JOHN TURNER
CONSULTING

GEOTECHNICAL INVESTIGATION REPORT

PROPOSED PUBLIC WORKS FACILITY
Park Place
Milton, Vermont 05468

Prepared for:

Krebs & Lansing Consulting Engineers, Inc
164 Main Street
Colchester, Vermont 05446

Prepared by:

John Turner Consulting, Inc.
12 Gregory Drive, Suite 7
South Burlington, Vermont 05403

JTC Project No. 21-04-079

December 13, 2021

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No. 110154

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December 13, 2021
Krebs & Lansing Consulting Engineers, Inc
164 Main Street
Colchester, Vermont 05446
Derick.read@krebsandlansing.com
P: 802.878.0375
Attn: Derick Read

RE: **Geotechnical Investigation Report**
Proposed Public Works Facility
Park Place
Milton, Vermont 05403

Dear Mr. Read:

In accordance with our proposal and authorization to proceed, John Turner Consulting, Inc. (JTC) has completed a geotechnical investigation for the above captioned project. Presented herein and attached are the results of the site subsurface investigation, and our recommendations regarding the design and construction of the foundation, and other geotechnical related concerns or issues.

We appreciate the opportunity to assist you on this venture and we look forward to working with you on this project through its completion. Please do not hesitate to contact us if you have any questions or require additional information.

Sincerely,
JOHN TURNER CONSULTING, INC.

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1.0 INTRODUCTION

John Turner Consulting, Inc. (JTC) is pleased to present this Geotechnical Investigation Report for the proposed public works facility to be located at Park Place in Milton, Vermont. Geotechnical explorations, laboratory testing, and engineering evaluations were conducted in general accordance with our proposed scope of services submitted to Krebs & Lansing Consulting Engineers, Inc on July 30, 2021.

The purpose of the geotechnical investigation was to obtain information on the subsurface conditions at the site and to provide geotechnical engineering recommendations to support the planning, design, and construction of the proposed public works facility. This investigation did not include an environmental assessment relative to oil, gasoline, solid waste, and/or other hazardous materials. Similarly, this investigation/evaluation did not include review of site design or construction issues such as infiltration systems, dry wells, underground utilities, protection of existing structures, retaining walls, temporary excavation support, and/or other site/temporary design issues unless specifically addressed herein.

Geotechnical explorations and laboratory testing services were performed in October and November of 2021. This report summarizes available project information, presents the geotechnical exploration and laboratory testing programs, describes the subsurface conditions encountered, and provides geotechnical engineering recommendations to support the planning, design, and construction of the proposed new building. The contents of this report are subject to the attached *Limitations*.

2.0 PROJECT INFORMATION

The following subsections provide general descriptions of the site, the regional geologic setting, and the proposed development.

2.1 Site Description

The subject site is currently an undeveloped, wooded parcel located on Park Place about 1000 feet south of its intersection with Bombardier Road.

2.2 Regional Geologic Setting

JTC's review of the "Surficial Material of the Milton-St. Alban Region" map, subsurface conditions at the site are expected to consist of marine or lacustrine sand and gravel deposits.

2.3 Proposed Development

JTC understands that the proposed development consists of the construction of a new single-story, approximately 28,500 square foot (sf) public works building, and a 14,400-sf salt shed. We understand that the intent is to support the proposed buildings on conventional shallow spread footing foundations with a concrete slab-on-grade.

The provided Plans does not indicate a finish-floor-elevation (FFE) for the proposed building but based on our conversation with Krebs & Lansing Consulting Engineers, Inc., JTC understands that proposed site grades will be raised by approximately 3.5 feet above ground surface such that major fills will be required for the proposed development.

Site-specific structural loading was not available at the time of this report. As such, JTC has assumed the following structural loading conditions based on our experience with similar developments:

- Strip/wall footing loads will be on the order of 2 to 3 kips per linear foot or less;
- Column loads will be on the order of 50 kips or less; and
- Live loads applied to the floor slab-on-grade will be on the order of 125 pounds per square foot (psf) or less.

3.0 GEOTECHNICAL EXPLORATIONS

JTC subcontracted Cascade Environmental to drill eight (8) geotechnical test borings (designated as B-1 through B-4, B-6, B-7, B-8 and B-9) via an ATV-mounted drill rig. JTC directed the drilling, testing, and sampling activities and logged the subsurface conditions encountered at each boring location.

The exploration locations were selected in relation to the existing site features and proposed development, and under the constraints of drill rig access and utility conflicts. Subsequently, the relative location of each exploration was established via measurements from existing site features and scaling the dimensions onto the provide

The test borings were advanced to depths ranging from 20 to 40 feet below the ground surface (bgs) utilizing 4¼-inch inside-diameter continuous-flight hollow-stem-augers (HSAs). As the borings were advanced, standard penetration tests (SPTs) were conducted at regular intervals and soil samples were obtained via 2-inch outside-diameter split-spoon samplers driven by a 140-pound Safe-T hammer. SPTs were performed in general accordance with ASTM D1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.

Soil samples were sealed in moisture-tight containers and returned to JTC's office for further review, classification, and/or geotechnical laboratory testing. The test borings were backfilled with soil cuttings upon completion of drilling. Detailed records of the soil, drilling, testing, sampling performed, and groundwater conditions observed at each test boring location are provided on the attached *Test Boring Logs*.

4.0 GEOTECHNICAL LABORATORY TESTING

JTC selected representative soil samples for geotechnical laboratory testing at our in-house laboratory. The following tests were performed:

- 2 Moisture contents;
- 2 Particle-size analyses

Geotechnical laboratory testing was performed in general accordance with ASTM procedures. Test results are provided on the attached *Geotechnical Laboratory Testing Reports*.

5.0 SUBSURFACE CONDITIONS

The following subsections describe the site soil, bedrock, and groundwater conditions encountered, based on results of the geotechnical explorations and laboratory testing. Detailed descriptions of the conditions observed at each test boring are provided on the attached *Test Boring Logs*.

5.1 Soil Profile

The overburden soils encountered at the test boring locations appear to be consistent with those described by the published geologic data. The primary soil strata are briefly described in the paragraphs below.

5.1.1 Forest Mat

Dark brown silty sand (SM) with frequent rootlets were encountered at the ground surface at all boring locations. This layer was approximately 0.5 to 2 ft thick across the site. These soils were considered to be very loose to loose based on SPT N-Values.

5.1.2 Marine Sand

Native granular soils described primarily as light brown to orange, Sand with silt (SP-SM) to poorly graded Sand (SP) were encountered beneath the Forest Mat at each exploration location. The Sand layer extended to a depth of approximately 2 to 7 feet bgs. These soils were considered to be very loose to medium dense based on SPT N-Values ranging from 6 to 14.

5.1.3 Lacustrine and Marine Silt

Native soils described primarily as grey-brown to grey Silt (ML) to sandy clayey Silt (CL-ML) were encountered beneath the Fill at each of the exploration locations. The Silt and Sand were encountered at depths of 20 to 40 feet bgs. These soils were considered to be very loose to medium dense based on SPT N-Values.

5.2 Bedrock

Practical refusal to further penetration of the augers and split-spoon sampler was encountered at boring location B-4 at depth 40.0 feet bgs. The refusal is interpreted to be refusal on probable bedrock. Bedrock may not impact excavation/construction of shallow foundations, depending on the final design FFE.

5.3 Groundwater

Groundwater and/or wet soils was encountered at a depth of approximately 7.5 feet bgs to 12 feet bgs at all borings at the time of drilling. Short-term (i.e., during drilling, upon completion of drilling, and/or a few hours after drilling) water levels observed in test borings performed in silt soils should be considered approximate. JTC estimates that this investigation occurred during a period of seasonally normal ground water. Site groundwater levels should be expected to fluctuate seasonally and in response to precipitation events, construction activity, site use, and adjacent site use.

6.0 GEOTECHNICAL ANALYSIS & RECOMMENDATIONS

The evaluation of the site and the proposed development was based on the subsurface conditions encountered at the geotechnical test borings, results of geotechnical laboratory testing, conceptual site plans, and preliminary/assumed structural loading conditions, as described herein.

Subsequently, JTC believes that the proposed building can be supported on a system of continuous and/or isolated shallow spread footings bearing on *Granular Backfill (VAOT 704.08A)* and/or improved subgrade soils, provided that the design and construction recommendations presented herein are satisfied.

The evaluation of the site and the proposed development was based on the subsurface conditions encountered at the geotechnical test borings, results of geotechnical laboratory testing, preliminary site plans, and preliminary/assumed structural loading conditions, as described herein.

