

March 14, 2025

via email

PRIMROSE SCHOOL OF ANDOVER

503 South Main Street
Andover, Massachusetts 01970

Attention: Mr. Beau Athia
Owner, Primrose School of Andover

**Regarding: PRELIMINARY STORMWATER MANAGEMENT AREA EVALUATION
PROPOSED CHILDCARE FACILITY
885 MAIN STREET
MAP 28, LOT 133
READING, MIDDLESEX COUNTY, MASSACHUSETTS
WHITESTONE PROJECT NO.: GM2523020.000**

Dear Mr. Athia:

Whitestone Associates, Inc. (Whitestone) is pleased to submit the results of a preliminary stormwater management (SWM) area evaluation in support of the proposed construction referenced above. Services were provided in general accordance with Whitestone's February 7, 2025 proposal.

1.0 PROJECT DESCRIPTION

The 1.93-acre property, located at 885 Main Street in Reading, Middlesex County, Massachusetts, is developed with a two-story, wood-framed, single-family residence with a paved driveway. The proposed redevelopment includes demolishing the existing building and constructing an approximately 7,000-square foot childcare facility, with associated playground, pavements, landscaping, and utilities. The site layout was provided in a January 7, 2024 *Site Plan* prepared by Stonefield Engineering and Design.

2.0 FIELD EXPLORATION & TESTING

2.1 Field Exploration

Field exploration consisted of excavating four test pits, identified as TP-1 through TP-4, with a Kubota KX080-4 compact excavator. The test pits subsequently were backfilled to the surface with excavated soils from the investigation after observing soil conditions and conducting infiltration testing. The locations of the test pits are shown on the accompanying *Test Location Plan* included as Figure 1. *Records of Subsurface Exploration* for the test pits are provided in Appendix A.

The subsurface tests were conducted in the presence of a Whitestone engineer, who conducted field tests, recorded visual classifications, and collected samples of the various strata encountered. The test pits were located in the field using phone-based GPS. These locations are presumed to be accurate to the degree implied by the method used (± 20 feet).

Office Locations:

Groundwater level observations were recorded during and immediately after the completion of field operations prior to backfilling the test pits. Seasonal variations, temperature effects, man-made effects, and recent rainfall conditions may influence the levels of the groundwater, and the observed levels will depend on the permeability of the soils. Groundwater elevations derived from sources other than seasonally observed groundwater monitor wells may not be representative of true groundwater levels. Visual indications of the estimated seasonal groundwater high (ESGWH) in TP-2 was approximately 1.0 feet above the measured.

2.2 Infiltration Testing

Prior to infiltration testing, test pits TP-1, TP-2 and TP-3 were excavated to a depth of 10 fbg to assess soil conditions. Infiltration tests I-1, I-2, and I-3 were then conducted as falling head tests in cased holes at the locations shown on the *Test Location Plan*. PVC casing, 4.0 inches in diameter, was installed to the depths tabulated below. The soil was pre-soaked for approximately 1.0 hour. Following testing, the casings were removed. The results are tabulated below.

| SUMMARY OF INFILTRATION TESTING | | | | |
|---------------------------------|-------------------------------------|-------------------|-----------------------------------|---------------------------|
| Location | Approximate Ground Elevation (feet) | Test Depth (fbgs) | Approximate Test Elevation (feet) | Infiltration Rate (in/hr) |
| I-1 (TP-1) | 109 | 4.8 | 104.2 | 10.0 |
| I-2 (TP-2) | 109 | 4.5 | 104.5 | 6.3 |
| I-3 (TP-3) | 106 | 4.5 | 101.5 | >10.0 |

The infiltration rates appear high for glacial till, which typically has infiltration in the 1.0 inch per hour (in/hr) to 2.0 in/hr range. The measured high rates may be due to leakage around the casing. In addition, the high infiltration rate measured in infiltration test I-1, which was conducted in existing fill, is not representative of glacial till.

Typically, a Factor of Safety (FoS) is applied to field infiltration rates to account for siltation and consolidation of the soils below systems over time. Safety factors used should consider how critical the systems are to the development, and the available storage. If the system is critical and storage is limited, a higher FoS should be applied. Infiltration rates are variable and dependent on test depth and stratification.

The former topsoil layer observed in the test pits may act as an impermeable layer below the proposed infiltration system. Whitestone recommends a mounding analysis be completed to determine the impact of the former topsoil layer to design of the system.

2.3 Laboratory Testing

Laboratory testing was conducted to determine additional, pertinent engineering characteristics of representative samples of on-site soils. The laboratory testing was conducted in general accordance with applicable ASTM standard test methods and included physical/textural testing of the existing fill and glacial till deposits.

The results of the laboratory testing are presented in this section in a general manner and qualitatively interpreted. The results are incorporated into the findings and recommendations discussed throughout this report. Quantitative test results are provided in Appendix B.

