth of 2.0'.
						Bottom of test pit at 2.0 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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TEST PIT LOG

TP-8

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/3/20 **DATE COMPLETED:** 12/3/20
TEST PIT LOCATION: Prop. parking lot north of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 9 ft.
GROUNDWATER LEVELS:
▽ **DURING EXCAVATION:** 2.0 ft.
▼ **AT END OF EXCAVATION:** -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 40's / Sunny
TEST PIT DIMENSIONS: 8.5' x 4.5'
LOGGED BY: SD **CHECKED BY:** TG

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	1.0	0 ft. - 1 ft.: Topsoil
2.5		E		Subsoil	3.0	1 ft. - 3 ft.: Silty SAND with Gravel (SM), fine to medium, trace coarse, ~30% fines, 15-20% fine to coarse subrounded gravel, trace of organic soil, trace of roots, light brown, wet (subsoil) ▽
5.0		E		Sand and Gravel		3 ft. - 9 ft.: Silty SAND with Gravel (SM), fine to coarse, 20-25% fines, 15-20% fine to coarse subrounded gravel, gray, wet
		M				
7.5		D				
			1		9.0	REMARK 1: Refusal on cobbles and boulders at depth of 9.0' (possible weathered rock). Bottom of test pit at 9.0 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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TEST PIT LOG

TP-9

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/4/20 **DATE COMPLETED:** 12/4/20
TEST PIT LOCATION: Near NW corner of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 6.2 ft.
GROUNDWATER LEVELS:
▽ **DURING EXCAVATION:** 3.6 ft.
▼ **AT END OF EXCAVATION:** -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 50's / Sunny
TEST PIT DIMENSIONS: 13.0' x 4.0'
LOGGED BY: TG **CHECKED BY:** SD

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.4	0 ft. - 0.4 ft.: Topsoil
		E		Subsoil	1.9	0.4 ft. - 1.9 ft.: Silty SAND (SM), fine to medium, 35-40% fines, 5-10% fine to coarse subrounded gravel, trace of organic soil, trace of roots, brown, moist (subsoil)
2.5		E		Sand and Gravel		1.9 ft. - 6.2 ft.: Silty SAND with Gravel (SM), fine to coarse, 20-25% fines, 20-25% fine to coarse subrounded gravel, 5-10% cobbles and boulders, gray, moist ▽
5.0		M				
		D	1		6.2	REMARK 1: Refusal on cobbles and boulders at depth ranging between 4.0' and 6.2' (possible weathered rock). Bottom of test pit at 6.2 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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TEST PIT LOG

TP-10

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/4/20 **DATE COMPLETED:** 12/4/20
TEST PIT LOCATION: West of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 2.7 ft.
GROUNDWATER LEVELS:
DURING EXCAVATION: Not encountered
AT END OF EXCAVATION: -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 50's / Sunny
TEST PIT DIMENSIONS: 14.0' x 4.0'
LOGGED BY: TG **CHECKED BY:** SD

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.3	0 ft. - 0.3 ft.: Topsoil
		E		Subsoil	2.1	0.3 ft. - 2.1 ft.: Silty SAND (SM), fine to medium, 35-40% fines, trace of organic soil, trace of roots, brown, moist (subsoil)
2.5		D	1	Sand and Gravel	2.7	2.1 ft. - 2.7 ft.: Silty SAND with Gravel (SM), fine to coarse, 25-30% fines, 20-25% fine to coarse subrounded to subangular gravel, trace of roots, gray, moist REMARK 1: Refusal on apparent rock at depth of 2.7'. Bottom of test pit at 2.7 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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TEST PIT LOG

TP-11

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/4/20 **DATE COMPLETED:** 12/4/20
TEST PIT LOCATION: West of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 3.2 ft.
GROUNDWATER LEVELS:
DURING EXCAVATION: Not encountered
AT END OF EXCAVATION: -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 50's / Sunny
TEST PIT DIMENSIONS: 9.0' x 5.0'
LOGGED BY: TG **CHECKED BY:** SD

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.5	0 ft. - 0.5 ft.: Topsoil
		E		Subsoil	2.0	0.5 ft. - 2 ft.: Silty SAND (SM), fine to medium, 35-40% fines, trace of organic soil, trace of roots, 20-25% cobbles and boulders, brown, moist (subsoil)
2.5		M	1	Weathered Rock		2 ft. - 3.2 ft.: Silty GRAVEL with Sand (GM), fine to coarse, subangular to angular, 15-20% fines, 15-20% fine to coarse sand, trace of roots, moist (weathered rock) REMARK 1: Encountered two boulders about 2.0' x 1.0'.
		D	2		3.2	REMARK 2: Refusal on apparent rock at depth of 3.2'. Bottom of test pit at 3.2 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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TEST PIT LOG

TP-12

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/3/20 **DATE COMPLETED:** 12/3/20
TEST PIT LOCATION: South of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 7 ft.
GROUNDWATER LEVELS:
DURING EXCAVATION: Not encountered
AT END OF EXCAVATION: -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 40's / Sunny
TEST PIT DIMENSIONS: 13.5' x 5.0'
LOGGED BY: SD **CHECKED BY:** TG

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	1.0	0 ft. - 1 ft.: Topsoil
2.5		E		Subsoil	4.0	1 ft. - 4 ft.: Silty SAND with Gravel (SM), fine to medium, trace coarse, 30-35% fines, 15-20% fine subrounded gravel, trace of organic soil, trace of roots, 10-15% boulders, light brown, moist (subsoil)
5.0		E		Sand and Gravel		4 ft. - 7 ft.: Poorly Graded SAND with Silt and Gravel (SP-SM), medium to coarse, trace fine, 10-15% fines, 30-35% fine to coarse subrounded to subangular gravel, 15-20% cobbles, dark brown, moist
		D	1		7.0	REMARK 1: Refusal on apparent rock at depth of 7.0'.
						Bottom of test pit at 7.0 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

LGCI
Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Road, Suite 2
Billerica, MA 01862
Telephone: (978) 330-5912
Fax: (978) 330-5056

TEST PIT LOG

TP-13

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/4/20 **DATE COMPLETED:** 12/4/20
TEST PIT LOCATION: South of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 4.8 ft.
GROUNDWATER LEVELS:
DURING EXCAVATION: Not encountered
AT END OF EXCAVATION: -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 50's / Sunny
TEST PIT DIMENSIONS: 11.0' x 4.5'
LOGGED BY: TG / SD **CHECKED BY:** TG