6.1 Site Preparation and Grading

Site preparation and grading should be performed in accordance with the following procedures:

- A geotechnical engineer should directly observe site preparation and grading activities;
- The site soils contain substantial proportions of fine sand, and silt, and may degrade and/or become unworkable when subjected to construction traffic or other disturbance during wet conditions. As such, site preparations, grading, and earthworks should be performed during a dry season if possible. The Contractor shall be aware of these conditions and must take precautions to minimize subgrade disturbance. Such precautions may include diverting storm run-off away from construction areas, reducing traffic in sensitive areas, minimizing the extent of exposed subgrade if inclement weather is forecast, backfilling excavations and footings as soon as practicable, grading (and compacting) exposed subgrades to promote surface water run-off, and maintaining an effective dewatering program, as necessary. Over-excavation to remove degraded or unworkable subgrade soils should be anticipated and budgeted (cost and schedule);
- Any existing buildings, structures, and/or associated foundations (including footings, foundation walls, slabs-on-grade, and/or basements) should be completely removed from proposed building and pavement areas and replaced/backfilled with properly placed and compacted *Structural Fill;*
- Any existing subsurface utilities and underground structures should be completely removed from the footprint of the proposed building and replaced/backfilled with properly placed and compacted *Structural Fill.* Any existing subsurface utilities in proposed pavement areas should be removed and/or appropriately abandoned in place (e.g., pressure grouting), as approved by the on-site geotechnical engineer;
- The site should be cleared and stripped of any existing asphalt-concrete pavement not designated to remain; existing trees/vegetation not designated to remain; Topsoil, Rootmat, forest mat; loamy/organic-laden Subsoil; and any otherwise unsuitable materials;
- In cut areas, the final foot of excavation should be performed using a smooth-edged cutting bucket (no teeth) to minimize subgrade disturbance;
- *Granular Backfill for Structures* (VAOT 704.08A) should be used for subgrade fill in the building pad as well as in parking and driveway areas. The placement of *Granular Backfill* materials to achieve design subgrades in the building pad should not begin until the exposed subgrade soils have been directly observed and approved by the on-site geotechnical engineer;

- *Granular Backfill* materials and placement and compaction requirements are provided in the attached Specifications.

6.2 Shallow Foundations and Foundation Walls

Based on the subsurface conditions encountered at the exploration locations and our current understanding and assumptions relative to the proposed development, the following foundation design recommendations are provided:

- The building can be supported on a system of continuous and/or isolated shallow spread footings bearing on improved Fill and/or on *Structural Fill* or crushed stone built-up from properly prepared native soil subgrades;
- Shallow foundations may be designed using an allowable bearing pressure of **1,500** psf. Design bearing pressures may be increased by one-third (⅓) when considering seismic and or transient wind loading conditions;
- Continuous wall footings should have a minimum width of 2 feet. Isolated column footings should have a minimum width of 3 feet;
- Exterior footings should be founded at least 5 feet below the lowest adjacent grade to provide adequate frost protection. Interior footings in heated portions of the building should be founded at least 2 feet below FFE;
    - Frost protected footings could also be designed and implemented for this application to reduce the founded depth.
- Total post-construction settlements due to applied foundation loads are estimated to be on the order of 1 inch or less, based on strip footing widths and column footing widths of up to 3 feet and 5 feet, respectively. Differential settlements along continuous wall footings and/or between isolated column footings are estimated to be on the order of 0.5 inches or less. The estimated settlements and resulting angular distortion are anticipated to be within the allowable limits for this type of structure.

Recommendations for shallow foundation subgrade preparation and construction are provided as follows:

- A geotechnical engineer or his/her representative should directly observe foundation subgrade preparation activities;
- If shallow and/or perched groundwater is encountered, it must be continuously maintained at least 2 feet below the bottom of excavation and subsequent construction grade until the backfilling is complete;
- The native foundation subgrade soils will be sensitive to moisture and will readily disturb or soften if exposed to wet conditions during construction activities. Therefore, the final foot, at a minimum, of excavation for foundations should be performed using a smooth-edged cutting bucket (no teeth) to minimize subgrade disturbance. Furthermore, if wet conditions are present or anticipated due to groundwater seepage, perched groundwater, and/or precipitation/stormwater, the foundation subgrade should be protected with a 6-inch (minimum) thick layer of ¾-inch minus crushed stone encased in a geotextile fabric (e.g., Mirafi 140N or equal). The fabric and Crushed Stone shall be placed immediately upon exposure of the native

foundation subgrade soils and densified with a plate compactor until exhibiting stable conditions. The purpose of the Crushed Stone is to protect the subgrade soils from disturbance, facilitate construction dewatering (if necessary), and provide a dry/stable subgrade upon which to progress construction

- Prior to setting forms and placing reinforcing steel, a geotechnical engineer should directly observe footing subgrades;
    - Footing subgrades should be level or suitably benched and free of standing water and/or debris;
    - Loose, soft, wet, frozen, or otherwise unsuitable soils should either be re-compacted or over-excavated to a suitable subgrade, as approved by the on-site geotechnical engineer; and
    - Over-excavations should be backfilled with properly placed and compacted *Structural Fill* as approved by the on-site geotechnical engineer.
- Foundation subgrade soils should be protected against physical disturbance, precipitation, and/or frost throughout construction. Surface water run-on/run-off should be diverted away from open foundation excavations. The Contractor shall ultimately be responsible for the means and methods to protect the foundation subgrade during construction;
- Interior footings, piers, and/or walls and the interior side of balanced perimeter foundation walls should be backfilled with *Clean Granular Fill* and/or 3-inch minus material meeting the requirements of *Structural Fill,* as described in the attached *Tables*;
- Exterior footings and exterior side of balanced perimeter foundation walls should be backfilled with non-frost-susceptible fill in order to mitigate potential adverse effects of frost. Exterior footing and foundation wall backfill should consist of well-graded, free-draining, granular soil conforming to the requirements of *Clean Granular Fill*, as described in the attached *Tables*;
- Backfill for footings and foundation walls should be placed in uniform horizontal lifts having a maximum loose lift thickness of 8 inches and compacted to 95 percent of its modified proctor maximum dry density (MPMDD; per ASTM D1557). Thinner lifts may be required in order to achieve the required compaction criteria; and
- To minimize the potential for foundation wall damage during the backfill and compaction activities, it is recommended that foundation wall backfill be placed in a manner that maintains a balanced fill height on both sides of the wall (up to the final exterior grade).

6.3 Floor Slab-On-Grade

Design recommendations for the floor slab-on-grade are provided as follows:

- A modulus of vertical subgrade reaction, kvi, of 125 pounds per cubic inch (pci) should be available for structural design of the floor slabs-on-grade, provided that the subgrade, Structural Fill, and the Crushed Stone are prepared as recommended in Subsections 6.0, 6.1 and 6.2;
- Floor slabs-on-grade may be underlain by a minimum 9-inch thick layer of *Clean Granular Fill* to provide a capillary break and a stable working surface.
- Floor slabs-on-grade should be isolated structurally from foundation walls and columns/piers to allow for differential movement.

During construction, we expect that much of the building footprint will be excavated or disturbed during site preparation and grading (Subsection 6.1), excavations for shallow foundations (Subsection 6.2), and/or excavations for new underground utilities. It is imperative that the subgrade beneath the floor slab-on-grade be reinstated with properly placed and compacted *Structural Fill* and/or prepared as recommended herein. Additionally:

- A geotechnical engineer should directly observe the subgrade soils prior to the placement of the recommended *Crushed Stone* base course;
  - The subgrade should be level and free of standing water and/or debris;
  - Loose, soft, wet, frozen, or otherwise unsuitable soils should either be re-compacted or over-excavated to a suitable subgrade, as approved by the on-site geotechnical engineer; and
  - Over-excavations should be backfilled with properly placed and compacted Structural Fill.
- The *Crushed Stone* base course should not be placed until the subgrade has been reviewed by the on-site geotechnical engineer. Subsequently, the Clean Granular Fill should be compacted to the satisfaction of the geotechnical engineer to 95% of its MPMDD.

6.4 Seismic Considerations

Earthquake loadings must be considered under the requirements of the current edition of the *Vermont Fire and Building Safety Code* which refers to the 2015 edition of the International Building Code (IBC). IBC Table 1613.5.2 is used to establish the site class based on the average soil properties and soil profile. Site class is then used to determine the site coefficient and mapped spectral response for a given structure. Based on the conditions encountered at the test boring locations, the site is classified as:

Site Class D: Stiff Soil Profile.

Liquefaction refers to the loss of strength in saturated cohesionless soils due to the buildup of pore water pressures during cyclic or seismic loading. Based on the conditions encountered at the test boring locations, the site is not considered to be susceptible to liquefaction.

6.5 Re-Use of Site Soils

The native materials encountered at the test boring locations may not be suitable for re-use as *Granular Backfill* or *Common Fill.*

6.6 Construction Monitoring and Quality Control Testing

A qualified engineer or representative should be retained to review the site and subgrade operations, as required by Section 1705 of the Vermont State Building Code (VT-Code). Similarly, quality control testing, including in-place field density and moisture tests, should be performed to confirm that the specified compaction is achieved. It is recommended that JTC be retained to provide earthwork construction monitoring and quality control testing services.

Quality control testing recommendations are provided as follows:

- During site grading and foundation subgrade preparation, 3 field density tests should be performed for every 5,000 square feet (per lift) of Structural Fill placement, at a minimum. At least 3 tests should be performed on each lift of material even if the lift is less than 5,000 square feet;

- During foundation wall backfilling, 3 field density tests should be performed for every 100 linear feet (per lift) of fill placement, at a minimum. At least 3 tests should be performed on each lift of material even if the lift is less than 100 linear feet;
- During placement and compaction of Clean Granular Fill as the base course below the floor slab-on-grade and sidewalks, 3 field density tests should be performed for every 5,000 square feet of placement. At least 3 tests should be performed on each lift of material even if the lift is less than 5,000 square feet; and
- During placement and compaction of Common Fill in pavement areas, 3 field density tests should be performed for every 5,000 square feet of placement. At least 3 tests should be performed on each lift of material even if the lift is less than 5,000 square feet; and
- During backfilling of utility trenches, at least 1 test should be conducted on Structural Fill per 50 linear feet (per lift) of trench.

