LGCI
Lahlaf Geotechnical Consulting, Inc.

September 14, 2024

Ms. Katy Lillich, AIA, LEED AP, MCPPO
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Re: **Preliminary Geotechnical Report**
Proposed Neary Elementary School
Southborough, Massachusetts
LGCI Project No. 2404

Dear Ms. Lillich:

Lahlaf Geotechnical Consulting, Inc. (LGCI) has completed an additional preliminary geotechnical study for the proposed Neary Elementary School in Southborough, Massachusetts. We are submitting our preliminary geotechnical report electronically.

The soil 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 (3) 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

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Lahlaf Geotechnical Consulting, Inc.

PRELIMINARY GEOTECHNICAL REPORT
PROPOSED NEARY ELEMENTARY SCHOOL
SOUTHBOROUGH, MASSACHUSETTS

LGCI Project No. 2404
September 14, 2024

Prepared for:

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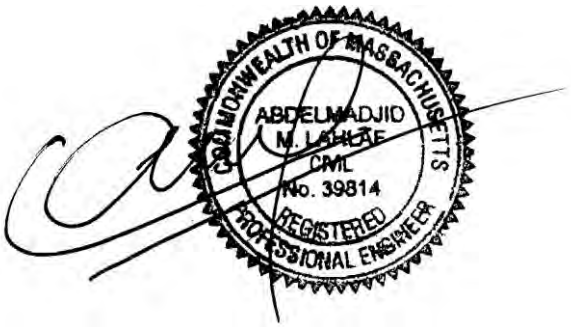

Abdelmadjid M. Lahlaf, Ph.D., P.E.
Principal Engineer

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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 Neary Elementary School in Southborough, Massachusetts. We performed our preliminary services in two (2) phases:

Our initial preliminary phase services were performed in general accordance with our proposal No. 23154-Rev. 2 dated December 27, 2023, revised on February 9, 2024. Ms. Katy Lillich of Arrowstreet authorized our services by signing our proposal on February 16, 2024.

Our additional preliminary phase services were performed in general accordance with our proposal No. 24078 dated July 22, 2024. Ms. Katy Lillich of Arrowstreet authorized our additional preliminary phase services by signing our proposal on July 30, 2024.

1.2 Purpose and Scope of Services

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

- Coordinated our exploration locations with Arrowstreet.
- Marked the exploration locations at the site and notified Dig Safe Systems Inc. (Dig Safe) and the Town of Southborough for utility clearance.
- Engaged a drilling subcontractor for two (2) days to advance eight (8) soil borings at the site, including four (4) soil borings as part of our initial preliminary phase services, and four (4) soil borings as part of our additional preliminary phase services.
- Provided an LGCI geotechnical field representative at the site to coordinate and observe the borings, describe the soil samples, and prepare field logs.
- Submitted six (6) soil samples collected from the borings for laboratory testing, including four (4) soil samples as part of our initial preliminary phase services, and two (2) soil samples as part of our additional preliminary phase services.
- Prepared this preliminary geotechnical report containing the results of our preliminary subsurface explorations and our preliminary recommendations for foundation design and construction.

Following our previous preliminary explorations, LGCI prepared a preliminary geotechnical report dated May 1, 2024. The present report includes the results of our previous report and supersedes it.

Our scope does not include preparing specifications, reviewing contract documents, attending meetings, or providing construction services. LGCI would be pleased to perform these services when needed. Recommendations for stormwater management, erosion control, pavement design, site specific seismic and liquefaction analyses, pile analysis and design, slope stability analyses, FEMA 100-year flood elevation, historic uses of site, contaminated soil and groundwater treatment and disposal requirements and techniques, and cost or quantity estimates are not included in our scope of work.

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.

1.3 Site Description

Our understanding of the site is based on our field observations, our discussions with Arrowstreet, and on the following drawings:

- Drawings TP-1 to TP-5 titled: "Topographic Plan, Neary Elementary School, Southborough, MA (Worcester County)," (Existing Conditions Plan) prepared by Beals and Thomas, dated March 22, 2024, and provided to LGCI by Arrowstreet via e-mail on September 3, 2024.

The site is located at 53 Parkerville Road in Southborough, Massachusetts as shown in Figure 1. The site is bordered by wooded land and private properties on the southern side, by Clifford Street and private properties on the western side, by wooded land and the existing Trottier Middle School on the northern side, and by Parkerville Road and private properties on its eastern side. The site is currently occupied by the existing school building, paved parking lots, athletic fields, including a baseball field, a soccer field, a practice field, tennis courts, and grass and landscaped areas. We understand that an existing leach field is present at the site. Based on the information provided to us by Arrowstreet, we understand that there may be a capped landfill within a portion of the site. We understand that the northern portion of the site is located within a flood zone.

Based on the Existing Conditions Plan, we understand that the existing grades at the site range between El. 262 feet near the northern portion of the site and El. 290 feet near the southern portion of the site. The existing grades vary across the site as describes below:

- Flood zone located to the north of the existing school – The elevations range between El. 262 feet near the northeastern corner of the site and El. 280 feet near the northwestern corner of the site.

- The existing tennis court – The elevations range between El. 271 feet and El. 272 feet.
- The existing baseball field north of the existing school – The elevations range between El. 270 feet and El. 273 feet.
- The existing soccer field east of the existing school – The elevations range between El. 268 feet and El. 269 feet.
- The existing parking lot east of the existing school – The elevations range between El. 267 feet and El. 272 feet.
- The existing parking lot located to the west of the existing school – The elevations range between El. 270 feet and El. 273 feet. The grades around the existing school range between El. 270 feet and El. 274 feet.

1.4 Project Description

Our understanding of the proposed construction is based on our conversations with Arrowstreet and on the following document:

- Drawing titled: "Building Footprint, Neary Elementary School, 53 Parkerville Rd., Southborough, MA 01772," (Building Layout) prepared by Arrowstreet, dated April 23, 2024, and provided to LGCI by Arrowstreet via e-mail on September 3, 2024.

We understand that the City of Southborough has engaged Arrowstreet to design the new Neary Elementary School. Based on the Building Layout, we understand that the proposed construction will consist of an irregular-shaped building located mostly within the footprint of the existing school building. We understand that the project is in the preliminary phases and the footprint, number of stories, finished floor elevation (FFE) of the proposed building, and the proposed exterior grades have not been established at the time of this preliminary geotechnical report. We understand that the existing building will be demolished to allow for the construction of the proposed building.

1.5 Elevation Datum

We understand that the elevations provided in the Existing Conditions Plan are referenced with respect to the North American Vertical Datum of 1988 (NAVD88). Elevations are in feet.

2. SITE AND SUBSURFACE CONDITIONS

2.1 Surficial Geology

LGCI reviewed a surficial geologic map titled: "Surficial Materials Map of the Marlborough Quadrangle, Massachusetts," prepared by Stone, J.R., and Stone, B.D., Scientific Investigation Map 3402, Quadrangle 92 – Marlborough, 2018.

The surficial geologic map of the site indicates that the natural soils in the general vicinity of the site consist of coarse deposits and swamp deposits.

The coarse deposits consist of Sand Deposits, Sand and Gravel Deposits, 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 to 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.

The swamp deposits are described as organic muck and peat that contain minor amounts of sand, silt, and clay, are stratified and are poorly sorted, and occur in swamps and freshwater marshes, in kettle depressions, or in poorly drained areas.

The Surficial Geologic Map is shown in Figure 2.

2.2 LGCI's Explorations

2.2.1 General

LGCI coordinated our exploration locations with Arrowstreet and marked the exploration locations in the field. LGCI notified Dig Safe and the Town of Southborough for utility clearance prior to starting our explorations at the site.

Unless notified otherwise, we will dispose of the soil samples obtained during our explorations after three (3) months.

2.2.2 LGCI's Soil Borings

As part of our initial preliminary explorations, LGCI engaged Soil X Corp. (Soil X) of Leominster, Massachusetts to advance four (4) soil borings (B-1 to B-4) at the site on April

15, 2024. The borings were advanced with a Diedrich D-70 Turbo ATV drill rig using 4-¼-inch inner-diameter hollow stem augers. The borings extended to depths ranging between 15.0 and 21.3 feet beneath the ground surface. Upon completion, the boreholes were backfilled with the drill cuttings.

As part of our additional preliminary explorations, LGCI engaged Soil X to advance an additional four (4) soil borings (B-101 to B-104) at the site on August 22, 2024. The borings were advanced with a Diedrich D-70 Turbo ATV drill rig using 4-¼-inch inner-diameter hollow stem augers. The borings extended to depths ranging between 19.3 and 20.8 feet beneath the ground surface. Upon completion, the boreholes were backfilled with the drill cuttings, sand, gravel, and concrete (as noted in the boring logs). The ground surface was restored with cold patch asphalt in paved areas.

Soil X performed Standard Penetration Tests (SPT) and obtained split spoon samples 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.

An LGCI geotechnical field representative observed and logged the borings in the field.

2.2.3 Exploration Logs and Locations

The boring locations are shown in Figure 3. Appendix A contains LGCI's boring logs and Table 1 includes a summary of LGCI's borings.

2.3 Subsurface Conditions

The subsurface description in this report is based on a limited number of borings and is intended to highlight the major soil strata encountered during our explorations. The subsurface conditions are known only at the actual boring locations. Variations may occur and should be expected between boring locations. The boring logs represent conditions that we observed at the time of our explorations 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 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 LGCI's borings were as follows, starting at the ground surface.

Topsoil – A layer of surficial organic topsoil was encountered at the ground surface in all borings, except in borings B-101 and B-102. The thickness of the topsoil ranged between 0.8 and 2.0 feet.

Asphalt – A layer of surficial asphalt was encountered at the ground surface in borings B-101 and B-102. The thickness of the asphalt ranged between 0.5 and 0.8 feet.

Subsoil – A layer of subsoil was encountered beneath the topsoil in boring B-4. The subsoil extended to a depth of 2 feet beneath the ground surface. The sample in this layer was described as poorly graded sand with silt. The fines content in the subsoil ranged between 10 and 15 percent, and the gravel content ranged between 10 and 15 percent.

The SPT N-value in this layer was 16 blows per foot (bpf), indicating medium dense material. Please note that the high SPT N-values recorded in the subsoil may be due to obstructions such as cobbles and boulders present in the subsoil and may not represent the true density of the subsoil.

Fill – A layer of fill was encountered beneath the topsoil and asphalt in all borings except in borings B-3 and B-4. The fill extended to depths ranging between 3.0 and 10.5 feet beneath the ground surface. The samples in this layer were mostly described as silty sand, poorly graded sand, and well graded sand. One (1) sample was described as buried organic soil, one (1) sample was described as poorly graded gravel, and one (1) sample was described as well graded gravel. The fines content in the fill ranged between 0 and 40 percent, and the gravel content ranged between 0 and 30 percent. When described as gravel, the sand content in the fill ranged between 30 and 35 percent. The fill contained traces of organic soil, wood, roots, and asphalt. One (1) sample in the fill contained traces of weathered rock.

The SPT N-values in this layer ranged between 3 blows per foot (bpf) and refusal, with most values lower than 30 bpf, indicating mostly loose to medium dense material. Please note that the high SPT N-values recorded in the fill may be due to obstructions such as cobbles and boulders present in the fill and may not represent the true density of the fill.

Swamp Deposit – A layer of swamp deposit was encountered beneath the fill in boring B-101. The swamp deposit extended to a depth of 11 feet beneath the ground surface. The samples in this layer were described as a silty sand. The fines content in the subsoil ranged between 30 and 55 percent, and the gravel content was approximately 0 percent. This layer contained traces of wood and organic soil.

The SPT N-values in this layer were 13 and 18 bpf, indicating medium dense material. Please note that the high SPT N-values recorded in the swamp deposit may be due to obstructions such as cobbles and boulders present in the swamp deposit and may not represent the true density of the swamp deposit.

Sand and Gravel – A layer of sand and gravel was encountered beneath the layer of topsoil, fill, subsoil, and swamp deposits in all borings. The sand and gravel extended to the termination depths in all the borings, except boring B-104, where the sand and gravel layer extended to a depth of 19 feet beneath the ground surface. The samples in this layer were described mostly as silty sand. Five (5) samples were described as poorly graded sand, five (5) samples were described as well graded sand, and one (1) sample was described as silty gravel. The fines content in this layer ranged between 5 and 40 percent, and the gravel content ranged between 0 and 40 percent. When described as a gravel, the sand content ranged between 25 and 30 percent. The sand and gravel contained traces of weathered rock.