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.4	0 ft. - 0.4 ft.: Topsoil
		E		Subsoil	2.3	0.4 ft. - 2.3 ft.: Silty SAND with Gravel (SM), fine to medium, trace coarse, 30-35% fines, 15-20% fine to coarse subrounded to subangular gravel, trace of organic soil, trace of roots, 15-20% cobbles and boulders, light brown, moist (subsoil)
2.5		D		Sand and Gravel	4.8	2.3 ft. - 4.8 ft.: Silty SAND with Gravel (SM), fine to coarse, 15-20% fines, 25-30% fine to coarse subrounded to subangular gravel, 15-20% cobbles, brown, moist
			1			REMARK 1: Refusal on apparent rock at depth of 4.8'.
						Bottom of test pit at 4.8 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Road, Suite 2
Billerica, MA 01862
Telephone: (978) 330-5912
Fax: (978) 330-5056

TEST PIT LOG

TP-14

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/4/20 **DATE COMPLETED:** 12/4/20
TEST PIT LOCATION: East of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 0.7 ft.
GROUNDWATER LEVELS:
DURING EXCAVATION: Not encountered
AT END OF EXCAVATION: -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 50's / Sunny
TEST PIT DIMENSIONS: 11.0' x 4.0'
LOGGED BY: SD / TG **CHECKED BY:** TG

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		D	1	Topsoil	0.7	0 ft. - 0.7 ft.: Topsoil REMARK 1: Refusal on apparent rock at depth of 0.7'. Bottom of test pit at 0.7 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Road, Suite 2
Billerica, MA 01862
Telephone: (978) 330-5912
Fax: (978) 330-5056

TEST PIT LOG

TP-15

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/3/20 **DATE COMPLETED:** 12/3/20
TEST PIT LOCATION: East of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 5 ft.
GROUNDWATER LEVELS:
▽ **DURING EXCAVATION:** 2.5 ft.
▼ **AT END OF EXCAVATION:** -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 40's / Sunny
TEST PIT DIMENSIONS: 13.5' x 4.5'
LOGGED BY: SD **CHECKED BY:** TG

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.5	0 ft. - 0.5 ft.: Topsoil
2.5		E		Subsoil		0.5 ft. - 4 ft.: Silty SAND (SM), fine to medium, trace coarse, 25-30% fines, 10-15% fine to coarse subangular gravel, trace of organic soil, trace of roots, 15-20% cobbles, brown, wet (subsoil) ▽
		M			4.0	
5.0		D	1	Sand and Gravel	5.0	4 ft. - 5 ft.: Silty SAND with Gravel (SM), fine to coarse, 15-20% fines, 25-30% fine to coarse subrounded to subangular gravel, 25-30% cobbles, gray, wet

REMARK 1: Refusal on apparent rock at depth of 5.0'.
Bottom of test pit at 5.0 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Road, Suite 2
Billerica, MA 01862
Telephone: (978) 330-5912
Fax: (978) 330-5056

TEST PIT LOG

TP-16

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/3/20 **DATE COMPLETED:** 12/3/20
TEST PIT LOCATION: East of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 10.5 ft.
GROUNDWATER LEVELS:
▽ **DURING EXCAVATION:** 3.5 ft.
▼ **AT END OF EXCAVATION:** -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 40's / Sunny
TEST PIT DIMENSIONS: 12.5' x 4.5'
LOGGED BY: SD **CHECKED BY:** TG

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	1.0	0 ft. - 1 ft.: Topsoil
2.5		E		Subsoil	5.0	1 ft. - 5 ft.: Silty SAND (SM), fine to medium, trace coarse, 25-30% fines, 10-15% fine subrounded gravel, trace of organic soil, trace of roots, ~15% cobbles and boulders, light brown, wet (subsoil) ▽
5.0		E		Sand and Gravel		5 ft. - 10.5 ft.: Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 5-10% fines, 15-20% fine to coarse subrounded to subangular gravel, 25-30% cobbles and boulders, gray, moist
7.5						
10.0		D				
			1		10.5	REMARK 1: Refusal on apparent rock at depth of 10.5'.
						Bottom of test pit at 10.5 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Road, Suite 2
Billerica, MA 01862
Telephone: (978) 330-5912
Fax: (978) 330-5056

TEST PIT LOG

TP-17

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/4/20 **DATE COMPLETED:** 12/4/20
TEST PIT LOCATION: Prop. parking lot north of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 3.1 ft.
GROUNDWATER LEVELS:
▽ **DURING EXCAVATION:** 1.5 ft.
▼ **AT END OF EXCAVATION:** -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 50's / Sunny
TEST PIT DIMENSIONS: 22.0' x 3.0'
LOGGED BY: TG **CHECKED BY:** SD

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.2	0 ft. - 0.2 ft.: Topsoil
		E		Subsoil	1.9	0.2 ft. - 1.9 ft.: Silty SAND (SM), fine to medium, 35-40% fines, 0-5% fine subrounded gravel, trace of organic soil, trace of roots, brown, moist (subsoil) ▽
2.5		M	1	Sand and Gravel	3.1	1.9 ft. - 3.1 ft.: Silty SAND with Gravel (SM), fine to coarse, 25-30% fines, 15-20% fine to coarse subrounded gravel, trace of roots, gray, wet
						REMARK 1: Refusal on cobbles and boulders at depth ranging between 0.2' and 3.1'. Bottom of test pit at 3.1 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

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Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Road, Suite 2
Billerica, MA 01862
Telephone: (978) 330-5912
Fax: (978) 330-5056

TEST PIT LOG

TP-18

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/4/20 **DATE COMPLETED:** 12/4/20
TEST PIT LOCATION: Near driveway NE of proposed building
COORDINATES: NA
SURFACE EL.: NA (see note 1) **TOTAL DEPTH:** 3.9 ft.
GROUNDWATER LEVELS:
DURING EXCAVATION: Not encountered
AT END OF EXCAVATION: -

EXCAVATION SUBCONTRACTOR: Northern Drill Service, Inc.
EXCAVATION FOREMAN: Dave Edilberti
EXCAVATOR TYPE/MODEL: Komatsu PC 120
WEATHER: 50's / Sunny
TEST PIT DIMENSIONS: 14.0' x 3.0'
LOGGED BY: TG **CHECKED BY:** SD

Depth (ft)	El. (ft)	Excavation Effort	Remark	Strata	Depth El.(ft.)	Material Description
		E		Topsoil	0.3	0 ft. - 0.3 ft.: Topsoil
		E		Subsoil	2.8	0.3 ft. - 2.8 ft.: Silty SAND (SM), fine to medium, 30-35% fines, trace fine subangular gravel, trace of organic soil, trace of roots, brown, moist (subsoil)
2.5		D	1	Sand and Gravel	3.9	2.8 ft. - 3.9 ft.: Silty SAND with Gravel (SM), fine to coarse, 15-20% fines, 15-20% fine to coarse subrounded gravel, trace of roots, light brown, moist REMARK 1: Refusal on apparent rock at depth of 3.9'. Bottom of test pit at 3.9 feet. Backfilled excavation with excavated material.