Physical and Textural Analysis: Two representative samples were subjected to laboratory testing that included moisture content determination (ASTM D2216) and washed gradation analysis (ASTM D422) in order to conduct supplementary engineering soil classifications in general accordance with ASTM D2487. The soil strata tested were classified by the Unified Soil Classification System (USCS), provided in Appendix C. The results of the laboratory testing are summarized in the following table.

| PHYSICAL/TEXTURAL ANALYSES SUMMARY | | | | | |
|------------------------------------|--------|--------------|----------------------|---------------------------|---------------------|
| Exploration | Sample | Depth (fbgs) | Moisture Content (%) | Passing No. 200 Sieve (%) | USCS Classification |
| TP-2 | S-2 | 3.0 | 9.0 | 28.3 | GM |
| TP-3 | S-3 | 3.0 | 13.9 | 6.5 | FILL (SP-SM) |

3.0 SUBSURFACE CONDITIONS

The soil conditions encountered within the subsurface tests conducted by Whitestone consisted of the following generalized strata in order of increasing depth. *Records of Subsurface Exploration* are provided in Appendix A.

Surface Cover Materials: The test pits encountered 3.0 inches to 5.0 inches of topsoil at the ground surface. In test pits TP-2 and TP-4, the topsoil was underlain by 10 inches and 19 inches, respectively, of subsoil with roots.

Existing Fill: Beneath the surface cover materials, test pits TP-1 and TP-3 encountered existing fill, consisting of gray to brown, silty sand with gravel to poorly graded sand with silt and gravel, cobbles, boulders. The existing fill extended to depths of 6.5 fbgs and 3.5 fbgs in test pits TP-1 and TP-3, respectively. In test pit TP-1, the existing fill was underlain by 6.0 inches of former topsoil and 6.0 inches of former subsoil with roots. In test pit TP-3, the existing fill was underlain by 6.0 inches of former topsoil.

Glacial Till: Beneath the surface cover materials or former topsoil/subsoil, the test pits encountered glacial till, consisting of brown, silty sand with gravel (USCS: SM) or silty gravel with sand (USCS: GM), cobbles, boulders. The test pits were terminated in the glacial till at a depth of 10 fbgs.

Groundwater: Groundwater was encountered in only test pit TP-2 during the exploration at a depth of 10 fbgs. As noted above, no indications of ESGWH were observed in the test pits. Groundwater levels should be expected to fluctuate seasonally and following periods of precipitation.

Whitestone appreciates being of service to Primrose School of Andover. Please contact us with any questions regarding this report.

Sincerely,

WHITESTONE ASSOCIATES, INC.