The SPT N-values in this layer ranged between 9 bpf and refusal, with most values higher than 30 bpf, indicating mostly dense to very dense material. Please note that the high SPT N-values in the sand and gravel may be due to obstructions such as cobbles and boulders in the sand and gravel and may not represent the true density of the sand and gravel.

Weathered Rock – A layer of weathered was encountered within and beneath the sand and gravel layer in borings B-102 and B-104, respectively. The weathered rock was encountered in boring B-102 between depths of 9 and 16 feet beneath the ground surface, and it extended to the termination depth of boring B-104. The samples in this layer were described as silty sand. The fines content in this layer ranged between 20 and 25 percent, and the gravel content ranged between 20 and 35 percent.

The SPT N-values in this layer ranged between 9 bpf and refusal with most values greater than 15 bpf, indicating medium dense to very dense material. Please note that the high SPT N-values in the weathered rock may be due to obstructions such as cobbles and boulders in the weathered rock and may not represent the true density of the weathered rock.

2.4 Groundwater

Groundwater was encountered in all borings in the initial preliminary explorations on April 15, 2024, at depths ranging between 2.0 feet and 10.0 feet beneath the ground surface; and groundwater was encountered in all borings in the additional preliminary explorations on August 22, 2024, at depths ranging between 0.0 feet and 16.0 feet beneath the ground surface as shown in Table 1 and in the boring logs.

The groundwater information reported herein is based on observations made during or shortly after the completion of drilling. In addition, groundwater was Therefore, the reported groundwater levels may not represent the actual groundwater conditions, as 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.

2.5 Laboratory Test Data

LGCI submitted six (6) soil samples collected from the borings for grain-size analysis. The results of the grain-size analyses are provided in the test data sheets included in Appendix B 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
B-1	S2	Fill	2 - 4	19.8	43.2	37.0
B-2	S3	Fill	4 – 6	20.9	48.8	30.3
B-3	S2 Bot. 13”	Native Soil	2 – 4	37.6	54.0	8.4
B-4	S2	Native Soil	2 – 4	34.5	50.3	15.2
B-102	S2	Native Soil	3 – 5	37.9	53.7	8.4
B-104	S2	Fill	2 – 4	15.9	78	6.1

3. EVALUATION AND RECOMMENDATIONS

3.1 General

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

3.1.1 Surficial asphalt, Topsoil, Subsoil, Existing Fill, and Swamp Deposits

- Asphalt, surficial topsoil, subsoil, existing fill, and swamp deposits were encountered in the borings. These materials are not suitable to support foundations.

- The topsoil should be removed from within the entire construction area, including the proposed building footprint and the paved areas.

- The subsoil and swamp deposits should be entirely removed from within the proposed building footprint. Furthermore, the existing fill was observed to be variable in composition and density. In addition, the existing fill contained traces of organic soil, wood, roots, and asphalt. Existing fill that was not placed with strict moisture, density, and gradation control presents risk of unpredictable settlement that may result in poor performance of floor slabs and foundations. Due to these risks, the existing fill should be entirely removed from within the proposed building footprint and replaced with Structural Fill. We anticipate that the removal will extend up to depths of about 11 feet. The removal may extend to greater depths at locations not explored by LGCI. Laterally, the removal should extend beyond the proposed building footprint a distance equal to the distance between the bottom of the proposed footings and the top of the natural sand and gravel, or 5 feet, whichever is greater.

- LGCI considered the alternative option of improving the existing fill and swamp deposits with aggregate piers (APs) or rigid inclusions (RIs). However, this option would not be viable where the existing fill is shallower than 6 feet. We recommend preparing the current documents assuming the “remove and replace” option. LGCI will further evaluate the ground improvement option by means of APs or RIs after additional explorations are performed at the site. The remainder of the report was prepared assuming the “remove and replace” option.

- The subgrade of footings should be prepared in accordance with the recommendations in Section 4.1.

- Within paved areas, the existing fill and subsoil should be removed to the top of the natural sand and gravel or to a depth of 18 inches beneath the bottom of the proposed pavement, whichever occurs first. Where organic soil is exposed, the organic soil should be removed. The existing fill and subsoil deeper than 18 inches beneath the bottom of the

proposed pavement can remain in place provided these materials are firm and unyielding following proofrolling as described in Section 4.1.

- If the swamp deposits are encountered at shallow depths, they should be improved following the recommendation above after removing the top 24 inches beneath the bottom of the proposed pavement.

3.1.2 Shallow Footings and Slabs-on-Grade

Based on the results of the borings, the subsurface conditions are suitable to support shallow spread and continuous footings bearing on Structural Fill placed directly on top of the sand and gravel layer after entirely removing the topsoil, subsoil, the existing fill, and the swamp deposits. The proposed slabs may be designed as slabs-on-grade. Our recommendation for net allowable bearing capacity in the sand and gravel is presented in Section 3.2.1. Our recommendations for slabs-on-grade are presented in Section 3.3. Our recommendations for lateral pressures for the proposed basement walls and other retaining walls, if any, are presented in Section 3.5. Section 4.1 provides recommendations for preparation of subgrades.

3.1.3 Additional Explorations

We recommend performing additional explorations at the site. We recommend performing soil borings and test pits. We also recommend installing at least two (2) groundwater observation wells at the site. LGCI will provide a proposal for the additional services after the proposed building layout, size, and locations are established.

3.2 Foundation Recommendations

3.2.1 Footing Design

- We recommend entirely removing the surficial topsoil, the subsoil, the existing fill, and swamp deposits from within the proposed building footprint as described in Section 3.1.1.

- We recommend supporting the proposed building on spread footings bearing on Structural Fill placed directly on the natural sand and gravel.

- We recommend designing the proposed footings using a net allowable bearing pressure of 5 kips per square foot (ksf). We recommend that the footings bear on a minimum of 12 inches of Structural Fill placed directly on top of the natural sand and gravel or on weathered rock. The Structural Fill should extend at least 1 foot laterally beyond the limits of the footings.

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

- 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 Estimates

Based on our experience with similar soils and designs using a net allowable bearing pressure of 5 ksf, we anticipate that the total settlement will be approximately 1 inch, and that the differential settlement of the footings will be 3/4 inch or less over a distance of 25 feet. We believe that total and differential settlements of this magnitude are tolerable for a similar structure. However, 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

3.3.1 Slabs-on-Grade

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

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

- For the design of the floor slab 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 a 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 during the 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.

- The backfill in interior utility trenches should be properly compacted.

- In order for the movement of exterior slabs not to be transmitted to foundations or superstructures, exterior slabs, such as approach slabs and sidewalks, should be isolated from the superstructure.

3.3.2 Under-slab Drains and Waterproofing

The finished floor elevation (FFE) of the proposed ground floor was not provided to us. LGCI will make a recommendation about the need for an under-slab drainage system after additional explorations are performed, and the groundwater observation wells monitored; and after the proposed FFE is established.

3.4 Seismic Design

Based on the SPT N-values from the borings, we estimate that the seismic criteria for the site are as follows:

- Site Class: D
- Spectral Response Acceleration at short period (Ss): 0.191g
- Spectral Response Acceleration at 1 sec. (S_1): 0.067g
- Site Coefficient Fa (Table 1613.5.3(1)): 1.6
- Site Coefficient Fv (Table 1613.5.3(2): 2.4
- Adjusted spectral response S_{MS}: 0.306g
- Adjusted spectral response S_{M1}: 0.161g

Based on the SPT data from the borings, the site soils are not susceptible to liquefaction.

3.5 Lateral Pressures for Wall Design

3.5.1 Lateral Earth Pressures

Lateral earth pressures for the design of below-grade walls, and site retaining walls, if any, are provided below.

Coefficient of Active Earth Pressure, K_A:	0.31
Coefficient of At-Rest Earth Pressure, K_o:	0.47
Coefficient of Passive Earth Pressure, K_p:	3.25
Total Unit Weight γ:	125 pcf

Note: The values in the table are based on a friction angle for the backfill of 32 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 on a vertical wall face.

- Exterior walls of below-ground spaces and other 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 retaining walls.

- We recommend providing weep holes at the bottom of site retaining walls, including temporary SOE systems, to promote drainage where possible. Alternatively, a pipe should be placed at the base of the wall to collect the water. Groundwater collected by the wall drains should be discharged into 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 the 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 4 feet.

- Where a permanent vertical uniform load will be applied to 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 lateral construction surcharge load of 100 pounds per square foot (psf) should be applied uniformly over the height of the wall.

- We recommend using an ultimate friction factor of 0.5 between the weathered rock and the bottom of the wall. Below-grade walls should be designed for minimum factors of safety of 1.5 for sliding and 2.0 for overturning.

3.5.2 Seismic Pressures

In accordance with the Massachusetts State Building Code, 9th Edition (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 the walls (for horizontal backfill), where S_s is the maximum considered earthquake spectral response acceleration (defined in Section 3.4), F_a is the site coefficient (defined in Section 3.4), 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 should 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 should be included in the total static lateral soil pressure, and their earthquake lateral force should be computed and added to the force determined above.

3.5.3 Perimeter Drains

- We recommend that free-draining material be placed within 3 feet of the exterior of walls of below-ground spaces, if any. To reduce the potential for dampness in below-ground spaces, proposed below-ground walls should be damp-proofed.

- We recommend that drains be provided behind the exterior of walls of below-ground spaces. The drains should consist of 4-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 for separation and filtration.

- To the extent possible, groundwater collected by the wall drains should be discharged in a lower area if gravity flow is possible. In any case, the groundwater collected by the wall drains should be discharged in accordance with municipal, state, and other applicable standards.

3.6 Parking Lots, Driveways, and Sidewalks

3.6.1 General

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

- We recommend entirely removing the topsoil from within the footprint of the proposed driveways and parking lots.

- The existing fill, subsoil, and swamp deposits should be improved in accordance with the recommendations in Section 4.1.

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

3.6.2 Sidewalks

- Sidewalks 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 sidewalk, the joints between sidewalk concrete sections should be sealed with a waterproof compound. The sidewalks 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 sidewalk surfaces.

3.6.3 Pavement Sections

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 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 Transportation dated 2023.

Areas to receive relatively highly concentrated, sustained loads such as dumpsters, loading areas, and storage bins are typically installed over a rigid pavement section to distribute concentrated loads and reduce the possibility of high stress concentrations on the subgrade.

Typical rigid pavement sections consist of 6 inches of concrete placed over a minimum of 12 inches of subbase material.

3.7 Underground Utilities

Boulders at the bottom of utility trenches should be removed to at least 12 inches below the pipe invert and the resulting excavation should be backfilled with suitable backfill. Utilities should be placed on suitable bedding material in accordance with the manufacturer's recommendations. "Cushion" material should be placed, by hand, above the utility pipe in maximum 6-inch lifts. The lift should be compacted by hand to avoid damage to the utility. Where the bedding/cushion material consists of crushed stone, it should be wrapped in a geotextile fabric.

Compaction of fill in utility trenches should be in accordance with our recommendations in Section 4.3. To reduce the potential for damage to utilities, placement and compaction of fill immediately above the utilities should be performed in accordance with the manufacturer's recommendations.

4. CONSTRUCTION CONSIDERATIONS

4.1 Subgrade Preparation

- Asphalt, topsoil, organic materials, existing fill, buried organic soil, buried subsoil, swamp deposits, abandoned utilities, buried foundations, and other below-ground structures should be entirely removed from within the footprints of the proposed buildings 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.

- Cobbles and boulders should be removed at least 6 inches from beneath footings and 18 inches beneath the bottom of slabs and paved areas. The resulting excavations should be backfilled with compacted Structural Fill under the building and with Ordinary Fill under the subbase of paved areas.

- The bottom of the excavation resulting from the removal of the existing fill and subsoil, or natural soil 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.

- After the surficial existing fill and subsoil are removed to a depth of 18 inches and the swamp deposits, if any are removed to a depth of 24 inches beneath the bottom of the proposed pavement and within walkways in accordance with the recommendations in Section 3.1, the exposed existing fill and subsoil deeper than 18 inches and the swamp deposits deeper than 24 inches beneath the bottom of the proposed pavement should be improved by compacting the exposed surface with at least six (6) passes 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 existing fill deeper than 18 inches beneath the bottom of the proposed pavement is observed, the soft and/or pumping material should be removed and replaced.

- Fill placed within the footprint of the proposed buildings should meet the gradation and compaction requirements of Structural Fill, shown in Section 4.3.1.