6.7 Additional Considerations

Additional design recommendations are provided as follows:

- Exterior concrete sidewalks shall be underlain by at least 12 inches of Clean Granular Fill. The thickness of the Clean Granular Fill shall be increased to no less than 18 inches for exterior concrete slabs located adjacent to exterior doorways and ramps to provide additional frost protection at building entry/exit points;
- Roof drains or similar features should be provided to collect roof run-off and prevent ponding near the building. Roof drains and other stormwater controls should not discharge to foundation drains;
- The exterior ground surface adjacent to the building should be sloped away from the building to provide for positive drainage. Similarly, the final surface materials adjacent to the building should be relatively impermeable to reduce the volume of precipitation infiltrating into the subsurface proximate to building foundations. Such impermeable materials include cement concrete, bituminous concrete, and/or vegetated silty/clayey topsoil; and
- Permanent fill or cut slopes should have a maximum slope of 2.5H:1V (horizontal to vertical) or flatter for dry conditions. Permanent fill or cut slopes should be no steeper than 3H:1V for wet/submerged conditions (e.g., stormwater basin) unless a properly designed surface slope stabilization system (e.g. rip rap, geosynthetics) is provided.

Additional construction considerations/recommendations are provided as follows:

- Safe temporary excavation and/or fill slopes are the responsibility of the Contractor. Excavations should be conducted in accordance with local, state, and federal (OSHA) requirements, at a minimum. If an excavation cannot be properly sloped or benched due to space limitations, adjacent structures, and/or seepage, the Contractor should install an engineered shoring system to support the temporary excavation;
- Subgrade conditions will be influenced by excavation methods, precipitation, stormwater management, groundwater control(s), and/or construction activities. Most of the site soils are

poorly-drained, moisture-sensitive, and considered susceptible to disturbance when exposed to wet conditions and construction activities. As such, the Contractor shall be aware of these conditions and must take precautions to minimize subgrade disturbance. Such precautions may include diverting storm run-off away from construction areas, reducing traffic in sensitive areas, minimizing the extent of exposed subgrade if inclement weather is forecast, backfilling excavations and footings as soon as practicable, and maintaining an effective dewatering program, as necessary;

- Proper groundwater control and stormwater management are necessary to maintain site stability. Groundwater should be removed in advance of excavation and continuously maintained at least 2 feet below the working construction grade until earthworks and/or backfilling are complete;
- If groundwater seepage and/or wet soils due to shallow groundwater are observed, a ¾-inch minus crushed stone base should be placed atop the exposed subgrade soils. The stone should be immediately placed atop the undisturbed subgrade and then tamped with a plate compactor until exhibiting stable conditions. The stone shall be protected, as required, with a geotextile filter fabric such as Mirafi 140N or equal. The purpose of the stone base is to protect the wet subgrade, facilitate dewatering, and provide a dry/stable base upon which to progress construction; and
- All slopes should be protected from erosion during (and after) construction.

7.0 CLOSING

We trust the contents of this report are responsive to your needs at this time. Should you have any questions or require additional assistance, please do not hesitate to contact our office.

APPENDIX A: LIMITATIONS

Explorations

1. The analyses and recommendations presented in this report are based in part upon the data obtained from widely-spaced subsurface explorations. Subsurface conditions between exploration locations may vary from those encountered at the exploration locations. The nature and extent of variations between explorations may not become evident until construction. If variations appear, it will be necessary to re-evaluate the recommendations of this report.
2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretation of widely-spaced explorations and samples; actual strata transitions are probably more gradual. For specific information, refer to the individual test pit and/or boring logs.
3. Water level readings have been made in the test pits and/or test borings under conditions stated on the logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors differing from the time the measurements were made.

Review

4. It is recommended that John Turner Consulting, Inc. be given the opportunity to review final design drawings and specifications to evaluate the appropriate implementation of the geotechnical engineering recommendations provided herein.
5. In the event that any changes in the nature, design, loading, or location of the proposed areas are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and conclusions of the report modified or verified in writing by John Turner Consulting, Inc.

Construction

6. It is recommended that John Turner Consulting, Inc. be retained to provide geotechnical engineering services during the installation phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

Use of Report

7. This report has been prepared for the exclusive use of Krebs & Lansing Consulting Engineers, Inc for the application for the Proposed Public Works Facility to be located at Park Place in Milton, Vermont. All considerations are based on the available information and is in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.
8. This report has been prepared for this project by John Turner Consulting, Inc. This report was completed for preliminary design purposes and may be limited in its scope to complete an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to preliminary geotechnical design considerations.

APPENDIX B: RECOMMENDED SOIL GRADATION & COMPACTION SPECIFICATIONS

Table 1: Granular Backfill for Structures (VAOT 704.08A)

SIEVE SIZE	PERCENT PASSING BY WEIGHT
3-inch	100
No. 4	45 – 75
No. 100	0 – 12
No. 200	0 - 6

1. Specification from VAOT Section 704.08.
2. Granular backfill for structures shall be obtained from approved sources.
3. It shall consist of satisfactorily graded, free draining granular material reasonably free from loam, silt, clay, and organic material.
4. Place and compact within ± 3% of optimum moisture content.
5. Compact to at least 95% relative compaction per ASTM D1557.
6. The adequacy of the compaction efforts should be verified by field density testing.

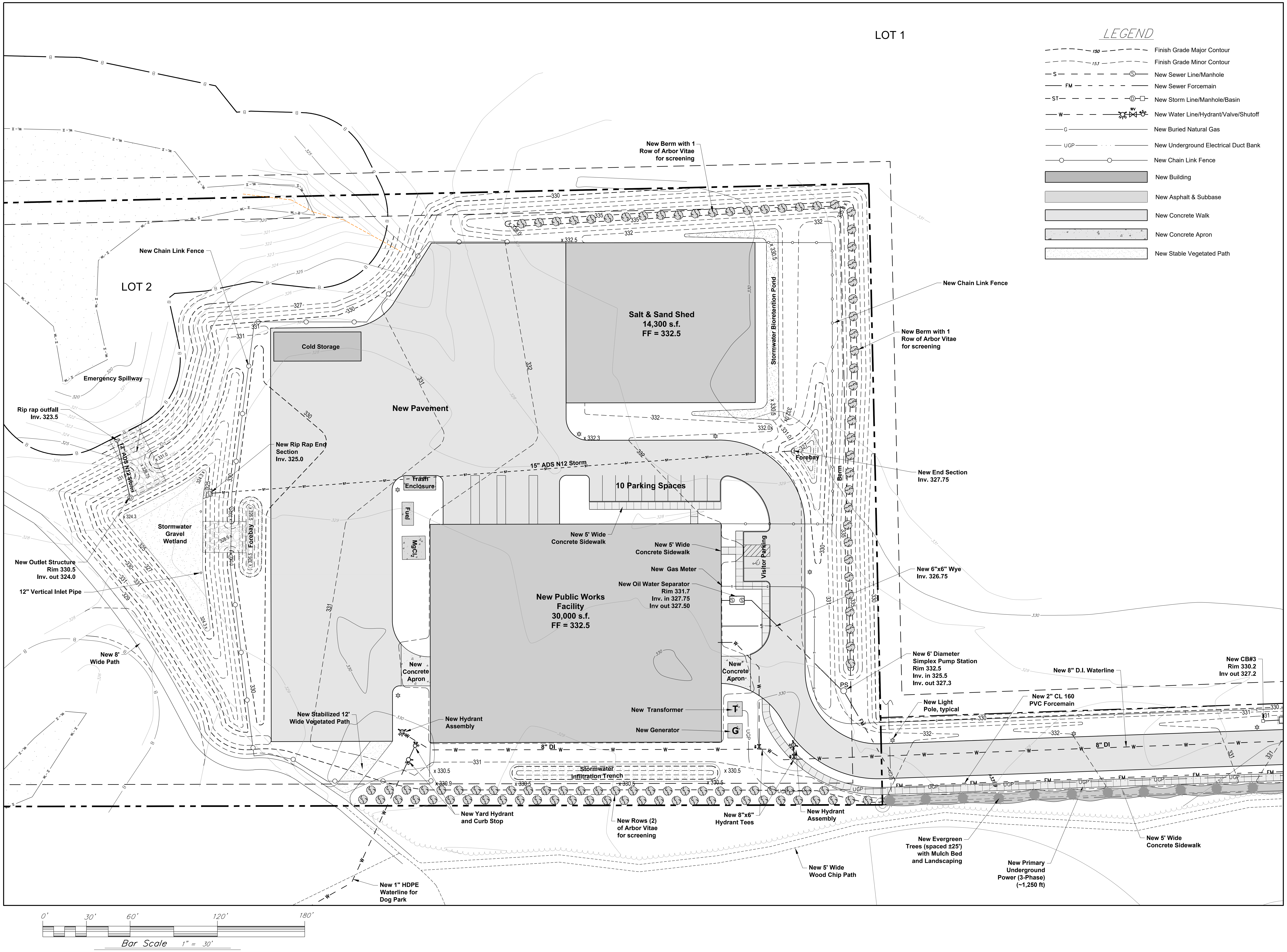
TABLE 2: Clean Granular Fill

Clean SIEVE SIZE	PERCENT PASSING BY WEIGHT
3-inch	100
¾-inch	60 – 90
No. 4	20 – 70
No. 200	2 – 8

NOTES:

1. For minimum 9-inch base below floor slab-on-grade.
2. For minimum 18-inch base for exterior concrete slabs exposed to frost.
3. For minimum 24-inch base at exterior ramps, aprons, and loading bays adjacent to entrances/exit ways.
4. For use as footing and foundation wall backfill.
5. For use as backfill behind unbalanced foundation/retaining walls.
6. Place in lifts not exceeding 12 inches for heavy vibratory rollers and 8 inches for vibratory plate compactors.
7. Place and compact within ± 3% of optimum moisture content.
8. Compact to at least 95% relative compaction per ASTM D1557.
9. Compaction efforts should be verified by field density testing.
10. Compact to at least 95% relative compaction per ASTM D1557 when placed as foundation wall backfill in conjunction with a bond break.
11. Compaction efforts should be verified by field density testing.