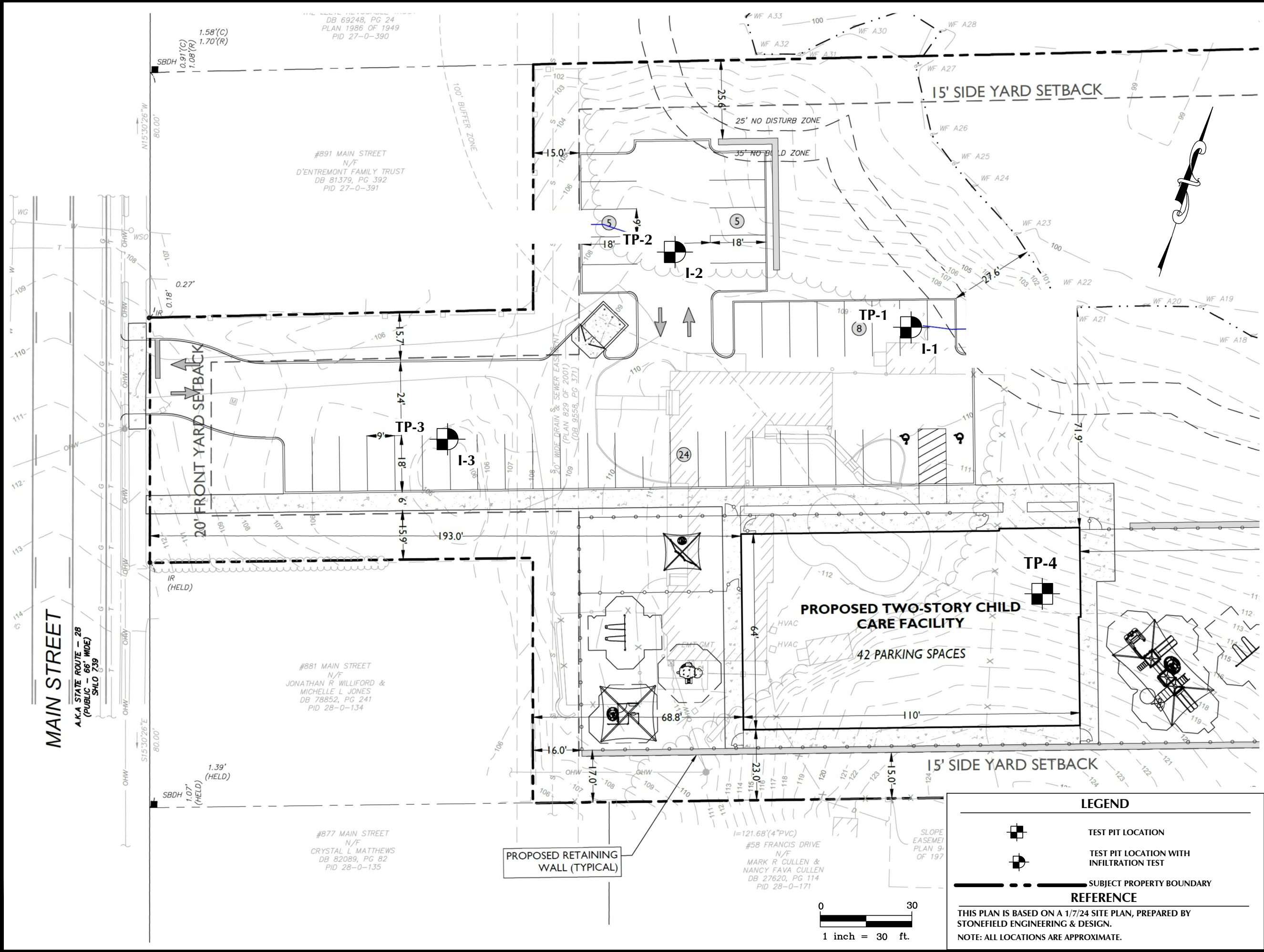
Richard W.M. McLaren
 Senior Consultant



Ryan R. Roy, PE
 Vice President

FIGURE 1
Test Location Plan

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LEGEND

- TEST PIT LOCATION
- TEST PIT LOCATION WITH INFILTRATION TEST
- SUBJECT PROPERTY BOUNDARY

REFERENCE

THIS PLAN IS BASED ON A 1/7/24 SITE PLAN, PREPARED BY STONEFIELD ENGINEERING & DESIGN.
 NOTE: ALL LOCATIONS ARE APPROXIMATE.

WHITESTONE
 An Employee-Owned Company

352 TURNPIKE ROAD, SUITE 105, SOUTHBOROUGH, MA 01772
 508.485.0755 WHITESTONEASSOC.COM

| | |
|--|--------------------------|
| DRAWING TITLE: TEST LOCATION PLAN | |
| CLIENT: PRIMROSE SCHOOL OF ANDOVER | |
| PROJECT: PRELIMINARY STORMWATER MANAGEMENT AREA EVALUATION PROPOSED CHILDCARE FACILITY 885 MAIN STREET READING, MIDDLESEX COUNTY, MASSACHUSETTS | |
| PROJECT #: GM2523020.000 | |
| DESIGNED BY: MR | PROJ. MGR.: RR |
| DATE: 3/4/25 | FIGURE: |
| SCALE: 1" = 30' | 1 |

APPENDIX A
Records of Subsurface Exploration

RECORD OF SUBSURFACE EXPLORATION

| | | | |
|--|----------------------------------|---|----------------------------------|
| Project: Proposed Childcare Facility | | WAI Project No.: GM2523020.000 | |
| Location: 885 Main Street, Reading, Middlesex County, Massachusetts | | Client: Primrose School of Andover | |
| Surface Elevation: ± 109.0 feet NAVD88 | Date Started: 2/18/2025 | Water Depth Elevation | Cave-In Depth Elevation |
| Termination Depth: 10.0 feet bgs | Date Completed: 2/18/2025 | (feet bgs) (ft NAVD88) | (feet bgs) (ft NAVD88) |
| Proposed Location: SWM Area | Logged By: ZH | During: -- -- | At Completion: -- -- |
| Excavating Method: Compact Excavator | Contractor: WJ | At Completion: -- -- | At Completion: -- -- |
| Test Method: Visual Observation | Rig Type: Kubota KX080-4 | 24 Hours: -- -- | |

| SAMPLE INFORMATION | | | DEPTH | STRATA | DESCRIPTION OF MATERIALS (Classification) | REMARKS |
|--------------------|--------|------|--------|---------------|--|------------------------------|
| Depth (ft.) | Number | Type | (feet) | | | |
| | | | 0.0 | | | No Indications of ESHGW |
| | | | | TOPSOIL | 4" Topsoil | |
| | | | | EXISTING FILL | Brown, Silty Sand with Gravel (FILL) | Cobbles and Boulders |
| 4 | 1 | Grab | | | | |
| | | | 5.0 | | | Infiltration Test @ 4.8 fbgs |
| | | | 6.5 | | | |
| 7 | 2 | Grab | 7.0 | TOPSOIL | 6" Former Topsoil | |
| | | | 7.5 | SUBSOIL | 6" Former Subsoil, Roots | |
| | | | | GLACIAL TILL | Brown, Silty Sand with Gravel (SM) | |
| 9 | 3 | Grab | | | | |
| | | | 10.0 | | | |
| | | | | | Test Pit TP-1 Terminated at Depth of 10.0 feet below ground surface. | |
| | | | 13.0 | | | |
| | | | 15.0 | | | |