- Fill placed under the subbase of paved areas should meet the gradation and compaction requirements of Ordinary Fill, shown in Section 4.3.2.

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

- Loose or soft soils identified during the compaction of the footing or floor slab subgrades should be excavated to a suitable bearing stratum, as determined by the representative of LGCI. Grades should be restored by backfilling with Structural Fill or crushed stone.

- When crushed stone is required in the drawings or is used for the convenience of the contractor, it should be wrapped in a geotextile fabric for separation except where introduction of the geotextile fabric promotes sliding. A geotextile fabric should not be placed between the bottoms of the footings and the crushed stone.

- An LGCI representative should observe the exposed subgrades 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 a filter fabric.

4.2 Subgrade Protection

The onsite fill and natural 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 6 inches of soil just before pouring the 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 the 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 for the top 12 inches under sidewalks, exterior slabs, 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 the 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, most of the onsite fill is too silty and does not meet the gradation requirements for Ordinary Fill or Structural Fill. The existing fill can be used in landscaped areas. The natural sand and gravel may be used as Ordinary Fill.

The contractor should avoid mixing the reusable soils with fine-grained and/or organic soils. The soils to be reused should be excavated and stockpiled separately for compliance testing. Soils with 20 percent or greater fines contents 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 the 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.

Suitable imported material and amended/improved onsite materials should be stockpiled separately from unimproved onsite soils.

Materials to be used as fill should first be tested for compliance with the applicable gradation specifications.

4.5 Groundwater Control Procedures

Based on the groundwater levels measured in our borings, we anticipate that groundwater control procedures will be needed during construction. We anticipate that filtered deep sump pumps and sump pumps installed in a series of pits located at least 3 feet below the bottom of planned excavations may be sufficient to handle groundwater and surface runoff that may enter the excavation during wet weather. The contractor should be prepared to use multiple sump pumps to maintain a dry excavation during the removal of the existing fill.

The contractor should be permitted to employ whatever commonly accepted means and practices are 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 the excavations during construction. The placement of reinforcing steel or concrete in standing water should not be permitted.

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 fabric. 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.

4.6 Temporary Excavations

All excavations to receive human traffic should be constructed in accordance with 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 the stability of the excavation sides and bottom.

5. RECOMMENDATIONS FOR FUTURE WORK

We recommend engaging LGCI to perform the following services:

- Perform additional explorations at the site and update our geotechnical report.
- Prepare Earth Moving Specifications and review the geotechnical aspect of contract drawings.
- Review contractor submittals and Request for Information (RFIs);
- Provide a field representative during construction to observe the removal of the unsuitable soil, and to observe the subgrade of footings and slabs.

6. REPORT LIMITATIONS

Our analyses 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 Arrowstreet for the Proposed Neary Elementary School in Southborough, 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:

American Society of Civil Engineers, "Minimum Design Loads and Associated Criteria for Buildings and Other Structures," ASCE/SEI 7-16, 2017.

The Commonwealth of Massachusetts (2017), "The Massachusetts State Building Code, Ninth (9^{th}) Edition."

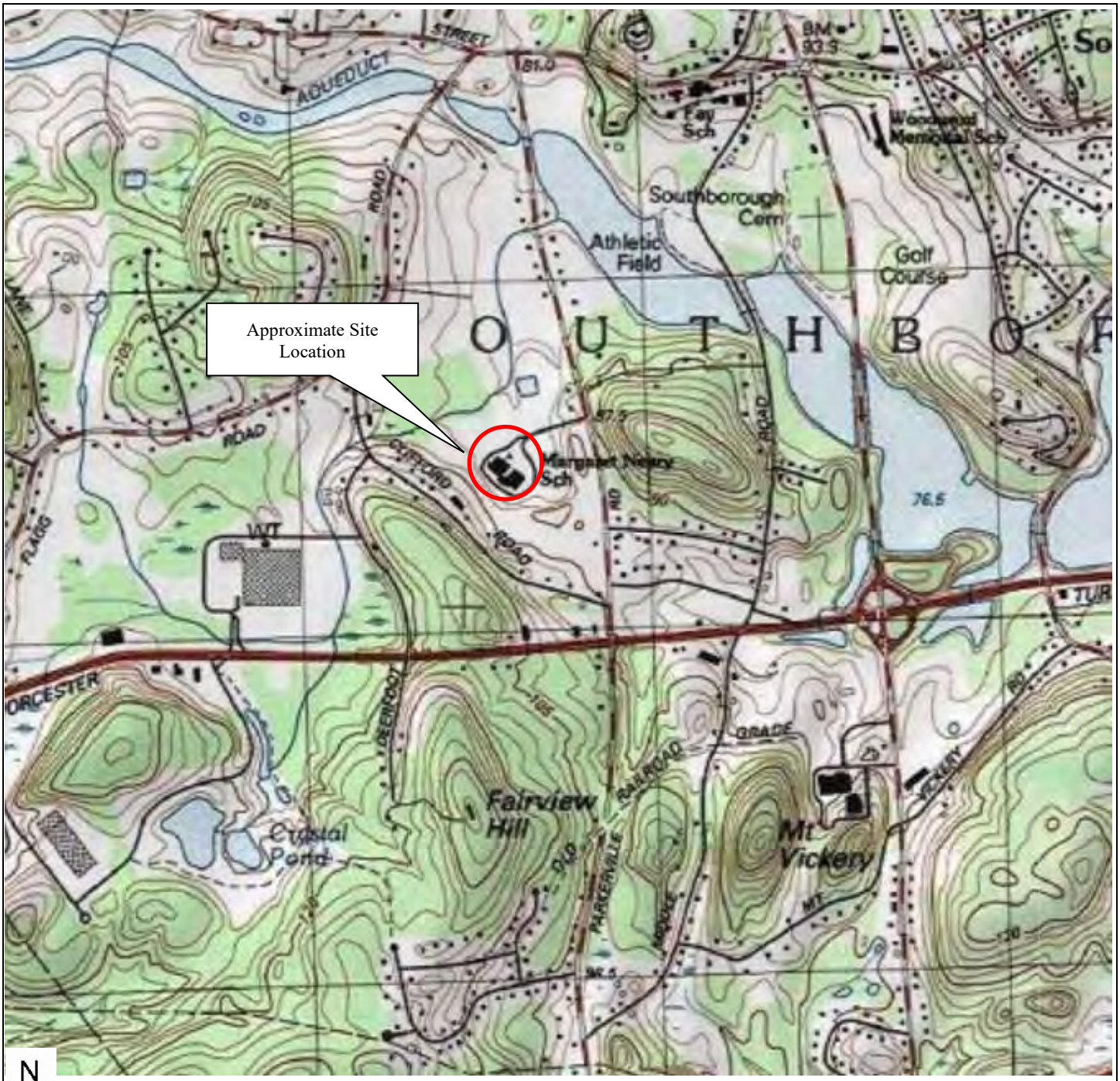
The Department of Labor, Occupational Safety and Health Administration (1989), "Occupational Safety and Health Standards - Excavations; Final Rule," 20 CFR Part 1926, Subpart P.

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

Table 1 - Summary of LGCI's Borings
Proposed Neary Elementary School
Southborough, MA
LGCI Project No. 2404

Boring No.	Ground Surface Elevation (ft.)[1]	Groundwater[2] Depth / El. (ft.)	Bottom of Topsoil / **Asphalt** Depth / El. (ft.)	Bottom of Fill / **Subsoil** Depth / El. (ft.)	Bottom of Swamp Deposits Depth / El. (ft.)	Bottom of Sand and Gravel Depth / El. (ft.)	Bottom of Weathered Rock Depth / El. (ft.)	Bottom of Boring Depth / El. (ft.)
Preliminary Phase Explorations								
B-1	275.0	4.2 / **270.8**	1.0 / **274.0**	6.0 / **269.0**	- / **-**	21.3 [3]/ **253.7**	- / **-**	21.3 / **253.7**
B-2	274.0	2.9 / **271.1**	1.0 / **273.0**	6.2 / **267.8**	- / **-**	15.0 [4]/ **259.0**	- / **-**	15.0 / **259.0**
B-3	277.0	2.0 / **275.0**	1.2 / **275.8**	- / **-**	- / **-**	17.0 [3]/ **260.0**	- / **-**	17.0 / **260.0**
B-4	276.0	3.1 / **272.9**	0.8 / **275.2**	**2.0** / **274.0**	- / **-**	19.0 [3]/ **257.0**	- / **-**	19.0 / **257.0**
Additional Preliminary Phase Explorations								
B-101	270.0	7.0 / **263.0**	**0.5** / **269.5**	7.0 / **263.0**	11.0 / **259.0**	20.8 [3]/ **249.2**	- / **-**	20.8 / **249.2**
B-102	272.0	5.0 / **267.0**	**0.8** / **271.2**	3.0 / **269.0**	- / **-**	19.4 [3,5]/ **252.6**	- / **-**	19.4 / **252.6**
B-103	273.0	4.0 / **269.0**	2.0 / **271.0**	6.0 / **267.0**	- / **-**	19.3 [3]/ **253.7**	- / **-**	19.3 / **253.7**
B-104	272.0	0.0 / **272.0**	0.8 / **271.2**	10.5 / **261.5**	- / **-**	19.0 / **253.0**	19.4 [6]/ **252.6**	19.4 / **252.6**

1. The ground surface elevation was interpolated to the nearest foot from drawings TP-4 and TP-5 (Sheets 4 and 5 of 5) titled: "Topographic Plan, Neary Elementary School, Southborough, MA," prepared by Beals and Thomas, Inc. (B&T), dated March 22, 2024, and provided to LGCI by Arrowstreet via e-mail on Sepetmber 3, 2024.
2. Groundwater was measured during drilling, at the end of drilling, after drilling, or based on sample moisture whichever is shallower.
3. Boring terminated in the sand and gravel layer.
4. Boring terminated on refusal in the sand and gravel layer.
5. A layer of weathered rock was encountered in boring B-102, between depths of 9 and 16 feet beneath the ground surface.
6. Boring terminated in the weathered rock layer.
7. "-" means groundwater or layer was not encountered.

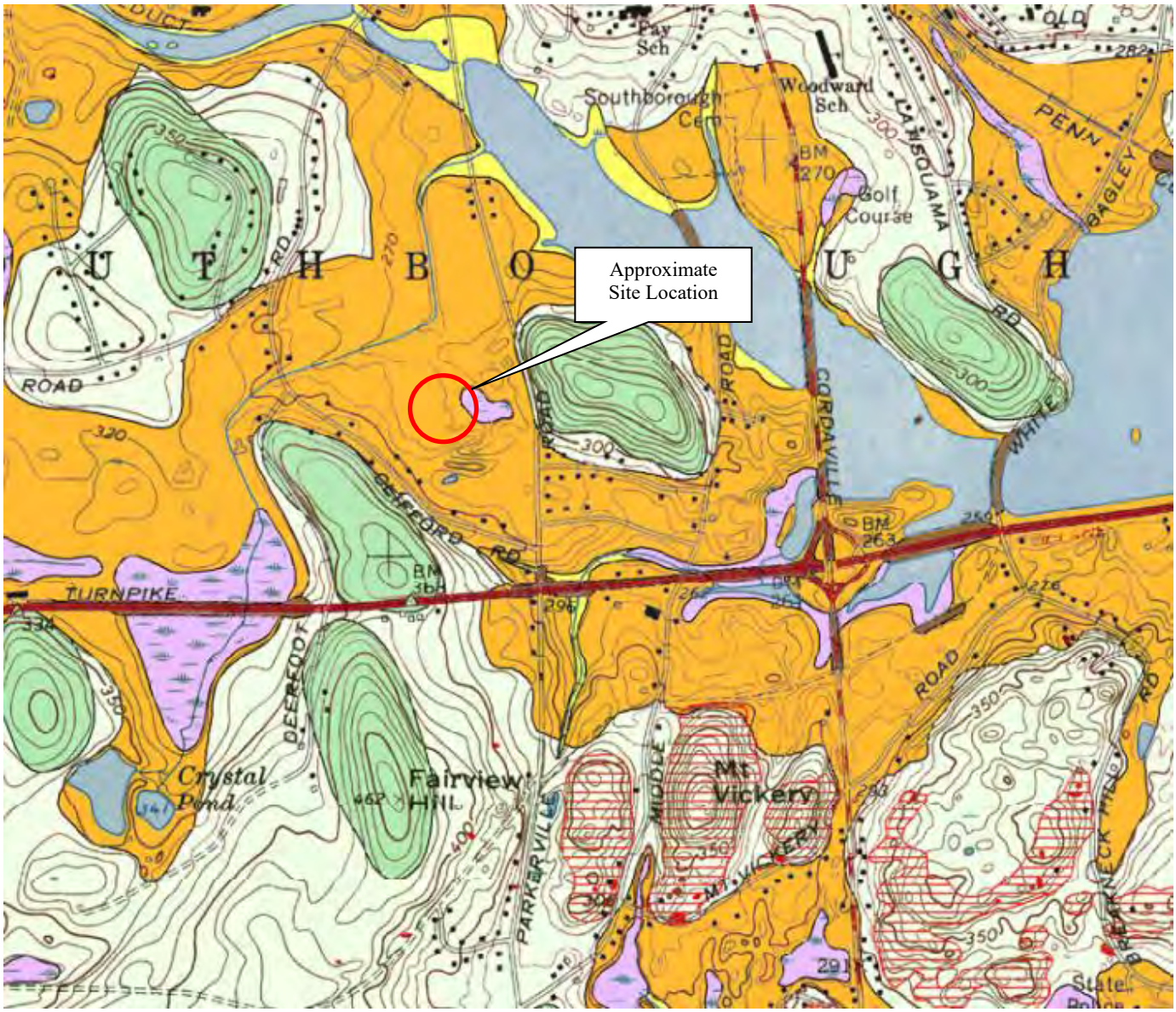


Contour Intervals: 3 meters

0.4 mi

Note: Figure based on USA Topo Maps of Southborough, MA *ngmdb.usgs.gov/topoview/viewer*