GENERAL COMMENTS: **E = Easy, M - Moderate, D = Difficult, V = Very Difficult**

1. Ground surface elevation not available.

APPENDIX D – LGCI's Boring Logs, Groundwater Observation Well Installation Reports, and Photographs of the Rock Cores

LGCI
Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Road, Suite 2
Billerica, MA 01862
Telephone: (978) 330-5912
Fax: (978) 330-5056

BORING LOG

B-1-OW
PAGE 1 OF 1

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/10/20 **DATE COMPLETED:** 12/10/20
BORING LOCATION: Near NW corner of proposed building
COORDINATES: NA
SURFACE El.: NA (see note 1) **TOTAL DEPTH:** 14 ft.
WEATHER: 30's / Sunny
GROUNDWATER LEVELS:
DURING DRILLING: -
AT END OF DRILLING: 10.0 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Northern Drill Service, Inc.
DRILLING FOREMAN: Jon Beirholm
DRILLING METHOD: Drive and wash with 4-inch casing
DRILL RIG TYPE/MODEL: Mobile Drill B-48
HAMMER TYPE: Automatic
HAMMER WEIGHT: 140 lb. **HAMMER DROP:** 30 in.
SPLIT SPOON DIA.: 1.375 in. I.D., 2 in. O.D.
CORE BARREL SIZE: NX
LOGGED BY: TG **CHECKED BY:** SD

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
		0	S1	1-1-8 (2)	24/11		Topsoil	0.5	S1 - Top 3": Topsoil
							Subsoil		Bot. 8": Silty SAND with Gravel (SM), fine to medium, 30-35% fines, 15-20% fine to coarse subrounded to angular gravel, trace of organic soil, trace of roots, brown, moist
		2	S2	43	6/5	1			S2 - Similar to S1 Bot. 8", 25-30% fine to coarse subangular to angular gravel, gray
		2.5						2.5	REMARK 1: Split spoon refusal at depth of 2.5'. Advanced button bit about 1.5'.
		4	C1		60/57	2	Rock		C1 - min/ft: 12.6, 5.7, 3.5, 6.3, 7.5 REC=95%, RQD= 66% Very hard, fresh to slightly weathered, sound to moderately fractured, gray, medium grained, Rhyolite
5									REMARK 2: Rock core sampler jammed at depth of 5'.
		9	C2		60/59				C2 - min/ft: 6.6, 3.3, 2.0, 3.1, 4.0 REC=98%, RQD=92% Very hard, fresh, sound to moderately fractured, gray, medium grained, Rhyolite
10		14						14.0	
15									Bottom of borehole at 14.0 feet. Installed groundwater observation well in borehole.
20									
25									

GENERAL NOTES:
1. Ground surface elevation not available.

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Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Road, Suite 2
Billerica, MA 01862
Telephone: (978) 330-5912
Fax: (978) 330-5056

BORING LOG

B-2

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/11/20 **DATE COMPLETED:** 12/11/20
BORING LOCATION: Near NE corner of proposed building
COORDINATES: NA
SURFACE El.: NA (see note 1) (see note 1) **TOTAL DEPTH:** 0.5 ft.
WEATHER: 50's / Sunny
GROUNDWATER LEVELS:
DURING DRILLING: Not encountered
AT END OF DRILLING: Not encountered
OTHER: -

DRILLING SUBCONTRACTOR: Northern Drill Service, Inc.
DRILLING FOREMAN: Jon Beirholm
DRILLING METHOD: Drive and wash with 4-inch casing
DRILL RIG TYPE/MODEL: Mobile B-48 ATV Rig
HAMMER TYPE: Automatic
HAMMER WEIGHT: 140 lb. **HAMMER DROP:** 30 in.
SPLIT SPOON DIA.: 1.375 in. I.D., 2 in. O.D.
CORE BARREL SIZE: NA
LOGGED BY: TG **CHECKED BY:** SD

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
0		0 - 0.5	S1	42	6/4	1 2	Topsoil	0.5	S1 - Topsoil REMARK 1: Split spoon sampler refusal on rock at depth of 0.5'. REMARK 2: Moved borehole 18' south and encountered refusal at 0.5'. Exposed a 1' x 2' area of rock with a shovel. Bottom of borehole at 0.5 feet. Backfilled borehole with drill cuttings.
5									
10									
15									
20									
25									

GENERAL NOTES:
1. Ground surface elevation not available.

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Lahlaf Geotechnical Consulting, Inc.
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Billerica, MA 01862
Telephone: (978) 330-5912
Fax: (978) 330-5056

BORING LOG

B-3-OW
PAGE 1 OF 1

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/10/20 **DATE COMPLETED:** 12/11/20
BORING LOCATION: Near SE corner of proposed building
COORDINATES: NA
SURFACE El.: NA (see note 1) **TOTAL DEPTH:** 18 ft.
WEATHER: 30's / Sunny
GROUNDWATER LEVELS:
DURING DRILLING: -
AT END OF DRILLING: Not Encountered
OTHER: -

DRILLING SUBCONTRACTOR: Northern Drill Service, Inc.
DRILLING FOREMAN: Jon Beirholm
DRILLING METHOD: Drive and wash with 4-inch casing
DRILL RIG TYPE/MODEL: Mobile Drill B-48
HAMMER TYPE: Automatic
HAMMER WEIGHT: 140 lb. **HAMMER DROP:** 30 in.
SPLIT SPOON DIA.: 1.375 in. I.D., 2 in. O.D.
CORE BARREL SIZE: NX
LOGGED BY: TG **CHECKED BY:** SD