RECORD OF SUBSURFACE EXPLORATION

| Project: Proposed Childcare Facility | | WAI Project No.: GM2523020.000 | | | | | | | | | | | | | | | | | | | | | |
|--|-------------|--|-------------|-------------------------|--|---------------------------|--|------------|-------------|------------|-------------|--------------|----|--|--|-------------------|----|-------------------|----|--------------|----|--|--|
| Location: 885 Main Street, Reading, Middlesex County, Massachusetts | | | | | | | | | | | | | | | | | | | | | | | |
| Surface Elevation: ± 109.0 feet NAVD88 | | Date Started: 2/18/2025 | | | | | | | | | | | | | | | | | | | | | |
| Termination Depth: 10.0 feet bgs | | Date Completed: 2/18/2025 | | | | | | | | | | | | | | | | | | | | | |
| Proposed Location: SWM Area | | Logged By: ZH | | | | | | | | | | | | | | | | | | | | | |
| Excavating Method: Compact Excavator | | Contractor: WJ | | | | | | | | | | | | | | | | | | | | | |
| Test Method: Visual Observation | | Rig Type: Kubota KX080-4 | | | | | | | | | | | | | | | | | | | | | |
| | | <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th colspan="2">Water Depth Elevation</th> <th colspan="2">Cave-In Depth Elevation</th> </tr> <tr> <th>(feet bgs)</th> <th>(ft NAVD88)</th> <th>(feet bgs)</th> <th>(ft NAVD88)</th> </tr> <tr> <td>During: 10.0</td> <td>--</td> <td></td> <td></td> </tr> <tr> <td>At Completion: --</td> <td>--</td> <td>At Completion: --</td> <td>--</td> </tr> <tr> <td>24 Hours: --</td> <td>--</td> <td></td> <td></td> </tr> </table> | | Water Depth Elevation | | Cave-In Depth Elevation | | (feet bgs) | (ft NAVD88) | (feet bgs) | (ft NAVD88) | During: 10.0 | -- | | | At Completion: -- | -- | At Completion: -- | -- | 24 Hours: -- | -- | | |
| Water Depth Elevation | | Cave-In Depth Elevation | | | | | | | | | | | | | | | | | | | | | |
| (feet bgs) | (ft NAVD88) | (feet bgs) | (ft NAVD88) | | | | | | | | | | | | | | | | | | | | |
| During: 10.0 | -- | | | | | | | | | | | | | | | | | | | | | | |
| At Completion: -- | -- | At Completion: -- | -- | | | | | | | | | | | | | | | | | | | | |
| 24 Hours: -- | -- | | | | | | | | | | | | | | | | | | | | | | |

| SAMPLE INFORMATION | | | DEPTH | STRATA | DESCRIPTION OF MATERIALS (Classification) | REMARKS |
|--------------------|--------|------|--------|-----------------|--|-----------------------------|
| Depth (ft.) | Number | Type | (feet) | | | |
| | | | 0.0 | | | No Indications of ESHGW |
| 0.5 | 1 | Grab | | TOPSOIL | 3" Topsoil | |
| | | | | SUBSOIL | 10" Subsoil, Roots | |
| 3 | 2 | Grab | | GLACIAL TILL | Brown, Silty Gravel with Sand (GM) | Infiltration Test @ 4.5 fbs |
| 5 | 3 | Grab | 5.0 | | | |
| 8 | 4 | Grab | | | | |
| | | | 10.0 | | | |
| | | | | | Test Pit TP-2 Terminated at Depth of 10.0 feet below ground surface. | |
| | | | 13.0 | | | |
| | | | 15.0 | | | |