Client:	Project:	Figure 1 – Site Location Map	
Arrowstreet	Proposed Neary Elementary School		
LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Southborough, MA	LGCI Project No.: 2404	Date: Sept. 2024



N

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

Swamp deposits—Organic muck and peat that contain minor amounts of sand, silt, and clay, are stratified and poorly sorted, and occur in swamps and freshwater marshes, in kettle depressions, or in poorly drained areas. Unit is shown only where deposits are estimated to be at least 3 ft thick; most deposits are less than 10 ft thick. Swamp deposits overlie glacial deposits or bedrock. They locally overlie glacial till even where they occur within thin glacial meltwater deposits

Note: Figure based on map titled: “Surficial Materials Map of the Marlborough Quadrangle, Massachusetts,” prepared by Stone J.R. and Stone, B.D., Scientific Investigation Map 3402 , Quadrangle 92 – Marlborough, 2018.

Client:	Project:	Figure 2 – Surficial Geologic Map	
Arrowstreet	Proposed Neary Elementary School		
LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Southborough, MA	LGCI Project No.: 2404	Date: Sept. 2024

Legend

Approximate location of borings advanced by Soil X Corporation of Leominster, MA on August 22, 2024, and observed by Lahlaf Geotechnical Consulting, Inc. (LGCI).

0 40 80 120

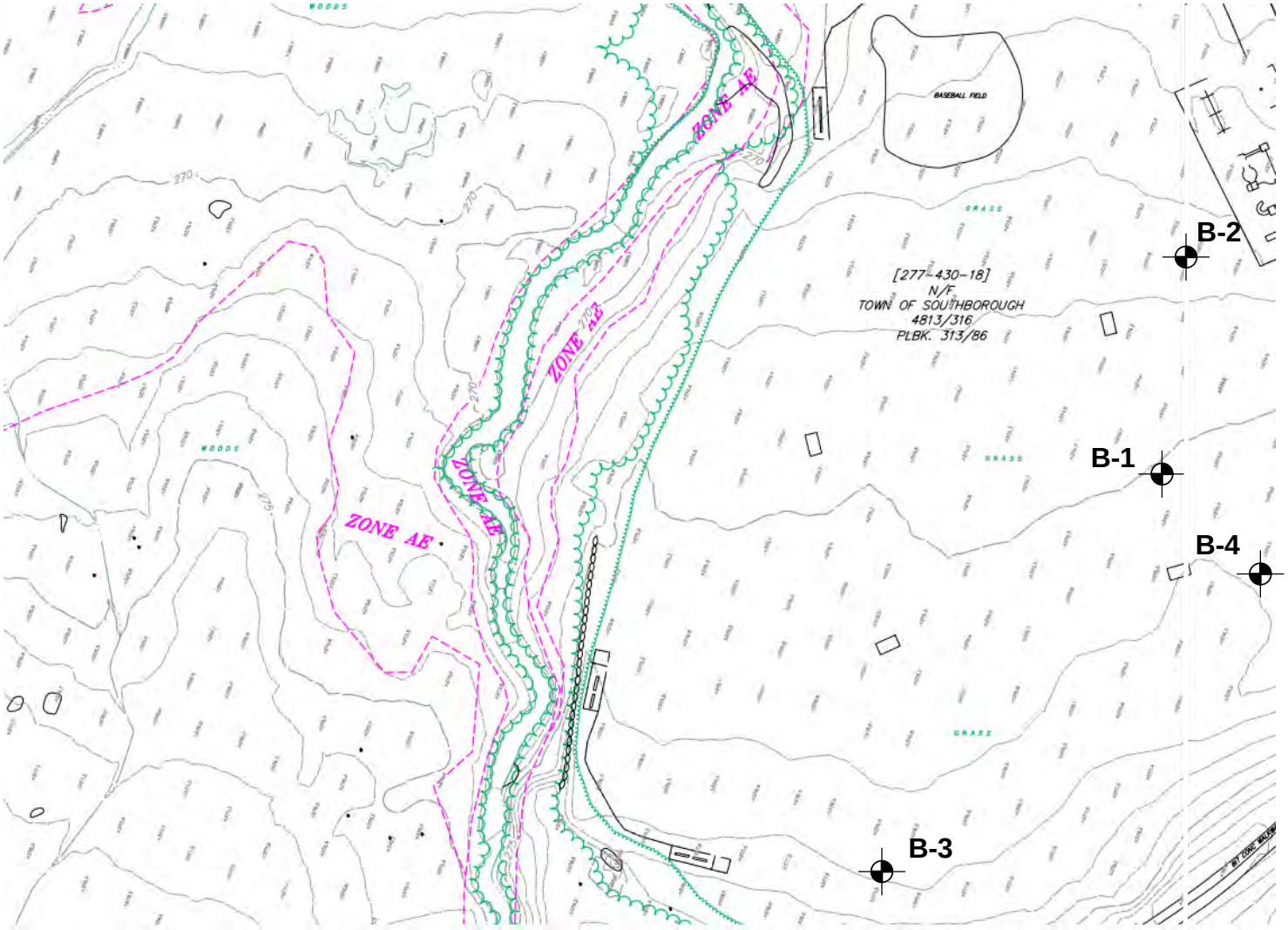
Approximate Scale (ft.)

Note:
Figure based on drawing TP-5 (Sheet 5 of 5) titled: "Topographic Plan, Neary Elementary School, Southborough, MA," prepared by Beals and Thomas, Inc. (B&T), dated March 22, 2024, and provided to LGCI by Arrowstreet via e-mail on September 3, 2024.

Client: Arrowstreet	Project: Proposed Neary Elementary School	Figure 3A – Boring Location Plan	
LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Southborough, MA	LGCI Project No.: 2404	Date: Sept. 2024

Legend

Approximate location of borings advanced by Soil X Corporation of Leominster, MA on April 15, 2024, and observed by Lahlaf Geotechnical Consulting, Inc. (LGCI).



0 40 80 120

Approximate Scale (ft.)

Note:
Figure based on drawing TP-4 (Sheet 4 of 5) titled: "Topographic Plan, Neary Elementary School, Southborough, MA," prepared by Beals and Thomas, Inc. (B&T), dated March 22, 2024, and provided to LGCI by Arrowstreet via e-mail on September 3, 2024.

Client: Arrowstreet	Project: Proposed Neary Elementary School	Figure 3B – Boring Location Plan	
LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Southborough, MA	LGCI Project No.: 2404	Date: Sept. 2024

Appendix A – LGCI's Boring Logs

LGCI
Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Rd.
North Billerica, MA 01862
Telephone: 9783305912
Fax: 9783305056

BORING LOG

B-1
PAGE 1 OF 1

CLIENT: Arrowstreet
PROJECT NAME: Proposed Neary Elementary School
LGCI PROJECT NUMBER: 2404
PROJECT LOCATION: Southborough, MA

DATE STARTED: 4/15/24 **DATE COMPLETED:** 4/15/24
BORING LOCATION: Near center of site
COORDINATES: NA
SURFACE El.: 275 ft. (see note 1) **TOTAL DEPTH:** 21.3 ft.
WEATHER: 40's / Sunny
GROUNDWATER LEVELS:
DURING DRILLING: 10.0 ft. / El. 265.0 ft. Based on sample moisture
AT END OF DRILLING: 4.2 ft. / El. 270.8 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Soil X, Corp.
DRILLING FOREMAN: Edwin Fajardo
DRILLING METHOD: Hollow Stem Auger (4-1/4" I.D.)
DRILL RIG TYPE/MODEL: Diedrich D-70 turbo
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: SG **CHECKED BY:** AS

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	3-3-31-39 (34)	24/17		Topsoil	1.0	S1 - Top 12": Topsoil
		2	S2	34-35-56-39 (91)	24/16		Fill	274.0	Bot. 5": Poorly Graded Gravel with Sand (GP), fine to coarse, subangular, ~30% fine to coarse sand, ~5% fines, brown and white, moist S2 - Silty SAND with Gravel (SM), fine to coarse, 35-40% fines, ~20% fine subangular gravel, brown grey, moist
		4	S3	26-24-21-12 (45)	24/15				S3 - Similar to S2
5	270.0	6	S4	19-81/2" (81/2")	8/8	1		6.0	
		6.7				2	Sand and Gravel	269.0	S4 - Silty SAND with Gravel (SM), fine to medium, 15-20% fines, 15-20% fine subrounded gravel, brown grey, moist REMARK 1: SS bouncing on possible boulder at depth of 6.7 feet. REMARK 2: HSA grinding on possible boulder from depths between 6.7 and 8 feet.
		8	S5	13-15-21-19 (36)	24/8				S5 - Similar to S4
10	265.0	10	S6	13-19-95/3" (114/9")	15/15				S6 - Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 5-10% fines, 20-25% fine to coarse subangular gravel, brown grey, wet
		11.3				3			REMARK 3: HSA grinding on possible boulder from depths between 11.5 and 15 feet.
15	260.0	15	S7	17-28-14-13 (42)	24/17				S7 - Silty SAND with Gravel (SM), fine to coarse, 15-20% fines, 20-25% fine to coarse subangular gravel, brown grey, wet
		17							
20	255.0	20	S8	19-85-60/3" (145/9")	15/15				S8 - Similar to S7
		21.3						21.3	Bottom of borehole at 21.3 feet. Backfilled borehole with drill cuttings.
25	250.0								

GENERAL NOTES:

1. The ground surface elevation was interpolated to the nearest foot based on drawing TP-4 (Sheet 4 of 5) titled: "Topographic Plan, Neary Elementary School, Southborough, MA ," prepared by Beals and Thomas, Inc. (B&T), dated March 22, 2024, and provided to LGCI by Arrowstreet via e-mail on Sepember 3, 2024.