APPENDIX C: SITE PLAN & TEST BORING LOCATION PLAN



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CIVIL ENGINEER:

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STAMP:

Vermont State Plane Grid North (NAD83)
N

Project:

TOWN OF MILTON
Public Works Facility

Bombardier Road

Project No.	21282
Scale	1" = 30'
Drawn by	TJB/SLM
Checked by	DMR
Date	11/18/21

Revisions

No.	Date	Description

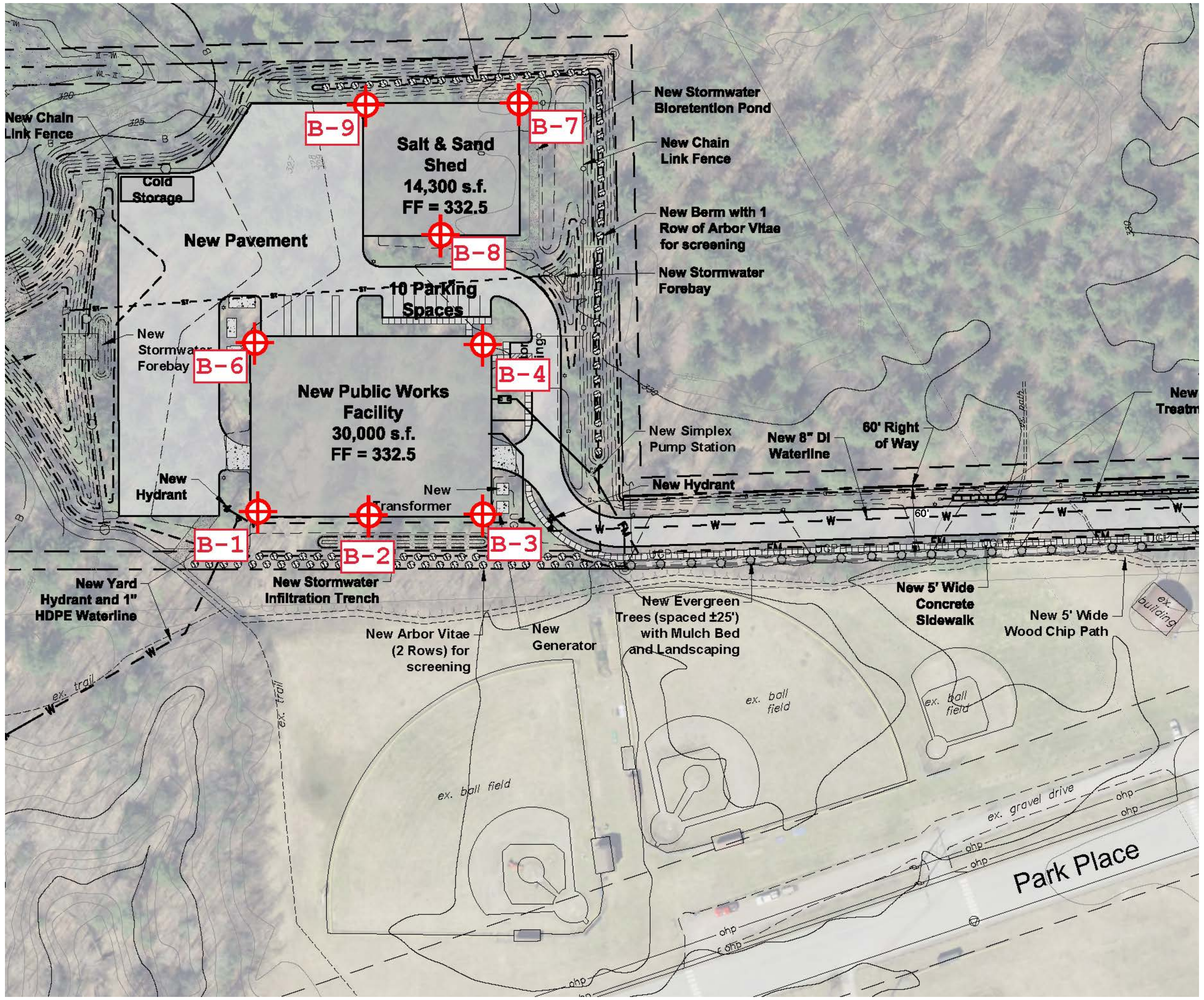
Drawing Title

Site Plan

Drawing No.

C1.01

21282\DWGS\KL BASE 2021.dwg



Notes:

1. Test borings were performed on Oct.18 & 19, 2021 under the direction of JTC. Test boring locations should be considered approximate.
2. Refer to the Test Boring Logs for the subsurface conditions encountered at each boring location.
3. Basemap source(s): October 2021 "Google Maps".
4. Not to Scale.

Krebs & Lansing Consulting Engineers
164 Main Street
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Proposed Milton Public Works Building
Park Place
Milton, Vermont

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CONSULTING

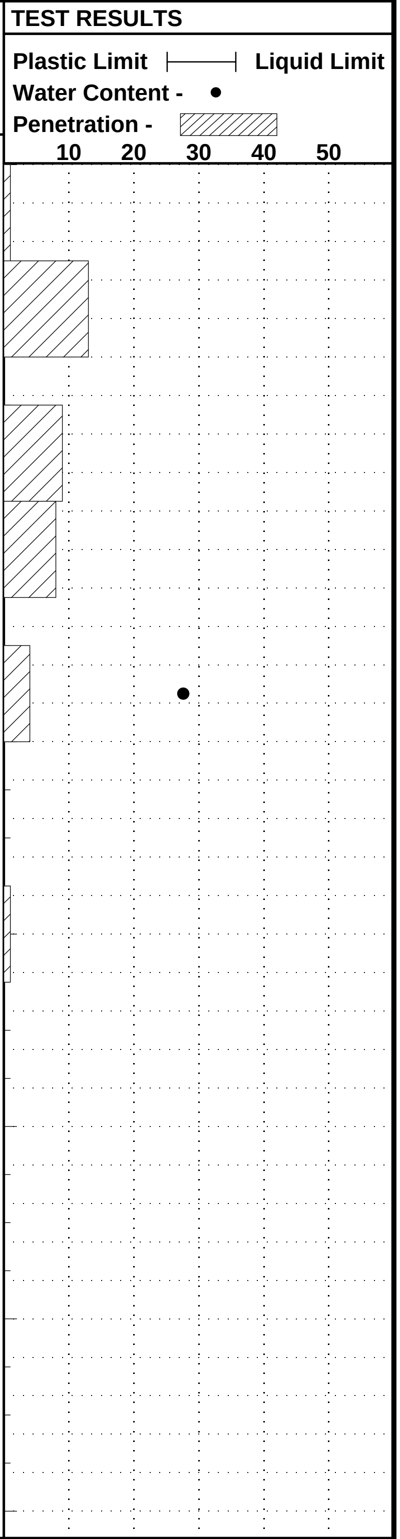
TEST BORING LOCATION PLAN

APPENDIX D: TEST BORING LOGS & KEY TO SYMBOLS AND DESCRIPTIONS

LOG OF BORING No. B-1

PROJECT: Milton Public Works Building **PROJECT NO.:** 21-04-079
CLIENT: Krebs & Lansing Consulting Engineers
PROJECT LOCATION: Milton, VT
LOCATION: See Boring Location Plan **ELEVATION:**
DRILLER: CASCADE **LOGGED BY:** EL
DRILLING METHOD: 4.25" I.D. HSA **DATE:** 10/18/21
DEPTH TO - WATER> INITIAL: ▽ 10.0 **AFTER 24 HOURS:** ▼

Depth (feet)	Description	Graphic	Elevation (feet)	Sample No.	Blow Counts	% < #200
0	[FOREST MAT] Dark brown, silty Sand (SM), roots, organics; very loose 0.5			SS01	WOH .5 .5 1	
	[MARINE SAND] Light brown, poorly graded Sand (SP-SM) with silt; very loose 2.2			SS02	2 6 7 8	
4	[LACUSTRINE AND MARINE SILT] Grey-brown, Silt (ML); medium dense -becomes loose			SS03	5 5 4 4	
8				SS05	5 5 3 2	
▽	-becomes wet and very loose			SS05	1 2 2 3	
12						
16				SS06	WOH WOH 1 1	
20	-becomes grey			SS07	WOH WOH WOH WOH	
24				SS08	WOH WOH WOH 1	
28	Boring terminated at 27 ft.					



Test boring backfilled with soil cuttings upon completion.

This information pertains only to this boring and should not be interpreted as being indicative of the site.