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
		0	S1	0-0-1-11 (1)	24/6		Topsoil	0.3	S1 - Top 4": Topsoil
							Subsoil		Bot. 2": SILT with Sand, slightly plastic, 10-15% fine sand, trace of organic soil, trace of roots, brownish orange, moist (subsoil)
		2	S2	38/2"	2/1	1		2.2	S2 - Similar to S1 Bot. 2", 10-15% fine subangular to angular gravel
		2.2							REMARK 1: Split spoon sampler refusal on rock at depth of 2.2'. Advanced button bit to depth of 3'.
		3							C1 - min/ft: 3.4, 3.4, 2.7, 5.3, 3.8
5			C1		60/58				REC=97%, RQD=69%
									Very hard, fresh to slightly weathered, sound to moderately fractured, gray, medium grained, Rhyolite
		8							C2 - min/ft: 4.6, 3.5, 5.1, 4.3, 5.6
10			C2		60/60		Rock		REC=100%, RQD=51%
									Hard to very hard, fresh to slightly weathered, sound to moderately fractured, gray, medium grained, Rhyolite
		13							C3 - min/ft: 5.9, 5.6, 7.7, 11.7, 16.9
15			C3						REC=97%, RQD=88%
									Very hard, fresh, sound to moderately fractured, gray, medium grained, Rhyolite
						2			REMARK 2: Broke a button bit clearing out the borehole after coring.
		18						18.0	
20									Bottom of borehole at 18.0 feet. Installed groundwater observation well in borehole
25									

GENERAL NOTES:
1. Ground surface elevation not available.

LGCI
Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Road, Suite 2
Billerica, MA 01862
Telephone: (978) 330-5912
Fax: (978) 330-5056

BORING LOG

B-4
PAGE 1 OF 1

CLIENT: Drummey Rosane Anderson, Inc.
PROJECT NAME: Prop. Northeast Metro Reg. Vocational Tech. H.S.
LGCI PROJECT NUMBER: 2025
PROJECT LOCATION: Wakefield, MA

DATE STARTED: 12/10/20 **DATE COMPLETED:** 12/10/20
BORING LOCATION: Along western side of proposed building
COORDINATES: NA
SURFACE El.: NA (see note 1) **TOTAL DEPTH:** 8 ft.
WEATHER: 30's / Sunny
GROUNDWATER LEVELS:
DURING DRILLING: -
AT END OF DRILLING: 0.8 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Northern Drill Service, Inc.
DRILLING FOREMAN: Jon Beirholm
DRILLING METHOD: Drive and wash with 4-inch casing
DRILL RIG TYPE/MODEL: Mobile Drill B-48
HAMMER TYPE: Automatic
HAMMER WEIGHT: 140 lb. **HAMMER DROP:** 30 in.
SPLIT SPOON DIA.: 1.375 in. I.D., 2 in. O.D.
CORE BARREL SIZE: NX
LOGGED BY: TG **CHECKED BY:** SD

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
		0					Topsoil	0.3	S1 - Top 3": Topsoil
			S1	2-1-2-1 (3)	24/7		Subsoil		Bot. 4":Silty SAND (SM), fine to medium, 35-40% fines, 0-5% fine subrounded to angular gravel, trace of organic soil, trace of roots, brownish orange, moist (subsoil)
		2						2.6	S2 - Top 7": Similar to S1 Bot. 4", 10-15% fine to coarse subrounded to angular gravel
			S2	2-2-9-12 (11)	24/13		Sand and Gravel		Bot. 6": Silty SAND with Gravel (SM), fine to coarse, 15-20% fines, ~20% fine to coarse subrounded to subangular gravel, light brown, moist (natural)
		4							S3 - Similar to S2 Bot. 6", 20-25% fine to coarse subrounded to subangular gravel
5			S3	15-16-18-27 (34)	24/13				
		6				1		6.0	REMARK 1: Split spoon sampler refusal at depth of 6'.
						2	Rock		REMARK 2: Advanced button bit for 10 minutes. Advanced button bit from depth of 6' to 8' into rock.
								8.0	Bottom of borehole at 8.0 feet. Backfilled borehole with drill cuttings and 1.5 bags of gravel.
10									
15									
20									
25									

GENERAL NOTES:
1. Ground surface elevation not available.

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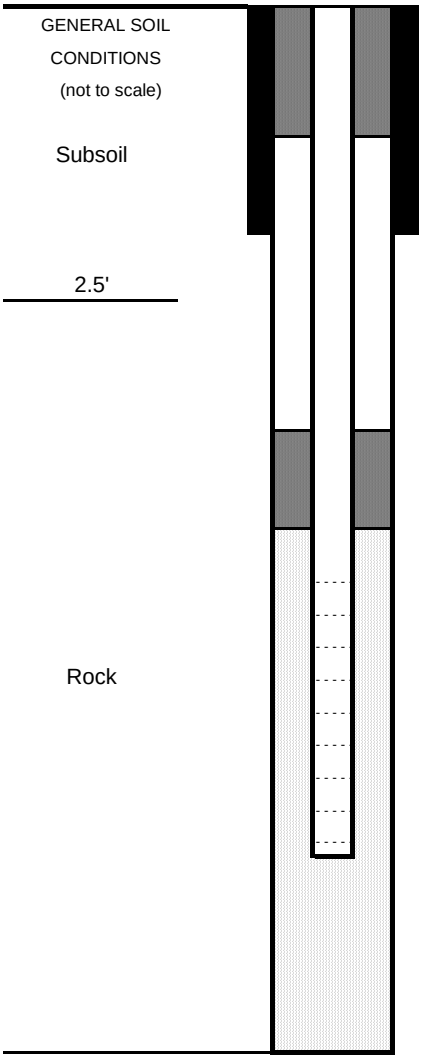
GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

Boring No. : **B-1-OW**

Project Name: **Proposed Northeast Metro Regional Vocational Technical High School, Wakefield, MA**	
LGCI Project Number: **2025**	
Client: **Drummey Rosane Anderson, Inc.**	
Drilling Subcontractor: Northern Drill Services, Inc.	Date Started: 12/10/20
Drilling Foreman: Jon Beirholm	Date Completed: 12/10/20
LGCI Engineer: Tom Greenwood	Location: Near NW corner of proposed building
Ground Surface Elevation: Not available	Total Depth of Boring: 14 ft.
Groundwater Depth: 10' Below Ground Surface	Drill Rig Type: Mobile Drill B-48
	Drilling Method: Drive and wash with 4-inch casing



Riser Stickup 3.1' above ground surface

THICKNESS OF SURFACE SEAL	1 foot
TYPE OF SURFACE SEAL	Concrete
TYPE OF SURFACE CASING	Riser pipe
ID OF SURFACE CASING	4 inch
DEPTH TO BOTTOM OF CASING	1 foot
ID OF RISER PIPE	2 inch
TYPE OF RISER PIPE	Schedule 40 PVC
TYPE OF BACKFILL AROUND RISER PIPE	Filter sand
DEPTH TO TOP OF SEAL	2 feet
TYPE OF SEAL	Bentonite
DEPTH TO BOTTOM OF SEAL	3 feet
DEPTH TO TOP OF PERVIOUS SECTION	4 feet
TYPE OF PERVIOUS SECTION	Schedule 40 PVC
DESCRIBE OPENINGS	0.01 inch slots
ID OF PERVIOUS SECTION	2 inch
TYPE OF BACKFILL AROUND PERVIOUS SECTION	Filter sand (Holliston sand)
DEPTH TO BOTTOM OF PERVIOUS SECTION	14 feet
DEPTH TO BOTTOM OF SAND COLUMN	14 feet
TYPE OF BACKFILL BELOW PERVIOUS SECTION	Filter sand (Holliston sand)
DIAMETER OF BOREHOLE	4 inch
DEPTH TO BOTTOM OF BOREHOLE	14 feet

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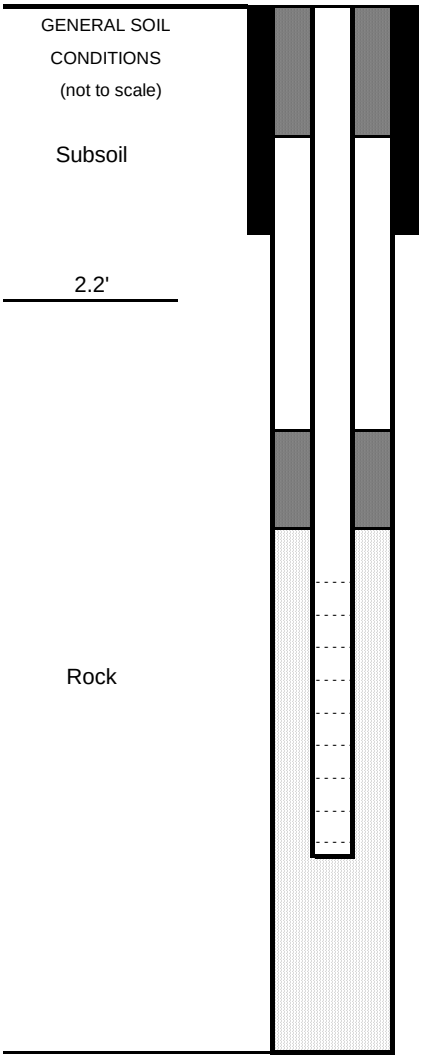
GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

Boring No. : **B-3-OW**

Project Name: **Proposed Northeast Metro Regional Vocational Technical High School, Wakefield, MA**	
LGCI Project Number: **2025**	
Client: **Drummey Rosane Anderson, Inc.**	
Drilling Subcontractor: Northern Drill Services, Inc.	Date Started: 12/10/20
Drilling Foreman: Jon Beirholm	Date Completed: 12/11/20
LGCI Engineer: Tom Greenwood	Location: Near SE corner of proposed building
Ground Surface Elevation: Not available	Total Depth of Boring: 18 ft.
Groundwater Depth: 4.9' Below Ground Surface	Drill Rig Type: Mobile Drill B-48
	Drilling Method: Drive and wash with 4-inch casing