LGCI
Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Rd.
North Billerica, MA 01862
Telephone: 9783305912
Fax: 9783305056

BORING LOG

B-2
PAGE 1 OF 1

CLIENT: Arrowstreet
PROJECT NAME: Proposed Neary Elementary School
LGCI PROJECT NUMBER: 2404
PROJECT LOCATION: Southborough, MA

DATE STARTED: 4/15/24 **DATE COMPLETED:** 4/15/24
BORING LOCATION: Near eastern side of site
COORDINATES: NA
SURFACE EI.: 274 ft. (see note 1) **TOTAL DEPTH:** 15.01 ft.
WEATHER: 50's / Sunny
GROUNDWATER LEVELS:
DURING DRILLING: 4.0 ft. / El. 270.0 ft. Based on sample moisture
AT END OF DRILLING: 2.9 ft. / El. 271.1 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Soil X, Corp.
DRILLING FOREMAN: Edwin Fajardo
DRILLING METHOD: Hollow Stem Auger (4-1/4" I.D.)
DRILL RIG TYPE/MODEL: Diedrich D-70 turbo
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: SG **CHECKED BY:** AS

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	1.0	S1 - Top 12": Topsoil
		2	S1	2-6-13-18 (19)	24/20			273.0	Bot. 8": Well Graded GRAVEL with Silt and Sand (GW-GM), fine to coarse, subangular, ~5% fines, 30-35% fine to coarse sand, grey and white, moist
			S2	20-20-22-80/3" (42)	21/13				S2 - Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 5-10% fines, 15-20% fine to coarse subangular gravel, grey, moist
	270.0	3.8					Fill		
5		4	S3	10-10-9-7 (19)	24/12				S3 - Silty SAND with Gravel (SM), fine to coarse, ~30% fines, ~20% fine subangular gravel, grey, wet
		6	S4	8-17-28-27 (45)	24/17			6.1 267.9	S4 - Top 1": Buried Organic Soil
		8				1			Bot. 16": Silty SAND with Gravel (SM), fine to coarse, ~30% fines, ~20% fine subangular gravel, trace of weathered rock, grey, wet
	265.0								REMARK 1: HSA grinding on possible boulder at depth of 9 feet.
10		10	S5	17-20-20-31 (40)	24/12		Sand and Gravel		S5 - Poorly Graded SAND with Silt and Gravel (SP-SM), fine to coarse, 10-15% fines, 20-25% fine to coarse subrounded gravel, brown, wet
		12				2			REMARK 2: HSA grinding on possible boulder/cobbles at depths between 12 and 15 feet.
	260.0								
15		15	S6	100/0"	0/0			15.0	S6 - No Recovery
									Bottom of borehole at 15.0 feet. Backfilled borehole with drill cuttings.
	255.0								
20									
	250.0								
25									

GENERAL NOTES:

1. The ground surface elevation was interpolated to the nearest foot based on drawing TP-4 (Sheet 4 of 5) titled: "Topographic Plan, Neary Elementary School, Southborough, MA ," prepared by Beals and Thomas, Inc. (B&T), dated March 22, 2024, and provided to LGCI by Arrowstreet via e-mail on Sepember 3, 2024.

LGCI
Lahlaf Geotechnical Consulting, Inc.
100 Chelmsford Rd.
North Billerica, MA 01862
Telephone: 9783305912
Fax: 9783305056

BORING LOG

B-3
PAGE 1 OF 1

CLIENT: Arrowstreet
PROJECT NAME: Proposed Neary Elementary School
LGCI PROJECT NUMBER: 2404
PROJECT LOCATION: Southborough, MA

DATE STARTED: 4/15/24 **DATE COMPLETED:** 4/15/24
BORING LOCATION: Near weastern side of site
COORDINATES: NA
SURFACE El.: 277 ft. (see note 1) **TOTAL DEPTH:** 17 ft.
WEATHER: 50's / Sunny
GROUNDWATER LEVELS:
DURING DRILLING: 2.0 ft. / El. 275.0 ft. Based on sample moisture
AT END OF DRILLING: 2.5 ft. / El. 274.5 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Soil X, Corp.
DRILLING FOREMAN: Edwin Fajardo
DRILLING METHOD: Hollow Stem Auger (4-1/4" I.D.)
DRILL RIG TYPE/MODEL: Diedrich D-70 turbo
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: SG **CHECKED BY:** AS

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	1-2-7-12 (9)	24/19		Topsoil	1.2	S1 - Top 14": Topsoil
	275.0	2	S2	28-26-33-31 (59)	24/17			275.8	Bot. 5": Poorly Graded SAND with Silt (SP-SM), fine to medium, 5-10% fines, 0-5% fine gravel, grey with orange stripes, moist S2 - Top 4": Similar to S1, Bot. 5" Bot. 13": Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 5-10% fines, 35-40% mostly fine subangular gravel, brown grey, wet
5		4	S3	15-20-21-13 (41)	24/16				S3 - Top 7": Similar to S2, Bot. 13" Bot. 9": Silty SAND with Gravel (SM), fine to medium, 15-20% fines, 15-20% fine to coarse subrounded to subangular gravel, brown, wet
	270.0	6	S4	15-13-18-19 (31)	24/4				S4 - Similar to S3, Bot. 9", fine to coarse
		8					Sand and Gravel		
10		10	S5	25-31-61-50 (92)	24/14				S5 - Silty GRAVEL with Sand (GM), fine to coarse, angular, 15-20% fines, 25-30% fine to coarse sand, grey, wet
	265.0	12							
15		15	S6	20-25-26-25 (51)	24/12				S6 - Silty SAND with Gravel (SM), fine to medium, 15-20% fines, 15-20% fine to coarse subangular gravel, grey, wet
	260.0	17						17.0	Bottom of borehole at 17.0 feet. Backfilled borehole with drill cuttings.
20									
	255.0								
25									

GENERAL NOTES:

1. The ground surface elevation was interpolated to the nearest foot based on drawing TP-4 (Sheet 4 of 5) titled: "Topographic Plan, Neary Elementary School, Southborough, MA ," prepared by Beals and Thomas, Inc. (B&T), dated March 22, 2024, and provided to LGCI by Arrowstreet via e-mail on Sepember 3, 2024.

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BORING LOG

B-4
PAGE 1 OF 1

CLIENT: Arrowstreet
PROJECT NAME: Proposed Neary Elementary School
LGCI PROJECT NUMBER: 2404
PROJECT LOCATION: Southborough, MA

DATE STARTED: 4/15/24 **DATE COMPLETED:** 4/15/24
BORING LOCATION: Near southern center of site
COORDINATES: NA
SURFACE EI.: 276 ft. (see note 1) **TOTAL DEPTH:** 19 ft.
WEATHER: 50's / Sunny
GROUNDWATER LEVELS:
DURING DRILLING: 4.0 ft. / El. 272.0 ft. Based on sample moisture
AT END OF DRILLING: 3.1 ft. / El. 272.9 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Soil X, Corp.
DRILLING FOREMAN: Edwin Fajardo
DRILLING METHOD: Hollow Stem Auger (4-1/4" I.D.)
DRILL RIG TYPE/MODEL: Diedrich D-70 turbo
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: SG **CHECKED BY:** AS

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
	275.0	0	S1	1-4-12-10 (16)	24/17		Topsoil	0.8 / 275.2	S1 - Top 10": Topsoil Bot. 7": Poorly Graded SAND with Silt and Gravel (SP-SM), fine to medium, 10-15% fines, 10-15% fine subrounded gravel, light brown, moist
		2	S2	11-14-15-17 (29)	24/13		Subsoil	2.0 / 274.0	S2 - Silty SAND (SM), fine to coarse, ~15% fines, ~35% fine to coarse subrounded gravel, brown, moist
5		4	S3	14-13-9-8 (22)	24/9				S3 - Silty SAND (SM), fine to medium, 20-25% fines, 5-10% fine subrounded gravel, trace of weathered rock, brown grey, wet
	270.0	6	S4	8-7-8-12 (15)	24/8				S4 - Similar to S3
		8				1			REMARK 1: HSA grinding on possibe boulder/cobbles at depth of 8 feet.
10		10	S5	9-9-6-7 (15)	24/12		Sand and Gravel		S5 - Silty SAND with Gravel (SM), fine to coarse, ~15% fines, 15-20% fine to coarse gravel, trace of weathered rock, brown grey, wet
	265.0	12							
15		15	S6	6-6-6-5 (12)	24/7				S6 - Silty SAND (SM), fine to medium, trace of coarse, 35-40% fines, 5-10% fine to coarse subrounded gravel, grey, wet
	260.0	17	S7	7-13-17-26 (30)	24/14				S7 - Poorly Graded SAND with Silt and Gravel (SP-SM), fine to medium, ~10% fines, 15-20% fine to coarse subangular gravel, trace of weathered rock, grey with red, wet
		19						19.0	
20									Bottom of borehole at 19.0 feet. Backfilled borehole with drill cuttings.
	255.0								
25									

GENERAL NOTES:

1. The ground surface elevation was interpolated to the nearest foot based on drawing TP-4 (Sheet 4 of 5) titled: "Topographic Plan, Neary Elementary School, Southborough, MA ," prepared by Beals and Thomas, Inc. (B&T), dated March 22, 2024, and provided to LGCI by Arrowstreet via e-mail on Sepember 3, 2024.

LGCI
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BORING LOG

B-101
PAGE 1 OF 1

CLIENT: Arrowstreet
PROJECT NAME: Proposed Neary Elementary School
LGCI PROJECT NUMBER: 2404
PROJECT LOCATION: Southborough, MA

DATE STARTED: 8/22/24 **DATE COMPLETED:** 8/22/24
BORING LOCATION: NE of existing school
COORDINATES: NA
SURFACE El.: 270 ft. (see note 1) **TOTAL DEPTH:** 20.8 ft.
WEATHER: 70's / Sunny
GROUNDWATER LEVELS:
DURING DRILLING: 7.0 ft. / El. 263.0 ft. Based on sample moisture
AT END OF DRILLING: 7.0 ft. / El. 263.0 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Soil X, Corp.
DRILLING FOREMAN: Edwin Fajardo
DRILLING METHOD: Hollow Stem Auger (4-1/4" I.D.)
DRILL RIG TYPE/MODEL: Diedrich D-70 turbo
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: BH **CHECKED BY:** JKW

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
							Asphalt	0.5 / 269.5	
		1	S1	15-21-25-24 (46)	24/13		Fill		S1 - Poorly Graded SAND (SP), fine to medium, trace coarse, 0-5% fines, 25-30% fine to coarse subangular gravel, trace of asphalt, dark brown, moist
		3	S2	21-22-22-16 (44)	24/12				S2 - Poorly Graded SAND with Silt (SP-SM), fine to medium, trace coarse, 10-15% fines, 25-30% fine to coarse subangular gravel, trace of asphalt, dark brown, moist
5	265.0	5	S3	18-18-11-11 (29)	24/11				S3 - Similar to S2
		7	S4	7-6-7-9 (13)	24/15			7.0 / 263.0 ▼	S4 - Silty SAND (SM), fine, 30-35% fines, trace of wood, trace of organic odor, trace of organic soil, grey to dark brown, wet
		9	S5	6-8-10-8 (18)	24/19		Swamp Deposits		S5 - Similar to S4, dark grey
10	260.0	11	S6	4-6-12-14 (18)	24/19	1		11.0 / 259.0	REMARK 1: HSA chattering between depths of 11 to 19 feet beneath the ground surface.
		13	S7	13-12-11-10 (23)	24/16				S6 - Poorly Graded SAND with Silt (SP-SM), fine to coarse, 10-15% fines, dark grey, wet
15	255.0	15	S8	18-14-38-16 (52)	24/11				S7 - Silty SAND (SM), fine to coarse, ~20% fines, 0-5% fine subangular gravel, dark grey, wet
		17					Sand and Gravel		S8 - Silty SAND (SM), fine to medium, trace coarse, 20-25% fines, 35-40% fine to coarse subangular gravel, trace of weathered rock, grey, wet
		19	S9	40-48-18-93/4" (66)	22/11				S9 - Similar to S8, 30-35% fine to coarse subangular gravel
20	250.0	20.8						20.8	Bottom of borehole at 20.8 feet. Backfilled borehole with drill cuttings and 2 bags of gravel. Restored roadway with cold patch asphalt.
25	245.0								

GENERAL NOTES:

1. The ground surface elevation was interpolated to the nearest foot based on drawing TP-5 (Sheet 5 of 5) titled: "Topographic Plan, Neary Elementary School, Southborough, MA ," prepared by Beals and Thomas, Inc. (B&T), dated March 22, 2024, and provided to LGCI by Arrowstreet via e-mail on Sepember 3, 2024.

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BORING LOG

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PAGE 1 OF 1

CLIENT: Arrowstreet
PROJECT NAME: Proposed Neary Elementary School
LGCI PROJECT NUMBER: 2404
PROJECT LOCATION: Southborough, MA

DATE STARTED: 8/22/24 **DATE COMPLETED:** 8/22/24
BORING LOCATION: North of existing school
COORDINATES: NA
SURFACE El.: 272 ft. (see note 1) **TOTAL DEPTH:** 19.4 ft.
WEATHER: 70's / Sunny
GROUNDWATER LEVELS:
DURING DRILLING: 5.0 ft. / El. 267.0 ft. Based on sample moisture
AT END OF DRILLING: 8.6 ft. / El. 263.4 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Soil X, Corp.
DRILLING FOREMAN: Edwin Fajardo
DRILLING METHOD: Hollow Stem Auger (4-1/4" I.D.)
DRILL RIG TYPE/MODEL: Diedrich D-70 turbo
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: BH **CHECKED BY:** JKW

Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
		0	G1		10/10		Asphalt	0.8	G1 - Asphalt
		0.8 1	S1	14-16-68-45/1" (84)	19/12		Fill	271.2	S1 - Silty SAND with Gravel (SM), fine to coarse, 15-20% fines, 25-30% fine to coarse subangular gravel, dark brown, moist
	270.0	2.6 3	S2	15-21-32-31 (53)	24/14			3.0 269.0	S2 - Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 5-10% fines, 35-40% fine subangular gravel, brown, moist
5		5	S3	19-18-16-16 (34)	24/16		Sand and Gravel		S3 - Well Graded SAND with Silt (SW-SM), fine to coarse, 10-15% fines, 5-10% fine to coarse subangular gravel, brown, wet
	265.0	7							
		9	S4	24-63-43/4" (106/10")	16/9			9.0 263.0	S4 - Silty SAND with Gravel (SM), fine to coarse, 20-25% fines, 30-35% fine to coarse subangular gravel, trace of weathered rock, brown, wet
10		10.3							
	260.0								
		14	S5	27-29-30-24 (59)	24/14		Weathered Rock		S5 - Silty SAND with Gravel (SM), fine to coarse, 20-25% fines, 20-25% fine to coarse subangular gravel, trace of weathered rock, light brown to grey, wet
15		16							
	255.0								
		19 19.4	S6	101/5"	5/5			19.4	S6 - Silty SAND with Gravel (SM), fine to coarse, 15-20% fines, 15-20% fine to coarse subangular gravel, brown, wet
20									Bottom of borehole at 19.4 feet. Backfilled borehole with drill cuttings, 1 bag of gravel, 1 bag of sand, and 1 bag of concrete. Restored roadway with cold patch asphalt.
	250.0								
25									

GENERAL NOTES:

1. The ground surface elevation was interpolated to the nearest foot based on drawing TP-5 (Sheet 5 of 5) titled: "Topographic Plan, Neary Elementary School, Southborough, MA ," prepared by Beals and Thomas, Inc. (B&T), dated March 22, 2024, and provided to LGCI by Arrowstreet via e-mail on Sepember 3, 2024.

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BORING LOG

B-103
PAGE 1 OF 1

CLIENT: Arrowstreet
PROJECT NAME: Proposed Neary Elementary School
LGCI PROJECT NUMBER: 2404
PROJECT LOCATION: Southborough, MA

DATE STARTED: 8/22/24 **DATE COMPLETED:** 8/22/24
BORING LOCATION: West of existing school
COORDINATES: NA
SURFACE El.: 273 ft. (see note 1) **TOTAL DEPTH:** 19.3 ft.
WEATHER: 70's / Sunny
GROUNDWATER LEVELS:
DURING DRILLING: 4.0 ft. / El. 269.0 ft. Based on sample moisture
AT END OF DRILLING: 16.0 ft. / El. 257.0 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Soil X, Corp.
DRILLING FOREMAN: Edwin Fajardo
DRILLING METHOD: Hollow Stem Auger (4-1/4" I.D.)
DRILL RIG TYPE/MODEL: Diedrich D-70 turbo
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: BH **CHECKED BY:** JKW

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	2-3-4-6 (7)	24/11		Topsoil	2.0	S1 - Topsoil
	270.0	2	S2	3-3-3-5 (6)	24/19		Fill	271.0	S2 - Silty SAND (SM), 30-35% fines, 0-5% fine subangular gravel, trace of wood, trace of organic soil, dark brown, moist
5		4	S3	3-4-11-13 (15)	24/19				S3 - Top 10": Similar to S2, wet Bot. 9": Silty SAND (SM), mostly fine, 30-35% fines, grey, trace of wood, wet
		6	S4	17-15-16-15 (31)	24/10			6.0	
	265.0	8					Sand and Gravel	267.0	S4 - Silty SAND (SM), fine to coarse, 20-25% fines, 25-30% fine to coarse subangular gravel, brown, wet
10		9	S5	7-5-13-16 (18)	24/9				S5 - Silty SAND (SM), fine to medium, trace coarse, 15-20% fines, 0-5% fine subangular gravel, brown, wet
		11							
	260.0								
15		14	S6	5-9-11-13 (20)	24/11				S6 - Silty SAND (SM), fine to medium, 30-35% fines, 0-5% fine subangular gravel, light brown, wet
		16							
	255.0								
		19						19.3	
		19.3	S7	101/3"	3/0				S7 - No Recovery
20									Bottom of borehole at 19.3 feet. Backfilled borehole with drill cuttings and 2 bags of gravel.
	250.0								
25									

GENERAL NOTES:

1. The ground surface elevation was interpolated to the nearest foot based on drawing TP-5 (Sheet 5 of 5) titled: "Topographic Plan, Neary Elementary School, Southborough, MA ," prepared by Beals and Thomas, Inc. (B&T), dated March 22, 2024, and provided to LGCI by Arrowstreet via e-mail on Sepember 3, 2024.

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Fax: 9783305056

BORING LOG

B-104
PAGE 1 OF 1

CLIENT: Arrowstreet
PROJECT NAME: Proposed Neary Elementary School
LGCI PROJECT NUMBER: 2404
PROJECT LOCATION: Southborough, MA

DATE STARTED: 8/22/24 **DATE COMPLETED:** 8/22/24
BORING LOCATION: SW of existing school
COORDINATES: NA
SURFACE El.: 272 ft. (see note 1) **TOTAL DEPTH:** 19.4 ft.
WEATHER: 70's / Sunny
GROUNDWATER LEVELS:
DURING DRILLING: 0.0 ft. / El. 272.0 ft. Based on sample moisture
AT END OF DRILLING: 6.6 ft. / El. 265.4 ft.
OTHER: -

DRILLING SUBCONTRACTOR: Soil X, Corp.
DRILLING FOREMAN: Edwin Fajardo
DRILLING METHOD: Hollow Stem Auger (4-1/4" I.D.)
DRILL RIG TYPE/MODEL: Diedrich D-70 turbo
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: BH **CHECKED BY:** JKW

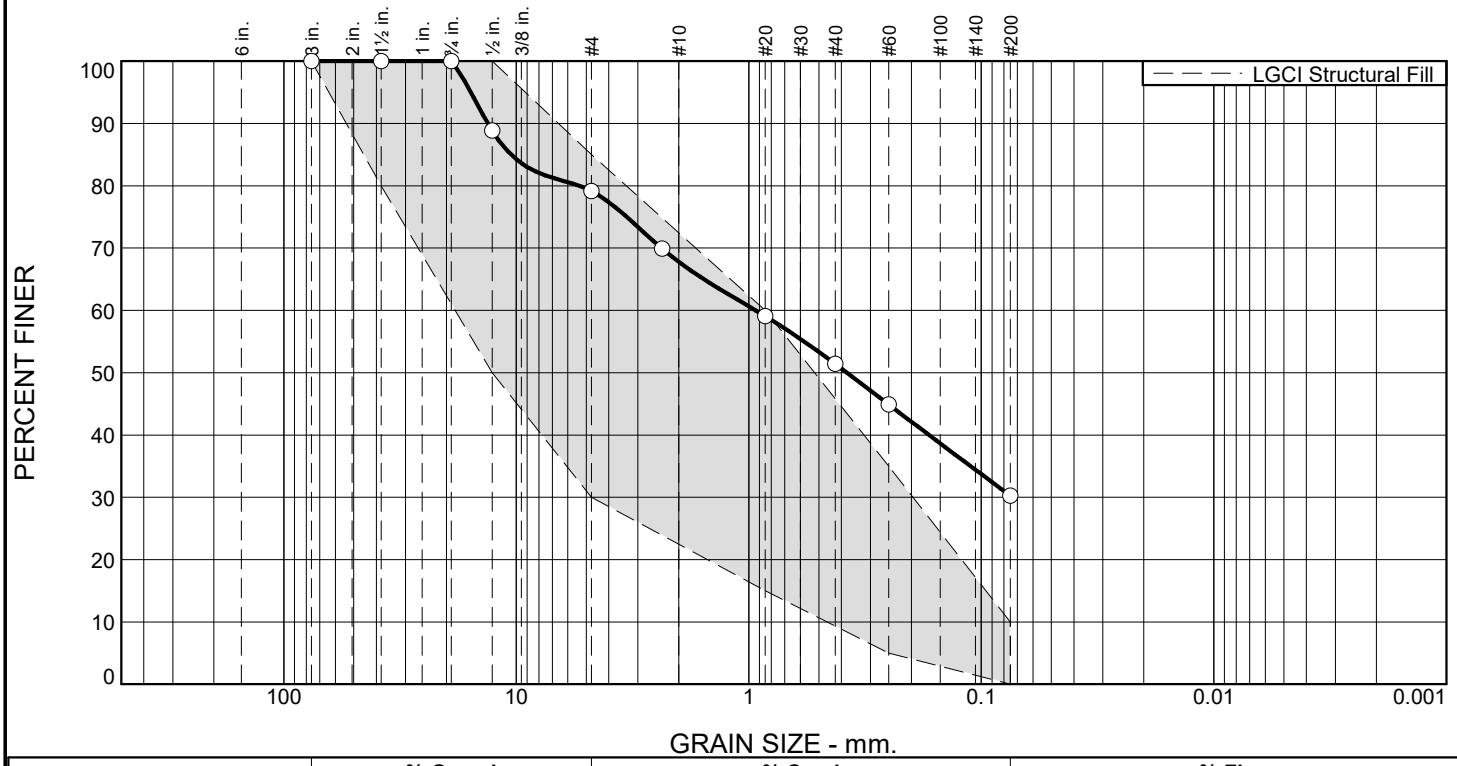
Depth (ft.)	El. (ft.)	Sample Interval (ft.)	Sample Number	Blow Counts (N Value)	Pen./Rec. (in.)	Remark	Strata	Depth El.(ft.)	Material Description
		0					Topsoil	0.8 271.2	S1 - Top 9": Topsoil
	270.0	2	S1	3-3-2-0 (5)	24/13		Fill		Bot. 4": Well Graded SAND with Silt (SW-SM), fine to coarse, ~10% fines, 0-5% fine subangular gravel, brown, wet
			S2	1-2-4-6 (6)	24/8				S2 - Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 5-10% fines, 15-20% fine to coarse subangular gravel, brown, wet
		4							
5			S3	2-1-2-2 (3)	24/6				S3 - Silty SAND (SM), fine to coarse, 30-35% fines, 0-5% fine subangular gravel, trace of organic soil, trace of roots, dark brown to black, wet
		6							
	265.0		S4	1-2-2-2 (4)	24/7				S4 - Similar to S3, 10-15% fine to coarse subangular gravel
		8							
			S5	2-2-3-16 (5)	24/15				S5 - Silty SAND (SM), fine to coarse, 30-35% fines, ~5% fine subangular gravel, trace of roots, grey, wet
10		10	S6	6-19/0" (19/0")	6/0	1		10.5 261.5	S6 - No Recovery REMARK 1: Split spoon bouncing observed at depth of 10.5 feet beneath the ground surface. Sampling terminated early to observe sample.
		10.5	S7	25-17-16-14 (33)	24/6		Sand and Gravel		S7 - Silty SAND with Gravel (SM), fine to coarse, 30-35% fines, 30-35% fine subangular gravel, grey, wet
	260.0	12.5							
		14							
15			S8	17-12-15-17 (27)	24/10				S8 - Similar to S7, 20-25% fines, brown to grey
		16							
	255.0								
		19	S9	102/5"	5/4		Weathered Rock	19.0 253.0	S9 - Silty SAND (SM), fine to coarse, 20-25% fines, 25-30% fine to coarse subangular gravel, trace of weathered rock, brown, wet
20		19.4						19.4	Bottom of borehole at 19.4 feet. Backfilled borehole with drill cuttings.
	250.0								
25									

GENERAL NOTES:

1. The ground surface elevation was interpolated to the nearest foot based on drawing TP-5 (Sheet 5 of 5) titled: "Topographic Plan, Neary Elementary School, Southborough, MA ," prepared by Beals and Thomas, Inc. (B&T), dated March 22, 2024, and provided to LGCI by Arrowstreet via e-mail on Sepember 3, 2024.