JOHN TURNER
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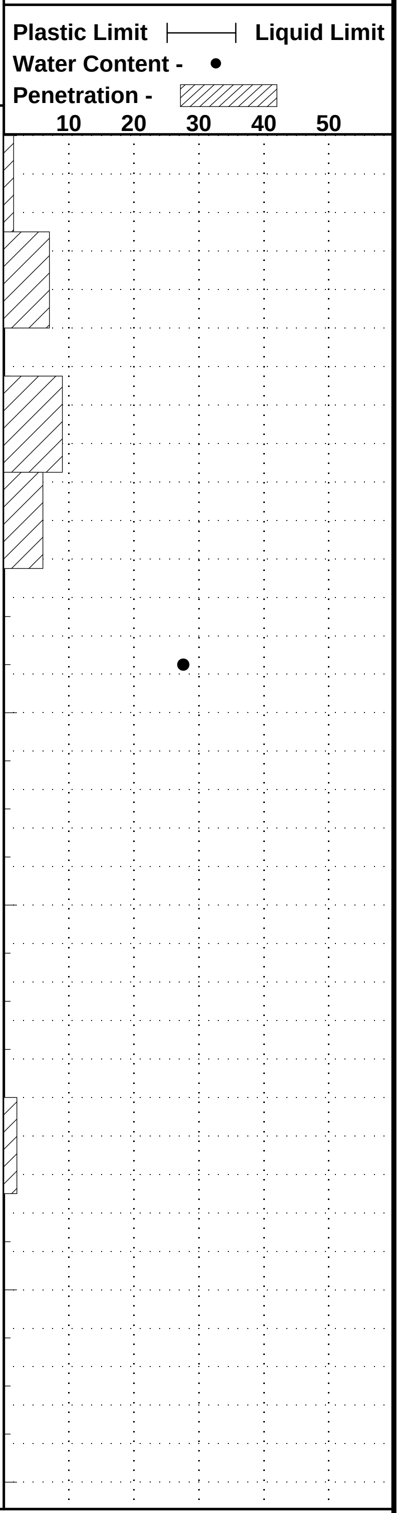
LOG OF BORING
No. B-2

PROJECT: Milton Public Works Building **PROJECT NO.:** 21-04-079
CLIENT: Krebs & Lansing Consulting Engineers
PROJECT LOCATION: Milton, VT
LOCATION: See Boring Location Plan **ELEVATION:**
DRILLER: CASCADE **LOGGED BY:** EL
DRILLING METHOD: 4.25" I.D. HSA **DATE:** 10/18/21
DEPTH TO - WATER> INITIAL: ∇ 8.5 **AFTER 24 HOURS:** ▼

Depth (feet)	Description	Graphic	Elevation (feet)	Sample No.	Blow Counts	% < #200
0	[FOREST MAT] Dark brown silty Sand (SM) roots, organics; very loose			SS01	.5 .5 1 1	
0.5	[MARINE SAND] Orange, poorly graded Sand (SP); loose			SS02	2 3 4 3	
3.5 / 4	[LACUSTRINE & MARINE SILT] Grey-brown, Silt (ML); loose; orange mottling					
				SS03	3 4 5 7	
8	-becomes light brown and sandy			SS04	6 4 2 3	
∇	-becomes wet					
	-becomes very loose			SS05	WOH WOH WOH 1	
12						
16				SS06	WOH WOH 1 1	
20	-becomes grey			SS07	WOH 1 1 1	
24						
				SS08	WOH WOH WOH WOH	
28	Boring terminated at 27 ft.					

TEST RESULTS



Test boring backfilled with soil cuttings upon completion.

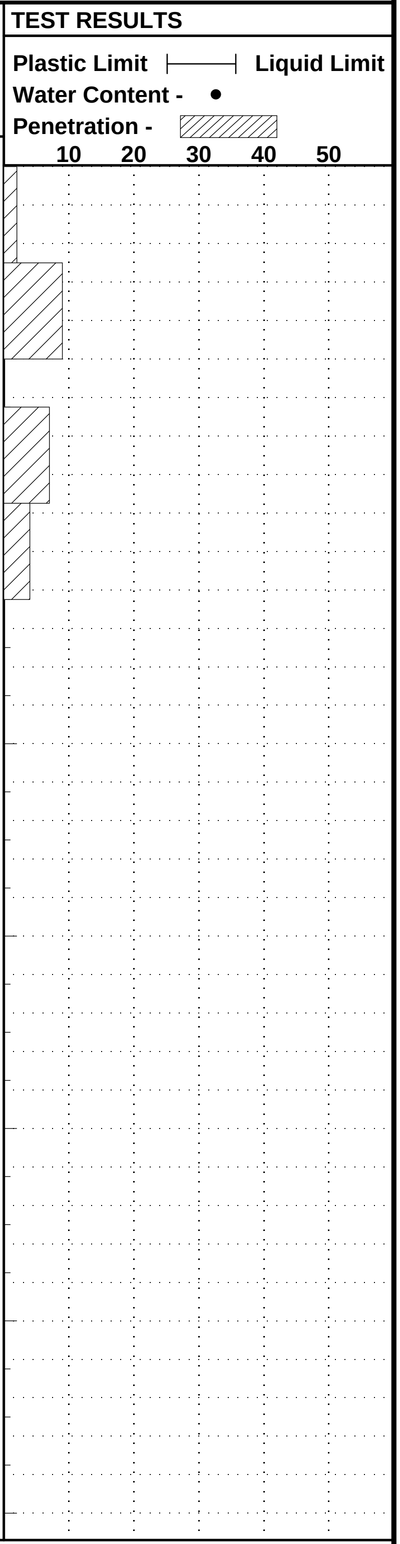
This information pertains only to this boring and should not be interpreted as being indicative of the site.

JOHN TURNER CONSULTING

LOG OF BORING No. B-3

PROJECT: Milton Public Works Building **PROJECT NO.:** 21-04-079
CLIENT: Krebs & Lansing Consulting Engineers
PROJECT LOCATION: Milton, VT
LOCATION: See Boring Location Plan **ELEVATION:**
DRILLER: CASCADE **LOGGED BY:** EL
DRILLING METHOD: 4.25" I.D. HSA **DATE:** 10/18/21
DEPTH TO - WATER> INITIAL: ▽ 7.5 **AFTER 24 HOURS:** ▼

Depth (feet)	Description	Graphic	Elevation (feet)	Sample No.	Blow Counts	% < #200
0	[FOREST MAT] Dark brown, silty Sand (SM), roots, organics; very loose			SS01	WOH 1 1 2	
	0.5 [MARINE SAND] Light brown, poorly graded Sand (SP); very loose			SS02	2 4 5 5	
	3.0 [LACUSTRINE & MARINE SILT] Grey, Silt (ML); loose; orange mottling					
4						
				SS03	3 4 3 3	
▽	-becomes light brown and sandy -becomes very loose and wet			SS04	2 2 2 2	
8						
				SS05	WOH WOH WOH WOH	
12						
				SS06	WOH WOH 1 1	
16						
20	-becomes grey			SS07	WOH WOH WOH WOH	
24						
				SS08	WOH WOH WOH WOH	
	Boring terminated at 27 ft.					
28						



Test boring backfilled with soil cuttings upon completion.

This information pertains only to this boring and should not be interpreted as being indicative of the site.

JOHN TURNER
CONSULTING

LOG OF BORING
No. B-4

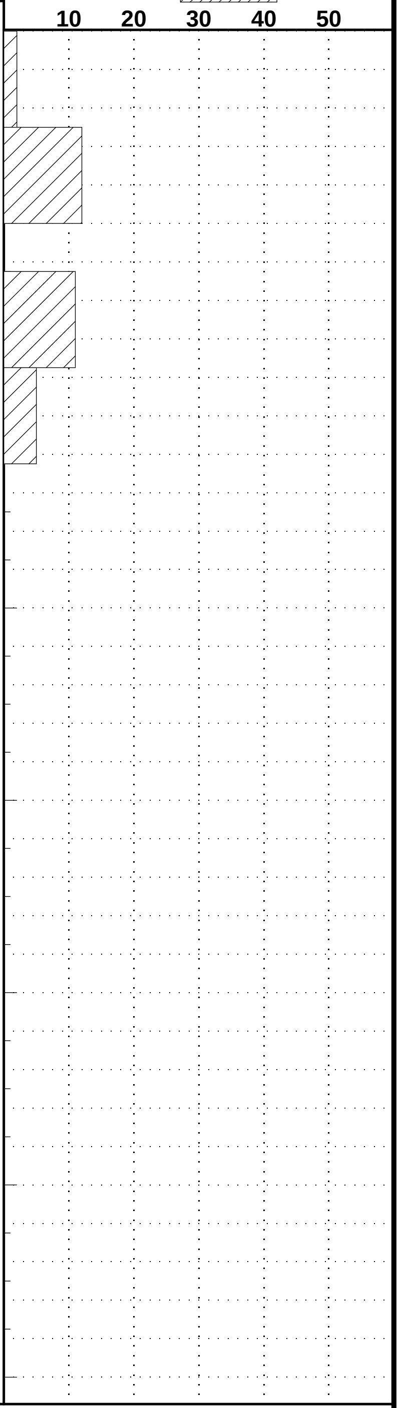
PROJECT: Milton Public Works Building **PROJECT NO.:** 21-04-079
CLIENT: Krebs & Lansing Consulting Engineers
PROJECT LOCATION: Milton, VT
LOCATION: See Boring Location Plan **ELEVATION:**
DRILLER: CASCADE **LOGGED BY:** EL
DRILLING METHOD: 4.25" I.D. HSA **DATE:** 10/19/21
DEPTH TO - WATER> INITIAL: ▽ 7.5 **AFTER 24 HOURS:** ▼

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Depth (feet)	Description	Graphic	Elevation (feet)	Sample No.	Blow Counts	% < #200
0	[FOREST MAT] Dark brown, silty Sand (SM), roots, organics; loose			SS01	1 1 1 3	
2.0 4	[MARINE SAND] Light brown, poorly graded Sand with silt (SP-SM); medium dense			SS02	3 5 7 8	
5.0	[LACUSTRINE & MARINE SILT] Grey, Silt (ML) with orange mottling; medium dense -6" layer of light brown fine Sand			SS03	5 5 6 2	
▽ 8	-becomes loose and wet			SS04	4 3 2 2	
	-becomes very loose			SS05	1 WOH WOH WOH	
12	-No sampling until 40.0'					
16						
20						
24						
28						

TEST RESULTS

Plastic Limit ├──┤ Liquid Limit
Water Content - ●
Penetration - ▨



Test boring backfilled with soil cuttings upon completion.