Riser Stickup 3.1' above ground surface

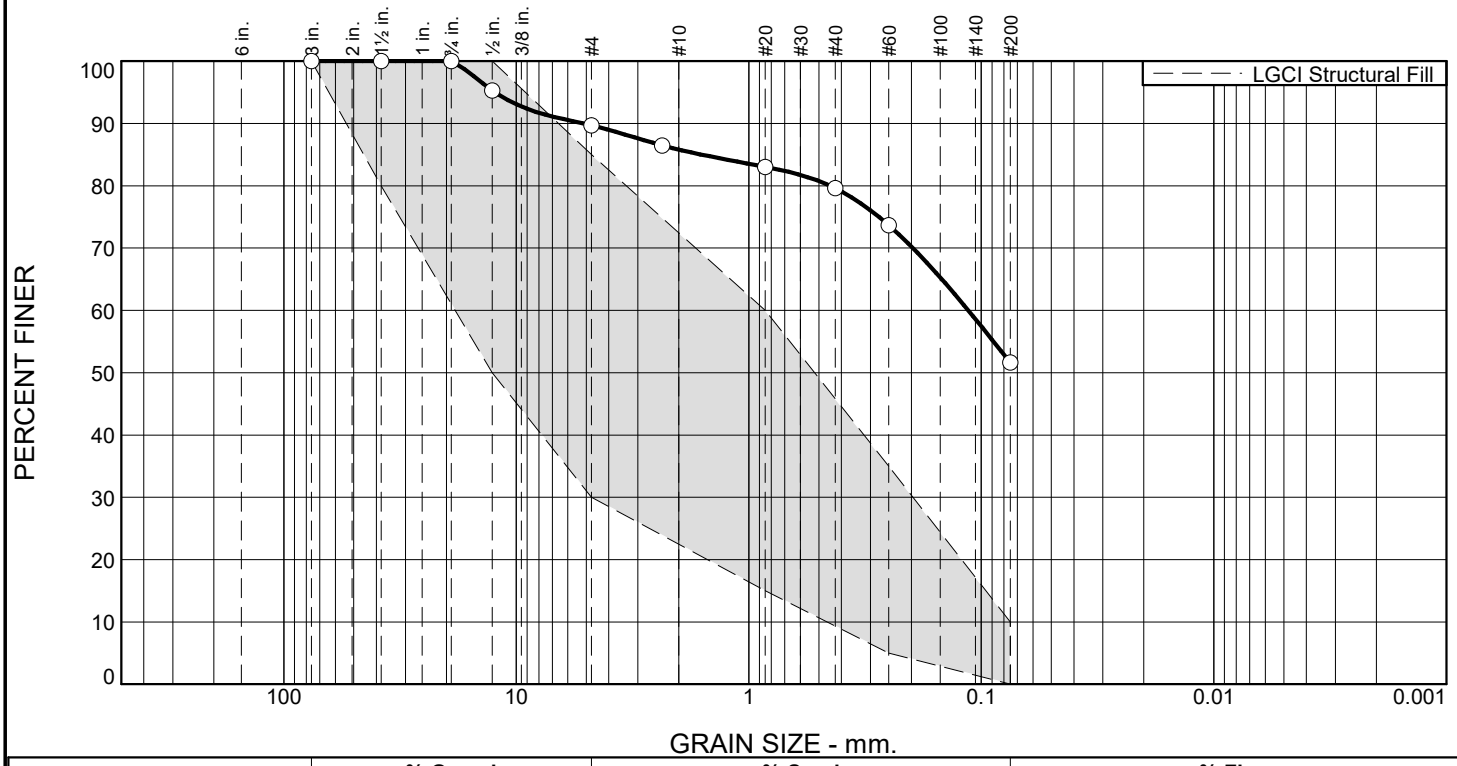
THICKNESS OF SURFACE SEAL	1 foot
TYPE OF SURFACE SEAL	Concrete
TYPE OF SURFACE CASING	Riser pipe
ID OF SURFACE CASING	4 inch
DEPTH TO BOTTOM OF CASING	1 foot
ID OF RISER PIPE	2 inch
TYPE OF RISER PIPE	Schedule 40 PVC
TYPE OF BACKFILL AROUND RISER PIPE	Filter sand
DEPTH TO TOP OF SEAL	4 feet
TYPE OF SEAL	Bentonite
DEPTH TO BOTTOM OF SEAL	6 feet
DEPTH TO TOP OF PERVIOUS SECTION	8 feet
TYPE OF PERVIOUS SECTION	Schedule 40 PVC
DESCRIBE OPENINGS	0.01 inch slots
ID OF PERVIOUS SECTION	2 inch
TYPE OF BACKFILL AROUND PERVIOUS SECTION	Filter sand (Holliston sand)
DEPTH TO BOTTOM OF PERVIOUS SECTION	18 feet
DEPTH TO BOTTOM OF SAND COLUMN	18 feet
TYPE OF BACKFILL BELOW PERVIOUS SECTION	Filter sand (Holliston sand)
DIAMETER OF BOREHOLE	4 inch
DEPTH TO BOTTOM OF BOREHOLE	18 feet

Core Photos (from top): B-1-C1, B-1-C2, B-3-C1, B-3-C2

Core Photos (from top): B-1-C1, B-1-C2, B-3-C1, B-3-C2

APPENDIX E – Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.3	3.9	6.2	28.0	51.6	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3"	100.0	100.0	
1.5"	100.0	80.0 - 100.0	
0.75"	100.0		
0.5"	95.3	50.0 - 100.0	
#4	89.7	30.0 - 85.0	X
#8	86.5		
#20	83.0	15.0 - 60.0	X
#40	79.6		
#60	73.7	5.0 - 35.0	X
#200	51.6	0.0 - 10.0	X

* LGCI Structural Fill

Material Description

ASTM (D 2488) Classification: Sandy SILT (ML), 35-40% fine sand, 10-15% fine subrounded gravel, trace of organic soil, trace of roots, trace of wood, brown, wet

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 5.1253 D_{85}= 1.5952 D_{60}= 0.1137
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Subsoil

Date Received: 12/3/2020 **Date Tested:** 12/9/2020

Tested By: TG

Checked By: AML

Location: Test Pit TP-1
Depth: 0.7' - 3.5'

Date Sampled: 12/3/2020

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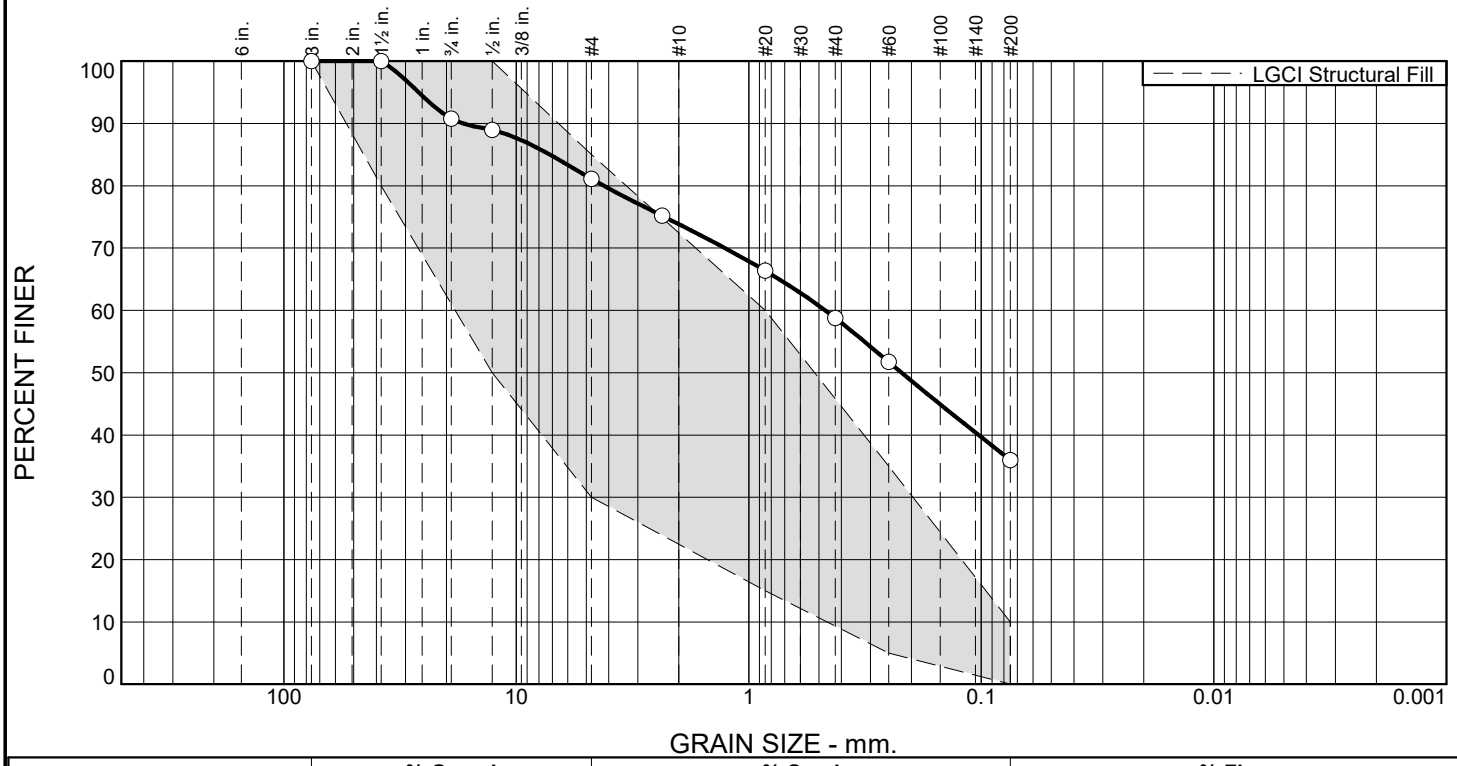
Project: Proposed Northeast Metro Reg. Vocational Tech. H.S., Wakefield, MA