Appendix B – Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	20.9	11.3	16.4	21.1	30.3	

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"	88.9	50.0 - 100.0	
#4	79.1	30.0 - 85.0	
#8	69.9		
#20	59.1	15.0 - 60.0	
#40	51.4		
#60	44.9	5.0 - 35.0	X
#200	30.3	0.0 - 10.0	X

* LGCI Structural Fill

Material Description

ASTM (D 2488) Classification: Silty SAND with Gravel (SM), fine to coarse, 30% fines, 20% fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

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

Coefficients

D_{90}= 13.2571 D_{85}= 10.5117 D_{60}= 0.9340
D_{50}= 0.3778 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Fill Material

Date Received: 4/15/24 **Date Tested:** 4/30/24

Tested By: SG

Checked By: SL

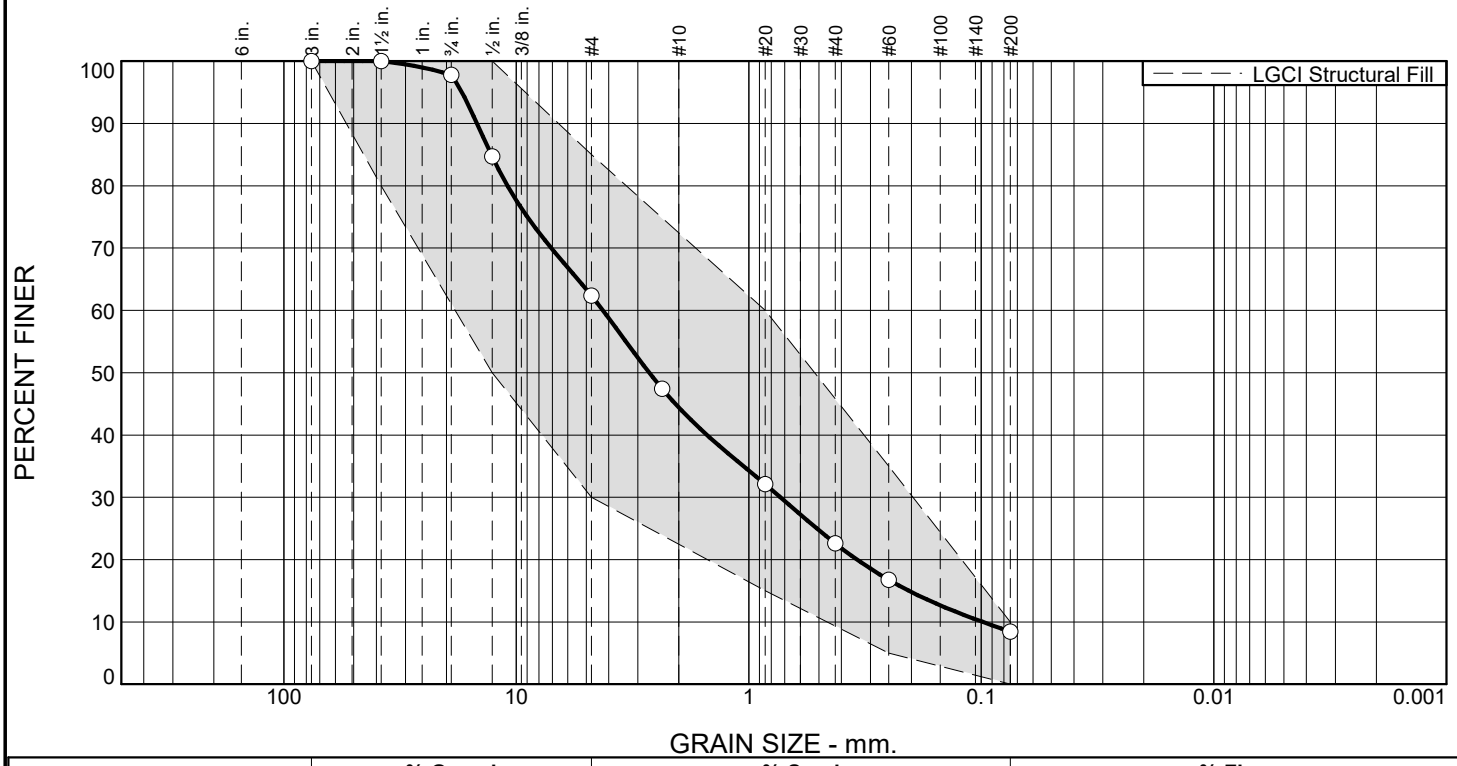
Location: B-2
Sample Number: S3 **Depth:** 4'-6'

Date Sampled: 4/15/24

LGCI
Lahlaf Geotechnical Consulting, Inc.

Client: Arrowstreet
Project: Proposed Neary Elementary School
Southborough, Massachusetts
Project No: 2404 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.2	35.4	18.0	21.8	14.2	8.4	

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"	97.8		
0.5"	84.7	50.0 - 100.0	
#4	62.4	30.0 - 85.0	
#8	47.4		
#20	32.1	15.0 - 60.0	
#40	22.6		
#60	16.8	5.0 - 35.0	
#200	8.4	0.0 - 10.0	

* LGCI Structural Fill

Material Description

ASTM (D 2488) Classification: Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 5-10% fines, 35-40% mostly fine gravel

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 14.7722 D_{85}= 12.8177 D_{60}= 4.2431
D_{50}= 2.6797 D_{30}= 0.7306 D_{15}= 0.2046
D_{10}= 0.0986 C_u= 43.05 C_c= 1.28

Remarks

Natural Soil Material

Date Received: 4/15/24 **Date Tested:** 4/30/24

Tested By: SG

Checked By: SL

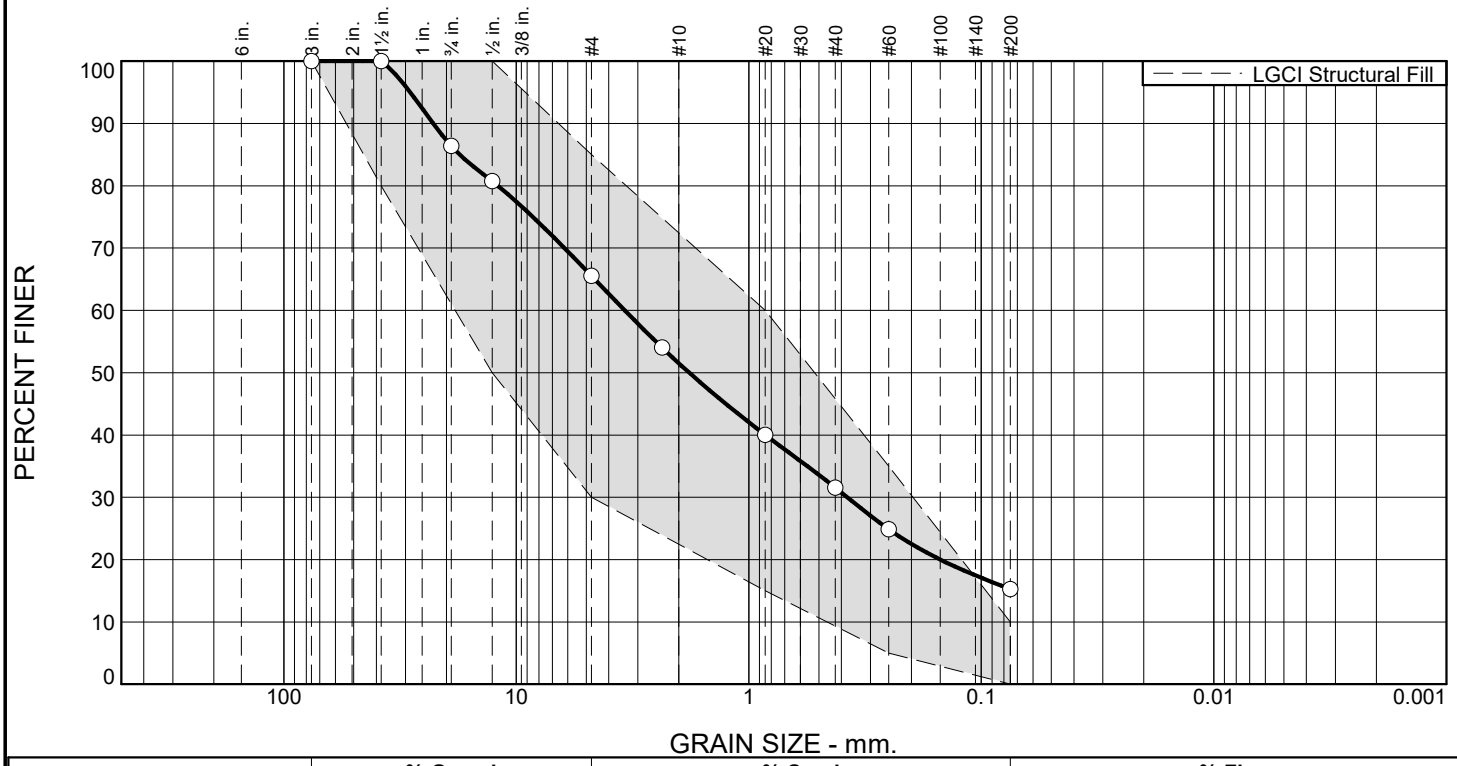
Location: B-3
Sample Number: S2 Bot. 13" **Depth:** 2'-4'

Date Sampled: 4/15/24

LGCI
Lahlaf Geotechnical Consulting, Inc.

Client: Arrowstreet
Project: Proposed Neary Elementary School
Southborough, Massachusetts
Project No: 2404 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	13.6	20.9	14.0	19.9	16.4	15.2	

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"	86.4		
0.5"	80.7	50.0 - 100.0	
#4	65.5	30.0 - 85.0	
#8	54.0		
#20	40.0	15.0 - 60.0	
#40	31.6		
#60	24.9	5.0 - 35.0	
#200	15.2	0.0 - 10.0	X

* LGCI Structural Fill

Material Description

ASTM (D 2488) Classification: Silty SAND with Gravel (SM), fine to coarse, 15-20% fines, 30-35% fine to coarse gravel

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 22.7705 D_{85}= 17.5075 D_{60}= 3.4161
D_{50}= 1.8018 D_{30}= 0.3765 D_{15}=
D_{10}= C_u= C_c=

Remarks

Natural Soil Material

Date Received: 4/15/24 **Date Tested:** 4/30/24

Tested By: SG

Checked By: SL

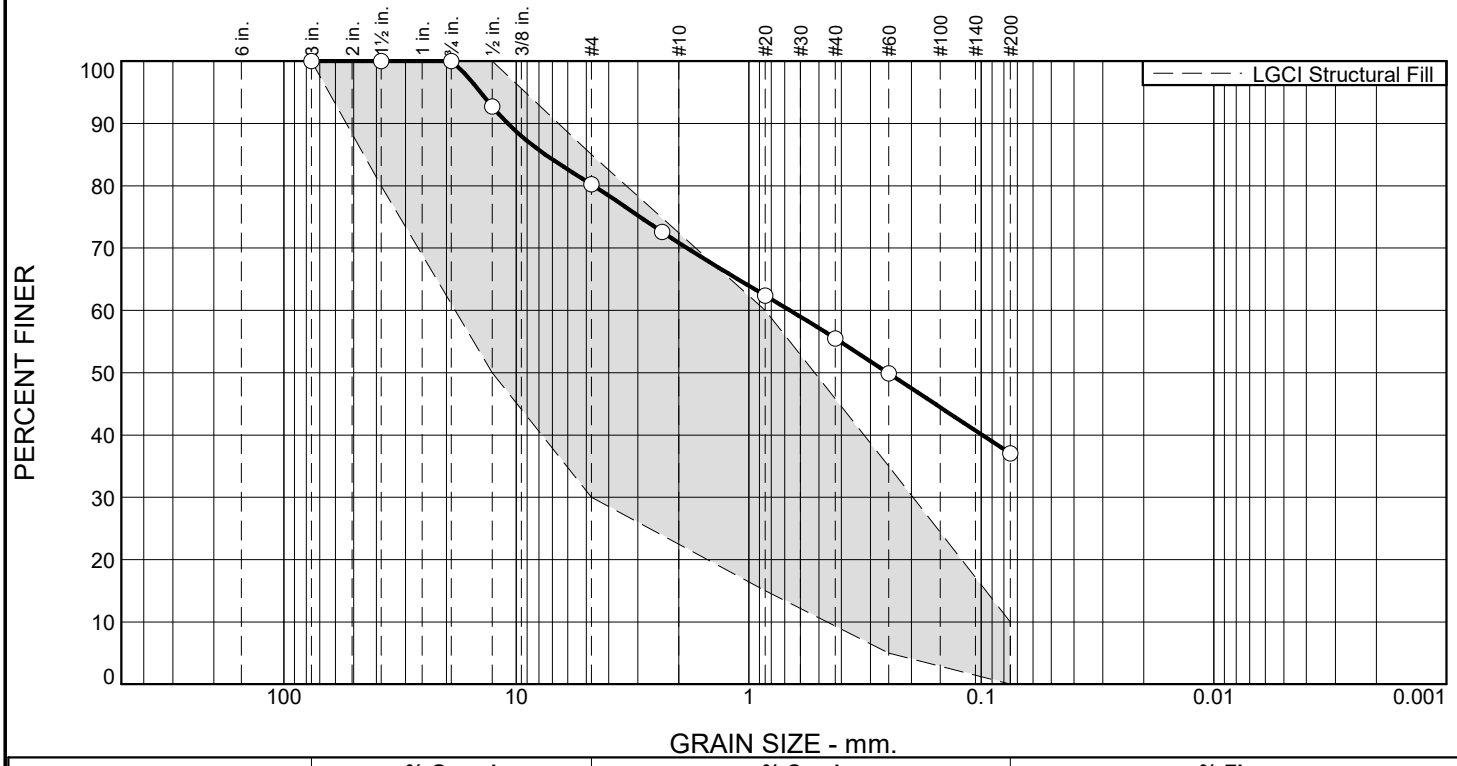
Location: B-4
Sample Number: S2 **Depth:** 2'-4'

Date Sampled: 4/15/24

LGCI
Lahlaf Geotechnical Consulting, Inc.