RECORD OF SUBSURFACE EXPLORATION

| | | | |
|--|----------------------------------|---|----------------------------------|
| Project: Proposed Childcare Facility | | WAI Project No.: GM2523020.000 | |
| Location: 885 Main Street, Reading, Middlesex County, Massachusetts | | Client: Primrose School of Andover | |
| Surface Elevation: ± 106.0 feet NAVD88 | Date Started: 2/18/2025 | Water Depth Elevation | Cave-In Depth Elevation |
| Termination Depth: 10.0 feet bgs | Date Completed: 2/18/2025 | (feet bgs) (ft NAVD88) | (feet bgs) (ft NAVD88) |
| Proposed Location: SWM Area | Logged By: ZH | During: -- -- | At Completion: -- -- |
| Excavating Method: Compact Excavator | Contractor: WJ | 24 Hours: -- -- | At Completion: -- -- |
| Test Method: Visual Observation | Rig Type: Kubota KX080-4 | | |

| SAMPLE INFORMATION | | | DEPTH | STRATA | DESCRIPTION OF MATERIALS (Classification) | REMARKS |
|--------------------|--------|------|--------|---------------|--|-----------------------------|
| Depth (ft.) | Number | Type | (feet) | | | |
| | | | 0.0 | | | No Indications of ESHGW |
| 0.5 | 1 | Grab | | TOPSOIL | 4" Topsoil | |
| | | | | EXISTING FILL | Gray, Poorly Graded Sand with Silt and Gravel (FILL) | |
| 2 | 2 | Grab | | | | |
| 3 | 3 | Grab | | | | |
| | | | 3.5 | | | |
| | | | 4.0 | TOPSOIL | 6" Former Topsoil | |
| | | | 5.0 | | | Infiltration Test @ 4.5 fbs |
| 5 | 4 | Grab | | GLACIAL TILL | Brown, Silty Sand with Gravel (SM) | |
| | | | | | | |
| 9 | 5 | Grab | | | | |
| | | | 10.0 | | | |
| | | | | | Test Pit TP-3 Terminated at Depth of 10.0 feet below ground surface. | |
| | | | 13.0 | | | |
| | | | 15.0 | | | |

RECORD OF SUBSURFACE EXPLORATION

| | | | |
|--|----------------------------------|---|----------------------------------|
| Project: Proposed Childcare Facility | | WAI Project No.: GM2523020.000 | |
| Location: 885 Main Street, Reading, Middlesex County, Massachusetts | | Client: Primrose School of Andover | |
| Surface Elevation: ± 115.0 feet NAVD88 | Date Started: 2/18/2025 | Water Depth Elevation | Cave-In Depth Elevation |
| Termination Depth: 10.0 feet bgs | Date Completed: 2/18/2025 | (feet bgs) (ft NAVD88) | (feet bgs) (ft NAVD88) |
| Proposed Location: SWM Area | Logged By: ZH | During: -- -- | At Completion: -- -- |
| Excavating Method: Compact Excavator | Contractor: WJ | At Completion: -- -- | At Completion: -- -- |
| Test Method: Visual Observation | Rig Type: Kubota KX080-4 | 24 Hours: -- -- | |