Figure PAGE 1 of 2

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LOG OF BORING
No. B-4

PROJECT: Milton Public Works Building **PROJECT NO.:** 21-04-079
CLIENT: Krebs & Lansing Consulting Engineers
PROJECT LOCATION: Milton, VT
LOCATION: See Boring Location Plan **ELEVATION:**
DRILLER: CASCADE **LOGGED BY:** EL
DRILLING METHOD: 4.25" I.D. HSA **DATE:** 10/19/21
DEPTH TO - WATER> INITIAL: ▽ 7.5 **AFTER 24 HOURS:** ▼

Depth (feet)	Description	Graphic	Elevation (feet)	Sample No.	Blow Counts	% < #200	TEST RESULTS Plastic Limit ├──┤ Liquid Limit Water Content - ● Penetration - ▨ 10 20 30 40 50
32							
36							
40	-Auger refusal at 40.0' Boring terminated at 40 ft.						
44							
48							
52							
56							

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Test boring backfilled with soil cuttings upon completion.

JOHN TURNER CONSULTING

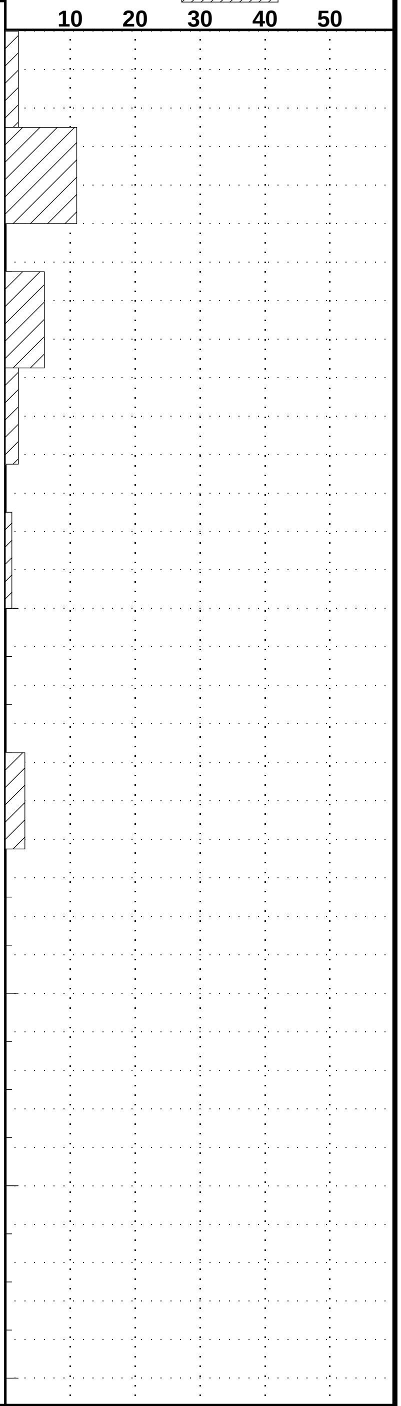
LOG OF BORING No. B-6

PROJECT: Milton Public Works Building **PROJECT NO.:** 21-04-079
CLIENT: Krebs & Lansing Consulting Engineers
PROJECT LOCATION: Milton, VT
LOCATION: See Boring Location Plan **ELEVATION:**
DRILLER: CASCADE **LOGGED BY:** EL
DRILLING METHOD: 4.25" I.D. HSA **DATE:** 10/18/21
DEPTH TO - WATER> INITIAL: ▽ 8.5 **AFTER 24 HOURS:** ▼

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Depth (feet)	Description	Graphic	Elevation (feet)	Sample No.	Blow Counts	% < #200	TEST RESULTS
0	[FOREST MAT] Dark brown, silty Sand (SM), roots, organics; very loose			SS01	1 1 1 1		
0.5	[MARINE SAND] Light brown, poorly graded Sand (SP); very loose; orange mottling			SS02	2 5 6 8		
4	-becomes silty and medium dense						
	-becomes loose			SS03	7 3 3 4		
7.0	[LACUSTRINE & MARINE SILT] Brown-grey, Silt (ML); very loose -becomes wet			SS04	4 1 1 1		
8 ▽							
12				SS05	1 .5 .5 1		
16				SS06	2 2 1 3		
20	-becomes grey			SS07	WOR WOR WOR WOH		
24				SS08	WOH WOH WOH WOH		
28	Boring terminated at 27 ft.						

Plastic Limit ├──┤ Liquid Limit
Water Content - ●
Penetration - ▨



Test boring backfilled with soil cuttings upon completion.

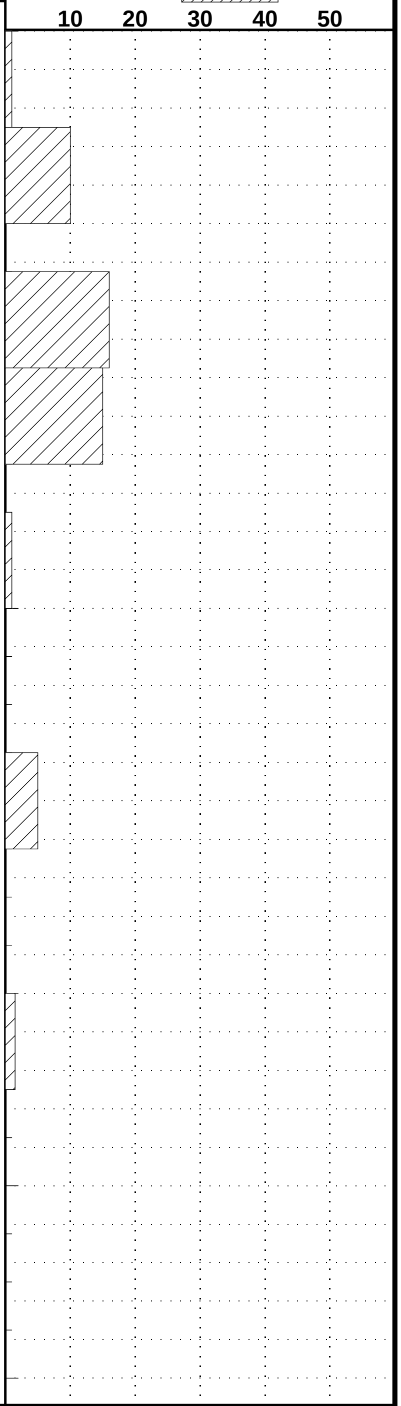
LOG OF BORING No. B-7

PROJECT: Milton Public Works Building **PROJECT NO.:** 21-04-079
CLIENT: Krebs & Lansing Consulting Engineers
PROJECT LOCATION: Milton, VT
LOCATION: See Boring Location Plan **ELEVATION:**
DRILLER: CASCADE **LOGGED BY:** EL
DRILLING METHOD: 4.25" I.D. HSA **DATE:** 10/18/21
DEPTH TO - WATER> INITIAL: ▽ 8.5 **AFTER 24 HOURS:** ▼

Depth (feet)	Description	Graphic	Elevation (feet)	Sample No.	Blow Counts	% < #200
0	[FOREST MAT] Dark brown, silty Sand (SM), roots, organics; loose — 0.5			SS01	.5 .5 .5 .5	
	[MARINE SAND] Light brown poorly graded Sand with silt (SP-SM); medium dense; orange mottling — 2.0			SS02	2 4 6 5	
4	[LACUSTRINE & MARINE SILT] Brown, Silt (ML); medium dense; orange mottling -becomes grey			SS03	5 9 7 8	
8				SS04	7 7 8 4	
▽	-becomes wet					
				SS05	.5 .5 .5 .5	
12						
	-becomes loose					
16				SS06	WOH 2 3 1	
20	-becomes very loose			SS07	WOH 1 .5 .5	
	Boring terminated at 22 ft.					
24						
28						

TEST RESULTS

Plastic Limit ├──┤ **Liquid Limit**
Water Content - ●
Penetration - ▨



Test boring backfilled with soil cuttings upon completion.

This information pertains only to this boring and should not be interpreted as being indicative of the site.

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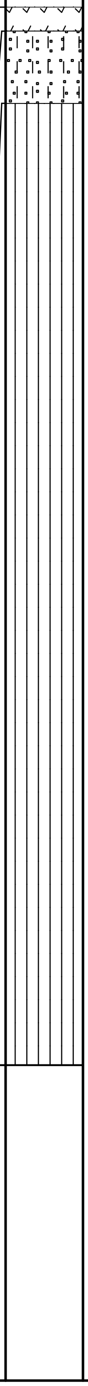
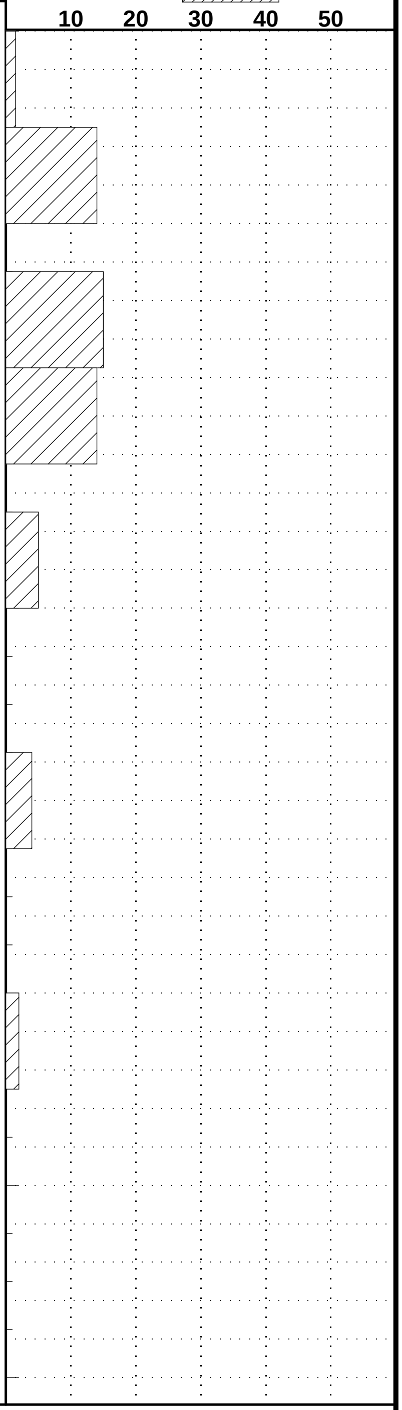
LOG OF BORING
No. B-8