Client: Arrowstreet
Project: Proposed Neary Elementary School
Southborough, Massachusetts
Project No: 2404 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	19.8	9.3	15.4	18.5	37.0	

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"	92.7	50.0 - 100.0	
#4	80.2	30.0 - 85.0	
#8	72.6		
#20	62.4	15.0 - 60.0	X
#40	55.5		
#60	49.9	5.0 - 35.0	X
#200	37.0	0.0 - 10.0	X

* LGCI Structural Fill

Material Description

STM (D 2488) Classification: Silty SAND with Gravel (SM), fine to coarse, 35-40% fines, 15-20% fine gravel

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 10.8651 D_{85}= 7.4884 D_{60}= 0.6656
D_{50}= 0.2525 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Fill Material

Date Received: 4/15/24 **Date Tested:** 4/30/24

Tested By: SG

Checked By: SL

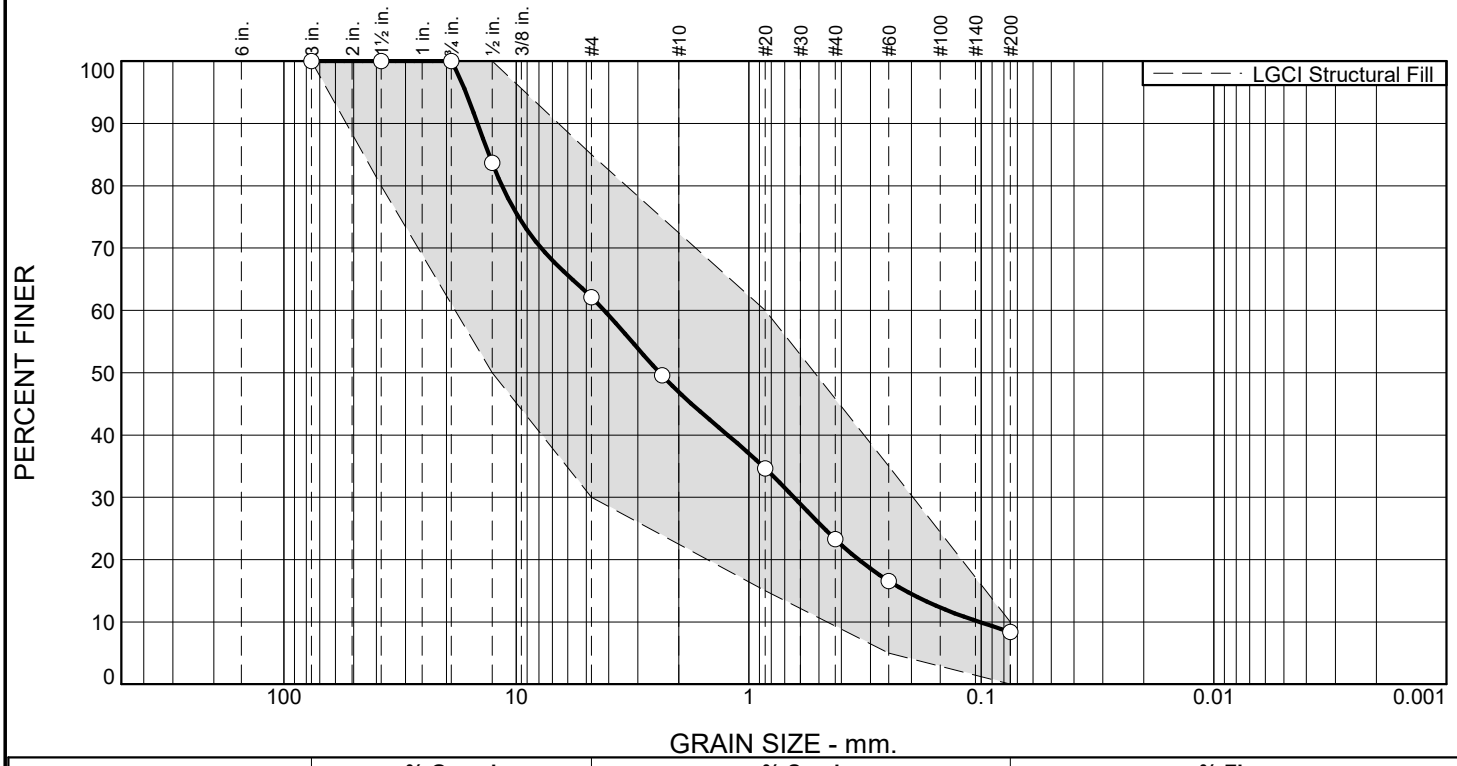
Location: B-5
Sample Number: S2 **Depth:** 2'-4'

Date Sampled: 4/15/24

LGCI
Lahlaf Geotechnical Consulting, Inc.

Client: Arrowstreet
Project: Proposed Neary Elementary School
Southborough, Massachusetts
Project No: 2404 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	37.9	15.2	23.6	14.9	8.4	

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	83.7	50.0 - 100.0	
#4	62.1	30.0 - 85.0	
#8	49.6		
#20	34.6	15.0 - 60.0	
#40	23.3		
#60	16.6	5.0 - 35.0	
#200	8.4	0.0 - 10.0	

* LGCI Structural Fill

Material Description

ASTM (D 2488) Classification: Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 5-10% fines, 35-40% fine subangular gravel, brown

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 14.6883 D_{85}= 13.1130 D_{60}= 4.1852
D_{50}= 2.4207 D_{30}= 0.6406 D_{15}= 0.2122
D_{10}= 0.1022 C_u= 40.95 C_c= 0.96

Remarks

Natural sand and gravel sample.

Date Received: 8/22/24 **Date Tested:** 8/30/24

Tested By: JKW

Checked By: SG

Location: Boring B-102
Sample Number: S2 **Depth:** 3.0'-5.0'

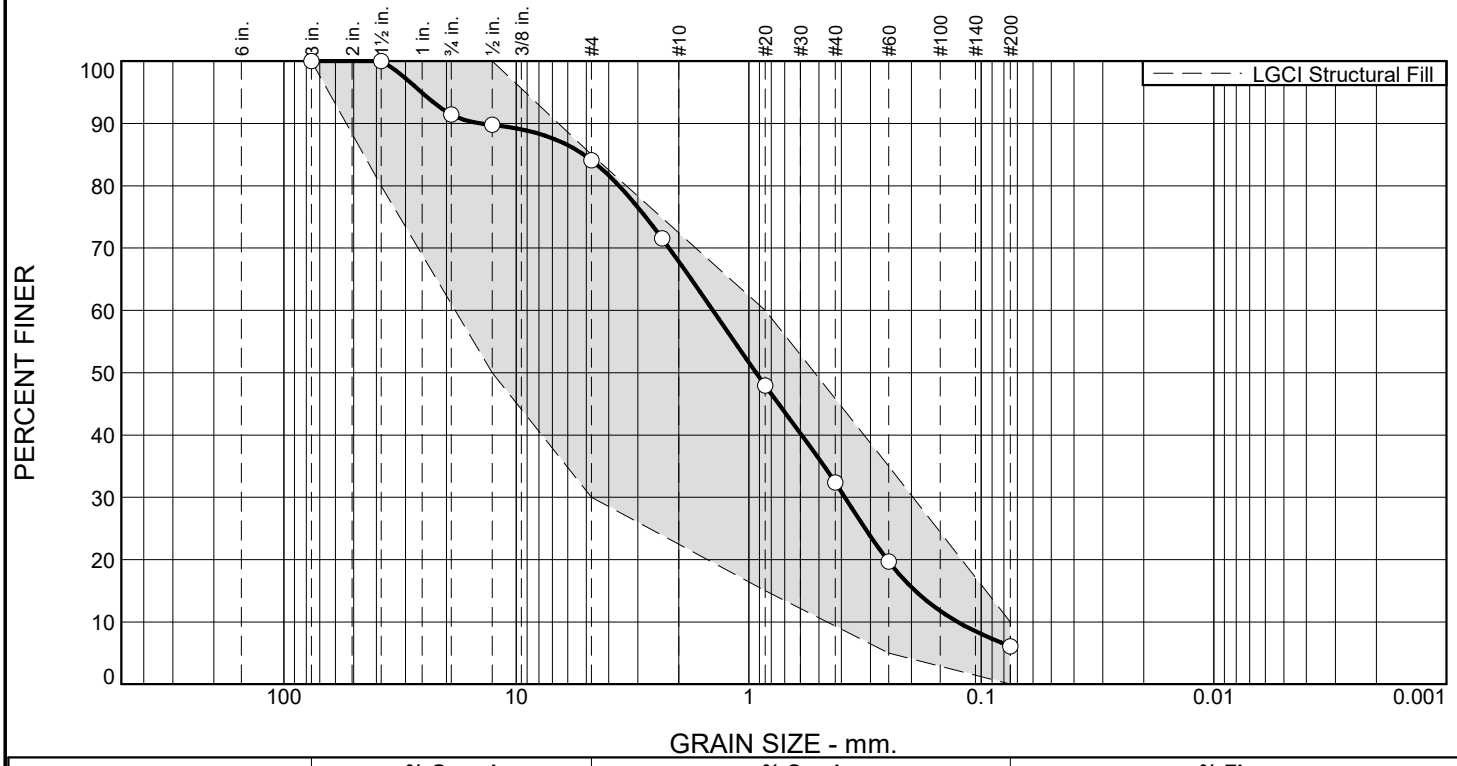
Date Sampled: 8/22/24

LGCI
Lahlaf Geotechnical Consulting, Inc.

Client: Arrowstreet
Project: Proposed Neary Elementary School, Southborough, MA

Project No: 2404 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	8.6	7.3	16.2	35.5	26.3	6.1	

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"	91.4		
0.5"	89.8	50.0 - 100.0	
#4	84.1	30.0 - 85.0	
#8	71.6		
#20	47.9	15.0 - 60.0	
#40	32.4		
#60	19.7	5.0 - 35.0	
#200	6.1	0.0 - 10.0	

* LGCI Structural Fill

Material Description

ASTM (D 2488) Classification: Well Graded SAND with Silt and Gravel (SW-SM), fine to coarse, 5-10% fines, 15-20% fine to coarse subangular gravel, brown

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}= 14.1142 D_{85}= 5.1317 D_{60}= 1.4263
D_{50}= 0.9309 D_{30}= 0.3858 D_{15}= 0.1922
D_{10}= 0.1264 C_u= 11.28 C_c= 0.83

Remarks

Fill sample.

Date Received: 8/22/24 **Date Tested:** 8/30/24

Tested By: JKW

Checked By: SG

Location: Boring B-104
Sample Number: S2 **Depth:** 2.0'-4.0'

Date Sampled: 8/22/24

LGCI
Lahlaf Geotechnical Consulting, Inc.

Client: Arrowstreet
Project: Proposed Neary Elementary School, Southborough, MA

Project No: 2404 **Figure**