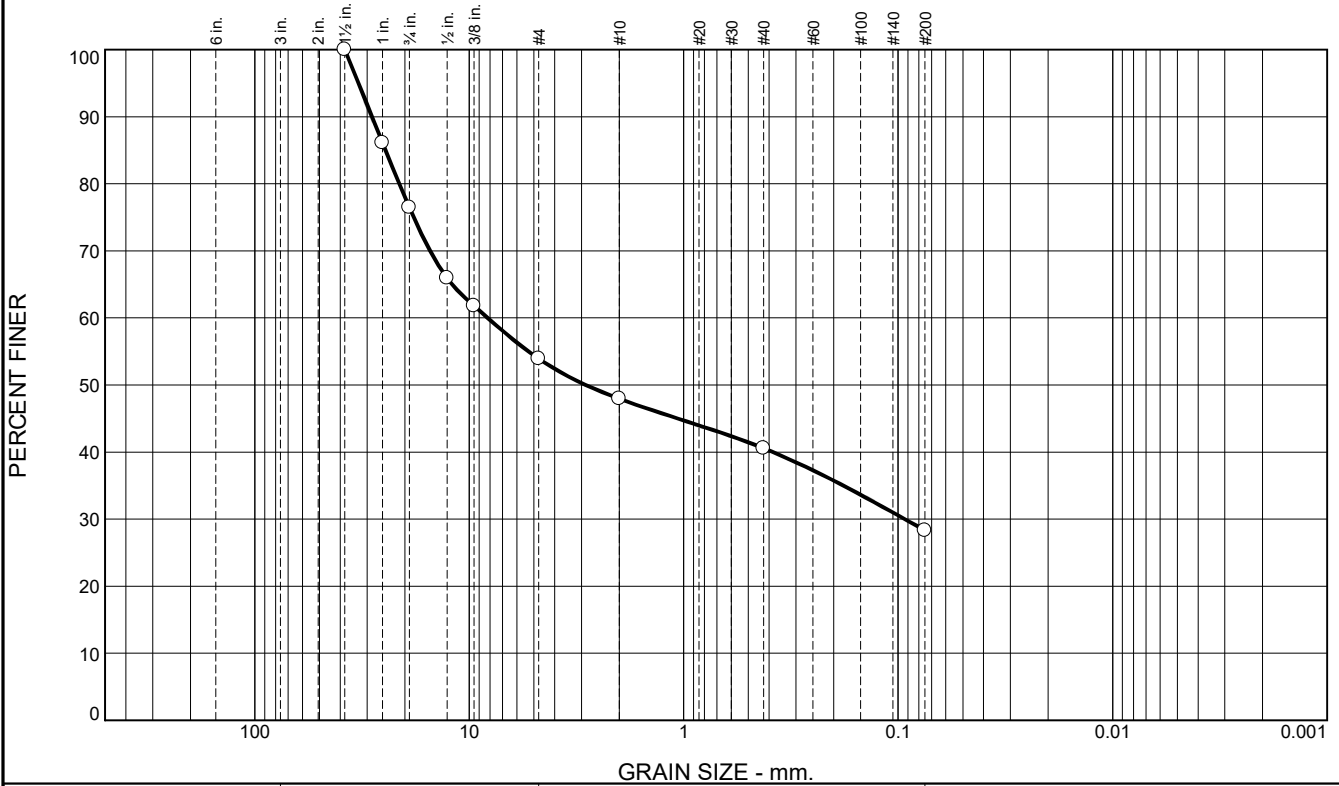
| SAMPLE INFORMATION | | | DEPTH | STRATA | DESCRIPTION OF MATERIALS (Classification) | REMARKS |
|--------------------|--------|------|--------|-----------------|--|-------------------------|
| Depth (ft.) | Number | Type | (feet) | | | |
| | | | 0.0 | | | No Indications of ESHGW |
| | | | | TOPSOIL | 5" Topsoil | |
| | | | | SUBSOIL | 19" Subsoil, Roots | |
| | | | | | | Cobbles and Boulders |
| 3 | 1 | Grab | | | | |
| 4 | 2 | Grab | | | | |
| | | | 5.0 | GLACIAL TILL | Brown, Silty Sand with Gravel (SM) | |
| 9 | 3 | Grab | | | | |
| | | | 10.0 | | | |
| | | | | | Test Pit TP-4 Terminated at Depth of 10.0 feet below ground surface. | |
| | | | 13.0 | | | |
| | | | 15.0 | | | |



APPENDIX B

Laboratory Test Results

Particle Size Distribution Report



| % +3" | % Gravel | | % Sand | | | % Fines | |
|-------|----------|------|--------|--------|------|---------|------|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 23.5 | 22.6 | 5.9 | 7.4 | 12.3 | 28.3 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|------------|---------------|----------------|--------------|
| 1.5" | 100.0 | | |
| 1" | 86.1 | | |
| 3/4" | 76.5 | | |
| 1/2" | 65.9 | | |
| 3/8" | 61.8 | | |
| #4 | 53.9 | | |
| #10 | 48.0 | | |
| #40 | 40.6 | | |
| #200 | 28.3 | | |

Material Description

Silty Gravel with Sand

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D₉₀= 28.4608 D₈₅= 24.6040 D₆₀= 8.2244
D₅₀= 2.8679 D₃₀= 0.0933 D₁₅=
D₁₀= C_u= C_c=

Classification

USCS= GM AASHTO= A-2-4(0)

Remarks

Moisture Content: 9.0%

* (no specification provided)

Location: TP-2
Sample Number: S-2 Depth: 3'