PROJECT: Milton Public Works Building **PROJECT NO.:** 21-04-079
CLIENT: Krebs & Lansing Consulting Engineers
PROJECT LOCATION: Milton, VT
LOCATION: See Boring Location Plan **ELEVATION:**
DRILLER: CASCADE **LOGGED BY:** EL
DRILLING METHOD: 4.25" I.D. HSA **DATE:** 10/18/21
DEPTH TO - WATER> INITIAL: ▽ 10.0 **AFTER 24 HOURS:** ▼

Depth (feet)	Description	Graphic	Elevation (feet)	Sample No.	Blow Counts	% < #200
0	[FOREST MAT] Dark brown, silty Sand (SM), roots, organics; very loose 0.5			SS01	.5 .5 1 2	
	[MARINE SAND] Light brown, poorly graded Sand with silt (SP-SM); loose; orange mottling 2.0			SS02	4 7 7 8	
4	[LACUSTRINE & MARINE SILT] Grey, Silt (ML); medium dense -orange color mottling			SS03	6 8 7 9	
8	- 8" Brown fine Sand with silt layer			SS04	7 6 8 9	
▽	- 6" layer of brown poorly graded Sand - becomes loose			SS05	1 3 2 1	
12						
16	- 12" Brown fine sand and silt layer			SS06	WOH WOH 4 4	
20	-becomes very loose			SS07	WOH 1 1 1	
	Boring terminated at 22 ft.					
24						
28						



TEST RESULTS
Plastic Limit ├──┤ Liquid Limit
Water Content - ●
Penetration - ▨



Test boring backfilled with soil cuttings upon completion.

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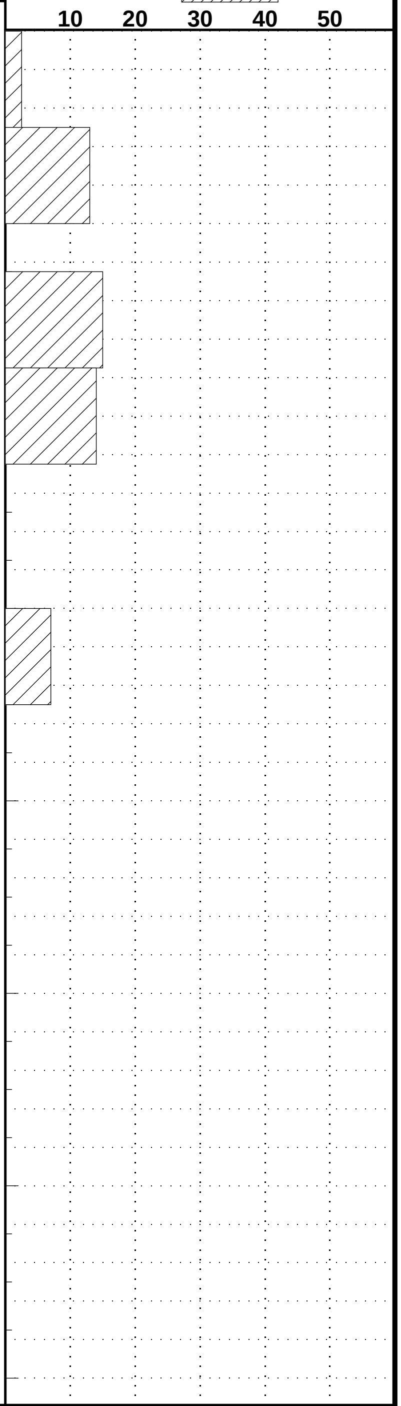
LOG OF BORING No. B-9

PROJECT: Milton Public Works Building **PROJECT NO.:** 21-04-079
CLIENT: Krebs & Lansing Consulting Engineers
PROJECT LOCATION: Milton, VT
LOCATION: See Boring Location Plan **ELEVATION:**
DRILLER: CASCADE **LOGGED BY:** EL
DRILLING METHOD: 4.25" I.D. HSA **DATE:** 10/19/21
DEPTH TO - WATER> INITIAL: ∇ 12.0 **AFTER 24 HOURS:** ▼

This information pertains only to this boring and should not be interpreted as being indicative of the site.

Depth (feet)	Description	Graphic	Elevation (feet)	Sample No.	Blow Counts	% < #200
0	[FOREST MAT] Dark brown, silty Sand (SM), roots, organics; very loose — 0.5			SS01	.5 .5 2 2	
	[MARINE SAND] Orange, poorly graded Sand and silt (SP-SM); loose — 2.0			SS02	4 7 6 6	
4	[LACUSTRINE & MARINE SILT] Grey-brown, Silt (ML); medium dense; orange mottling					
	-becomes grey			SS03	5 8 7 7	
8				SS04	8 8 6 5	
12 ∇	-becomes loose and wet			SS05	4 4 3 2	
16	-becomes very loose			SS06	WOH WOH WOH 1	
20	-Hard to drill due to loose fines Boring terminated at 20 ft.					
24						
28						

TEST RESULTS
Plastic Limit ├──┤ **Liquid Limit**
Water Content - ●
Penetration - ▨



Test boring backfilled with soil cuttings upon completion.

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KEY TO SYMBOLS AND DESCRIPTIONS

MAJOR DIVISIONS			SYMBOLS		TYPICAL NAMES
COARSE-GRAINED SOILS OVER 50% > No.200 SIEVE SIZE	GRAVELS MORE THAN 1/2 OF COARSE FRACTION > No.4 SIEVE SIZE	CLEAN GRAVELS WITH LESS THAN 5% FINES	GW	▨	Well-graded gravels or gravel-sand mixtures, little or no fines
			GP	▨	Poorly graded gravels or gravel-sand mixtures, little or no fines
		GRAVELS WITH OVER 15% FINES	GM	▨	Silty gravels, gravel-sand mixtures
			GC	▨	Clayey gravels, gravel-sand-clay mixtures
	SANDS MORE THAN 1/2 OF COARSE FRACTION < No.4 SIEVE SIZE	CLEAN SANDS WITH LESS THAN 5% FINES	SW	▨	Well-graded sand or gravelly sands, little or no fines
			SP	▨	Poorly graded sands or gravelly sands, little or no fines
		SANDS WITH OVER 15% FINES	SM	▨	Silty sand, sand-silt mixtures
			SC	▨	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS OVER 50% < No.200 SIEVE SIZE	SILTS & CLAYS LIQUID LIMIT 50% OR LESS		ML	▥	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
			CL	▨	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	▤	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS LIQUID LIMIT GREATER THAN 50%		MH	▥	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
			CH	▨	Inorganic clays of high plasticity, fat clays
			OH	▤	Organic clays of medium to high plasticity, organic silty clays, organic silts
HIGHLY ORGANIC SOILS			PT	▨	Peat and other highly organic soils

TYPICAL SYMBOLS

Shelby Tube	Auger Cuttings
Standard Split Spoon Sample	3" Split Spoon Sample
Rock Core	Dynamic Cone Penetrometer
Vane Shear	Bulk/Grab Sample
Geoprobe Sample	Sonic or Vibro-Core Sample
▽ Water Table (at time of drilling)	▼ Water Table (after 24 hours)

WELL SYMBOLS

- Recessed Cover Set in Concrete Top of Well, Recessed Pipe
- Covered Riser
- Capped Riser w/ Locking Cover
- Pipe Riser
- Concrete Seal
- Gravel Backfill
- Assorted Cuttings
- Bentonite Slurry
- Bentonite Pellets
- Silica Sand, blank PVC
- Slotted Pipe w/ Sand
- Endcap on Pipe Packed in Sand
- Silica Sand, No Pipe (End Plug)

SOIL MOISTURE MODIFIERS

Term	Description
Dry	Absence of moisture; dusty, dry to touch
Moist	Damp but no visible water
Wet	Visible free water

The descriptor "damp" should not be used (use "moist").
The descriptor "saturated" should not be used (use "wet").

CLASSIFICATION	RANGE OF GRAIN SIZES	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	Above 12"	Above 305
COBBLES	12" to 3"	305 to 76.2
GRAVEL	3" to No. 4	76.2 to 4.75
coarse	3" to 3/4"	76.2 to 19.1
fine	3/4" to No. 4	19.1 to 4.75
SAND	No. 4 to No. 200	4.75 to 0.075
coarse	No. 4 to No. 10	4.75 to 2.00
medium	No. 10 to No. 40	2.00 to 0.425
fine	No. 40 to No. 200	0.425 to 0.075
SILT & CLAY	Below No. 200	Below 0.075

RELATIVE DENSITY/CONSISTENCY

Gravel, Sand, and Silt (nonplastic)		Silt (plastic) and Clay		
N-Value	Relative Density	N-Value	Su	Consistency
0 - 4	Very Loose	0 - 2	0 - 250	Very Soft
5 - 10	Loose	3 - 4	251 - 500	Soft
11-30	Medium Dense	5 - 8	501 - 1000	Medium Stiff
31 - 50	Dense	9 - 15	1001 - 2000	Stiff
51 +	Very Dense	16 - 30	2001 - 4000	Very Stiff
		31 +	4001+	Hard

Standard Penetration Testing (SPT) N_{60} based on blows per 12 inches.
WR = Weight of Rods; WH = Weight of Hammer

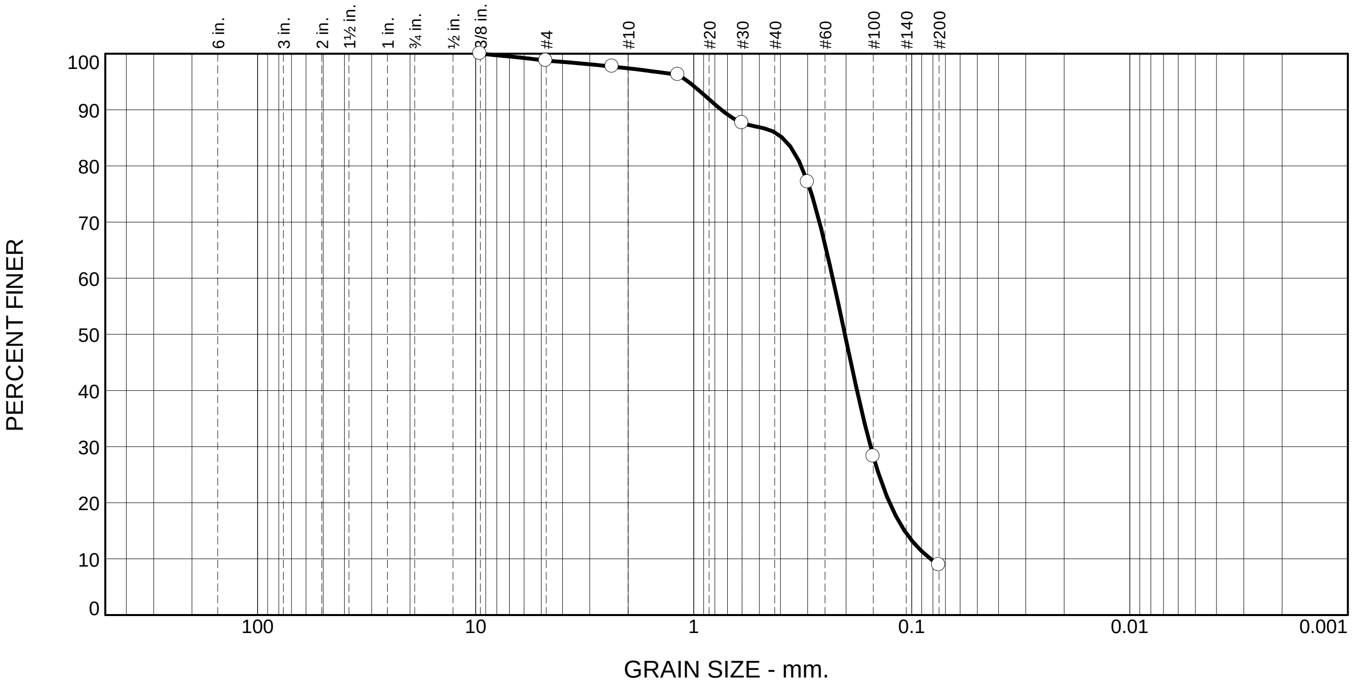
PERCENT OR PORTIONS OF SOIL

Term	Description
Parting:	> 1/16 in.
Seam:	0.5 in. to 1/16 in.
Layer:	12 in. to 0.5 in.
Stratum:	> 12 in.
Pocket:	Small erratic deposit
Lens:	Lenticular deposit
Occasional:	One or less per foot of thickness
Frequent	More than one per foot of thickness
Varved	Alternating seams or layers of silt and/or clay and sometimes f. sand

REFERENCE: UNIFIED SOIL CLASSIFICATION SYSTEM - ASTM D2488-93

APPENDIX E: GEOTECHNICAL LABORATORY TESTING RESULTS

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	1	2	11	77	9	

Test Results (ASTM C 136 & ASTM C 117)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8"	100		
#4	99		
#8	98		
#16	96		
#30	88		
#50	77		
#100	28		
#200	9		

* (no specification provided)

Material Description

Poorly Graded brown sand with silt

Atterberg Limits (ASTM D 4318)

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

Classification

USCS (D 2487)= SP-SM **AASHTO (M 145)=**

Coefficients

D_{90}= 0.7473 D_{85}= 0.3911 D_{60}= 0.2302
D_{50}= 0.2027 D_{30}= 0.1544 D_{15}= 0.1079
D_{10}= 0.0819 C_u= 2.81 C_c= 1.26

Remarks

Moisture: 3.8%

Date Received: 11/1/21 **Date Tested:** 11/2/21
Tested By: Chris Cote
Checked By: Adam Allen
Title: Lab Manager

Location: B-4 SS-02
Sample Number: VT-143 **Depth:** 2'-4'
Date Sampled: 10/19/21

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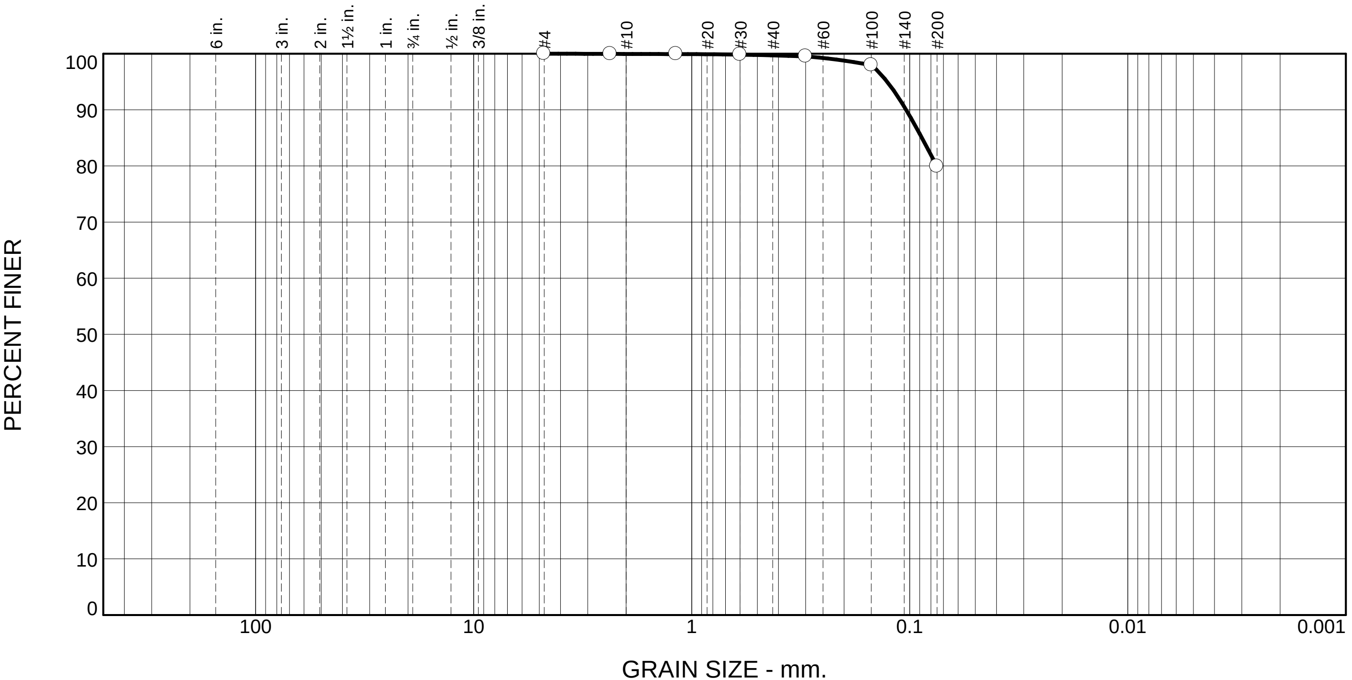
Client: Krebs and Lansing Consulting Engineers
Project: Milton Public Works

Project No: 21-04-079 **Figure** 001

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	0	20	80	

Test Results (ASTM C 136 & ASTM C 117)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100		
#8	100		
#16	100		
#30	100		
#50	100		
#100	98		
#200	80		

* (no specification provided)

Material Description

Brown Silt

Atterberg Limits (ASTM D 4318)

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

Classification

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

Coefficients

D_{90}=	0.1039	D_{85}=	0.0879	D_{60}=	
D_{50}=		D_{30}=		D_{15}=	
D_{10}=		C_u=		C_c=	

Remarks

Moisture: 27.6%

Date Received: 11/1/21 **Date Tested:** 11/2/21

Tested By: Chris Cote

Checked By: Adam Allen

Title: Lab Manager

Location: B-1 SS-04
Sample Number: VT-144 **Depth:** 10'-12'
Date Sampled: 10/18/21

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Client: Krebs and Lansing Consulting Engineers
Project: Milton Public Works

Project No: 21-04-079 **Figure** 002

APPENDIX F: SITE PHOTOGRAPHS PAGE

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Milton Public Works Building
Park Place
Milton, Vermont

SITE PHOTOGRAPHS

Set-up on B-3

Poorly graded sand and silt above the Lacustrine & Marine Silt

Brown and grey Lacustrine & Marine Silt

B-8 after boring collapsed

Near B-9, To West

Very loose, wet Lacustrine & Marine Silt