Project No: 2025 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.2	9.7	7.3	15.0	22.9	35.9	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3"	100.0	100.0	
1.5"	100.0	80.0 - 100.0	
0.75"	90.8		
0.5"	89.0	50.0 - 100.0	
#4	81.1	30.0 - 85.0	
#8	75.2		
#20	66.4	15.0 - 60.0	X
#40	58.8		
#60	51.7	5.0 - 35.0	X
#200	35.9	0.0 - 10.0	X

* LGCI Structural Fill

Material Description

ASTM (D 2488) Classification: Silty SAND with Gravel, fine to coarse, 35-40% fines, 15-20% fine to coarse subrounded gravel, trace of organic soil, trace of roots, light brown, moist

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 16.9724 D_{85}= 7.1728 D_{60}= 0.4689
D_{50}= 0.2202 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Subsoil

Date Received: 12/3/2020 **Date Tested:** 12/9/2020

Tested By: TG

Checked By: AML

Location: Test Pit TP-5
Depth: 0.5'- 3.5'

Date Sampled: 12/3/2020

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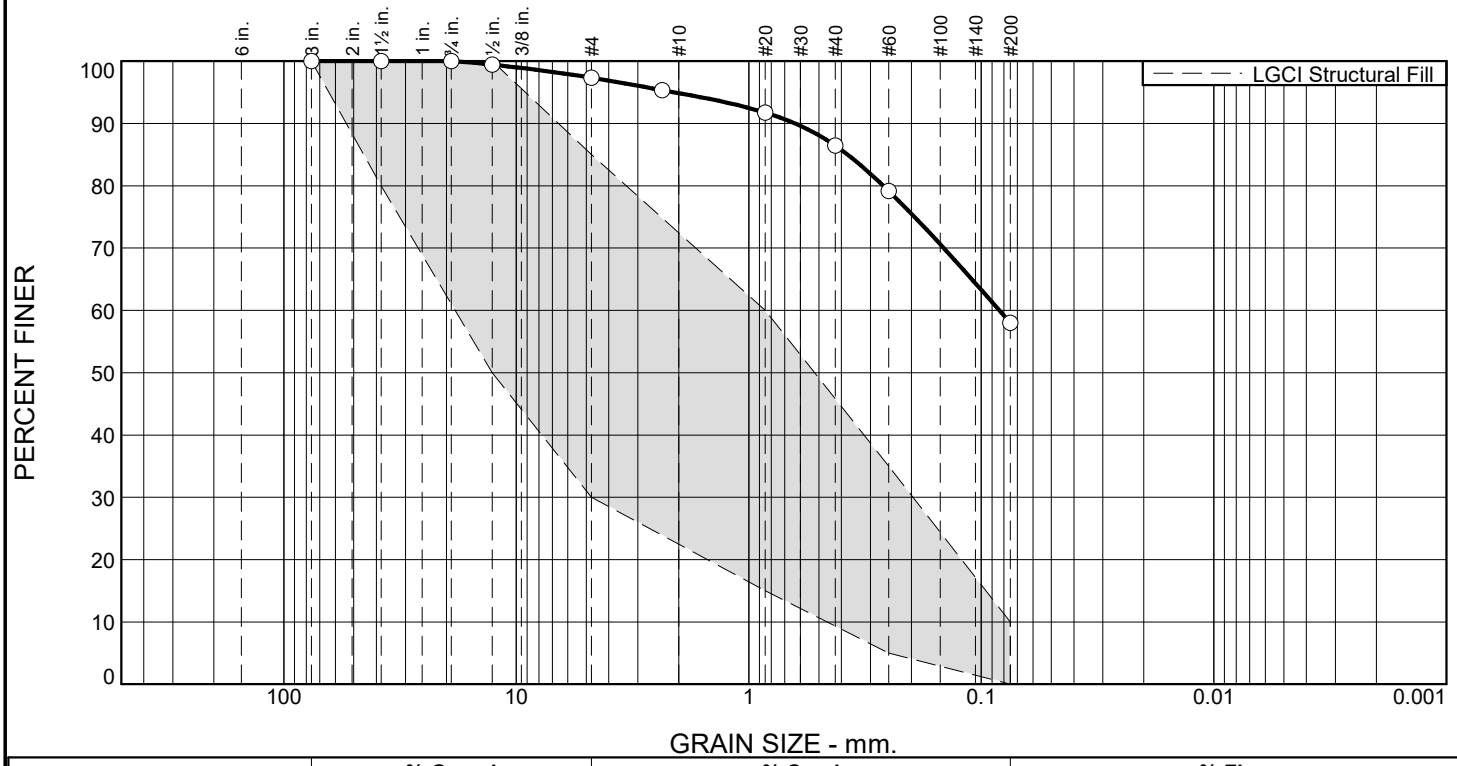
Project: Proposed Northeast Metro Reg. Vocational Tech. H.S., Wakefield, MA