Date: 2/28/25

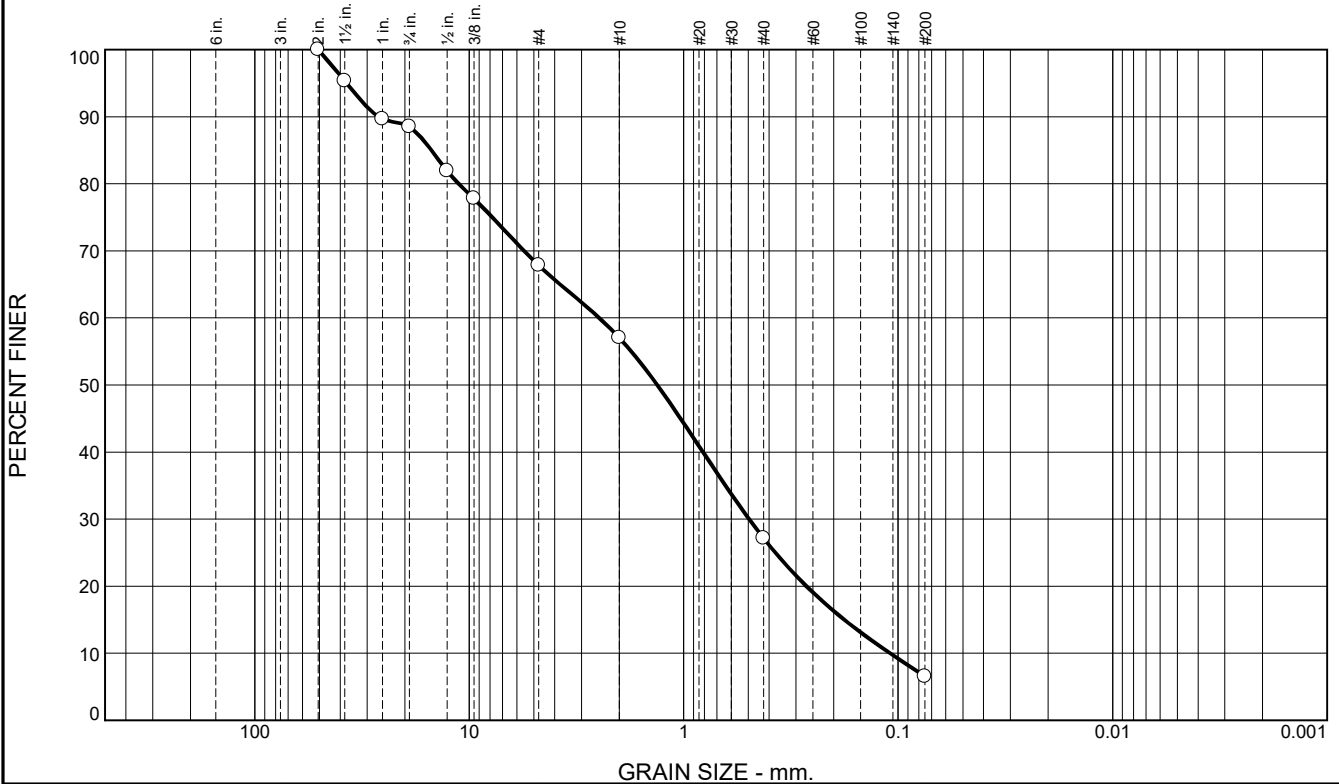


Client: Primrose School of Andover
Project: Proposed Primrose School SWM Improvements
885 Main Street, Reading, Middlesex County, MA
Project No: GM2523202.000

Figure S-1

Tested By: MM Checked By: RWM

Particle Size Distribution Report



| % +3" | % Gravel | | % Sand | | | % Fines | |
|-------|----------|------|--------|--------|------|---------|------|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0.0 | 11.5 | 20.7 | 10.8 | 29.8 | 20.7 | 6.5 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|------------|---------------|----------------|--------------|
| 2" | 100.0 | | |
| 1.5" | 95.3 | | |
| 1" | 89.7 | | |
| 3/4" | 88.5 | | |
| 1/2" | 81.9 | | |
| 3/8" | 77.8 | | |
| #4 | 67.8 | | |
| #10 | 57.0 | | |
| #40 | 27.2 | | |
| #200 | 6.5 | | |

Material Description

Poorly Graded Sand with Silt and Gravel

Atterberg Limits

PL= NP LL= NV PI= NV

Coefficients

D₉₀= 26.5551 D₈₅= 15.0311 D₆₀= 2.4806
D₅₀= 1.3316 D₃₀= 0.4961 D₁₅= 0.1786
D₁₀= 0.1094 C_u= 22.68 C_c= 0.91

Classification

USCS= SP-SM AASHTO= A-1-b

Remarks

Moisture Content: 10.1%

* (no specification provided)

Location: TP-3
Sample Number: S-3 Depth: 3'

Date: 2/28/25



Client: Primrose School of Andover
Project: Proposed Primrose School SWM Improvements
885 Main Street, Reading, Middlesex County, MA
Project No: GM2523202.000

Figure S-2

Tested By: MM Checked By: RWM

APPENDIX C
Supplemental Information
(USCS, Terms & Symbols)