Project No: 2025 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.6	2.5	8.4	28.5	58.0	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3"	100.0	100.0	
1.5"	100.0	80.0 - 100.0	
0.75"	100.0		
0.5"	99.4	50.0 - 100.0	
#4	97.4	30.0 - 85.0	X
#8	95.4		
#20	91.7	15.0 - 60.0	X
#40	86.5		
#60	79.2	5.0 - 35.0	X
#200	58.0	0.0 - 10.0	X

* LGCI Structural Fill

Material Description

ASTM (D 2488) Classification: Sandy SILT (ML), 35-40% fine sand, 0-5% fine subrounded gravel, trace of organic soil, trace of roots, 0-5% cobbles, brown

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS (D 2487)= AASHTO (M 145)=

Coefficients

D_{90}= 0.6334 D_{85}= 0.3753 D_{60}= 0.0836
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Subsoil

Date Received: 12/3/2020 **Date Tested:** 12/9/2020

Tested By: TG

Checked By: AML

Location: Test Pit TP-6
Depth: 0.5' - 3'

Date Sampled: 12/3/2020

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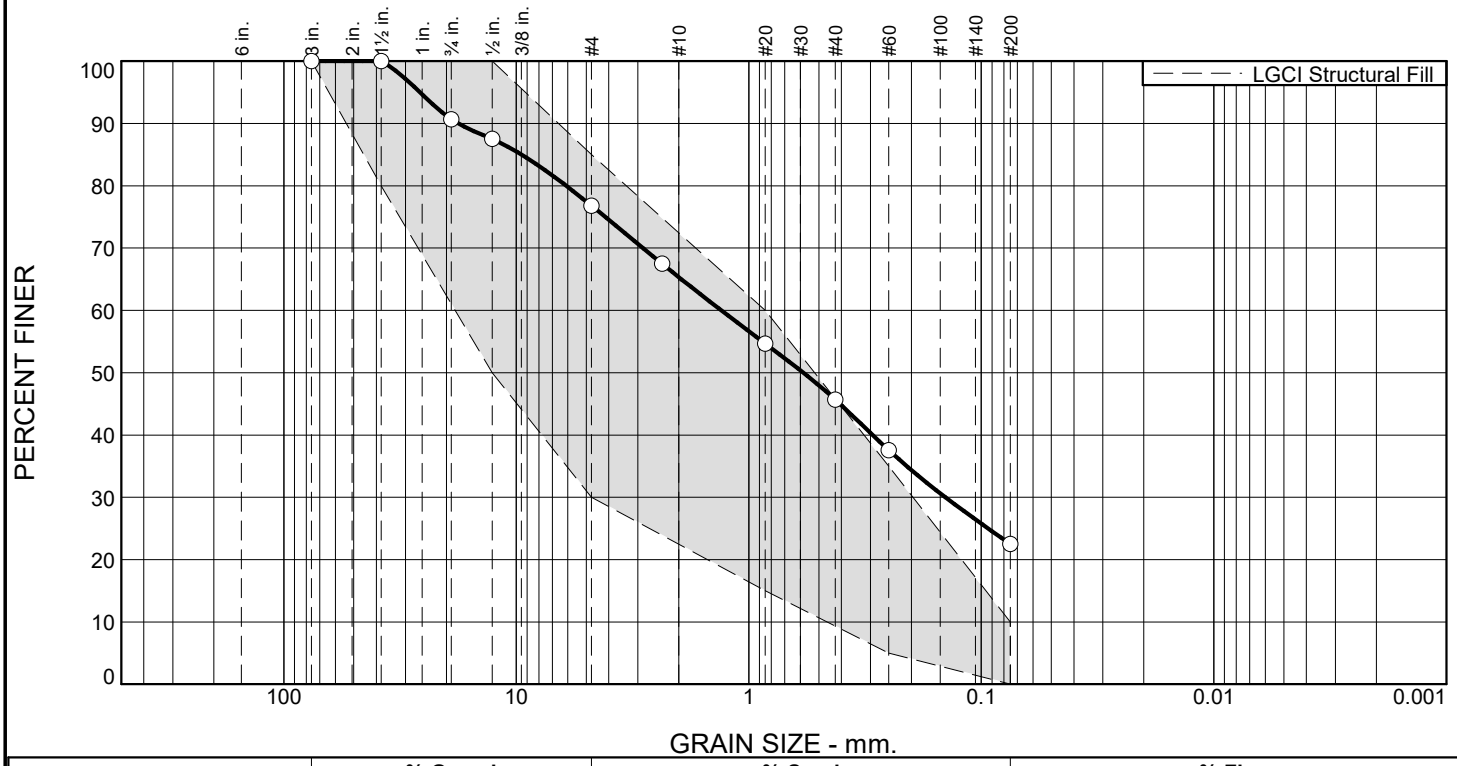
Project: Proposed Northeast Metro Reg. Vocational Tech. H.S., Wakefield, MA

Project No: 2025 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.3	13.9	11.5	19.6	23.2	22.5	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3"	100.0	100.0	
1.5"	100.0	80.0 - 100.0	
0.75"	90.7		
0.5"	87.5	50.0 - 100.0	
#4	76.8	30.0 - 85.0	
#8	67.5		
#20	54.7	15.0 - 60.0	
#40	45.7		
#60	37.6	5.0 - 35.0	X
#200	22.5	0.0 - 10.0	X

* LGCI Structural Fill

Material Description

ASTM (D 2488) Classification: Silty SAND with Gravel (SM), fine to coarse, 20-25% fines, 20-25% fine to coarse subrounded gravel, gray, moist

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= **AASHTO (M 145)=**

Coefficients

D_{90}= 17.7802 D_{85}= 9.4700 D_{60}= 1.3106
D_{50}= 0.5834 D_{30}= 0.1424 D_{15}=
D_{10}= C_u= C_c=

Remarks

Sand

Date Received: 12/4/2020 **Date Tested:** 12/9/2020

Tested By: TG

Checked By: AML

Location: Test Pit TP-9
Depth: 1.9' - 6.2'

Date Sampled: 12/4/2020

LGCI
Lahlaf Geotechnical Consulting, Inc.

Client: Drummey Rosane Anderson, Inc.

Project: Proposed Northeast Metro Reg. Vocational Tech. H.S., Wakefield, MA

Project No: 2025 **Figure**