UNIFIED SOIL CLASSIFICATION SYSTEM

SOIL CLASSIFICATION CHART

| MAJOR DIVISIONS | | | LETTER SYMBOL | TYPICAL DESCRIPTIONS |
|---|---|--|---------------|--|
| COARSE GRAINED SOILS | GRAVEL AND GRAVELLY SOILS | CLEAN GRAVELS (LITTLE OR NO FINES) | GW | WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES |
| | | GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES) | GP | POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES |
| | SAND AND SANDY SOILS | CLEAN SAND (LITTLE OR NO FINES) | GM | SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES |
| | | SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES) | GC | CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES |
| MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE | MORE THAN 50% OF COARSE FRACTION <u>RETAINED</u> ON NO. 4 SIEVE | CLEAN SAND (LITTLE OR NO FINES) | SW | WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES |
| | | SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES) | SP | POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES |
| | SILTS AND CLAYS | SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES) | SM | SILTY SANDS, SAND-SILT MIXTURES |
| | | SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES) | SC | CLAYEY SANDS, SAND-CLAY MIXTURES |
| FINE GRAINED SOILS | SILTS AND CLAYS | LIQUID LIMITS <u>LESS</u> THAN 50 | ML | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY |
| | | LIQUID LIMITS <u>GREATER</u> THAN 50 | CL | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| MORE THAN 50% OF MATERIAL IS <u>SMALLER</u> THAN NO. 200 SIEVE SIZE | SILTS AND CLAYS | LIQUID LIMITS <u>GREATER</u> THAN 50 | OL | ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY |
| | | LIQUID LIMITS <u>GREATER</u> THAN 50 | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS |
| HIGHLY ORGANIC SOILS | SILTS AND CLAYS | LIQUID LIMITS <u>GREATER</u> THAN 50 | CH | INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS |
| | | LIQUID LIMITS <u>GREATER</u> THAN 50 | OH | ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS |
| HIGHLY ORGANIC SOILS | | | PT | PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS |

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS FOR SAMPLES WITH 5% TO 12% FINES

GRADATION*

% FINER BY WEIGHT

TRACE..... 1% TO 10%
 LITTLE..... 10% TO 20%
 SOME..... 20% TO 35%
 AND..... 35% TO 50%

COMPACTNESS*

Sand and/or Gravel

RELATIVE DENSITY

LOOSE..... 0% TO 40%
 MEDIUM DENSE.... 40% TO 70%
 DENSE..... 70% TO 90%
 VERY DENSE..... 90% TO 100%

CONSISTENCY*

Clay and/or Silt

RANGE OF SHEARING STRENGTH IN POUNDS PER SQUARE FOOT

VERY SOFT..... LESS THAN 250
 SOFT..... 250 TO 500
 MEDIUM..... 500 TO 1000
 STIFF..... 1000 TO 2000
 VERY STIFF..... 2000 TO 4000
 HARD..... GREATER THAN 4000

* VALUES ARE FROM LABORATORY OR FIELD TEST DATA, WHERE APPLICABLE. WHEN NO TESTING WAS PERFORMED, VALUES ARE ESTIMATED.

L:\Geotechnical Forms and References\Reports\USCSTRMSSYM MA.docx

Office Locations:

NEW JERSEY

PENNSYLVANIA

MASSACHUSETTS

CONNECTICUT

FLORIDA

NEW HAMPSHIRE

NEW YORK

GEOTECHNICAL TERMS AND SYMBOLS

SAMPLE IDENTIFICATION

The Unified Soil Classification System is used to identify the soil unless otherwise noted.

SOIL PROPERTY SYMBOLS

- N: Standard Penetration Value: Blows per ft. of a 140 lb. hammer falling 30" on a 2" O.D. split-spoon.
- Qu: Unconfined compressive strength, TSF.
- Qp: Penetrometer value, unconfined compressive strength, TSF.
- Mc: Moisture content, %.
- LL: Liquid limit, %.
- PI: Plasticity index, %.
- δd: Natural dry density, PCF.
- ▼: Apparent groundwater level at time noted after completion of boring.

DRILLING AND SAMPLING SYMBOLS

- NE: Not Encountered (Groundwater was not encountered).
- SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
- ST: Shelby Tube - 3" O.D., except where noted.
- AU: Auger Sample.
- OB: Diamond Bit.
- CB: Carbide Bit
- WS: Washed Sample.

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

| <u>Term (Non-Cohesive Soils)</u> | <u>Standard Penetration Resistance</u> |
|----------------------------------|--|
| Very Loose | 0-4 |
| Loose | 4-10 |
| Medium Dense | 10-30 |
| Dense | 30-50 |
| Very Dense | Over 50 |

| <u>Term (Cohesive Soils)</u> | <u>Qu (TSF)</u> |
|------------------------------|-----------------|
| Very Soft | 0 - 0.25 |
| Soft | 0.25 - 0.50 |
| Firm (Medium) | 0.50 - 1.00 |
| Stiff | 1.00 - 2.00 |
| Very Stiff | 2.00 - 4.00 |
| Hard | 4.00+ |

PARTICLE SIZE

| | | | | | |
|----------|-------------|-------------|---------------|------|-----------------|
| Boulders | 8 in.+ | Coarse Sand | 5mm-0.6mm | Silt | 0.074mm-0.005mm |
| Cobbles | 8 in.-3 in. | Medium Sand | 0.6mm-0.2mm | Clay | -0.005mm |
| Gravel | 3 in.-5mm | Fine Sand | 0.2mm-0.074mm | | |

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Office Locations: