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GEOTECHNICAL DESIGN REPORT
REPLACEMENT OF I-95 BRIDGES OVER WEBB ROAD
MAINEDOT WIN 21900.01, BRIDGE NO. 5813 AND
MAINEDOT WIN 21894.01, BRIDGE NO. 1461
WATERVILLE, MAINE

by Haley & Aldrich, Inc.
Portland, Maine

for McFarland Johnson
Freeport, Maine

File No. 132212-004/005
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Attention: Theresa McAuliffe, P.E.
Transportation Manager

Subject: Geotechnical Design Report
Replacement of I-95 Bridges over Webb Road
MaineDOT WIN 21900.01, Bridge No. 5813 and
MaineDOT WIN 21894.01, Bridge No. 1461
Waterville, Maine

Ladies and Gentlemen:

We are pleased to submit our report entitled, "Geotechnical Design Report, Replacement of I-95 Bridges over Webb Road, MaineDOT WIN 21900.01 Bridge No. 5813 and MaineDOT WIN 21894.01 Bridge No. 1461, Waterville, Maine." This Geotechnical Design Report (GDR) has been prepared in accordance with our agreement with McFarland Johnson, dated 28 September 2021, and authorized by James M. Festa, P.E.

Introduction

This GDR presents the results of preliminary design phase (Phase I) and final design phase (Phase II) subsurface exploration and laboratory testing programs, technical evaluations, and geotechnical design recommendations for the subject project. This scope has been completed by Haley & Aldrich, Inc. (Haley & Aldrich) on behalf of McFarland Johnson for the proposed replacement of the I-95 bridges over Webb Road in Waterville, Maine (see Figure 1, Project Locus).

HORIZONTAL COORDINATE SYSTEM, ELEVATION DATUM, AND BASELINE STATIONING

Plan locations of test borings are reported as northing and easting coordinates relative to the Maine State Plane Coordinate System, North American Datum of 1983 (NAD 83), Maine 2000 West Zone. As-drilled test boring locations were related to station and offset distance/direction relative to the I-95 northbound (NB), southbound (SB), and NB diversion baseline stationing by Haley & Aldrich. The project elevation datum and elevations referenced herein are in feet (ft) and reference the North American Vertical Datum of 1988 (NAVD 88).

PROJECT LOCATION AND EXISTING SITE CONDITIONS

The existing bridges carry I-95 NB and SB traffic on two separate bridges over Webb Road in Waterville, Maine. The existing site conditions adjacent to Webb Road and I-95 consist of a predominantly vegetated highway median with the two-lane Webb Road crossing from approximately west to east beneath I-95. Based on our review of historic bridge plans dated 1958, we understand that the existing bridges each consist of three approximately 43-ft-long and 40-ft-wide spans. The existing bridge abutments are supported on concrete pile caps supported on steel H-piles, and the middle piers are supported on concrete spread footings bearing on soil.

PROPOSED BRIDGE STRUCTURES

The proposed single-span, two-lane bridges will carry I-95 over Webb Road along the same alignment as the existing bridges, as shown on Figure 2, Site and Subsurface Exploration Location Plan (on-line replacement). Bridge No. 5813 will carry I-95 NB and Bridge No. 1461 will carry I-95 SB. The proposed bridge structures will include full-height abutments adjacent to Webb Road. The total width and length of the bridges are planned to be 44.3 ft and 56 ft, respectively. Proposed finished roadway grades along the new approaches and bridge will approximately match current existing I-95 grades. Proposed finished roadway grades along Webb Road beneath the bridges will approximately match existing roadway grades.

A temporary roadway is planned to be constructed in the existing median between I-95 NB and I-95 SB, as shown on Figures 2 and 3 (Site and Subsurface Exploration Location Plans). This temporary roadway will carry I-95 NB traffic during the replacement of the existing I-95 NB bridge. After completion of the I-95 NB bridge, the temporary roadway will carry I-95 SB traffic during replacement of the existing I-95 SB bridge. It is our understanding that Webb Road will be closed during construction, and approximately 6 to 7 ft of temporary fill will be placed to construct the temporary roadway across Webb Road. A temporary bridge structure will not be required.

Geologic Setting

Based on Maine Geological Survey's Surficial Geology of the Waterville Quadrangle, Maine (2011) and soil samples observed in recent explorations, surficial deposits mapped at the site consist of artificial fill, marine deposits, glacial till and weathered bedrock.

Artificial fill was encountered in the recent explorations within the limits of the existing Webb Road and the existing highway embankments. The fill typically consisted of sand with varying amounts of gravel and trace silt. This material was placed during original construction of I-95.

Marine deposits were encountered beneath the man-placed fill in the recent explorations at the site. The marine deposits primarily consisted of soft/medium-dense to very stiff/dense silt and sand with varying amounts of gravel.

Glacial till deposits were encountered beneath the man-placed fill and/or marine unit in the recent explorations at the site. This glacial till unit primarily consisted of very stiff to hard silt with varying amounts of sand and gravel with minor deposits of very dense well-graded sand and gravel with varying amounts of silt.

According to Bedrock Geology of Maine (1985), bedrock within the site is primarily mapped as interbedded pelite, limestone, and sandstone of the Sangerville and Waterville Formations. The Sangerville and Waterville Formations are Silurian in age. Rock core samples collected from the recent explorations at the site consisted of phyllite with moderate to steeply dipping beds and intermittent calcite and quartz veins.

Subsurface Explorations

HISTORIC EXPLORATIONS BY OTHERS

A limited amount of subsurface information for the existing bridges is available and is shown on the historic drawings included in Appendix D.

PHASE I EXPLORATIONS BY HALEY & ALDRICH

Haley & Aldrich completed a Phase I subsurface exploration program in association with the subject project consisting of four test borings, designated BB-WWR-101 through BB-WWR-104, that were drilled at the site from 11 to 13 June 2018. Borings BB-WWR-101 and BB-WWR-102 were drilled for the I-95 NB bridge. Borings BB-WWR-103 and BB-WWR-104 were drilled for the I-95 SB bridge. The purpose of the subsurface exploration program was to characterize the general subsurface conditions along the proposed bridge alignment and in the vicinity of the proposed bridge substructures.

Boring locations were laid out in the field by Haley & Aldrich by taping from existing site features. As-drilled test boring locations and ground surface elevations at the test boring locations were determined in the field by MaineDOT using global positioning system (GPS) survey equipment upon drilling completion. The as-drilled station/offset distance and direction relative to the proposed baseline were determined by Haley & Aldrich. Location data for the explorations are summarized in Table I and the locations are shown graphically on Figure 2.

The test borings were drilled by New England Boring Contractors (NEBC) of Hermon, Maine using a Mobile B53 track-mounted drill rig. Test borings were advanced to depths ranging from approximately 25 to 42 ft below ground surface (BGS) using cased-washed drilling methods and 4-in. (HW-size) inside diameter (ID) steel casings. Soil samples were generally collected continuously and/or at standard, 5-ft intervals, by driving a 1-3/8-in. ID split spoon sampler with a 140-lb hammer dropped from a height of 30 in., as indicated on the test boring logs. The number of hammer blows required to advance the sampler through each 6-in. interval was recorded and is provided on the logs. The uncorrected SPT N-value (N-uncorrected) is defined as the total number of blows required to advance the sampler through the middle 12 in. of the 24-in. sampling interval.

The drill rig was equipped with a calibrated automatic hammer. Based on the calibration information provided by NEBC, a theoretical hammer efficiency factor of 0.677 was used for the automatic hammer. The energy-corrected SPT N-value (N_{60}) is equal to the uncorrected SPT N-value multiplied by the hammer efficiency factor (0.677) divided by 0.6 (i.e., 60% calculated hammer efficiency). Both the raw blow count (uncorrected N-values) and the corrected N-values are shown on the boring logs.

Test borings were advanced approximately 10 to 16.5 ft into bedrock using a 2-in. ID (NQ-size), diamond-tipped core barrel.

Soil and bedrock samples were collected and preserved in glass jars and wooden boxes, respectively. The samples that were not submitted for laboratory testing are available for review upon request, and are currently being stored at the Haley & Aldrich laboratory facility in Portland, Maine.

Observation wells were installed in two of the completed boreholes (i.e., BB-WWR-102 and BB-WWR-104) to provide information on the static groundwater levels at the site. The observation wells consisted of 2-in. ID machine-slotted polyvinyl chloride (PVC) pipe and solid PVC riser pipe extending to approximately 3 ft above the existing ground surface. The observation well was outfitted with a steel riser pipe with a locking steel cover. The observation well installation and groundwater monitoring reports are provided in Appendix B.

All Phase I drilling and sampling activities were performed in accordance with MaineDOT requirements.

PHASE II EXPLORATIONS BY HALEY & ALDRICH

Haley & Aldrich completed a Phase II subsurface exploration program at the site from 6 to 14 October 2021. The final design subsurface investigation consisted of eleven test borings, designated BB-WWR-201 through BB-WWR-210 and BB-WWR-208A.

Boring locations were laid out in the field by Haley & Aldrich using GPS survey equipment prior to the start of drilling. "As-drilled" test boring locations and ground surface elevations were determined in the field by MaineDOT using GPS survey equipment upon the completion of drilling and were provided to Haley & Aldrich. Location data for the explorations are summarized in Table I and are shown graphically on Figures 2 and 3.

The borings were drilled by NEBC of Hermon, Maine using a Mobile Drill B-53 track-mounted drill rig. Test borings were advanced to depths ranging from approximately 6.9 to 26.7 ft BGS using similar means and methods to those used to drill the Phase I test borings. The hammer efficiency factor for the automatic hammer used was 0.867 (86.7 percent theoretical hammer efficiency) as shown on the test boring logs.

Test borings BB-WWR-201 through BB-WWR-204 were advanced approximately 10 ft into bedrock using a 2.0-in. (NQ-size), diamond-tipped core barrel.

Soil and bedrock samples were collected and preserved in glass jars and wooden boxes, respectively. The soil and bedrock samples that were not submitted for laboratory testing are currently being stored at the Haley & Aldrich laboratory facility in Portland, Maine and are available for review upon request.

All drilling and sampling activities were performed in accordance with MaineDOT requirements.

Generalized Subsurface Conditions

The subsurface conditions encountered at the site during the recent subsurface exploration programs completed by Haley & Aldrich generally consist of the following geologic units presented in order of increasing depth BGS: topsoil, man-placed fill, marine deposits, glacial till, weathered bedrock, and bedrock. Refer to Table II for a summary of the soil units and encountered thicknesses in each test boring. A general description of each soil/bedrock unit is provided separately below. Detailed soil and bedrock descriptions are provided on the test boring logs included in Appendix A. Refer to Figures 4 through 7 (Interpretive Subsurface Profiles) for a graphical representation of the subsurface conditions present along the proposed bridge and temporary roadway alignments.

Please note that soil descriptions provided on the test boring logs do not represent actual field conditions other than at the specific test boring locations. The actual conditions encountered between boring locations may vary from those described herein and shown in Table II.

SOIL CONDITIONS

Unit	Approximate Range in Encountered Thickness (ft)	Generalized Description
Topsoil/Fill	0.3 to 4.0	Brown, dry to wet, very loose fine SAND (SP-SM) with varying amounts of silt; loose fine to coarse SAND (SW-SM, SW) with varying amounts of gravel and silt; loose Silty fine to medium SAND (SM) with varying amounts of silt and gravel; very soft to stiff SILT (ML) with varying amounts of sand and gravel; and/or stiff Sandy SILT (ML) with varying amounts of gravel. Contains roots. *(encountered in all borings except BB-WWR-209; diversion boring in I-95 median)*
Marine Deposit	1.9 to 16.3	Brown to grey, dry to wet, soft to hard SILT (ML) with varying amounts of sand and gravel; stiff Clayey SILT (ML) trace fine sand partings; medium-dense Silty fine to coarse SAND (SM) with varying amounts of gravel. *(encountered in all borings except BB-WWR-104; northwest of the SB bridge)*
Glacial Till	4.8 to 20.3	Brown to grey, moist to wet, very stiff to hard SILT (ML) with varying amounts of sand and gravel; hard Sandy SILT (ML) with varying amounts of sand and gravel; medium-dense to very dense SAND (SM) with varying amounts of silt and gravel; dense to very dense Silty SAND (SM) with varying amounts of gravel; medium-dense to dense fine to coarse GRAVEL (GM, GW, GP-GM) with varying amounts of silt and sand. *(encountered in all borings)*
Weathered Bedrock	0.2 to 5.2	Grey, weathered rock fragments and/or gravel. *(encountered in borings BB-WWR-101, BB-WWR-102, BB-WWR-104, BB-WWR-202, and BB-WWR-207)*

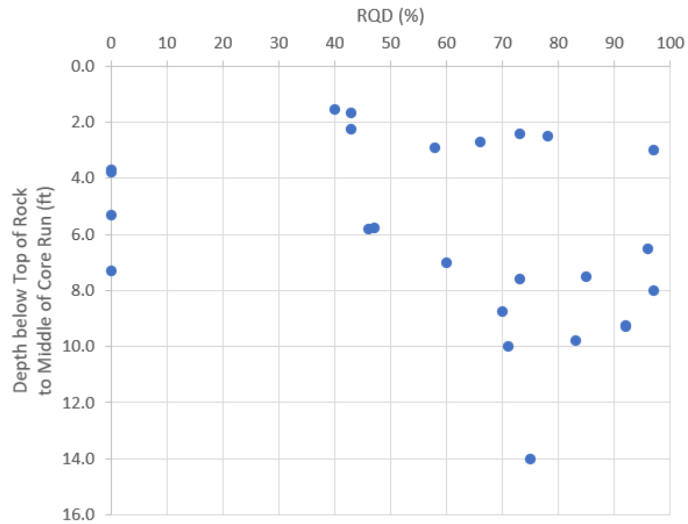
BEDROCK CONDITIONS

As stated previously, approximately 10 to 16.5 ft of bedrock was cored in each of the bridge test borings (rock coring was not conducted in the diversion borings). The sampled and recovered bedrock generally consisted of the following:

- Grey, aphanitic, PHYLLITE, hard, fresh to slightly weathered, discontinuities dipping at horizontal to vertical angles (0 to 90 degrees from horizontal axis), spacing very close to wide (<2 in. to 24 to 80 in.), discontinuity apertures are tight to open, discontinuity surfaces have calcite, quartz, and pyrite mineralization on some joint surfaces.

Rock quality designation (RQD) is a common parameter that is used to help assess the competency of sampled bedrock. RQD is defined as the sum of pieces of recovered bedrock greater than 4 in. in length divided by the total length of the bedrock core run. As shown on the adjacent figure, there were four core runs with RQD values of zero in the upper 8 ft of the rock. The remaining core runs had RQD values that ranged from 40 to 97 percent, indicating poor to excellent rock quality, with an average of 71 percent.

Photographs of the sampled bedrock are provided for reference in Appendix A.



GROUNDWATER CONDITIONS

As discussed previously, an observation well was installed in the completed boreholes BB-WWR-102 (northwest of the NB bridge) and BB-WWR-104 (northwest of the SB bridge). The observation wells were installed to provide information on the static groundwater levels at the site. The measured water levels during the period 12 June 2018 to 11 November 2021 ranged from approximately 2.4 to 7.5 ft BGS (elevation [El.] 231.7 to El. 226.6) at the NB bridge and approximately 2.6 to 7.0 ft BGS (El. 238.8 to El. 234.4) at the SB bridge.

In general, water levels may fluctuate with season, precipitation, local soil/bedrock conditions, and excavation means and methods. Therefore, water levels may vary from those summarized above, provided on the testing boring logs included in Appendix A, and shown on the groundwater monitoring reports included in Appendix B.

Laboratory Test Results

A geotechnical laboratory testing program was undertaken by Haley & Aldrich on representative soil and rock samples collected during the preliminary design (Phase I) and final design (Phase II) subsurface exploration programs to aid in soil classification and to determine the physical and strength properties of the soil and rock at the site. All laboratory testing was performed in accordance with applicable American Society for Testing Materials (ASTM) testing procedures by GeoTesting Express, Inc. (GTX) of Acton, Massachusetts. A summary of the lab testing results is provided below.

Laboratory Test	ASTM Test Designation	Unit	No. of Tests	Range in Test Results[1]
Grain Size of Soil (Sieve only)	ASTM D422	Fill	4	AASHTO Classification: A-1-b (0), A-4 (0) USCS Classification: ML, SW-SM, SM
		Marine Deposit	9	AASHTO Classification: A-1-b (0), A-2-4 (0), A-4 (0) USCS Classification: SP, ML, SP-SM
		Glacial Till	5	AASHTO Classification: A-1-b (0), A-4 (0) USCS Classification: ML, GM
Compressive Strength and Elastic Moduli of Rock	ASTM D7012 Method D	Bedrock	2	Peak Compressive Stress: 5,970 to 7,387 psi Young's Modulus: 2,890,000 to 55,300,000 psi Poisson's Ratio 0.12 to 0.21

[1] AASHTO = American Association of State Highway and Transportation Officials; psi = pounds per square in.; USCS = Unified Soil Classification System

All laboratory test results are shown on the test boring logs included in Appendix A with complete results provided in Appendix C.

Geotechnical Evaluations and Design Recommendations

Geotechnical design recommendations for the subject project, as discussed and provided herein, were developed in accordance with the following documents:

- AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, Ninth Edition, 2020, referred to herein as AASHTO LRFD; and
- MaineDOT Bridge Design Guide (BDG), August 2003, with Interim Revisions through June 2018, referred to herein as Bridge Design Guide.

Engineering calculations that support the recommendations outlined in this report are provided for reference in Appendix E.

APPROACH EMBANKMENTS

The proposed finished grades of I-95 at the bridge approaches will approximately match existing grades. Because of the limited amount of raise in grade and based on the subsurface conditions encountered in the Phase I and Phase II test borings drilled at the site, we anticipate that post-construction settlement of the new approach roadways will be negligible.

SEISMIC SITE CLASS AND DESIGN PARAMETERS

Site class was determined in accordance with AASHTO LRFD Section 3.10.3.1 using Method B. In instances where SPT N-values were equal to 0 (i.e., weight of rod or weight of hammer), were in excess of 100 blows per foot (bpf) or where bedrock was present, default values of 1, 100, and 100 bpf were used, respectively.

Based on the nature and thickness of the overburden soils and depth to bedrock at the site as determined from the test borings, we recommend the site be considered "Site Class D." Spectral accelerations were determined based on the geographic site location and the recommended "Site Class D" designation using the United States Geological Survey (USGS) software application Seismic Design Parameters version 2.0, which is based on a seismic event having a 7 percent probability of exceedance in 75 years (approximate 1,000-year return period). The recommended values are summarized below.

Design Parameter	Design Value
Site factor for short-period range of acceleration response spectrum, F_a =	1.600
Site factor for long-period range of acceleration response spectrum, F_v =	2.400
Site factor at zero-period on acceleration response spectrum, F_{pga} =	1.600
Horizontal response spectral acceleration coefficient at 0.2-s period on rock, S_S (g) =	0.161
Horizontal response spectral acceleration coefficient at 1.0-s period on rock, S_1 (g) =	0.046
Peak seismic ground acceleration coefficient on rock, PGA (g) =	0.077
Horizontal response spectral acceleration coefficient at 0.2-s period modified by F_a, S_{DS} (g) =	0.257
Horizontal response spectral acceleration coefficient at 1.0-s period modified by F_v, S_{D1} (g) =	0.111
Peak seismic ground acceleration coefficient modified by F_{pga}, As (g) =	0.123

In accordance with AASHTO LRFD Section 3.10.6, the site falls within Seismic Zone 1 based on the calculated value of S_{D1} (i.e., $S_{D1} < 0.15$).

Based on our review of the soil conditions encountered in the test borings and the laboratory testing results, it is our opinion that the overall potential for saturated granular soils present at the site to liquefy during the design earthquake event is low.

BRIDGE ABUTMENT AND WINGWALL FOUNDATION SUPPORT

As shown on the interpretive subsurface profiles (Figures 4 through 7), the subsurface conditions primarily consist of, in order of increasing depth BGS: topsoil, man-placed fill, marine deposits, glacial till, weathered bedrock, and bedrock. The weathered bedrock, glacial till, and bedrock are considered suitable for support of the bridge superstructures. Based on the depth to suitable bearing strata, the subsurface data available, and the proposed bridge geometry, we consider spread footings bearing on glacial till to be the most feasible foundation support option. It is our understanding that the existing bridge pier spread footings, bearing on glacial till, will be incorporated into a continuous, unreinforced concrete pad ("subfooting") that the new abutment footings will be placed onto.

We recommend that the abutments and wingwalls be supported on mass concrete footings founded on undisturbed glacial till. We understand the proposed bottom of subfootings will be at El. 218.3 for Abutments 1 and 2 for the I-95 NB bridge, and El. 226.8 and El. 226.0 for Abutments 1 and 2 respectively for the I-95 SB bridge. Based on the conditions encountered in the test borings, we anticipate that the soil present at these elevations will be glacial till. Please note that the available subsurface information indicates that the interface elevation between glacial till, weathered bedrock and bedrock is variable.

Foundation design recommendations, based on footing dimensions of 28.6-ft by 54-ft as scaled from draft plans provided by McFarland Johnson, are provided below.

- Bearing resistance:
  - For the service limit state, mass concrete footings should be designed such that footing contact pressures do not exceed 16.0 kips per square foot (ksf). At this pressure, it is estimated that settlement of footings bearing on glacial till or weathered bedrock will be less than 1 in. per LRFD Article 10.6.2.6.1. This presumptive bearing resistance is based on Table C10.6.2.6.1-1 of AASHTO LRFD.
  - For the strength limit state, footings should be designed for a factored bearing resistance of 21.1 ksf, using a resistance factor of 0.45. Bearing resistances for additional footing sizes are shown in Appendix E.
  - For the extreme event limit state, footings should be designed for a factored bearing resistance of 37.4 ksf, using a resistance factor of 0.8.
- Bearing Distribution and Eccentricity:
  - Application of permanent and transient loads is specified in AASHTO LRFD Section 11.5.6. We recommend the stress distribution at the base of the footing be assumed to be a triangular or trapezoidal distribution over the effective footing base as shown in AASHTO LRFD Figure 11.6.3.2-2.
  - The eccentricity of loading at the Strength Limit State, based on factored loads, should not exceed one-third of the spread footing dimensions in either direction. This eccentricity corresponds to the resultant of reaction forces falling within the middle two-thirds of the base width and length.
- Sliding Resistance:
  - In accordance with AASHTO LRFD Tables C3.11.5.3-1 and 10.5.5.2.2-1, we recommend that sliding resistance of abutment and wingwall footings be calculated using the design parameters presented below.

Subgrade Saturation Condition During Construction	Coefficient of Friction (tan δ)	Interface Friction Angle (δ, deg.)	Strength Limit State Resistance Factor for Sliding (φ_τ)	Service/Extreme Limit State Resistance Factor for Sliding (φ_τ)
Prepared in-the-dry	0.45	24	0.8	1.0

- Lateral passive soil resistance in front of the footings, if present, should be neglected in accordance with requirements of the BDG. Although not typically included, lateral resistance due to passive earth pressures in front of the subfootings may be used for subfooting design only. This was discussed with both McFarland Johnson and the Department during design, and it was agreed that use of lateral passive resistance for the subfootings was acceptable. The passive resistance should start 6 ft below the Webb Road final grade and use the Rankine lateral earth pressure coefficient presented below.

Substructure	Passive Lateral Earth Pressure Coefficients (K_p, dim.)	
	Rankine	Coulomb
Subfootings	3.00	7.33

ABUTMENT AND WINGWALL DESIGN

- Drainage:
  - The abutment and wingwall design should include a drainage system to intercept any groundwater and direct it to a suitable discharge point that does not adversely affect the performance of the abutment and wingwall spread footings. We recommend that drainage be provided in accordance with BDG Section 5.4.2.13.
- Lateral Earth Pressures:
  - Recommendations summarized in the table below are based on the following:
    - Abutments and wingwalls are backfilled with a free-draining material (i.e., Soil Type 4, BDG Table 3-3; total unit weight = 125 pounds per cubic foot (pcf); internal angle of friction = 32 degrees).
    - The abutment and wingwall backwalls are vertical.
    - Adequate drainage is provided, as recommended herein and in accordance with the requirements of the BDG, to eliminate the potential for unbalanced hydrostatic pressures to develop.

- A 0 degree backfill surface (i.e., horizontal) at Abutment 1 and 2 breastwalls.

Substructure	Active Lateral Earth Pressure Coefficient (K_a, dim.)		At-Rest Lateral Earth Pressure Coefficient (K_o)
	Rankine	Coulomb	
Abutment Breastwalls	0.31	0.27	0.47

- The Coulomb active earth pressure coefficients apply to wall designs that are "gravity-shaped" or short-heeled, cantilever-types where the top of the stem wall interferes with the shear zone. For long-heeled cantilever-type walls, we recommend the use of Rankine active earth pressure coefficients.
- In accordance with BDG Section 5.4.3, semi-integral abutments should be designed for Rankine active earth pressures over the rigid abutment height and a uniform pressure distribution due to the height of soil behind the superstructure/end diaphragm. We recommend that the superstructure backwall (end diaphragm) be designed for full passive pressure only.
- Additional lateral earth pressures due to live load surcharge are required in accordance with BDG Section 3.6.8 for abutments if an approach slab is not included. If an approach slab is not included, we recommend that the live load surcharge be estimated as a uniform horizontal earth pressure due to an equivalent height of soil that is related to the abutment and wingwall heights, as presented to BDG Table 3-4. When an approach slab is specified, reduction, not elimination of the surcharge load is permitted in accordance with AASHTO LRFD Section 3.11.6.5.

FROST PROTECTION

The minimum depth of embedment/cover for footings or other below-grade structures was evaluated in accordance with Section 5.2.1 of the MaineDOT BDG. Based on the site's design freezing index of 1,660 freezing degree-days, we recommend that the footings and walls bear a minimum of 6.0 ft below the lowest adjacent ground surface exposed to freezing. Refer to Appendix E for supporting documentation.

GLOBAL STABILITY

Computer-assisted, two-dimensional global stability evaluations were performed using the computer program Slide2 by Rocscience Inc. to evaluate global stability of the bridge approach embankments. Evaluations were performed perpendicular to the face of NB Abutment 2 (longitudinal to the bridge) and at two cross-sections perpendicular to the NB Abutment 2 East Wingwall (transverse to the bridge baseline). Based on the geometry and subsurface conditions present at the site, the locations of these stability evaluations were considered to be representative of the proposed bridge structures for the project.

Soil and rock material and strength properties used in the global stability evaluations were based on the results of laboratory testing and our experience. These values are summarized below.

	Unit Weight (pcf)	Friction Angle (degrees)	Undrained Shear Strength (psf)
Granular Borrow	125	32	0
Marine Deposit (Sand)	120	32	0
Glacial Till	130	38	0
Weathered Bedrock	130	38	0
Bedrock	infinite strength		

The calculated global stability factors of safety values are summarized below and calculations are included in Appendix E.

Structure	Factor of Safety	
	Static	Pseudo-Static
I-95 NB Abutment No. 2	2.2	2.1
I-95 NB Abutment No. 2 Wingwall Section 2	2.1	2.1
I-95 NB Abutment No. 2 Wingwall Section 2	2.1	2.0

The minimum calculated static factor of safety from our evaluations is 2.1. The minimum factor of safety required for static stability evaluations is 1.3 where the geotechnical parameters and subsurface stratigraphy are well defined, based on the requirements of LRFD Article 11.6.2.3. The minimum calculated factor of safety under pseudo-static earthquake loading from our evaluations is 2.0, using a horizontal coefficient of 0.06 (i.e., one-half of the peak ground acceleration coefficient, As). Values ranging from As/3 to As/2 are recommended in literature (Melo and Sharma, 2004). The reduction in As is due to soil slope flexibility and the fact that the peak ground acceleration during an earthquake lasts only for a very short period of time. The minimum factor of safety required for pseudo-static stability evaluations is 1.1 based on the requirements of LRFD. The calculated factor of safety for both the static case and pseudo-static case exceed the minimum required factor of safety.

Construction Considerations

The purpose of this section of the report is to provide comments and recommendations on items related to excavation, earthwork, and other geotechnical aspects of the proposed construction. Since it identifies potential construction issues related to foundations and earthwork, the information in this section is intended to aid personnel who monitor the construction activities. Prospective Contractors for this project should evaluate construction issues based on their own knowledge and experience in the Waterville, Maine area taking into consideration their proposed construction means, methods, and procedures.

EXCAVATION

We anticipate that excavation of the in-situ fill, marine deposits, and glacial till can be accomplished using normal earth-excavating equipment (i.e., hydraulic backhoes and excavators). In our opinion, temporary cut slopes in glacial till should typically be stable if constructed no steeper than about 1.5 horizontal to 1 vertical (1.5H:1V). Some sloughing and raveling should be anticipated in all temporary earth slopes. All temporary excavations should be made in accordance with Occupational Safety and Health Administration (OSHA) and other applicable regulatory agency requirements. The Contractor should be responsible for the design, stability, and safety of all temporary excavations.

As noted on the test boring logs, the naturally-deposited glacial till soils may contain cobbles and possibly some large boulders. We recommend that the Contract Documents require the Contractor to include provisions for cobble/boulder removal in their bid.

The following guidelines are recommended to protect the subgrade soils beneath footings:

- Make final excavations (e.g., within 5 ft of final subfooting bearing level) into bearing soils in-the-dry using smooth-bladed equipment to limit disturbance. Dewatering may be required within the excavation limits.
- During substructure construction, prevent water infiltration into the excavation to reduce the possibility of soil disturbance. All filling and concreting of subfootings should be performed in-the-dry. Subgrades that become disturbed due to water infiltration should be over-excavated and stabilized.
- Exposed subgrades should be examined in the field by a geotechnical engineer prior to rebar cage construction to verify strength and bearing capacity. Over-excavation may be necessary to remove weak, disturbed, or otherwise unacceptable soils.
- Exposed granular soils at bearing strata should be proofrolled until firm, as determined by a geotechnical engineer. Any soft areas revealed by proof-rolling should be excavated and replaced with approved granular material or additional subfooting concrete.
- Fill should be placed in lifts not exceeding 12 in. in loose measure and compacted using self-propelled vibratory equipment. In confined areas, the maximum loose layer should be reduced to 9 in., and compaction performed by hand-guided equipment. Cobbles or boulders having a size exceeding two-thirds of the loose lift thickness should be removed prior to compaction.
- Disturbance due to water infiltration and adverse weather could be reduced by maintaining footing excavations at least 12 in. above the final bearing level until immediately before placing subfooting concrete.
- Limit equipment traffic on exposed soil-bearing surfaces.
- Soil-bearing surfaces below completed foundations should be protected against freezing, before and after foundation construction. If construction is performed during freezing weather, footings should be backfilled to a sufficient depth (up to 6 ft) as soon as possible after they are constructed. Alternatively, insulating blankets or other means may be used for protection against freezing.

CONSTRUCTION DEWATERING

Based on the water levels measured in the observation wells installed at the site, we anticipate groundwater will be encountered during excavation for the abutment footings for both the NB and SB bridges since the bottom of excavation will be below the measured water levels. Because of this, we anticipate that temporary dewatering will be needed in order to complete the excavation and subgrade preparation in the dry and could likely be accomplished by passively pumping from open sumps and temporary ditches located at the base of the excavations. Sumps should be provided with filters suitable to prevent pumping of fine-grained soil particles.

The Contractor should be responsible for controlling all surface runoff, infiltration, and water from other sources at all times during excavation. Rainwater or snowmelt should be directed away from exposed foundation-bearing surfaces. Dewatering should be performed as required to maintain the undisturbed nature of soil surfaces and enable all final excavation, foundation construction, and backfilling to be completed “in-the-dry.”

Dewatering should be performed in accordance with all applicable regulations. Dewatering effluent should be treated as required by applicable state and local regulations.

SUBMITTAL REVIEWS

The Contract Drawings and special provisions should be written so that the requirements of the documents are consistent with the design intent of the geotechnical recommendations outlined herein. The special provisions should require that the Contractor and the Contractor’s engineer perform necessary analyses and submit the results to MaineDOT for review. We recommend that Haley & Aldrich be allowed to review the geotechnical-related submittals to ensure that the Contractor’s analyses/submittals are in accordance with the intent of the design as summarized herein. This will enable us to ensure compliance with the design concepts, assumptions, and special provisions, and to facilitate design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

CONSTRUCTION MONITORING

The geotechnical design and earthwork recommendations contained herein are based on the known and predictable behavior of a properly engineered and constructed foundation. Monitoring of the foundation construction activities is required to enable the geotechnical engineer to confirm that procedures and techniques used by the Contractor during construction are appropriate and will not impact the design of the bridge. Therefore, we recommend that an individual representing MaineDOT, qualified by geotechnical training and experience, be present at the site to provide monitoring during the foundation construction activities listed below.

- Determination of over-excavation limits of unsuitable soils below footing bearing levels.
- Preparation of the footing bearing surfaces.
- Placement and compaction of compacted fills below footing bearing level.

Limitations

This report is prepared for the exclusive use of McFarland Johnson and MaineDOT relative to the subject project. There are no intended beneficiaries other than McFarland Johnson and MaineDOT. Haley & Aldrich shall owe no duty whatsoever to any other person or entity on account of the Agreement or the report. Use of this report by any person or entity other than McFarland Johnson and MaineDOT for any purpose whatsoever is expressly forbidden unless such other person or entity obtains written authorization from McFarland Johnson and Haley & Aldrich. Use of this report by such other person or entity without the written authorization of McFarland Johnson and Haley & Aldrich shall be at such other person's or entities' sole risk and shall be without legal exposure or liability to Haley & Aldrich.

Use of this report by any person or entity, including by McFarland Johnson and MaineDOT, for a purpose other than relative to the subject project is expressly prohibited unless such person or entity obtains written authorization from Haley & Aldrich indicating that the report is adequate for such other use. Use of this report by any other person or entity for such other purpose without written authorization by Haley & Aldrich shall be at such person's or entities' sole risk and shall be without legal exposure or liability to Haley & Aldrich.

The information provided herein is based, in part, upon the data obtained from the referenced subsurface explorations. The nature and extent of variations between explorations may not become evident until construction. If variations then appear, it may be necessary to re-evaluate the recommendations of this report.

It is our understanding that this report may be included as a reference document in the documents that will be provided to the prospective Contractors for bidding. Please note that the recommendations included herein are superseded by the information contained in the documents and that the information contained in the documents takes precedence over the information provided in this report.

Closure

We appreciate the opportunity to continue to provide McFarland Johnson with geotechnical support services on this project. Please do not hesitate to contact us if you have any questions or comments.

Sincerely yours,
HALEY & ALDRICH, INC.

Erin A. Force

Justin A. DuBois, P.E.
Senior Engineer

Erin A. Force, P.E.
Senior Project Manager

STATE OF MAINE
ERIN A. FORCE
No. 12207
LICENSED
PROFESSIONAL ENGINEER

Wayne A. Chadbourne, P.E.
Principal

Enclosures:

- Table I – Phase I and Phase II Exploration Location Data
- Table II – Phase I and Phase II Exploration Subsurface Data
- Figure 1 – Project Locus
- Figures 2 and 3 – Site and Subsurface Exploration Location Plans
- Figures 4 through 7 – Interpretive Subsurface Profiles
- Appendix A – Test Boring Logs and Rock Core Photographs
- Appendix B – Observation Well Installation and Groundwater Monitoring Reports
- Appendix C – Laboratory Test Results
- Appendix D – Historic Bridge Drawings
- Appendix E – Geotechnical Design Calculations

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TABLES

TABLE I
PHASE I AND PHASE II EXPLORATION LOCATION DATA
Replacement of I-95 Bridges over Webb Road
MaineDOT WIN 21900.01, Bridge No. 5813
MaineDOT WIN 21894.01, Bridge No. 1461
Waterville, Maine

Haley & Aldrich, Inc. File No.: 132212-004

Test Boring No.[1]	Ground Surface Elevation (ft)[3,4]	Station[5]	Offset Distance (ft) & Direction[5]	Coordinates[2]	
				Northing	Easting
Northbound Bridge					
BB-WWR-101	227.6	120+53.2 NB	39.8 R	617232.8312	1161451.595
BB-WWR-102(OW)	234.1	120+90.3 NB	45.5 L	617307.942	1161396.846
BB-WWR-201	229.6	120+26.7 NB	36.1 L	617248.4	1161372.733
BB-WWR-202	226.0	121+0.7 NB	38.1 R	617274.662	1161474.202
Southbound Bridge					
BB-WWR-103	234.2	220+7.4 SB	34.9 R	617276.6288	1161225.733
BB-WWR-104(OW)	241.4	220+40.8 SB	45.7 L	617346.7724	1161173.829
BB-WWR-203	237.7	219+84.6 SB	33.3 L	617292.293	1161155.579
BB-WWR-204	233.3	220+63.3 SB	38.6 R	617322.662	1161257.696
Northbound Diversion					
BB-WWR-205	243.4	416+70.4 NB DIV	13.8 R	617065.106	1161199.873
BB-WWR-206	243.2	417+53.4 NB DIV	1.4 R	617142.756	1161230.762
BB-WWR-207	234.3	418+71.7 NB DIV	5.9 L	617248.219	1161284.813
BB-WWR-208	233.0	419+56.2 NB DIV	0.8 L	617318.222	1161332.452
BB-WWR-208A	232.9	419+57.6 NB DIV	3.3 R	617317.383	1161336.707
BB-WWR-209	252.2	424+53.1 NB DIV	2.6 R	617731.693	1161607.091
BB-WWR-210	255.4	425+57.2 NB DIV	2.0 R	617813.118	1161671.741

Notes:
1 Test boring locations are shown on Figure 2, Site and Subsurface Exploration Location Plan.
2 As-drilled coordinates of test borings were determined by MaineDOT using GPS survey equipment, are measured in feet and reference NAD83, Maine 2000 West Zone coordinate system.
3 Ground surface elevations at test boring locations were determined in the field by MaineDOT using GPS survey equipment.
4 Elevations are measured in feet and reference the North American Vertical Datum of 1988 (NAVD 88).
5 Station and offset relative to the Northbound, Southbound, and Northbound Diversion baseline information determined by Haley & Aldrich.

	Individual	Date
Prepared By:	JAD/TPJ	7/14/2020
Checked By:	JAD	3/3/2022
Reviewed By:	MMB	3/10/2022

TABLE II
PHASE I AND PHASE II EXPLORATION SUBSURFACE DATA
Replacement of I-95 Bridges over Webb Road
MaineDOT WIN 21900.01, Bridge No. 5813
MaineDOT WIN 21894.01, Bridge No. 1461
Waterville, Maine

Haley & Aldrich, Inc. File No.: 132212-004

Test Boring No.[1]	Ground Surface Elevation (ft)[2,3]	Topsoil/Fill	Marine Deposit			Glacial Till			Weathered Rock	
		Thickness	Depth to Top	El. of Top[2,3]	Thickness	Depth to Top	El. of Top[2,3]	Thickness	Depth to Top	El. of Top[2,3]
		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Northbound Bridge										
BB-WWR-101	227.6	2.0	2.0	225.6	3.0	5.0	222.6	4.8	9.8	217.8
BB-WWR-102(OW)	234.1	2.0	2.0	232.1	3.5	5.5	228.6	20.3	25.8	208.3
BB-WWR-201	229.6	2.0	2.0	227.6	2.0	4.0	225.6	12.6	NE	NE
BB-WWR-202	226.0	0.4	0.4	225.6	4.0	4.4	221.6	10.7	15.1	210.9
Southbound Bridge										
BB-WWR-103	234.2	1.0	1.0	233.2	2.5	3.5	230.7	8.8	12.3	221.9
BB-WWR-104(OW)	241.4	2.0	NE	NE	NE	2.0	239.4	12.5	14.5	226.9
BB-WWR-203	237.7	0.3	0.3	237.4	1.9	2.2	235.5	10.3	NE	NE
BB-WWR-204	233.3	1.0	1.0	232.3	2.0	3.0	230.3	10.4	NE	NE
Northbound Diversion										
BB-WWR-205	243.4	4.0	4.0	239.4	10.0	14.0	229.4	>3.0	NE	NE
BB-WWR-206	243.2	0.8	0.8	242.4	15.2	16.0	227.2	>1.0	NE	NE
BB-WWR-207	234.3	0.7	0.7	233.6	3.3	4.0	230.3	9.0	13.0	221.3
BB-WWR-208	233.0	2.0	2.0	231.0	3.0	5.0	228.0	>1.9	NE	NE
BB-WWR-208A	232.9	NE	NE	NE	NE	6.9	226.0	>10.6	NE	NE
BB-WWR-209	252.2	NE	0.0	252.2	16.3	16.3	235.9	>0.7	NE	NE
BB-WWR-210	255.4	0.5	0.5	254.9	12.4	12.9	242.5	>4.1	NE	NE

Notes:
1 Test boring locations are shown on Figure 2, Site and Subsurface Exploration Location Plan.
2 Ground surface elevations at test boring locations were determined in the field by MaineDOT using GPS survey equipment.
3 Elevations are measured in feet and reference the North American Vertical Datum of 1988 (NAVD 88).
4 NE = not encountered.

FIGURES

MAP SOURCE: ESRI

SITE COORDINATES: 44°31'29"N, 69°41'46"W

HALEY ALDRICH

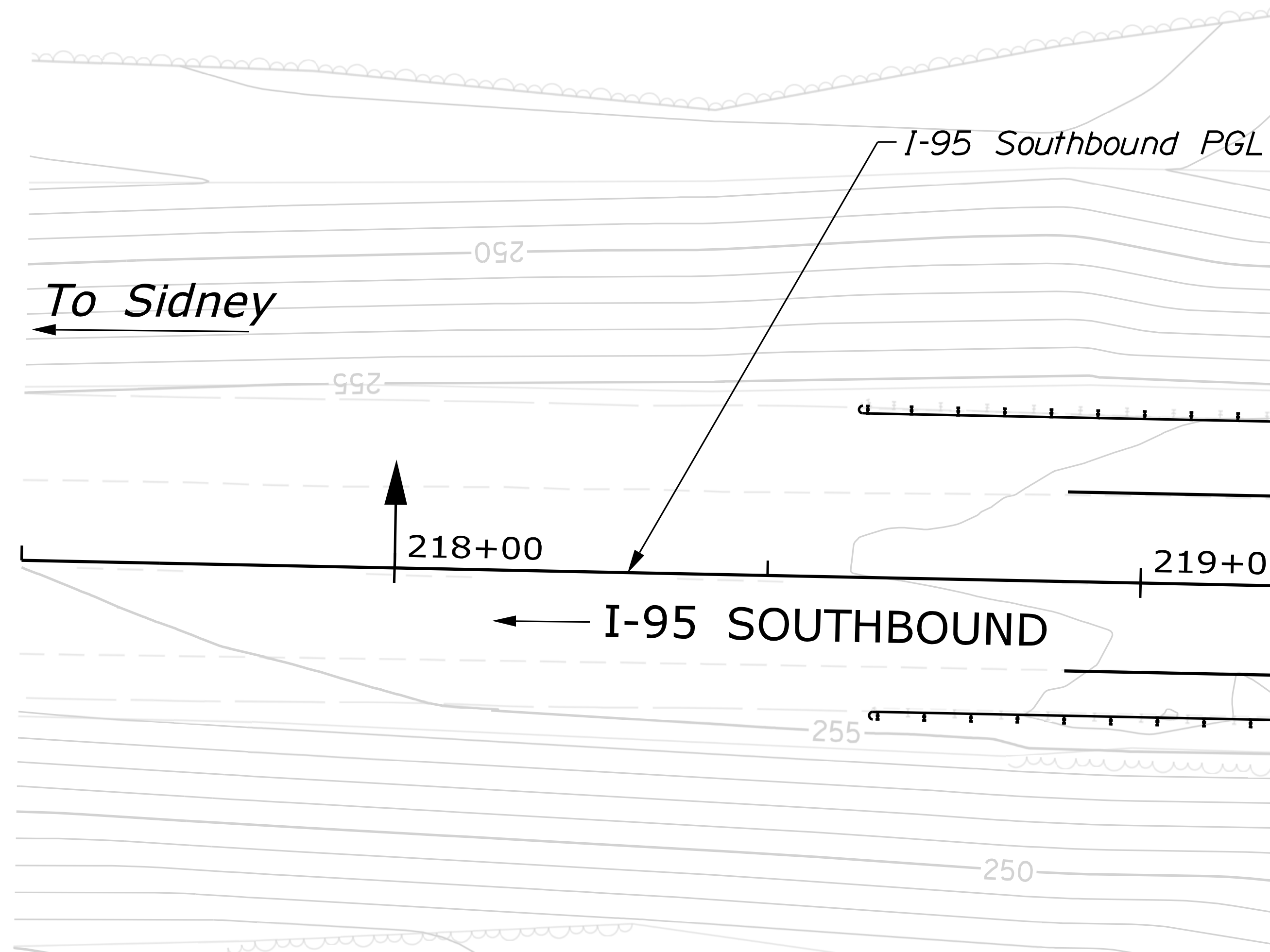
REPLACEMENT OF I-95 BRIDGES OVER WEBB ROAD
WATERVILLE, MAINE
WIN 21900.00 (NORTHBOUND), BRIDGE NO. 5813
WIN 21894.00 (SOUTHBOUND), BRIDGE NO. 1461

PROJECT LOCUS

APPROXIMATE SCALE: 1 IN = 2000 FT
MARCH 2021

FIGURE 1

132212-002/003_1_LOCUS.PDF



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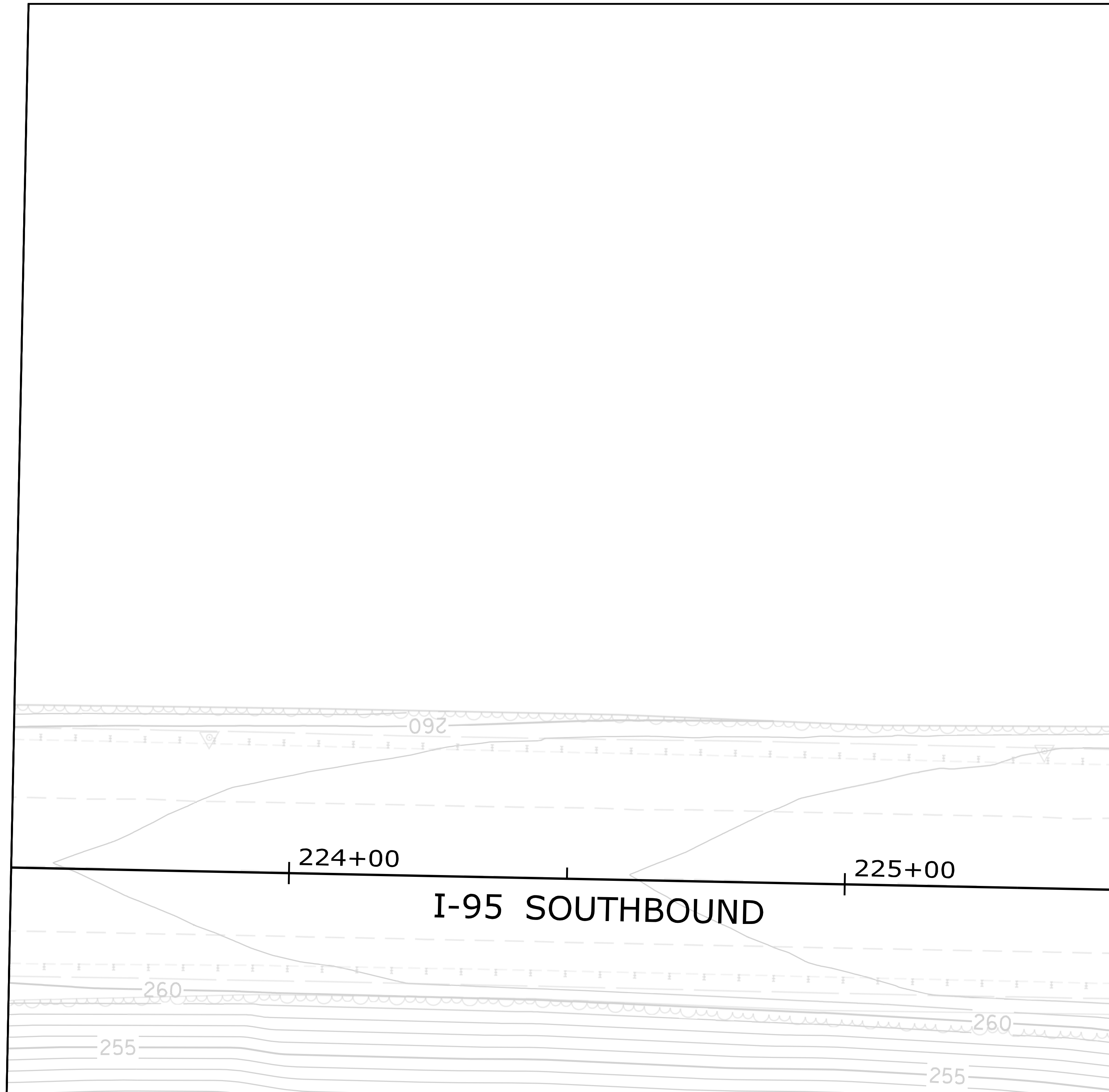
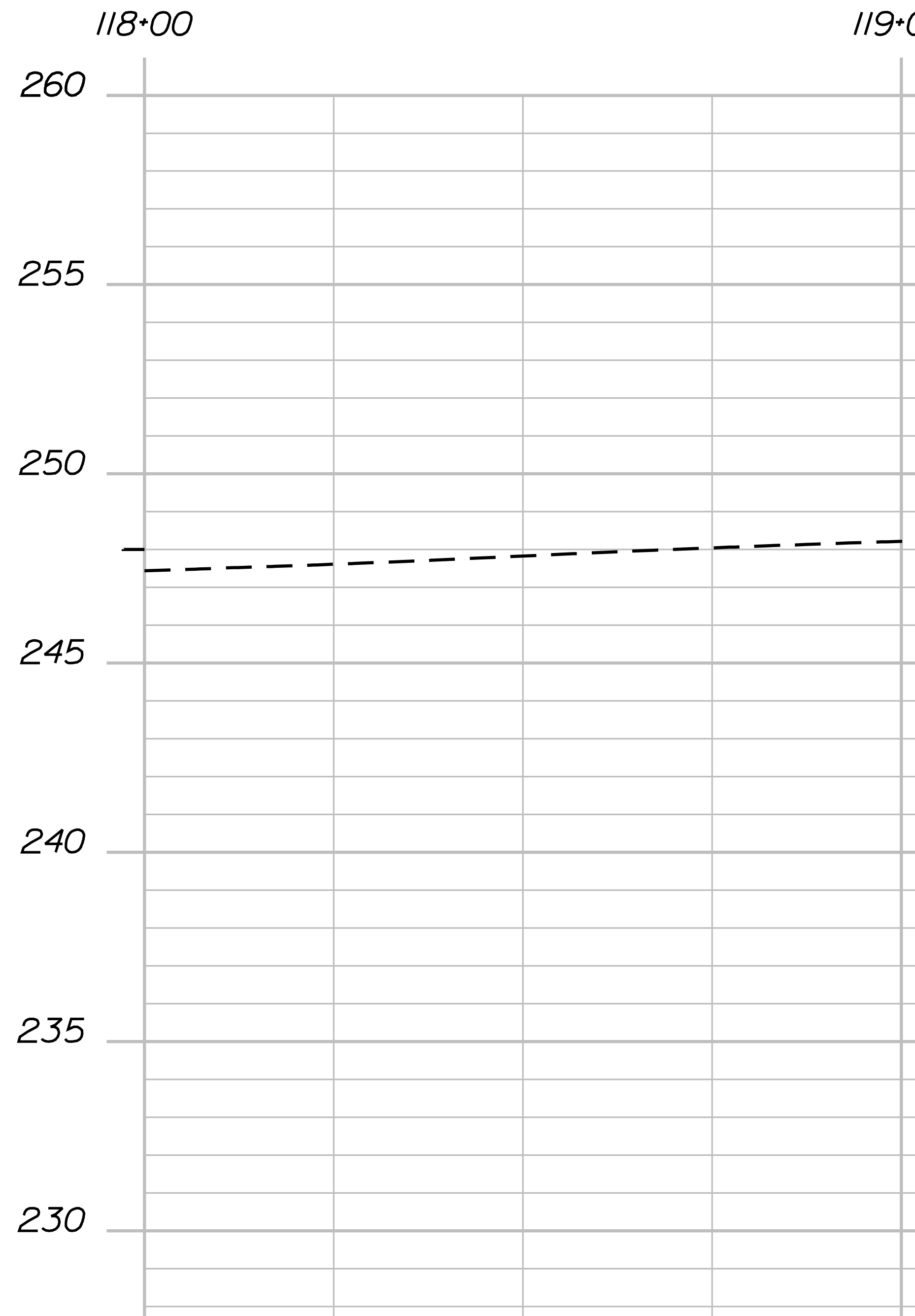


Date:3/17/2022



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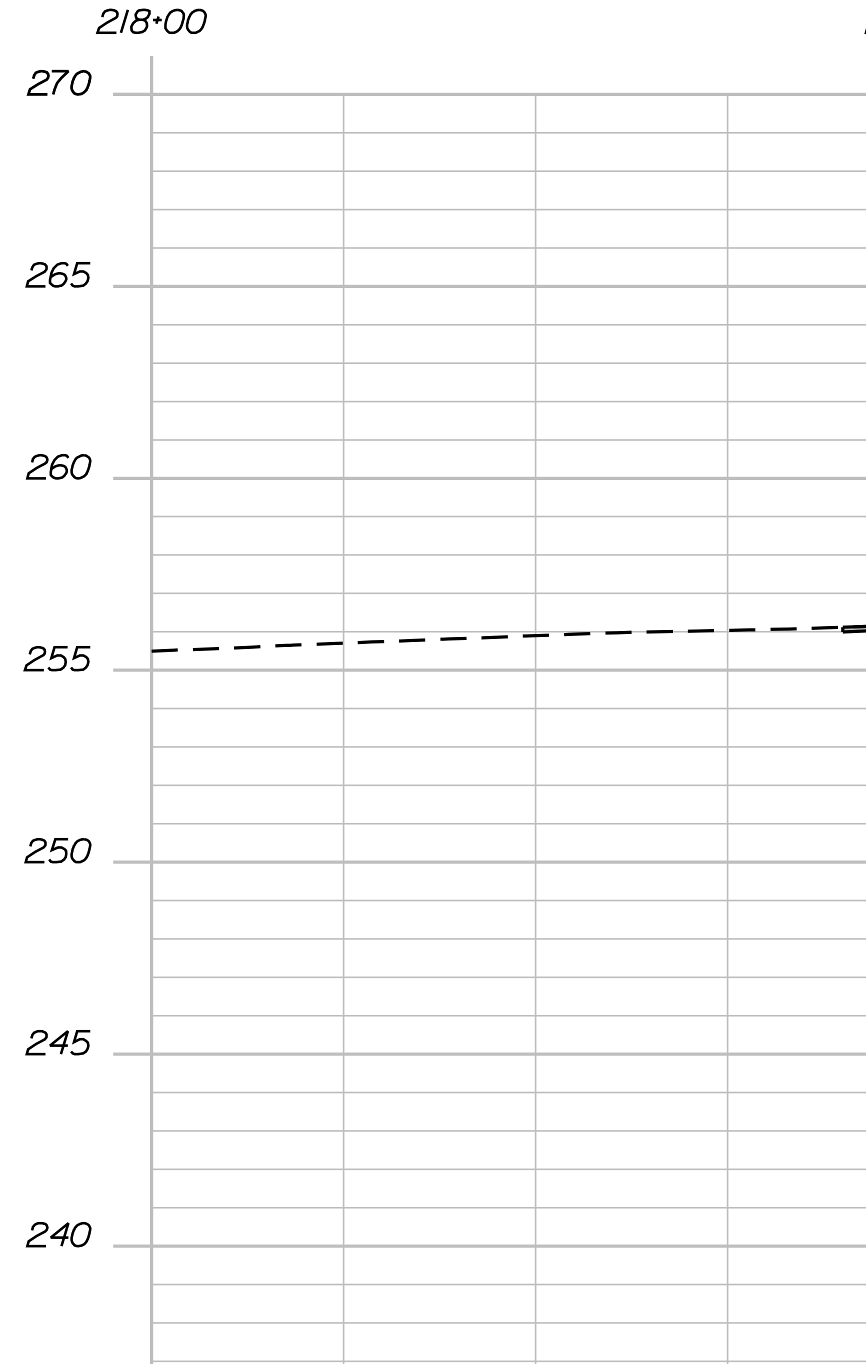

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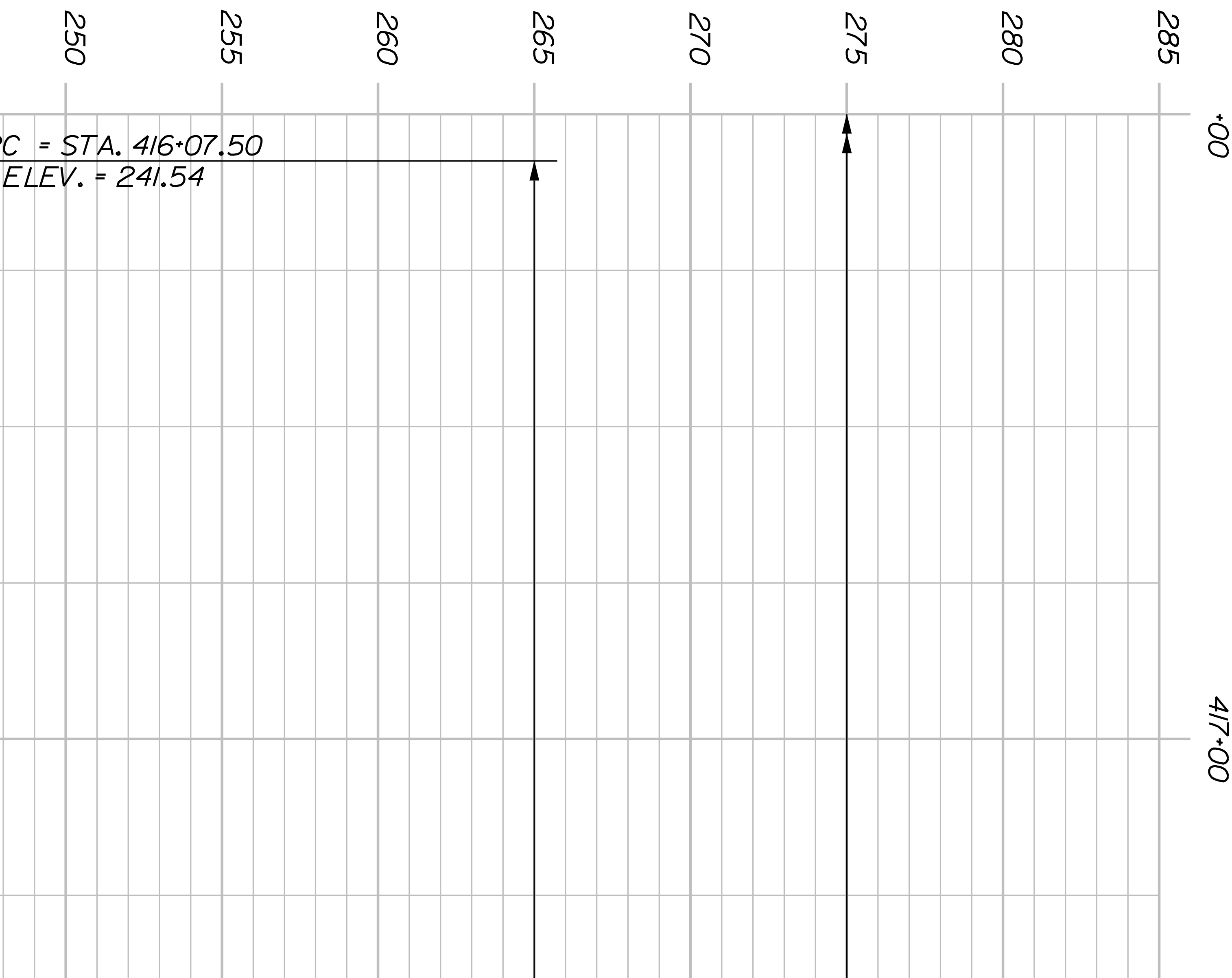

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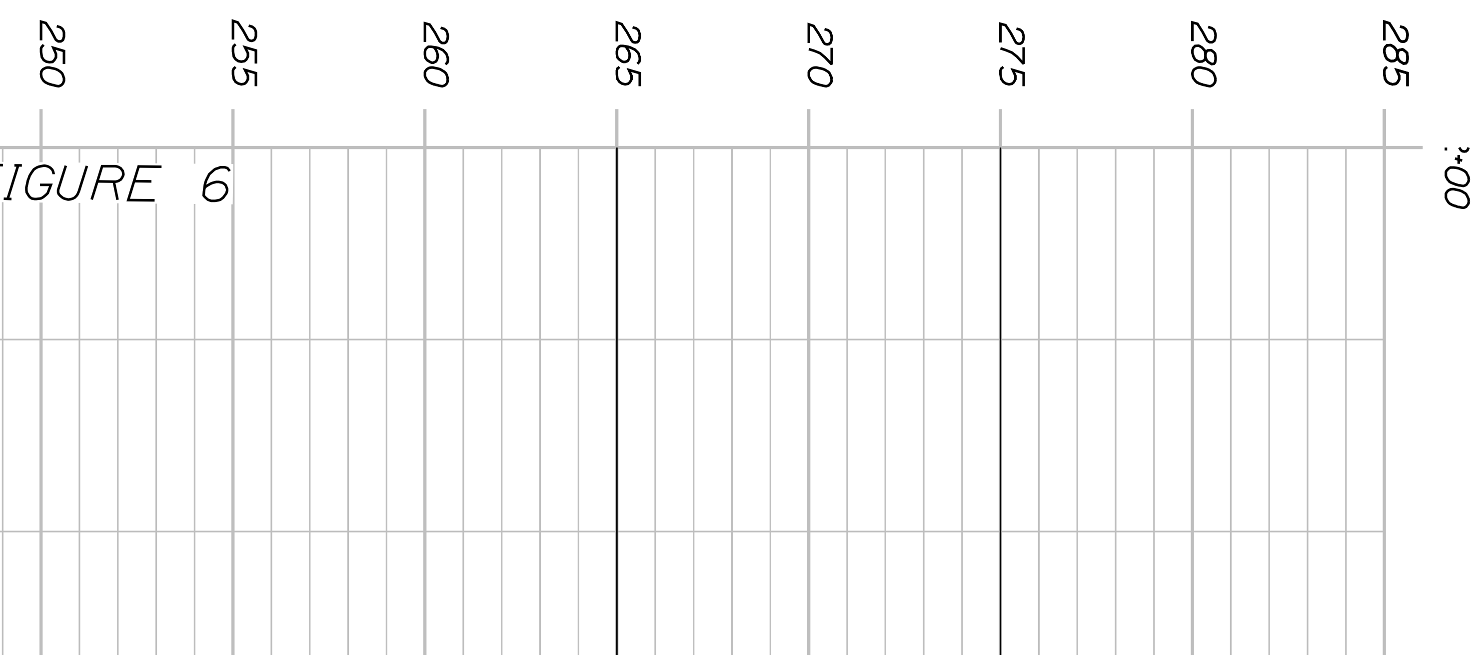

APPENDIX A

Test Boring Logs and
Rock Core Photographs

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-101
WIN: 21900.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	227.6	**Auger ID/OD:**	HSA-2.5 in. ID
Operator:	B. Enos	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	N. Klausmeyer	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	HW-300#/24 in.;SS-140#/30
Date Start/Finish:	06/12/2018	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2.0-in. ID
Boring Location:	Sta. 120+53.2 NB, 39.8 RT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	1.0 ft (during drilling)
Hammer Efficiency Factor:	0.677	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/1	0.0 - 2.0	WOH/WOH/WOH/ WOH			HSA			Brown, wet, very loose, fine SAND, little medium to coarse sand, little silt, trace roots, poorly graded -FILL-(SP-SM)	
								225.6		2.0	
	2DA	12/10	2.0 - 3.0	1/4/8/15	12	14				Grey, wet, medium dense, fine to medium SAND, trace silt, trace gravel, trace roots and organics -MARINE DEPOSITS-(SP)	G#474287 (A-1-b(0)) SP
	2DB	12/10	3.0 - 4.0					224.6		3.0	
	3DA	12/12	4.0 - 5.0	7/14/11/11	25	28		223.6		Grey, moist, very stiff, SILT, trace fine sand -MARINE DEPOSITS-(ML) 4.0	
5	3DB	12/12	5.0 - 6.0					222.6		Brown, wet, medium dense, fine to coarse SAND, some fine gravel, trace silt, trace organics -MARINE DEPOSITS-(SW-SM) 5.0	
										Brown, moist, very stiff, SILT, some fine to coarse sand, little gravel -GLACIAL TILL-(ML)	
										Note: Drill action and wash water contents indicate gravel from 5.0 to 9.8 ft.	
10								217.8		9.8	
										Grey, very hard, wet, WEATHERED BEDROCK Note: Sample collected from wash water return.	
	R1	40/23	11.5 - 14.8	RQD = 43%			NQ	216.1		-WEATHERED BEDROCK- 11.5	
							CORE			Note: Begin NQ Rock Core at 11.5 ft. Top of Bedrock El.216.1 R1: Grey, aphanitic PHYLLITE, hard, fresh to slightlyweathered, joints dipping at low to steep angles, very close to close, tight to open, calcite coatings on some joint surfaces, occasional calcite veins. Recovery=58% Rock Quality=Poor R1 Core Times (min:sec): 11.5-12.5' (4:33); 12.5-13.5' (2:47); 13.5-14.5' (2:21); 14.5-14.8' (2:07)	
	R2	9/9	14.8 - 15.6	RQD = 0%						R2: Similar to R1, except joints dipping at steep angles, very close, no calcite veins. Recovery=100% Rock Quality=Very Poor R2 Core Times (min:sec): 14.8-15.6' (2:58)	
15	R3	28.8/11	15.6 - 18.0	RQD = 0%						R3: Similar to R1, except joints very close. Recovery=38% Rock Quality=Very Poor R3 Core Times (min:sec): 15.6-16.6' (2:23); 16.6-17.6' (3:17); 17.6-18.0' (0:45)	
	R4	19/19	18.0 - 19.6	RQD = 0%						R4: Similar to R1, except joints very close. Recovery=100% Rock Quality=Very Poor R4 Core Times (min:sec): 18.0-19.0' (3:38); 19.0-19.6' (2:40)	
	R5	41/41	19.6 - 23.0	RQD = 83%						R5: Similar to R1, except fresh, joints very close to moderately close, occasional quartz/calcite veins, secondary pyrite mineralization on joint surfaces.	
20											
	R6	60/52	23.0 - 28.0	RQD = 75%							
25											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	**Project:** Replacement of I-95 Bridges over Webb Road **Location:** Waterville, Maine	**Boring No.:** BB-WWR-101 **WIN:** 21900.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	227.6	**Auger ID/OD:**	HSA-2.5 in. ID
Operator:	B. Enos	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	N. Klausmeyer	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	HW-300#/24 in.;SS-
Date Start/Finish:	06/12/2018	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2.0-in. ID
Boring Location:	Sta. 120+53.2 NB, 39.8 RT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	1.0 ft (during drilling)
Hammer Efficiency Factor:	0.677	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25							NQ CORE			Recovery=100% Rock Quality=Good R5 Core Times (min:sec): 19.6-20.0' (1:46); 20.0-21.0' (4:20); 21.0-22.0' (3:37); 22.0-23.0' (3:36) R6: Grey, aphanitic, PHYLLITE, hard, fresh, joints dipping at low, steep and vertical angles, very close to moderate spacing.	
								199.6		Recovery=87% Rock Quality=Fair R6 Core Times (min:sec): 23.0-24.0' (2:25); 24.0-25.0' (2:18); 25.0-26.0' (1:55); 26.0-27.0' (1:40); 27.0-28.0' (1:39) 28.0	
30										**Bottom of Exploration at 28.0 feet below ground surface.**	
35											
40											
45											
50											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-102
WIN: 21900.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	234.1	**Auger ID/OD:**	HSA 2.5 in. ID
Operator:	B. Enos	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	N. Klausmeyer	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	HW-300#/24 in.;SS-140#/30
Date Start/Finish:	06/11/2018	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 120+90.3 NB, 45.5 LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	5.2 ft (during drilling)
Hammer Efficiency Factor:	0.677	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/19	0.0 - 2.0	1/2/9/6	11	12	HSA			Brown, dry, stiff, Sandy SILT, little gravel, poorly graded, contains roots -FILL-(ML)	G#474286 (A-4(0)) ML
								232.6		1.5	
	2D	24/17	2.0 - 4.0	8/8/6/4	14	16		232.1		Brown, moist, stiff, SILT, little fine to medium sand, little gravel -FILL-(ML)	
										2.0	
								230.1		Brown, wet, medium dense, fine to medium SAND, little silt, trace gravel, trace organics, 1-in. organic layer at bottom of split spoon, slight organic odor -MARINE DEPOSITS-(SP-SM)	G#474285 (A-2-4(0)) SP-SM
5	3D	24/10	4.0 - 6.0	16/12/26/25	38	43				4.0	
								228.6		Brown, wet, dense, fine to medium SAND, little silt, 2-in. silt layer, contains organics, roots -MARINE DEPOSITS-(SP-SM) Note: Water encountered at 5.2 ft.	
										5.5	
										3-in. layer of fractured rock (Grey aphanitic PHYLLITE) -GLACIAL TILL-(GP)	
10								224.1		10.0	
	4D	24/17	10.0 - 12.0	10/13/15/16	28	32	43 HW			Brown, wet, hard, SILT, little fine to coarse sand, little gravel grading to grey with depth (color change at 11.5 ft), occasional interbedded weathered rock -GLACIAL TILL-(ML)	
							99				
							145				
							166				
							-				
15	5D	24/17	15.0 - 17.0	24/32/51/94	83	94	OPEN			Grey, wet, hard, SILT, little fine to coarse sand, little gravel -GLACIAL TILL-(ML)	
20								214.1		20.0	
	6D	13/13	20.0 - 21.1	42/59/23(2")	82	93				Grey, wet, hard, Sandy SILT, little gravel -GLACIAL TILL-(ML) Note: Refusal on split-spoon sampler at 21.1 ft.	G#474284 (A-4(0)) ML
25											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	Project: Replacement of I-95 Bridges over Webb Road Location: Waterville, Maine	Boring No.: BB-WWR-102 WIN: 21900.00

Driller:	New England Boring Contractors	Elevation (ft.)	234.1	Auger ID/OD:	HSA 2.5 in. ID
Operator:	B. Enos	Datum:	NAVD 88	Sampler:	Split Spoon-1.375 in. ID
Logged By:	N. Klausmeyer	Rig Type:	Mobile B-53 Track Mount	Hammer Wt./Fall:	HW-300#/24 in.;SS-
Date Start/Finish:	06/11/2018	Drilling Method:	Cased Wash Boring	Core Barrel:	NQ-2.0 in. ID
Boring Location:	Sta. 120+90.3 NB, 45.5 LT	Casing ID/OD:	HW-4.0 in. ID	Water Level*:	5.2 ft (during drilling)
Hammer Efficiency Factor:	0.677	Hammer Type:	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	7D	10/8	25.0 - 25.8	62/102(4")			OPEN	209.1		25.0	
								208.3		Grey, wet, very dense, fine GRAVEL and coarse SAND, little silt, trace medium to fine sand and coarse gravel, contains weathered rock -GLACIAL TILL-(GP-GM)	
										25.8	
										Note: Refusal on split-soon sampler at 25.8 ft. -WEATHERED BEDROCK-	
30	8D	1/1	30.0 - 30.1	150(1")			NQ CORE			Grey, very wet, WEATHERED BEDROCK	
								203.1		31.0	
	R1	50/50	31.8 - 36.0	RQD = 58%						Note: Advanced roller bit to 31.8 ft. Begin NQ rock core at 31.8 ft. Top of Bedrock El. 203.1 R1: Grey, aphanitic PHYLLITE, hard, fresh, joints dipping at moderate to steep angles, close to moderately close, tight, pyrite mineralization observed on some joint surfaces. Recovery=100% Rock Quality=Fair R1 Core Times (min:sec): 31.8-32.8' (7:18); 32.8-33.8' (7:04); 33.8-34.8' (6:31); 34.8-35.8' (5:57); 35.8-36.0' (2:33)	
35											
	R2	48/50	36.0 - 40.0	RQD = 60%						R2: Grey, aphanitic PHYLLITE, hard, fresh, joints dipping at moderate to steep angles, very close to moderately close, tight to open, calcite coating observed on single joint surface. Recovery=100% Rock Quality=Fair R2 Core Times (min:sec): 36.0-37.0' (5:30); 37.0-38.0' (5:09); 38.0-39.0' (4:44); 39.0-40.0' 4:47)	qp=5,970 psi
40	R3	24/24	40.0 - 42.0	RQD = 71%						Similar to R2, except moderately dipping joints. Pyrite observed on joint surface. Recovery=100% Rock Quality=Fair Note: R3 core times not recorded.	
								192.1		42.0	
										Bottom of Exploration at 42.0 feet below ground surface.	
45											
50											

Remarks:

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Boring No.: BB-WWR-102

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-103
WIN: 21894.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	234.2	**Auger ID/OD:**	HSA-2.5 in. ID
Operator:	B. Enos	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	N. Klausmeyer	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	HW-300#/24 in.;SS-140#/30
Date Start/Finish:	06/13/2018	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 220+7.4 SB, 34.9 RT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	3.6 ft (during drilling)
Hammer Efficiency Factor:	0.677	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1DA	24/16	0.0 - 2.0	2/1/1/1	2	2	HSA	233.2	Brown, very loose, fine to coarse SAND, some gravel, little silt, contains roots -FILL-(SW-SM) —1.0—	G#474299 (A-1-b(0)) SW-SM
	1DB							232.2	Brown, moist, soft, SILT, little fine to coarse sand, trace gravel, contains roots and organics -MARINE DEPOSITS-(ML) —2.0—	
	2D	24/9	2.0 - 4.0	1/2/2/17	4	5		230.7	Brown, wet, medium stiff, Sandy SILT, little gravel, trace organics -MARINE DEPOSITS-(ML) —3.5—	G#474300 (A-4(0)) ML
	3D	24/10	4.0 - 6.0	15/12/27/10	39	44			Light brown, wet, hard, SILT, little fine to coarse sand and gravel -GLACIAL TILL-(ML)	
5	4D	24/24	6.0 - 8.0	12/15/16/19	31	35			Light brown, wet, hard, SILT, little fine to coarse sand and gravel, -GLACIAL TILL-(ML)	
									Light brown, wet, hard, SILT, little fine sand, trace medium to coarse sand and gravel -GLACIAL TILL-(ML)	
10	5D	24/15	9.0 - 11.0	20/27/34/17	61	69	HW	223.2	Brown, moist, hard, SILT, some fine to coarse gravel, trace fine to coarse sand, 1-in. layer of gray weathered rock -GLACIAL TILL-(ML) —11.0—	
	6D	16/8	11.0 - 12.3	20/36/50(4")				221.9	Grey, wet, very dense, fine to coarse GRAVEL, little silt, trace fine to coarse sand -GLACIAL TILL-(GM) —12.3—	
								219.6	Note: refusal at 12.3 ft. Drill action and wash water contents indicate gravel and weathered rock chips. Top of bedrock encountered at 14.6 ft. Advance roller bit to 15.0 ft Begin NQ rock core at 15.0 ft. —14.6—	
15	R1	48/45	15.0 - 19.0	RQD = 73%			NQ Core CORE		Top of Bedrock El. 219.6 R1: Grey, aphanitic, PHYLLITEe, hard, fresh to slightly weathered, joints dipping at low to steep angles, very close to moderately close, tight to open, occasional quartz vein. Recovery=94% Rock Quality=Fair R1 Core Times (min:sec): 15.0-16.0' (2:22); 16.0-17.0' (2:14); 17.0-18.0' (2:24); 18.0-19.0' (3:04)	
20	R2	32/32	19.0 - 21.7	RQD = 47%					R2: Similar to R1, except one 2-in. quartz vein. Recovery=100% Rock Quality=Poor R2 Core Times (min:sec): 19.0-20.0' (2:44); 20.0-21.0' (3:38); 21.0-21.7' (3:00)	qp=7,387 psi
25	R3	40/40	21.7 - 25.0	RQD = 70%					R3: Grey, aphanitic, PHYLLITE, hard, fresh to slightly weathered, joints dipping at low and steep angles, very close to close, oxidation on joint surfaces, occasional 1-in. quartz veins. Recovery 100% Rock Quality=Fair R3 Core Times (min:sec): 21.7-22.0' (0:56); 22.0-23.0-' (3:32); 23.0-24.0' (3:17); 24.0-25.0' (4:12)	

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-103
WIN: 21894.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	234.2	**Auger ID/OD:**	HSA-2.5 in. ID
Operator:	B. Enos	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	N. Klausmeyer	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	HW-300#/24 in.;SS-
Date Start/Finish:	06/13/2018	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 220+7.4 SB, 34.9 RT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	3.6 ft (during drilling)
Hammer Efficiency Factor:	0.677	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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MD = Unsuccessful Split Spoon Sample Attempt
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MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25								209.2		25.0 **Bottom of Exploration at 25.0 feet below ground surface.**	
30											
35											
40											
45											
50											

Remarks:

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Boring No.: BB-WWR-103

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-104
WIN: 21894.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	241.4	**Auger ID/OD:**	HSA-2.5 in. ID
Operator:	B. Enos	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	N. Klausmeyer	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	HW-300#/24 in.;SS-140#/30
Date Start/Finish:	06/13/2018	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 220+40.8 SB, 45.7 LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	6.0 ft (during drilling)
Hammer Efficiency Factor:	0.677	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
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G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/12	0.0 - 2.0	1/1/5/12	6	7	OPEN			Brown, dry, loose, Silty fine to medium SAND, trace coarse sand, trace gravel, contains roots -FILL-(SM)	G#474301 (A-4(0)) SM
	2D	24/14	2.0 - 4.0	5/9/13/13	22	25		239.4		2.0 Brown, moist, very stiff, SILT, little fine to coarse sand, trace gravel -GLACIAL TILL-(ML)	
	3D	24/16	4.0 - 6.0	7/8/9/8	17	19				Brown, moist, very stiff, SILT, some fine to coarse sand, trace gravel -GLACIAL TILL-(ML)	G#474302 (A-4(0)) ML
5	4D	24/24	6.0 - 8.0	9/7/5/5	12	14				Note: Water encountered at 6.0 ft. Brown, wet, stiff, SILT, trace fine to medium sand, trace fine gravel -GLACIAL TILL-(ML)	
10	5D	24/14	10.0 - 12.0	8/9/12/30	21	24				Brown, wet, very stiff, SILT, some fine to coarse gravel, trace fine to medium sand, bottom 1 in. of sample weathered bedrock -GLACIAL TILL-(ML)	
15	6D	4/3	15.0 - 15.3	100(4")				226.9		14.5 Note: Drill action and wash water contents indicate weathered bedrock at 14.5 ft. Grey, very hard, wet, WEATHERED BEDROCK	
	R1	54/39	16.9 - 21.4	RQD = 43%			NQ Core	224.5		16.9 Top of Bedrock El. 224.5 R1: Grey, aphanitic to fine grained PHYLLITE, hard, fresh, joints dipping at high and low angles, very close to moderately close, open, slightly oxidized joint surfaces. Recovery=72% Rock Quality=Poor R1 Core Times (min:sec): 16.9-17.9' (2:53); 17.9-18.9' (3:06); 18.9-19.9' (3:26); 19.9-20.9' (3:29); 20.9-21.4' (2:12) Note: Collected remainder of R1 run in R2 recovery.	
							CORE				
20	R2	48/55	21.4 - 25.4	RQD = 96%						R2: Similar to R1, except joints dipping at low angles, very close to close, slight oxidation on joint surfaces, occasional quartz veins. Recovery=100% Rock Quality=Excellent R2 Core Times (min:sec): 21.4-22.4' (2:14); 22.4-23.4' (2:08); 23.4-24.4' (2:14); 24.4-25.4' (2:19) Note: Collected extra core sample in R3 from previous run.	
25											

Remarks:

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Boring No.: BB-WWR-104

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-104
WIN: 21894.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	241.4	**Auger ID/OD:**	HSA-2.5 in. ID
Operator:	B. Enos	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	N. Klausmeyer	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	HW-300#/24 in.;SS-
Date Start/Finish:	06/13/2018	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 220+40.8 SB, 45.7 LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	6.0 ft (during drilling)
Hammer Efficiency Factor:	0.677	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25	R3	18/26	25.4 - 26.9	RQD = 92%			NQ CORE	214.5		R3: Grey, aphanitic to fine grained PHYLLITE, hard, fresh, joints dipping at steep to vertical angles, close, tight to open, slight oxidation on joint surfaces, calcite coatings on some joint surfaces. Recovery=100% Rock Quality=Excellent R3 Core Times (min:sec): 25.4-26.4' (3:17); 26.4-26.9' (1:27) 26.9 **Bottom of Exploration at 26.9 feet below ground surface.**	
30											
35											
40											
45											
50											

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-201
WIN: 21900.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	229.6	**Auger ID/OD:**	--
Operator:	M. Porter	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	SS/HW/NW-140#/30 in.
Date Start/Finish:	10-7-2021/10-8-2021	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	120+26.7 NB, 36.1 LT	**Casing ID/OD:**	HW-4.0 in. ID/NW-3.0 in. ID	**Water Level*:**	2.8 ft
Hammer Efficiency Factor:	0.922	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/1	0.0 - 2.0	WOH/WOH/WOH/ WOH			PUSH			Dark brown, wet, very soft, Sandy SILT, trace roots -TOPSOIL-(ML)	
	2D/A	24/12	2.0 - 4.0	4/6/11/9	17	26		227.6		2.0	
								227.3		Dark brown, wet, very stiff, SILT (highly organic), some fine sand, trace medium sand, trace roots -MARINE DEPOSIT-(ML) 2.3	
	3D	24/10	4.0 - 6.0	10/12/11/15	23	35		225.6		Brown, moist, medium dense, Silty fine to coarse SAND, little gravel -MARINE DEPOSIT-(SM) 4.0	
5							80			Brown-grey, moist, hard, SILT, little fine to coarse sand, trace fine gravel, moderately bonded -GLACIAL TILL-(ML) Note: Wash fluid at 7 ft contains silt, sand and gravel.	
							113				
							95				
							83	221.6		8.0 Note: Wash fluid at 8 ft contains gravel, sand. Wash fluid at 9 ft contains gravel.	
							79				
10	4D	24/14	10.0 - 12.0	8/8/7/17	15	23	34	219.6		10.0 Brown, wet, very stiff, Sandy SILT, little gravel -GLACIAL TILL-(ML)	G#644201 A-4(0), ML
							20				
							21				
							34				
							27				
15	5D	19/19	15.0 - 16.6	17/19/45/50(1")	64	98				Grey, wet, hard, fine Sandy SILT, trace medium to coarse sand, trace fine gravel, well bonded -GLACIAL TILL-(ML)	
	R1	58/45	16.9 - 21.7	RQD = 66%			RC ~~NQ~~ CORE	213.0		16.6 Top of Bedrock El. 213.0 Note: Advanced roller cone to 16.6 ft, sloping bedrock. Begin NQ core at 16.9 ft. R1: Grey, aphanitic, PHYLLITE, hard, fresh. Joints dipping at horizontal to low angles, tight to open, silt coating on open joints, very close to close, smooth to rough, planar to stepped. One steeply dipping secondary joint at 17.9 ft. Rock Quality=Fair Recovery=78% R1 Core Times (min.sec): 16.9-17.9' (2:00); 17.9-18.9' (0:54); 18.9-19.9' (1:08); 19.9-20.9' (1:48); 20.9-21.9' (2:23)	
20											
	R2	60/60	21.7 - 26.7	RQD = 73%						R2: Grey, aphanitic, PHYLLITE, hard, fresh. Joints dipping at horizontal to low angles, very close to moderately close, tight to open, smooth, planar to stepped. Rock Quality=Fair Recovery=100% R2 Core Times (min:sec): 21.7-22.7' (1:32); 22.7-23.7' (1:02);	
25											

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-201
WIN: 21900.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	229.6	**Auger ID/OD:**	--
Operator:	M. Porter	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	SS/HW/NW-140#/30 in.
Date Start/Finish:	10-7-2021/10-8-2021	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	120+26.7 NB, 36.1 LT	**Casing ID/OD:**	HW-4.0 in. ID/NW-3.0 in. ID	**Water Level*:**	2.8 ft
Hammer Efficiency Factor:	0.922	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
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V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25							NQ CORE			23.7-24.7' (1:01); 24.7-25.7' (1:03); 25.7-26.7' (1:09)	
								202.9		26.7 **Bottom of Exploration at 26.7 feet below ground surface.**	
30											
35											
40											
45											
50											

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road	**Location:** Waterville, Maine	**Boring No.:** BB-WWR-202	**WIN:** 21900.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	226.0	**Auger ID/OD:**	--
Operator:	M. Porter	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	SS/HW/NW-140#/30 in.
Date Start/Finish:	10-8-2021/10-12-2021	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 121+0.7 NB, 38.1 RT	**Casing ID/OD:**	HW-4.0 in. ID/NW-3.0 in. ID	**Water Level*:**	0.2 ft
Hammer Efficiency Factor:	0.922	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D/A	24/12	0.0 - 2.0	WOH/1/1/2	2	3	PUSH	225.6		Dark brown, wet, very loose, fine to coarse SAND, little silt, trace fine gravel, trace roots -TOPSOIL-(SM)	G#644202 A-4(0), ML
										0.4	
	2D	24/14	2.0 - 4.0	6/6/8/10	14	22				Dark brown, wet, soft, SILT, little fine to coarse sand, trace fine gravel, trace roots -MARINE DEPOSIT-(ML)	
							112			Grey, mottled, moist, very stiff, SILT -MARINE DEPOSIT-(ML)	
	3D/A	24/14	4.0 - 6.0	6/7/9/21	16	25	100	221.6		Similar to 2D above 4.4	
5							199			Brown, wet, very stiff, SILT, trace fine to coarse sand, trace fine to coarse gravel -GLACIAL TILL-(ML)	
							364	219.8		6.2 Note: Washed ahead of casing from 6.4 to 8 ft, cobbles encountered.	
							170				
							79				
							51				
10	4D	24/4	10.0 - 12.0	30/23/14/12	37	57	84			Grey, wet, very dense, Sandy GRAVEL, little silt, poorly graded -GLACIAL TILL-(GM)	
							13				
							35				
							40				
							85				
15	5D	1/0	15.0 - 15.1	50(1")			62	210.9		15.1 Note: Spoon refusal on probable weathered bedrock at 15.1 ft. Advance roller bit to 15.3 ft and begin NQ core.	
	R1	60/60	15.3 - 20.3	RQD = 78%			RC NQ CORE	210.7		15.3 Top of Bedrock El.210.7 R1: Grey, aphanitic, PHYLLITE, hard, fresh. Joints dipping at low to moderate angles, tight, close to moderately close, rough, planar to stepped. One secondary joint dipping at steep angle at approximately 16.3 ft. Occasional quartz veins (approximately 1/8-in. thick). Rock Quality=Good Recovery=100% R1 Core Times (min:sec): 15.3-16.3' (1:20); 16.3-17.3' (1:05); 17.3-18.3' (0:56); 18.3-19.3' (0:58); 19.3-20.3' (1:08)	
20	R2	60/58	20.3 - 25.3	RQD = 85%						R2: Grey, aphanitic, PHYLLITE, hard, fresh. Joints dipping al horizontal to low angles, open, close to moderately close, smooth to rough. planar to undulating. Fractured zone at 21 to 2I.5 ft and 23.7 to 23.9 ft. Occasional quartz veins (approximately 1/8 to 1/4-in. thick). High angle folialion 23.8 to 25 ft. Rock Quality=Good Recovery=97% R2 Core Times (min:sec): 20.3-21.3' (1:01); 21.3-22 3' (0:58);	
25											

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-202
WIN: 21900.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	226.0	**Auger ID/OD:**	--
Operator:	M. Porter	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	SS/HW/NW-140#/30 in.
Date Start/Finish:	10-8-2021/10-12-2021	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 121+0.7 NB, 38.1 RT	**Casing ID/OD:**	HW-4.0 in. ID/NW-3.0 in. ID	**Water Level*:**	0.2 ft
Hammer Efficiency Factor:	0.922	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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MD = Unsuccessful Split Spoon Sample Attempt
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MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25								200.7		22.3-23.3' (1:06); 23.3-24.3' (1:03); 24.3-25.3' (1:05) 25.3	
										Bottom of Exploration at 25.3 feet below ground surface.	
30											
35											
40											
45											
50											

Remarks:

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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	**Project:** Replacement of I-95 Bridges over Webb Road **Location:** Waterville, Maine	**Boring No.:** BB-WWR-203 **WIN:** 21894.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	237.7	**Auger ID/OD:**	--
Operator:	M. Porter	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	SS/HW/NW-140#/30 in.
Date Start/Finish:	10-7-2021/10-7-2021	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 219+84.6 SB, 33.3 LT	**Casing ID/OD:**	HW-4.0 in. ID/NW-3.0 in. ID	**Water Level*:**	7.3 ft
Hammer Efficiency Factor:	0.922	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D/A	24/11	0.0 - 2.0	2/1/1/11	2	3	PUSH	237.4		Dark brown, damp, soft, SILT, little coarse sand, trace medium sand, trace fine gravel, trace roots -TOPSOIL-(ML) — 0.3	
	2D/A	24/12	2.0 - 4.0	7/10/8/12	18	28		235.5		Brown, moist, soft, SILT, little fine sand, trace roots -MARINE DEPOSIT-(ML) Brown, wet, very stiff, SILT, some fine sand -MARINE DEPOSIT-(ML) — 2.2	G#644203 A-4(0), ML
	3D	24/18	4.0 - 6.0	1/7/7/5	14	22	42			Brown, moist, very stiff, SILT, little fine to coarse sand, little gravel -GLACIAL TILL-(ML) Brown, wet, very stiff, SILT, trace weathered gravel -GLACIAL TILL-(ML) Note: Wash fluid contains silt, some sand.	
5							35				
							64				
							101	229.7		— 8.0	
							73			Note: Weathered rock fragments at 8 ft, mixed in with silt.	
							129				
10	4D	20/20	10.0 - 11.7	28/38/57/50(2")	95	146	RC			Brown-grey, wet, very dense, Silty fine SAND, weathered rock throughout. -GLACIAL TILL-(SM)	
								225.2		— 12.5	
	R1	60/58	13.0 - 18.0	RQD = 97%			NQ CORE			Top of Bedrock El. 225.2 Note: Advance rollerbit to 13 ft, begin NQ core. R1: Grey, aphanitic, PHYLLITE, hard, fresh. Joints dipping at moderate angles, moderately close to wide, tight, smooth, planar. Frequent quartz veins (approximately 1/8-in. thick), silt coating on joint surfaces. Secondary vertical joint at top of run, open, planar, rough. Rock Quality=Excellent Rccovery=97% R1 Core Times(min:sec): 13.0-14.0'(1:17) ; 14.0-15 0'(1:12); 15.0-16.0' (1:11); 16.0-17.0' (1: 14); 17.0-18.0' (1:19)	
15											
	R2	60/60	18.0 - 23.0	RQD = 97%						R2: Grey, aphanitic, PHYLLITE, hard, fresh. Joints dipping at moderate angles, close to wide, fresh to slightly weathered, silty sand coating on joint surface, smooth to rough, planar to stepped, tight. Occasional thin quartz veins (approximately 1/8-in. thick). Rock Quality=Excellent Recovery=100% R2 Core Times (min:sec): 18.0-19.0' (1.16); 19.0-20.0' (1:08); 20.0-21.0' (1:14); 21.0-22.0' (1:15); 22.0-23.0' (1:15)	
20											
								214.7		— 23.0 **Bottom of Exploration at 23.0 feet below ground surface.**	
25											

Remarks:

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Boring No.: BB-WWR-203

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-204
WIN: 21894.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	233.3	**Auger ID/OD:**	SSA-5.0-in. OD
Operator:	M. Porter	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	SS/NW-140#/30 in.
Date Start/Finish:	10-12-2021/10-12-2021	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 220+63.3 SB, 38.6 RT	**Casing ID/OD:**	NW-3.0 in. ID	**Water Level*:**	1.3 ft
Hammer Efficiency Factor:	0.922	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/8	0.0 - 2.0	WOH/1/2/2	3	5	SSA	232.3		Grey-brown, damp, soft, SILT, trace fine to medium sand, trace coarse gravel, trace organics -TOPSOIL/FILL-(ML) 1.0	
										Grey-brown mottled, damp, hard, SILT, trace fine to medium sand -MARINE DEPOSIT-(ML)	
	2D/A	24/16	2.0 - 4.0	5/13/11/15	24	37		230.3		3.0	
								229.3		Brown, damp, dense, Silty fine to medium SAND, little coarse gravel -GLACIAL TILL-(SM) 4.0	
	3D/A	24/21	4.0 - 6.0	9/11/16/15	27	41		228.3		Brown, damp, hard, SILT, little fine sand, little coarse gravel, trace medium to coarse sand -GLACIAL TILL-(ML) 5.0	G#644204 A-1-b(0), GM
5							29			Brown, damp, dense, fine GRAVEL, some fine to coarse sand, some silt, trace coarse gravel -GLACIAL TILL-(GM)	
							58			Note: Casing driving becomes hard at 8 ft. Cored through boulder from 8.3 to 11 ft.	
							88				
							35				
							30				
10							6				
							16	221.3		12.0	
	4D	17/8	12.0 - 13.4	9/60/50(5")			23			Grey, wet, hard, SILT, some fine to medium sand, trace coarse sand, trace fine to coarse gravel, rock in tip -GLACIAL TILL-(ML) 13.4	
	R1	30/26	13.7 - 16.2	RQD = 40%			RC NQ CORE	219.9		Top of Probable Bedrock El. 219.9	
15										Note: Advance roller cone to 13.7 ft, begin NQ core. R1: Grey, aphanitic, PHYLLITE, hard, fresh. Joints dipping at low to moderate angles, tight to open, close, rough, undulating to stepped. Occasional quartz veins. Highly fractured zone at 15.2 to 16.2 ft.	
	R2	24/18	16.2 - 18.2	RQD = 0%						Rock Mass=Poor Recovery=87%	
										R1 Core Times (min:sec): 13.7-14.7' (1:02); 14.7-15.7' (1:31); 15.7-16.2' (1:30)	
	R3	24/20	18.2 - 20.2	RQD = 46%						R2: Grey, aphanitic, PHYLLITE, hard, fresh to slightly weathered. Joints dipping at low angles, open, close, rough, undulating. Secondary vertical joint. Highly fractured zones at top and bottom of run.	
20	R4	60/60	20.2 - 25.2	RQD = 92%						Rock Mass=Very Poor Recovery=75%	
										R2 Core Times (min:sec): 16.2-17.2' (1:52); 17.2-18.2' (2:55)	
										R3: Similar to R2, secondary vertical joint. Highly fractured at 19.2 to 20.2 ft. Rock Mass=Poor Recovery=83%	
										R3 Core Times (min:sec): 18.2-19.2' (1:33): 19.2-20.2' (1:51)	
25										R4: Grey, aphanitic, PHYLLITE, hard, fresh. Joints dipping at horizontal to low angles, tight to open, close to moderately close,	

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-204
WIN: 21894.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	233.3	**Auger ID/OD:**	SSA-5.0-in. OD
Operator:	M. Porter	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	SS/NW-140#/30 in.
Date Start/Finish:	10-12-2021/10-12-2021	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	NQ-2.0 in. ID
Boring Location:	Sta. 220+63.3 SB, 38.6 RT	**Casing ID/OD:**	NW-3.0 in. ID	**Water Level*:**	1.3 ft
Hammer Efficiency Factor: 0.922		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140 lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25							NQ CORE	208.1		smooth to rough, planar to undulating. Occasional quartz stringers and veins up to 1-in. thick. High angle foliation. Rock Mass=Excellent Recovery=100% R4 Core Times (min:sec): 20.2-21.2' (2:20); 21.2-22.2' (2:29); 22.2-23.2' (2:46); 23.2-24.2' (2:10); 24.2-25.2' (2:23) 25.2 **Bottom of Exploration at 25.2 feet below ground surface.**	
30											
35											
40											
45											
50											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	Project: Replacement of I-95 Bridges over Webb Road Location: Waterville, Maine	Boring No.: BB-WWR-205 WIN: 21900.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	243.4	**Auger ID/OD:**	HSA 2.5 in. ID
Operator:	M. Porter	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	SS-140#/30 in.
Date Start/Finish:	10-6-2021/10-6-2021	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	--
Boring Location:	Sta. 416+70.4 NB DIV, 13.8 RT	**Casing ID/OD:**	--	**Water Level*:**	2.1 ft
Hammer Efficiency Factor:	0.922	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D/A	24/14	0.0 - 2.0	1/1/2/3	3	5	HSA	243.3		Dark brown, dry, medium stiff, SILT, trace organics -ROOTMAT-(ML) 0.1	G#644205 A-4(0), ML
								242.4		Grey-brown, damp, medium stiff, SILT, roots -TOPSOIL-(ML) 1.0	
	2D	24/24	2.0 - 4.0	2/3/5/4	8	12				Grey-brown, damp, stiff, SILT, trace fine to medium sand, reworked native soil -FILL-(ML) 4.0	
	3D	24/24	4.0 - 6.0	2/4/5/8	9	14		239.4		Grey-brown mottled, damp, stiff, SILT -MARINE DEPOSIT-(ML)	
5											
10	4D	24/24	10.0 - 12.0	2/2/3/3	5	8				Grey-brown mottled, medium stiff, SILT -MARINE DEPOSIT-(ML)	
								229.4		14.0 Note: Drill action indicates gravel from 14 to 14.8 ft.	
15	5D	24/18	15.0 - 17.0	8/6/4/12	10	15				Brown, wet, stiff, SILT, some fine sand, trace medium to coarse sand, trace fine to coarse gravel, well bonded, cobble in tip -GLACIAL TILL-(ML)	
								226.4		17.0 **Bottom of Exploration at 17.0 feet below ground surface.** No Refusal	
20											
25											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-206
WIN: 21900.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	243.2	**Auger ID/OD:**	HSA-2.5 in. ID
Operator:	M. Porter	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	SS-140#/30 in.
Date Start/Finish:	10-6-2021/10-6-2021	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	--
Boring Location:	Sta. 417+53.4 NB DIV, 1.4 RT	**Casing ID/OD:**	--	**Water Level*:**	Cave-in at 2 ft - Dry
Hammer Efficiency Factor:	0.922	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D/A	24/16	0.0 - 2.0	1/4/5/6	9	14	HSA	242.4		Dark brown, dry, stiff, SILT, trace roots -TOPSOIL-(ML) ——0.8 Brown, dry, stiff, SILT -MARINE DEPOSIT-(ML)	G#644206 A-4(0), ML
	2D	24/24	2.0 - 4.0	4/5/4/5	9	14				Brown-grey mottled, damp, stiff, SILT, trace fine to medium sand -MARINE DEPOSIT-(ML)	
5	3D	24/24	4.0 - 6.0	3/5/7/9	12	18				Brown-grey mottled, moist, very stiff, SILT -MARINE DEPOSIT-(ML)	
10	4D	24/24	10.0 - 12.0	3/3/4/4	7	11				Brown-grey, damp, stiff, Clayey SILT, trace fine sand partings -MARINE DEPOSIT-(ML)	
15	5D/A	24/22	15.0 - 17.0	7/11/11/15	22	34		227.2		Brown-grey, wet, hard, SILT, trace fine sand partings -MARINE DEPOSIT-(ML) ——16.0	
								226.2		Brown-grey, moist, hard, SILT, little fine to coarse sand, trace fine to coarse gravel, well bonded -GLACIAL TILL-(ML) ——17.0	
										Bottom of Exploration at 17.0 feet below ground surface.	
										No Refusal	
20											
25											

Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	Project: Replacement of I-95 Bridges over Webb Road Location: Waterville, Maine	Boring No.: BB-WWR-207 WIN: 21900.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	234.3	**Auger ID/OD:**	--
Operator:	M. Porter	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	SS/HW-140#/30 in.
Date Start/Finish:	10-6-2021/10-6-2021	**Drilling Method:**	Cased Wash Boring	**Core Barrel:**	--
Boring Location:	Sta. 418+71.7 NB DIV, 5.9 LT	**Casing ID/OD:**	HW-4.0 in. ID	**Water Level*:**	1.4 ft
Hammer Efficiency Factor:	0.922	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
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U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D/A	24/15	0.0 - 2.0	1/1/3/5	4	6	PUSH	233.6		Dark brown, dry, medium stiff, SILT, trace roots -TOPSOIL-(ML) 0.7 Brown-grey mottled, dry, medium stiff, SILT -MARINE DEPOSIT-(ML)	
	2D	24/19	2.0 - 4.0	6/6/7/14	13	20				Brown-grey mottled, damp, very stiff, SILT, trace fine to coarse sand, trace fine gravel -MARINE DEPOSIT-(ML)	G#644207 A-4(0), ML
	3D	24/15	4.0 - 6.0	5/9/11/13	20	31	35	230.3		4.0 Brown-grey, dry, hard, SILT, trace fine sand, trace fine to coarse gravel -GLACIAL TILL-(ML)	
5							36				
							46				
							49				
							60				
							103	225.3		9.0	
10	4D	24/10	10.5 - 12.5	9/18/11/11	29	45	RC			Brown, wet, dense, fine to coarse GRAVEL, some silt, little fine to coarse sand -GLACIAL TILL-(GM)	
								221.3		13.0 Note: Drill action and rock shards in wash water indicate weathered bedrock from 13 to 15.5 ft. -WEATHERED BEDROCK-	
15								218.8		Note: Top of probable bedrock at 15.5 ft 15.5 **Bottom of Exploration at 15.5 feet below ground surface.**	
20											
25											

Remarks:

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Boring No.: BB-WWR-207

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-208
WIN: 21900.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	233.0	**Auger ID/OD:**	HSA-2.5 in. ID
Operator:	M. Porter	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	SS-140#/30 in.
Date Start/Finish:	10-13-2021/10-13-2021	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	--
Boring Location:	Sta. 419+56.2 NB DIV, 0.8 LT	**Casing ID/OD:**	--	**Water Level*:**	3.7 ft
Hammer Efficiency Factor:	0.922	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
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MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/14	0.0 - 2.0	WOH/2/4/2	6	9	HSA			Dark brown, damp, stiff, SILT, trace fine to medium sand, trace roots -TOPSOIL-(ML)	
	2D	24/18	2.0 - 4.0	4/7/22/8(3")	29	45		231.0		2.0 Grey-brown mottled, damp, hard, SILT, trace fine to medium sand, trace roots -MARINE DEPOSIT-(ML) Note: Cobbles/boulders at 3.7 ft, offset boring 2 ft southwest.	G#644208 A-4(0), ML
5	3D	20/15	5.0 - 6.7	8/6/12/9(2")	18	28		228.0		5.0 Grey-brown, damp, very stiff, SILT, trace fine to coarse sand, trace fine to coarse gravel, well bonded, wet in tip -GLACIAL TILL-(ML) Note: Cobbles/boulders at 6.9 ft. Refusal on probable boulder.	
								226.1		6.9 **Bottom of Exploration at 6.9 feet below ground surface.**	
10											
15											
20											
25											

Remarks:

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-208A
WIN: 21900.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	232.9	**Auger ID/OD:**	HSA-2.5 in. ID
Operator:	M. Porter	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	SS-140#/30 in.
Date Start/Finish:	10-13-2021/10-14-2021	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	--
Boring Location:	Sta. 419+57.6 NB DIV, 3.3 RT	**Casing ID/OD:**	--	**Water Level*:**	6.9 ft
Hammer Efficiency Factor:	0.922	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							HSA			See Test Boring BB-WWR-208 for overburden details from 0 to 6.9 ft	
6.9								226.0		Boulders and cobbles at 7.7 ft	
10.0	1D	24/15	10.0 - 12.0	3/6/10/10	16	25		222.9		Grey, wet, very stiff, SILT, little coarse gravel, trace medium to coarse sand, trace fine gravel -GLACIAL TILL-(ML) Cobbles and boulders at 13.3 ft	
15	2D	18/16	15.0 - 16.5	12/18/50	68	104				Brown-grey, wet, hard, SILT, some medium sand, little fine to coarse gravel -GLACIAL TILL-(ML)	
17.5								215.4		**Bottom of Exploration at 17.5 feet below ground surface.** Note: Auger refusal on probable bedrock at 17.5 ft.	

Remarks:

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Boring No.: BB-WWR-208A

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-209
WIN: 21900.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	252.2	**Auger ID/OD:**	HSA-2.5 in. ID
Operator:	M. Porter	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	SS-140#/30 in.
Date Start/Finish:	10-13-2021/10-13-2021	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	--
Boring Location:	Sta. 424+53.1 NB DIV, 2.6 RT	**Casing ID/OD:**	--	**Water Level*:**	Dry
Hammer Efficiency Factor:	0.922	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D	24/17	0.0 - 2.0	1/3/7/11	10	15	HSA			Brown, dry, stiff, SILT -MARINE DEPOSIT-(ML)	
	2D	24/22	2.0 - 4.0	8/10/13/15	23	35				Brown mottled, dry, hard, SILT, trace fine sand -MARINE DEPOSIT-(ML)	G#644209 A-4(0), ML
	3D	24/24	4.0 - 6.0	12/17/16/18	33	51				Similar to 2D above -MARINE DEPOSIT-(ML)	
5											
10	4D	24/24	10.0 - 12.0	4/3/4/5	7	11				Brown-grey, moist, stiff, Clayey SILT, trace fine sand partings -MARINE DEPOSIT-(ML)	
15	5D/A	24/17	15.0 - 17.0	5/18/17/13	35	54				Similar to 4D above, except hard -MARINE DEPOSIT-(ML)	
								235.9		16.3	
										Brown, dry, very dense, Gravelly SAND, some silt -GLACIAL TILL-(SM)	
								235.2		17.0	
										Bottom of Exploration at 17.0 feet below ground surface. No Refusal	
20											
25											

Remarks:

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Boring No.: BB-WWR-209

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Replacement of I-95 Bridges over Webb Road
Location: Waterville, Maine

Boring No.: BB-WWR-210
WIN: 21900.00

Driller:	New England Boring Contractors	**Elevation (ft.)**	255.4	**Auger ID/OD:**	HSA-2.5 in. ID
Operator:	M. Porter	**Datum:**	NAVD 88	**Sampler:**	Split Spoon-1.375 in. ID
Logged By:	T. Jones	**Rig Type:**	Mobile B-53 Track Mount	**Hammer Wt./Fall:**	SS-140#/30 in.
Date Start/Finish:	10-13-2021/10-13-2021	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	--
Boring Location:	Sta. 425+57.2 NB DIV, 2.0 RT	**Casing ID/OD:**	--	**Water Level*:**	Dry
Hammer Efficiency Factor:	0.922	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample Attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample Attempt
V = Field Vane Shear Test, PP = Pocket Penetrometer
MV = Unsuccessful Field Vane Shear Test Attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = Weight of 140lb. Hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0	1D/A	24/22	0.0 - 2.0	1/3/5/8	8	12	HSA	254.9		Brown, dry, stiff, SILT, trace fine sand, trace roots -TOPSOIL-(ML) — 0.5	
										Brown, dry, stiff, SILT, trace roots -MARINE DEPOSIT-(ML)	
	2D	24/24	2.0 - 4.0	4/6/7/9	13	20				Brown mottled, damp, very stiff, SILT, trace fine to medium sand -MARINE DEPOSIT-(ML)	G#644210 A-4(0), ML
	3D	24/24	4.0 - 6.0	6/8/7/9	15	23				Brown-grey, damp, very stiff, SILT, little clay, trace organics -MARINE DEPOSIT-(ML)	
5											
10	4D	24/24	10.0 - 12.0	3/4/4/5	8	12				Brown-grey, damp, stiff, Clayey SILT, few fine sand partings, trace organics -MARINE DEPOSIT-(ML)	
								242.5		Note: Becomes gravelly at 12.9 ft based on drill action. — 12.9	
15	5D	24/23	15.0 - 17.0	6/10/10/7	20	31				Brown-grey, moist, hard, SILT, some fine sand, little coarse sand, trace fine gravel, moderately bonded -GLACIAL TILL-(ML)	
								238.4		— 17.0 **Bottom of Exploration at 17.0 feet below ground surface.** No Refusal	
20											
25											

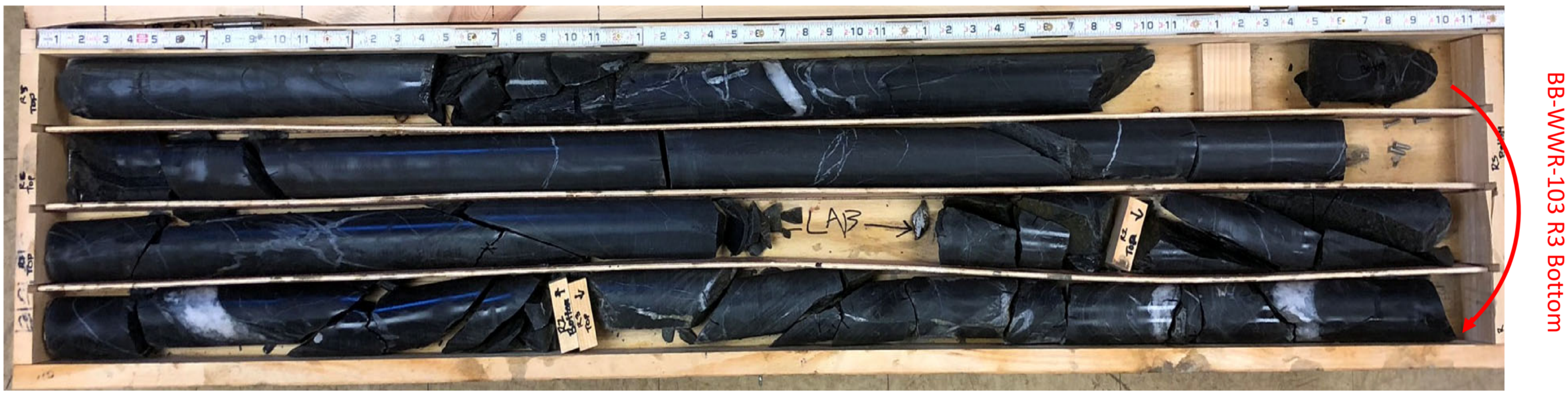
Remarks:

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

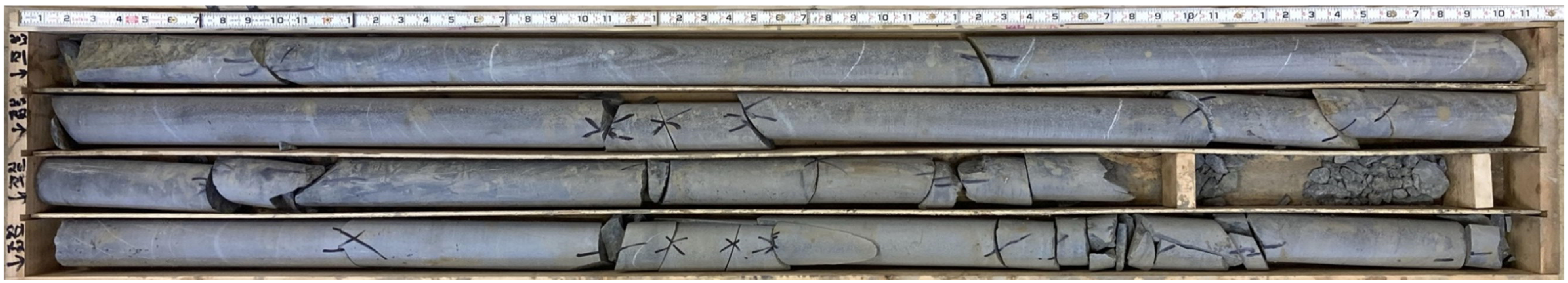
ROCK CORE PHOTOGRAPHS
REPLACEMENT OF I-95 BRIDGES OVER WEBB ROAD
MAINEDOT WIN 21900.01 & WIN 21894.01
WATERVILLE, MAINE

Top Row: BB-WWR-102, Run No. R1 31.8’ (left) to 36.0’ (right)
Top Middle Row: BB-WWR-102, Run No. R2 36.0’ (left) to 40.0’ (right)
Bottom Middle Row: BB-WWR-102, Run No. R3 40.0’ (left) to 42.0’ (middle-left), BB-WWR-101, Run No. R1 11.5’ (middle-left) to 14.8 (middle-right), BB-WWR-101, Run No. R2 14.8’ (middle-right) to 15.6’ (right)
Bottom Row: BB-WWR-101, Run No. R3 15.6’ (left) to 18.0’ (middle-left), BB-WWR-101, Run No. R4 18.0’ (middle-left) to 19.6’ (middle)



Top Row: BB-WWR-101, Run No. R5 19.6’ (left) to 23.0’ (middle-right). BB-WWR-103, Bottom Portion of R3 (middle-right to right)
Top Middle Row: BB-WWR-101, Run No. R6 23.0’ (left) to 28.0’ (right)
Bottom Middle Row: BB-WWR-103, Run No. R1 15.0’ (left) to 19.0’ (middle-right), BB-WWR-103, Run No. R2 19.0’ (middle-right) to 21.7’ (right)
Bottom Row: BB-WWR-103, Run No. R2 19.0’ (left) to 21.7’ (middle-left), BB-WWR-103, Run No. R3 21.7’ (middle-left) to 25.0’ (right)

Top Row: BB-WWR-104, Run No. R1 16.9’ (left) to 21.4’ (right)
Top Middle Row: BB-WWR-104, Run No. R2 21.4’ (left) to 25.4’ (right)
Bottom Middle Row: BB-WWR-104, Run No. R3 25.4’ (left) to 26.9’ (right)



Top Row: BB-WWR-203, Run No. R1 13.0' (left) to 18.0' (right)
Top Middle Row: BB-WWR-203, Run No. R2 18.0' (left) to 23.0' (right)
Bottom Middle Row: BB-WWR-201, Run No. R1 16.9' (left) to 21.7' (right)
Bottom Row: BB-WWR-201, Run No. R2 21.7' (left) to 26.7' (right)

Top Row: BB-WWR-202, Run No. R1 15.3’ (left) to 20.3’ (right)
Top Middle Row: BB-WWR-202, Run No. R2 20.3’ (left) to 25.3’ (right)
Bottom Middle Row: BB-WWR-204, Run No. R1 13.7’ (left) to 16.2’ (middle), BB-WWR-204, Run No. R2 16.2’ (middle) to 18.2’ (middle right)
Bottom Row: BB-WWR-204, Run No. R3 18.2’ (left) to 20.2’ (middle)

Top Row: BB-WWR-204, Run No. R4 20.2’ (left) to 24.6’ (right)
Top Middle Row: BB-WWR-204, Run No. R4 24.6’ (left) to 25.2’ (middle left)

APPENDIX B

Observation Well Installation and Groundwater Monitoring Reports

HALEY ALDRICH

OBSERVATION WELL INSTALLATION REPORT

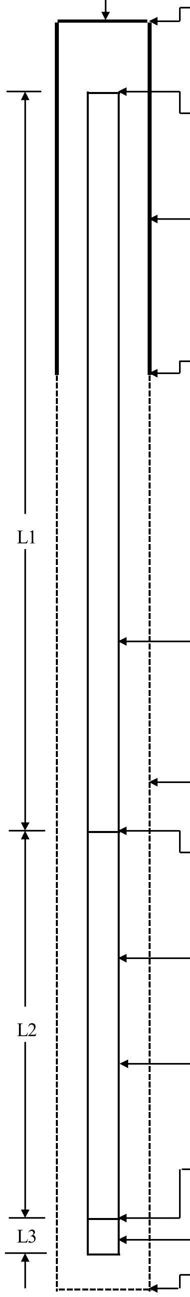
Well No. **BB-WWR-102(OW)**
Boring No. **BB-WWR-102(OW)**

PROJECT	Replacement of I-95 Bridges over Webb Rd.	**H&A FILE NO.**	132212-002/-003
LOCATION	Waterville, Maine	**PROJECT MGR.**	E. Force
CLIENT	MacFarland-Johnson, Inc.	**FIELD REP.**	N. Klausmeyer
CONTRACTOR	New England Boring Contractors	**DATE INSTALLED**	6/11/2018
DRILLER	Brad Enos	**WATER LEVEL**	2.8'

Ground El. 234.1 ft
El. Datum NAVD88
Location See Plan
☑ **Guard Pipe**
☐ **Roadway Box**

SOIL/ROCK CONDITIONS	BOREHOLE BACKFILL
	-FILTER SAND-
-FILL-	
2.0	2.0
	-BENTONITE SEAL-
	3.0
-MARINE DEPOSITS-	
5.5	
-GLACIAL TILL-	-FILTER SAND-
25.7	
-WEATHERED ROCK-	
31.0	
-BEDROCK-	
42.0	**42.0**

(Bottom of Exploration)
(Numbers refer to depth from ground surface in feet)



Type of protective cover/lock	Steel Cover/Padlock	
Height of top of guard pipe above ground surface	3.2	ft
Height of top of riser pipe above ground surface	3.2	ft
Type of protective casing:	Steel Guard Pipe	
Length	4.7	ft
Inside Diameter	4.0	in
Depth of bottom of guard pipe	1.5	ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite Seal	2.0	1.0

Type of riser pipe:	Schedule 40 PVC	
Inside diameter of riser pipe	2.0	in
Type of backfill around riser	Holliston Sand (Filter Sand)	
Diameter of borehole	4.0	in
Depth to top of well screen	4.7	ft
Type of screen	Schedule 40 PVC	
Screen gauge or size of openings	0.01	in
Diameter of screen	2.0	in
Type of backfill around screen	Holliston Sand (Filter Sand)	
Depth of bottom of well screen	14.7	ft
Bottom of Silt trap	15.0	ft
Depth of bottom of borehole	42.0	ft

(Not to Scale)

Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length
7.9 ft	+	10.0 ft	+	0.3 ft	=	18.2 ft

COMMENTS:

Form 2007

GROUNDWATER MONITORING REPORT

HALEY ALDRICH

OW/PZ NUMBER **BB-WWR-102(OW)**

PROJECT	Replacement of I95 Northbound Bridge Over Webb Rd.	**H&A FILE NO.**	132212-004
LOCATION	Waterville, Maine	**PROJECT MGR.**	E. Force
CLIENT	McFarland-Johnson, Inc.	**FIELD REP.**	N. Klausmeyer
CONTRACTOR	New England Boring Contractors	**DATE**	6/11/2018

ELEVATION OF REFERENCE POINT 234.1 **REFERENCE POINT:** **Ground Surface** ☑ **PVC** ☐ **Other** ☐

Date	Time	Elapsed Time (days)	Depth of Water from Reference Point (ft)	Elevation of Water	Remarks	Read By
6/12/2018	2:41 PM	1	2.8	231.3	Sunny & 70s	NLK
6/13/2018	8:47 AM	2	3.1	231.0	Sunny & 70s	NLK
6/14/2018	9:45 AM	3	3.0	231.1	Cloudy & 70s (overnight rain)	NLK
6/20/2018	5:25 PM	9	4.1	230.0	Sunny & 80s	NLK
7/2/2018	5:30 PM	21	3.3	230.8	Sunny & 80s	NLK
7/13/2018	5:15 PM	32	3.3	230.8	Sunny & 80s	NLK
7/26/2018	4:15 PM	45	4.3	229.9	Sunny & 70s (rain in past several days)	NLK
8/13/2018	2:20 PM	63	7.5	226.6	Partly Cloudy & 80s	NLK
10/14/2021	9:00 AM	1221	2.5	231.6	Sunny 60s	TPJ
11/11/2021	9:45 AM	1249	2.4	231.7	Sunny 50s	JKF

OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No.	Boring No.
BB-WWR-104(OW)	BB-WWR-104(OW)

PROJECT	Replacement of I-95 Bridges over Webb Rd.	**H&A FILE NO.**	132212-002/-003
LOCATION	Waterville, Maine	**PROJECT MGR.**	E. Force
CLIENT	MacFarland-Johnson, Inc.	**FIELD REP.**	N. Klausmeyer
CONTRACTOR	New England Boring Contractors	**DATE INSTALLED**	6/13/2018
DRILLER	Brad Enos	**WATER LEVEL**	3.9'

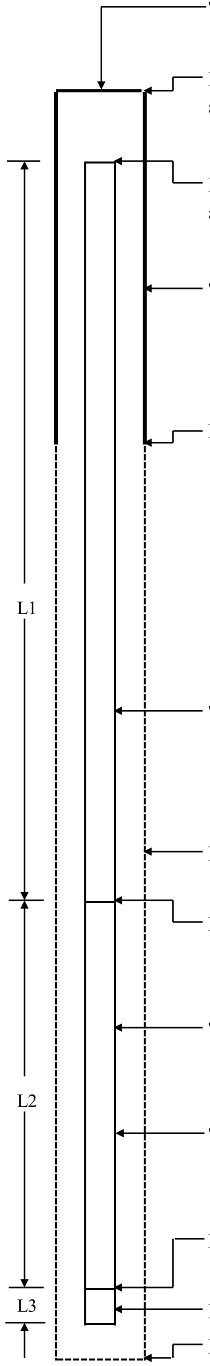
Ground El. 241.4 ft **Location** See Plan ☑ **Guard Pipe**

El. Datum NAVD88 ☐ **Roadway Box**

SOIL/ROCK CONDITIONS	**BOREHOLE BACKFILL**
-FILL-	-FILTER SAND-
2.0	
	3.0
	-BENTONITE SEAL-
	4.0
-GLACIAL TILL-	-FILTER SAND-
14.5	
-WEATHERED ROCK-	
14.0	14.6
-BEDROCK-	-GRAVEL-
26.9	**26.9**

(Bottom of Exploration)

(Numbers refer to depth from ground surface in feet)



Type of protective cover/lock	Steel Cover/Padlock	
Height of top of guard pipe above ground surface	2.9	ft
Height of top of riser pipe above ground surface	2.9	ft
Type of protective casing:	Steel Guard Pipe	
Length	5.2	ft
Inside Diameter	4.0	in
Depth of bottom of guard pipe	2.3	ft

Type of Seals	**Top of Seal (ft)**	**Thickness (ft)**
Bentonite Seal	3.0	1.0

Type of riser pipe:	Schedule 40 PVC	
Inside diameter of riser pipe	2.0	in
Type of backfill around riser	Holliston Sand (Filter Sand)	
Diameter of borehole	4.0	in
Depth to top of well screen	4.5	ft
Type of screen	Schedule 40 PVC	
Screen gauge or size of openings	0.01	in
Diameter of screen	2.0	in
Type of backfill around screen	Holliston Sand (Filter Sand)	
Depth of bottom of well screen	14.5	ft
Bottom of Silt trap	14.6	ft
Depth of bottom of borehole	26.9	ft

(Not to Scale)

Riser Pay Length (L1)		Length of screen (L2)		Length of silt trap (L3)		Pay length
7.4 ft	+	10.0 ft	+	0.1 ft	=	17.5 ft

COMMENTS:

Form 2007

GROUNDWATER MONITORING REPORT

OW/PZ NUMBER	BB-WWR-104(OW)
Page	1 of 1

PROJECT	Replacement of I95 Southbound Bridge Over Webb Rd.	**H&A FILE NO.**	132212-004
LOCATION	Waterville, Maine	**PROJECT MGR.**	E. Force
CLIENT	McFarland-Johnson, Inc.	**FIELD REP.**	N. Klausmeyer
CONTRACTOR	New England Boring Contractors	**DATE**	6/14/2018

ELEVATION OF REFERENCE POINT 241.4 **REFERENCE POINT: Ground Surface** ☑ **PVC** ☐ **Other** ☐

Date	Time	Elapsed Time (days)	Depth of Water from Reference Point (ft)	Elevation of Water	Remarks	Read By
6/14/2018	10:03 AM	0	3.9	237.5	Initial Reading - Cloudy & 70s (overnight rain)	NLK
6/20/2018	5:28 PM	6	4.5	236.9	Sunny & 80s	NLK
7/2/2018	5:30 PM	18	4.6	236.8	Sunny & 80s	NLK
7/13/2018	5:15 PM	29	4.4	237.1	Sunny & 80s	NLK
7/26/2018	4:15 PM	42	7.0	234.5	Sunny & 70s (rain in past several days)	NLK
8/13/2018	2:20 PM	60	7.0	234.4	Partly Cloudy & 80s	NLK
10/13/2021	3:00 PM	1217	2.8	238.6	Sunny 60s	TPJ
11/11/2021	10:00 AM	1246	2.6	238.8	Sunny 50s	JKF

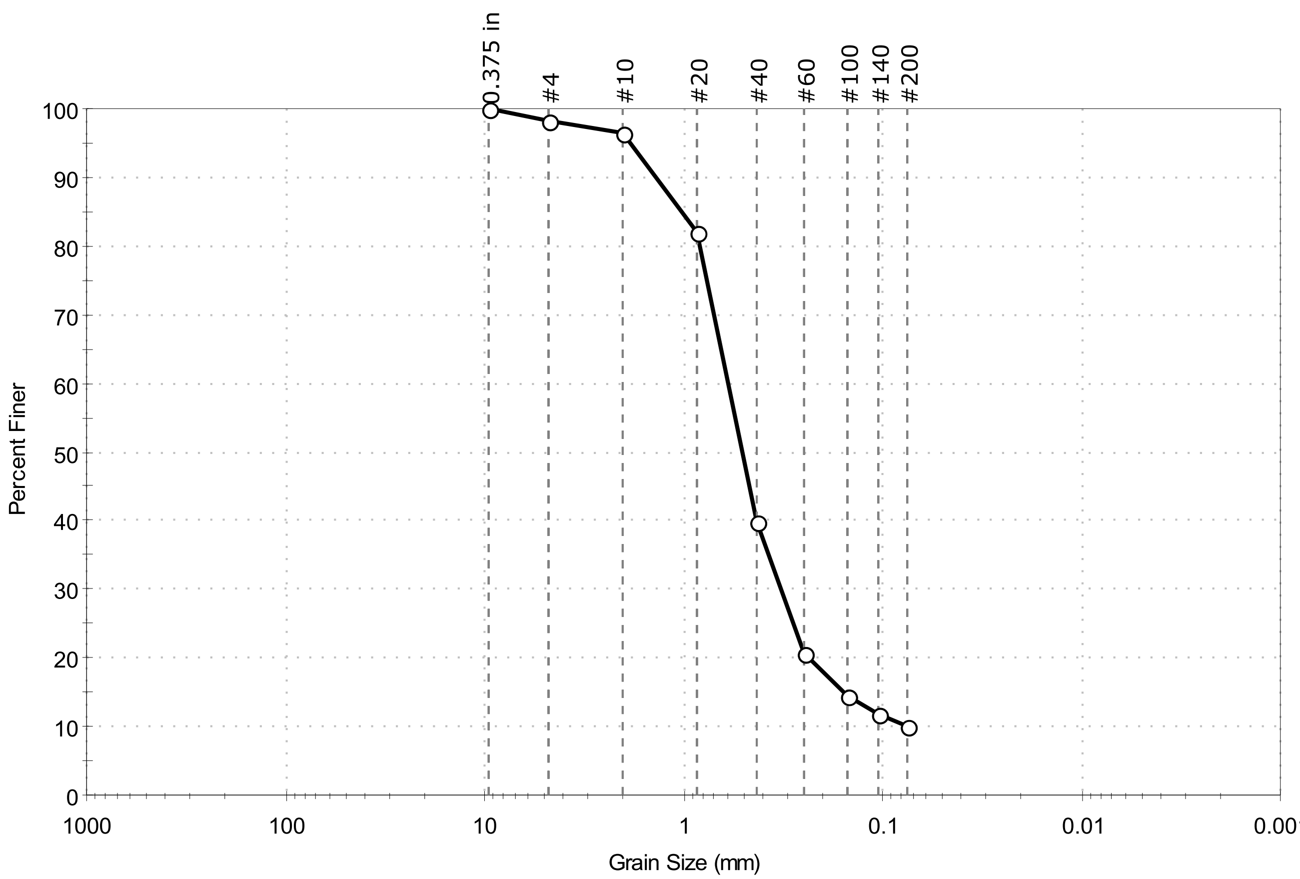
APPENDIX C

Laboratory Test Results

GeoTesting EXPRESS

Client:	Haley & Aldrich, Inc.				
Project:	I-95 NB Bridge Over Webb Rd				
Location:	Waterville, ME			Project No:	GTX-308851
Boring ID:	BB-WWR-101	Sample Type:	jar	Tested By:	GA
Sample ID:	2DA	Test Date:	10/03/18	Checked By:	emm
Depth :	2-3 ft	Test Id:	474287		
Test Comment:	---				
Visual Description:	Moist, very dark gray sand with silt				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	1.8	88.2	10.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	98		
#10	2.00	97		
#20	0.85	82		
#40	0.42	40		
#60	0.25	21		
#100	0.15	15		
#140	0.11	12		
#200	0.075	10		

Coefficients

D_{85} =1.0086 mm

D_{30} =0.3227 mm

D_{60} =0.5909 mm

D_{15} =0.1558 mm

D_{50} =0.5014 mm

D_{10} =N/A

C_u =N/A

C_c =N/A

Classification

ASTM N/A

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

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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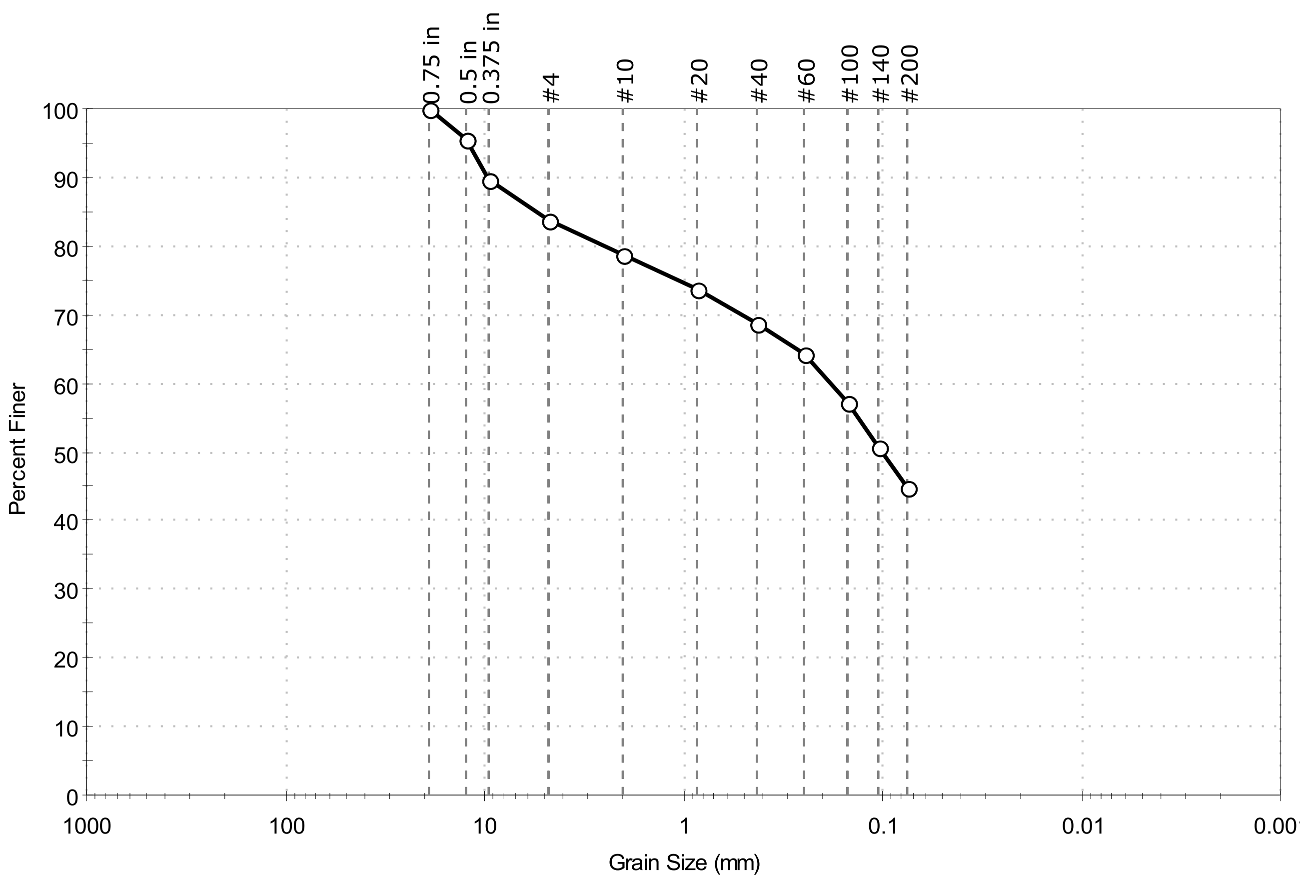
GeoTesting EXPRESS

Client:	Haley & Aldrich, Inc.				
Project:	I-95 NB Bridge Over Webb Rd				
Location:	Waterville, ME			Project No:	GTX-308851
Boring ID:	BB-WWR-102 (OW)	Sample Type:	jar	Tested By:	GA
Sample ID:	1D	Test Date:	09/28/18	Checked By:	emm
Depth :	0-1.5 ft	Test Id:	474286		
Test Comment:	---				
Visual Description:	Moist, dark brown silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	16.3	38.8	44.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	96		
0.375 in	9.50	90		
#4	4.75	84		
#10	2.00	79		
#20	0.85	74		
#40	0.42	69		
#60	0.25	64		
#100	0.15	57		
#140	0.11	51		
#200	0.075	45		

Coefficients

D_{85} =5.5380 mm D_{30} =N/A

D_{60} =0.1833 mm D_{15} =N/A

D_{50} =0.1008 mm D_{10} =N/A

C_u =N/A C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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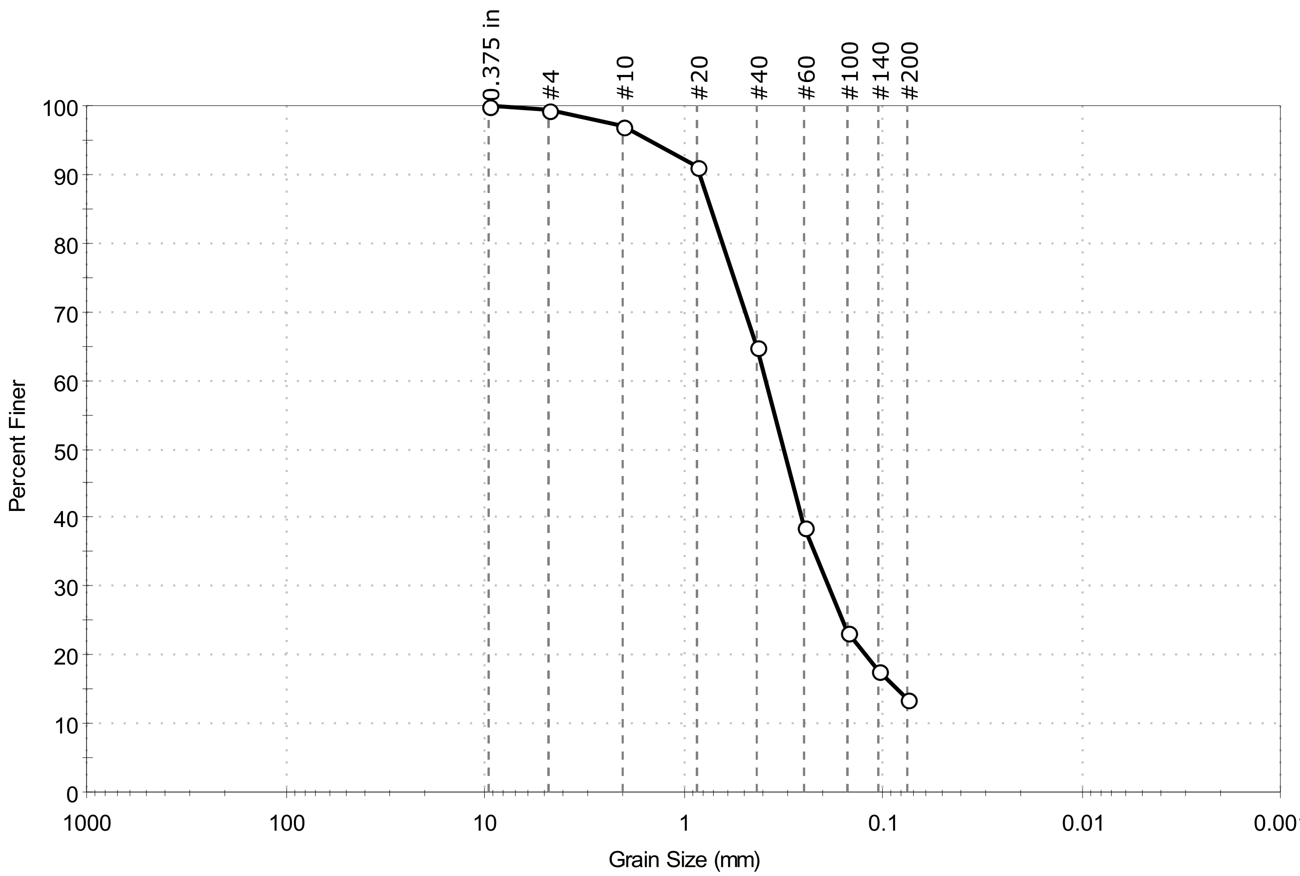
Client:	Haley & Aldrich, Inc.				
Project:	I-95 NB Bridge Over Webb Rd				
Location:	Waterville, ME			Project No:	GTX-308851
Boring ID:	BB-WWR-102 (OW)	Sample Type:	jar	Tested By:	GA
Sample ID:	2D	Test Date:	10/03/18	Checked By:	emm
Depth :	2-4 ft	Test Id:	474285		
Test Comment:	---				
Visual Description:	Moist, dark grayish brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.6	85.8	13.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	99		
#10	2.00	97		
#20	0.85	91		
#40	0.42	65		
#60	0.25	39		
#100	0.15	23		
#140	0.11	18		
#200	0.075	14		

Coefficients

D_{85} =0.7234 mm
D_{30} =0.1875 mm
D_{60} =0.3840 mm
D_{15} =0.0840 mm
D_{50} =0.3137 mm
D_{10} =N/A
C_u =N/A
C_c =N/A

Classification

ASTM N/A

AASHTO Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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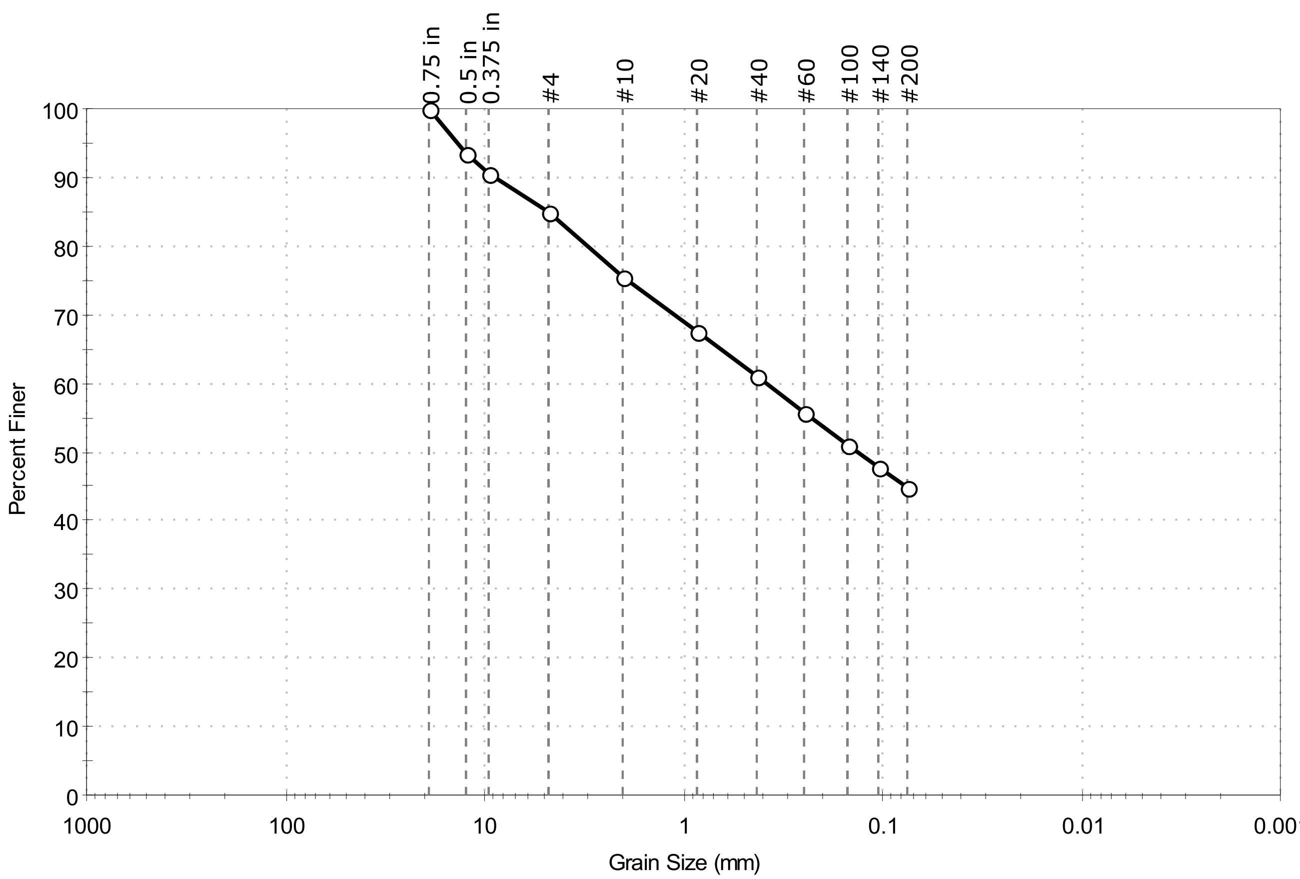
Client:	Haley & Aldrich, Inc.				
Project:	I-95 NB Bridge Over Webb Rd				
Location:	Waterville, ME			Project No:	GTX-308851
Boring ID:	BB-WWR-102 (OW)	Sample Type:	jar	Tested By:	GA
Sample ID:	6D	Test Date:	10/03/18	Checked By:	emm
Depth :	20-21.1 ft	Test Id:	474284		
Test Comment:	---				
Visual Description:	Moist, dark gray silty sand with gravel				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	15.0	40.1	44.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	94		
0.375 in	9.50	91		
#4	4.75	85		
#10	2.00	76		
#20	0.85	68		
#40	0.42	61		
#60	0.25	56		
#100	0.15	51		
#140	0.11	48		
#200	0.075	45		

Coefficients

D_{85} =4.7749 mm	D_{30} =N/A
D_{60} =0.3775 mm	D_{15} =N/A
D_{50} =0.1337 mm	D_{10} =N/A
C_u =N/A	C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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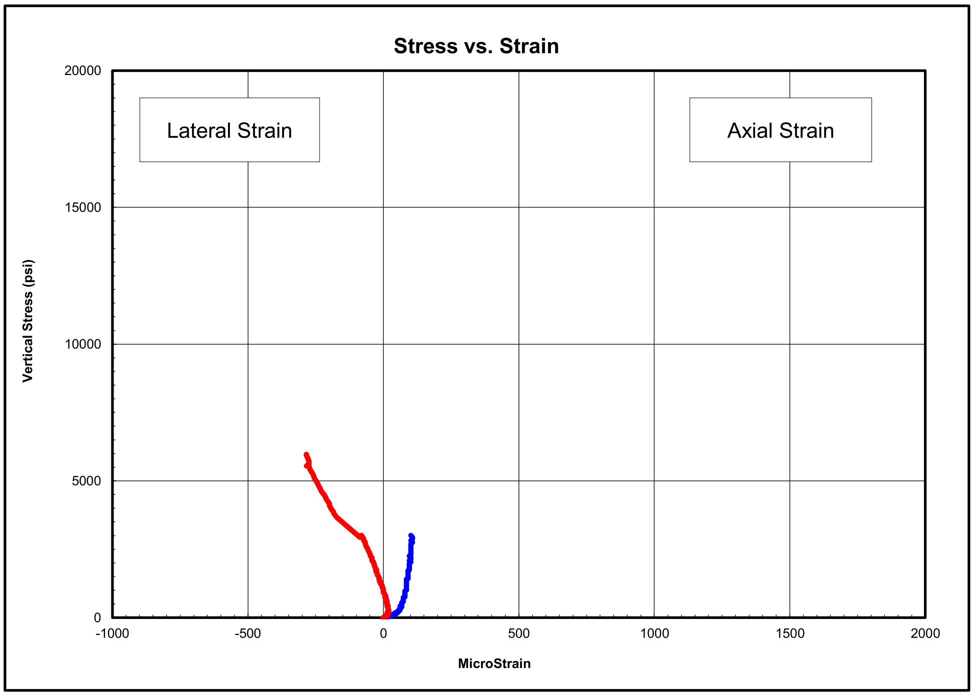
Client:	Haley & Aldrich, Inc.
Project Name:	I-95 NB Bridge Over Webb Rd
Project Location:	Waterville, ME
GTX #:	308851
Test Date:	9/28/2018
Tested By:	tlm
Checked By:	jsc
Boring ID:	BB-WWR-102 (OW)
Sample ID:	R2
Depth, ft:	39.1-39.7
Sample Type:	rock core
Sample Description:	See photographs Intact material failure

Compressive Strength and Elastic Moduli of Rock by ASTM D7012 - Method D



Peak Compressive Stress: 5,970 psi

The axial strain gauges failed before the peak value was attained.

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
600-2200	55,300,000	---
2200-3800	---	---
3800-5400	---	---

Notes: Test specimen tested at the approximate as-received moisture content and at standard laboratory temperature.
The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.
Young's Modulus and Poisson's Ratio calculated using the tangent to the line in the stress range listed.
Calculations assume samples are isotropic, which is not necessarily the case.

Client:	Haley & Aldrich, Inc.	Test Date:	9/27/2018
Project Name:	I-95 NB Bridge Over Webb Rd	Tested By:	tlm
Project Location:	Waterville, ME	Checked By:	jsc
GTX #:	308851		
Boring ID:	BB-WWR-102 (OW)		
Sample ID:	R2		
Depth:	39.1-39.7 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average		
Specimen Length, in:	4.26	4.26	4.26		
Specimen Diameter, in:	1.98	1.98	1.98		
Specimen Mass, g:	595.83				
Bulk Density, lb/ft^3	173	**Minimum Diameter Tolerence Met?**		**YES**	
Length to Diameter Ratio:	2.2	**Length to Diameter Ratio Tolerance Met?**		**YES**	

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:
Is the maximum gap $\leq$ 0.02 in.? YES

Maximum difference must be < 0.020 in.
Straightness Tolerance Met? **YES**

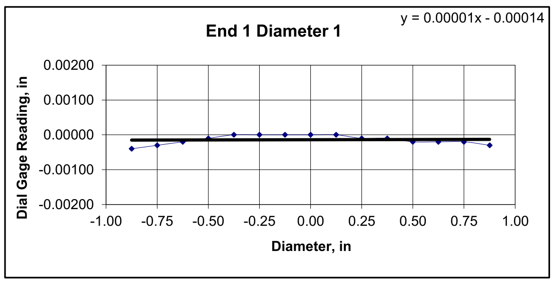
END FLATNESS AND PARALLELISM (Procedure FP1)

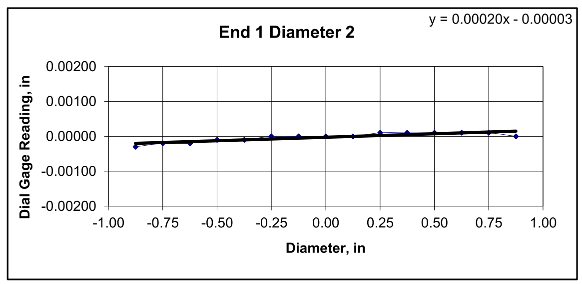
END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00040	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020	-0.00020	-0.00020	-0.00030
Diameter 2, in (rotated 90°)	-0.00030	-0.00020	-0.00020	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000

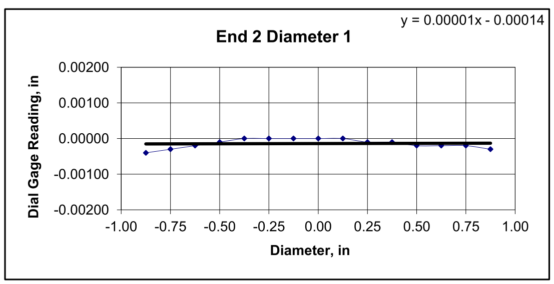
Difference between max and min readings, in:
0° = 0.00040 90° = 0.00040

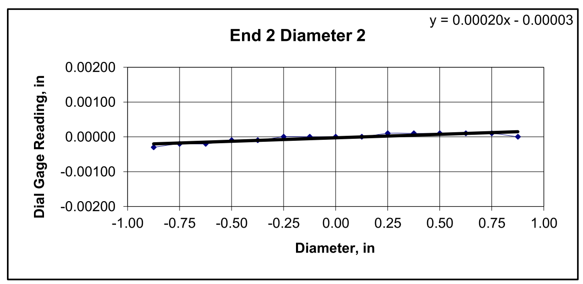
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	-0.00040	-0.00030	-0.00020	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00010	-0.00020	-0.00020	-0.00020	-0.00030
Diameter 2, in (rotated 90°)	-0.00030	-0.00020	-0.00020	-0.00010	-0.00010	0.00000	0.00000	0.00000	0.00000	0.00010	0.00010	0.00010	0.00010	0.00010	0.00000

Difference between max and min readings, in:
0° = 0.0004 90° = 0.0004
Maximum difference must be < 0.0020 in. Difference = $\pm$ 0.00020
Flatness Tolerance Met? **YES**









DIAMETER 1

End 1:	
Slope of Best Fit Line	0.00001
Angle of Best Fit Line:	0.00065
End 2:	
Slope of Best Fit Line	0.00001
Angle of Best Fit Line:	0.00065
Maximum Angular Difference:	0.00000

Parallelism Tolerance Met? **YES**
Spherically Seated

DIAMETER 2

End 1:	
Slope of Best Fit Line	0.00020
Angle of Best Fit Line:	0.01146
End 2:	
Slope of Best Fit Line	0.00020
Angle of Best Fit Line:	0.01146
Maximum Angular Difference:	0.00000

Parallelism Tolerance Met? **YES**
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

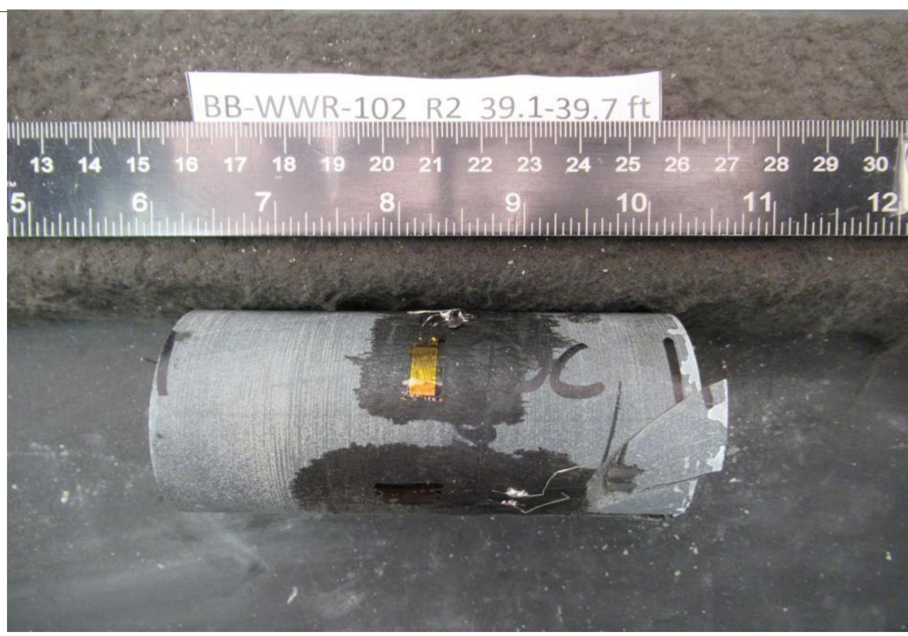
END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00040	1.980	0.00020	0.012	YES
Diameter 2, in (rotated 90°)	0.00040	1.980	0.00020	0.012	YES
END 2					
Diameter 1, in	0.00040	1.980	0.00020	0.012	YES
Diameter 2, in (rotated 90°)	0.00040	1.980	0.00020	0.012	YES

Maximum angle of departure must be $\leq$ 0.25°

Perpendicularity Tolerance Met? **YES**

Client:	Haley & Aldrich, Inc.
Project Name:	I-95 NB Bridge Over Webb Rd
Project Location:	Waterville, ME
GTX #:	308851
Test Date:	9/28/2018
Tested By:	tlm
Checked By:	jsc
Boring ID:	BB-WWR-102
Sample ID:	R2
Depth, ft:	39.1-39.7

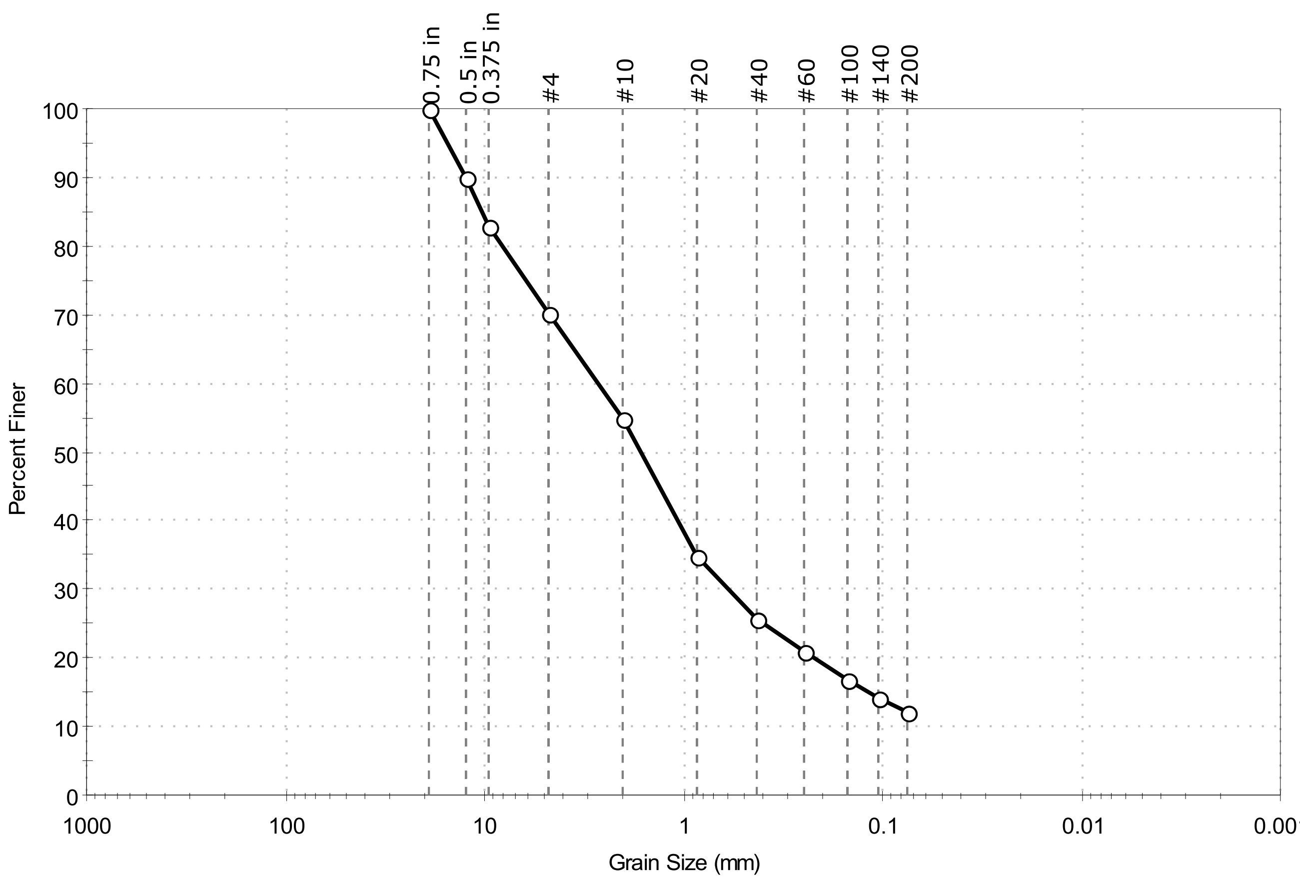
After cutting and grinding



After break

Client:	Haley & Aldrich, Inc.					
Project:	I-95 SB Bridge Over Webb Rd					
Location:	Waterville, ME				Project No:	GTX-308852
Boring ID:	BB-WWR-103		Sample Type:	jar	Tested By:	GA
Sample ID:	1DA		Test Date:	09/28/18	Checked By:	emm
Depth :	0-1 ft		Test Id:	474299		
Test Comment:	---					
Visual Description:	Moist, very dark brown silty sand with gravel					
Sample Comment:	---					

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	29.8	58.0	12.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	90		
0.375 in	9.50	83		
#4	4.75	70		
#10	2.00	55		
#20	0.85	35		
#40	0.42	26		
#60	0.25	21		
#100	0.15	17		
#140	0.11	14		
#200	0.075	12		

Coefficients

D_{85} =10.2800 mm　　D_{30} =0.5931 mm

D_{60} =2.6568 mm　　D_{15} =0.1163 mm

D_{50} =1.6181 mm　　D_{10} =N/A

C_u =N/A　　C_c =N/A

Classification

ASTM　N/A

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

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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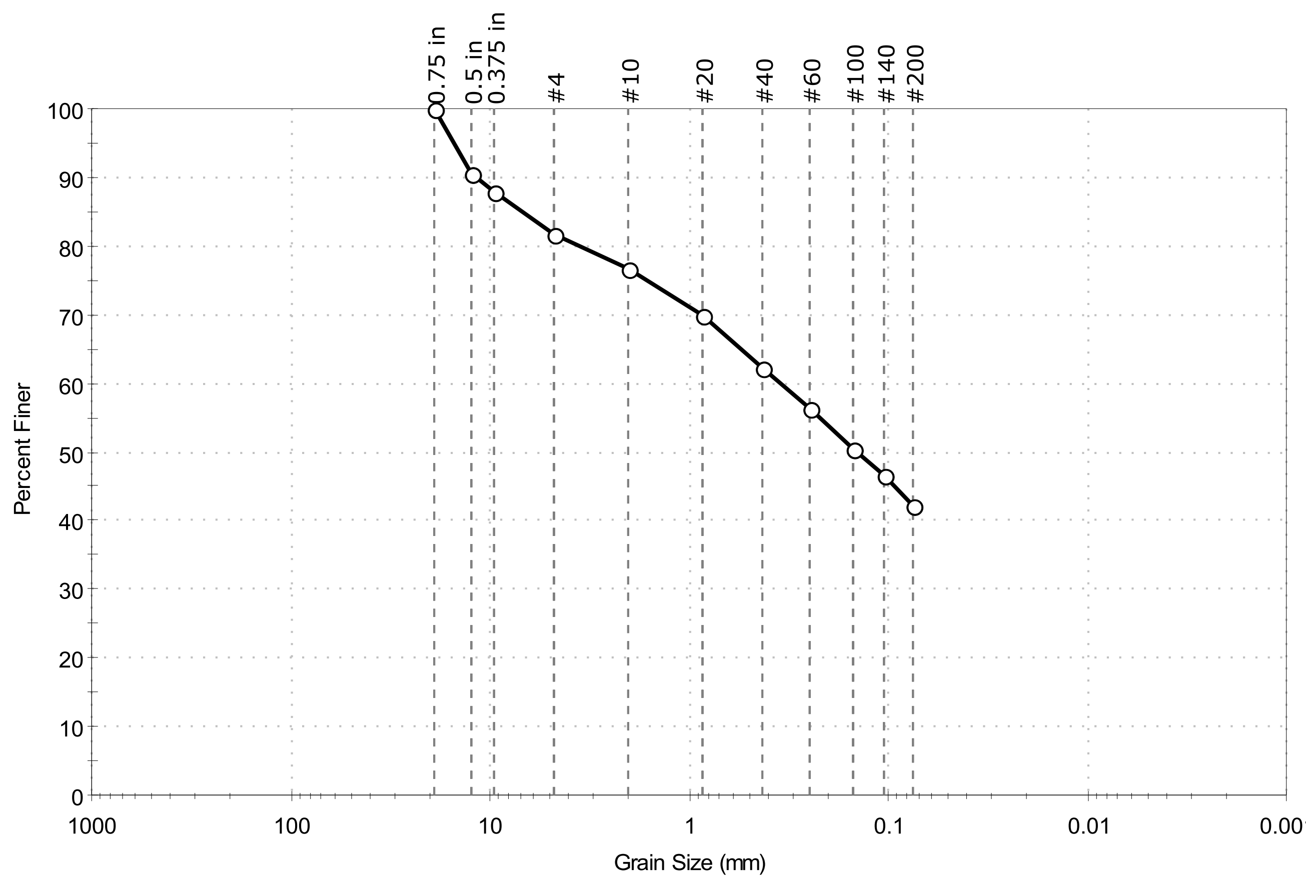
Client:	Haley & Aldrich, Inc.
Project:	I-95 SB Bridge Over Webb Rd
Location:	Waterville, ME
Project No:	GTX-308852
Boring ID:	BB-WWR-103
Sample ID:	2D
Depth :	2-4 ft
Sample Type:	jar
Test Date:	09/28/18
Test Id:	474300
Tested By:	GA
Checked By:	emm
Test Comment:	---
Visual Description:	Moist, dark grayish brown silty sand with gravel
Sample Comment:	---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	18.3	39.6	42.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.75 in	19.00	100		
0.5 in	12.50	90		
0.375 in	9.50	88		
#4	4.75	82		
#10	2.00	77		
#20	0.85	70		
#40	0.42	62		
#60	0.25	56		
#100	0.15	50		
#140	0.11	47		
#200	0.075	42		

Coefficients

D_{85} =6.8524 mm　　D_{30} =N/A

D_{60} =0.3459 mm　　D_{15} =N/A

D_{50} =0.1445 mm　　D_{10} =N/A

C_u =N/A　　C_c =N/A

Classification

ASTM　N/A

AASHTO　Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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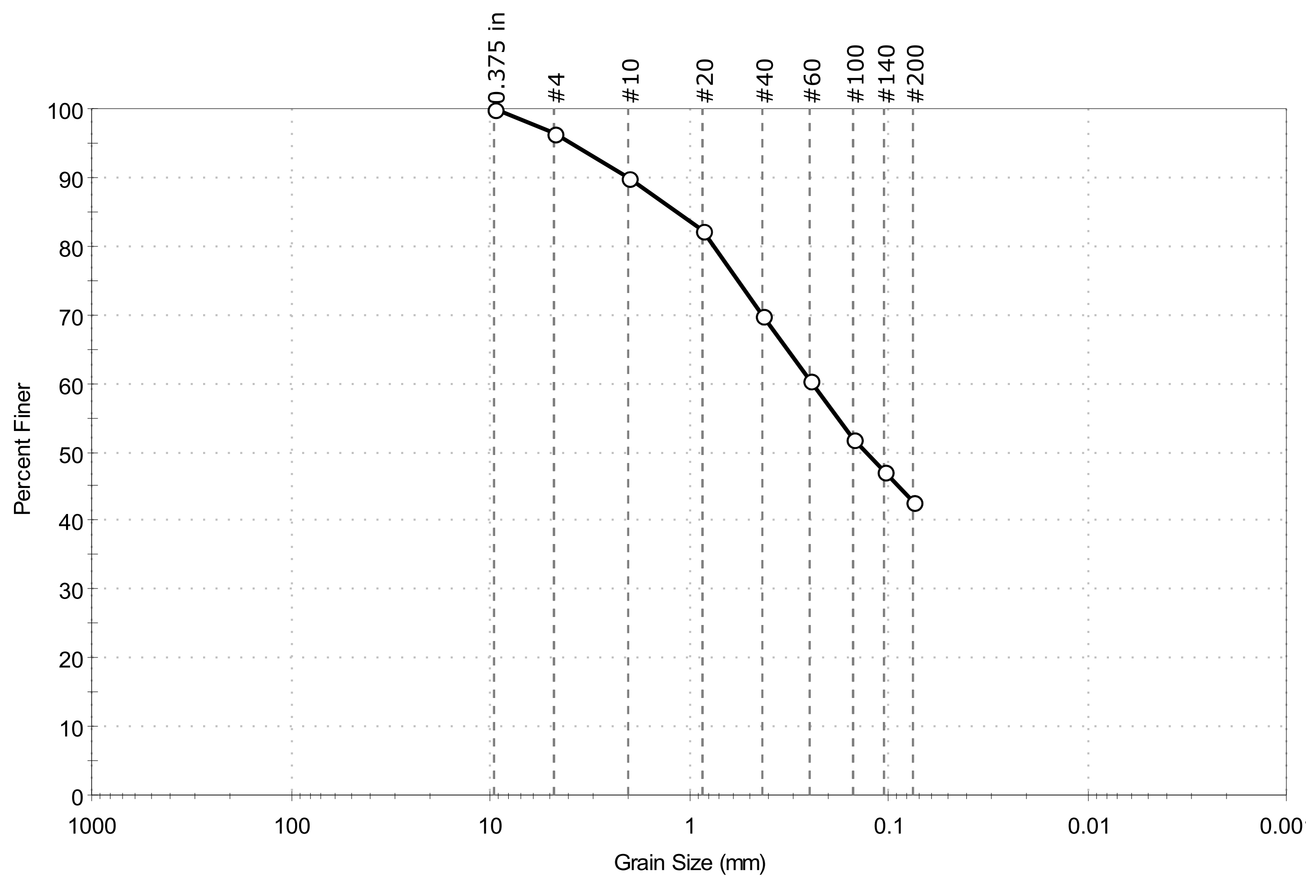
Client:	Haley & Aldrich, Inc.				
Project:	I-95 SB Bridge Over Webb Rd				
Location:	Waterville, ME			Project No:	GTX-308852
Boring ID:	BB-WWR-104(OW)	Sample Type:	jar	Tested By:	GA
Sample ID:	1D	Test Date:	09/28/18	Checked By:	emm
Depth :	0-2 ft	Test Id:	474301		
Test Comment:	---				
Visual Description:	Moist, very dark brown silty sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	3.6	53.5	42.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	96		
#10	2.00	90		
#20	0.85	82		
#40	0.42	70		
#60	0.25	61		
#100	0.15	52		
#140	0.11	47		
#200	0.075	43		

Coefficients

D_{85} =1.1547 mm | D_{30} =N/A
D_{60} =0.2423 mm | D_{15} =N/A
D_{50} =0.1301 mm | D_{10} =N/A
C_u =N/A | C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

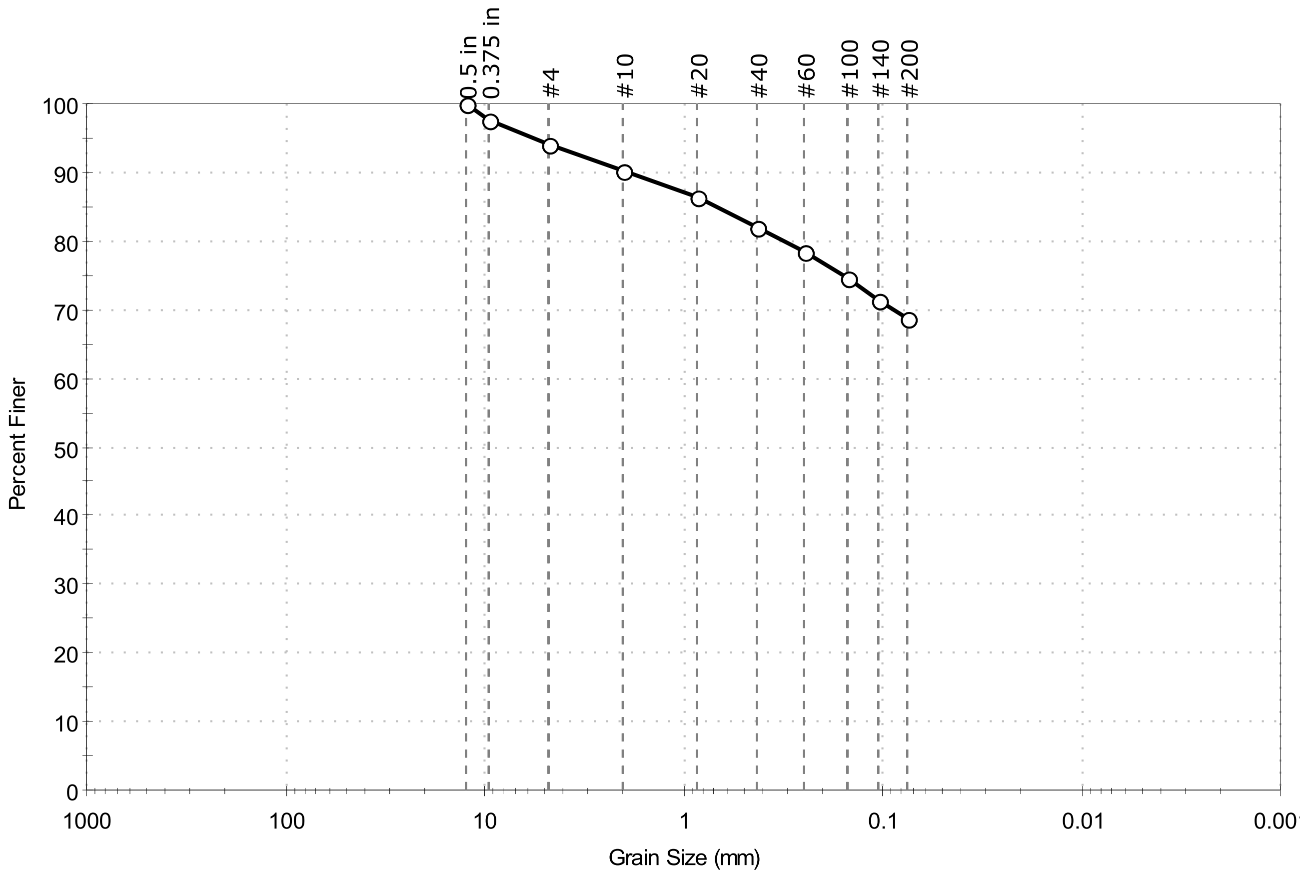
Client:	Haley & Aldrich, Inc.		
Project:	I-95 SB Bridge Over Webb Rd		
Location:	Waterville, ME	Project No:	GTX-308852
Boring ID: BB-WWR-104(OW)	Sample Type: jar	Tested By:	GA
Sample ID: 3D	Test Date: 09/28/18	Checked By:	emm
Depth : 4-6 ft	Test Id: 474302		

Test Comment: ---

Visual Description: Moist, dark gray sandy clay

Sample Comment: ---

Particle Size Analysis - ASTM D422



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	6.0	25.3	68.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.5 in	12.50	100		
0.375 in	9.50	98		
#4	4.75	94		
#10	2.00	90		
#20	0.85	86		
#40	0.42	82		
#60	0.25	78		
#100	0.15	75		
#140	0.11	71		
#200	0.075	69		

Coefficients

D_{85} =0.6839 mm D_{30} =N/A

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

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

C_u =N/A C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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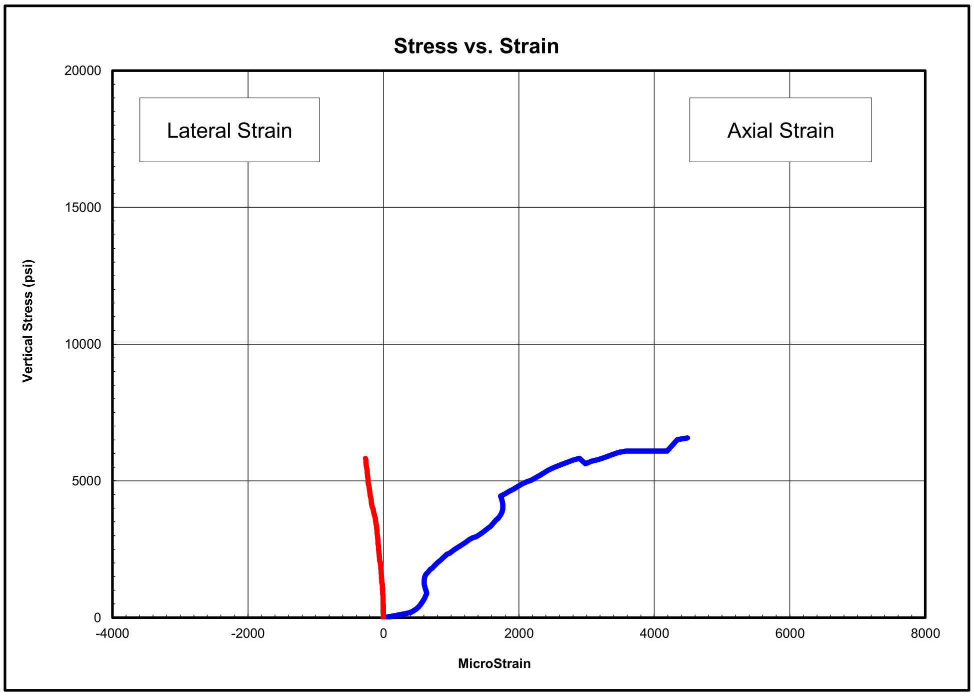
GeoTesting EXPRESS

Client:	Haley & Aldrich, Inc.
Project Name:	I-95 SB Bridge Over Webb Rd
Project Location:	Waterville, ME
GTX #:	308852
Test Date:	10/1/2018
Tested By:	tlm
Checked By:	jsc
Boring ID:	BB-WWR-103
Sample ID:	R2
Depth, ft:	21.4-22.0
Sample Type:	rock core
Sample Description:	See photographs Discontinuity failure

Compressive Strength and Elastic Moduli of Rock by ASTM D7012 - Method D



Peak Compressive Stress: 7,387 psi

The strain gauges failed before the peak value was attained. Young's Modulus and Poisson's Ratio within the third stress range could not be determined.

Stress Range, psi	Young's Modulus, psi	Poisson's Ratio
700-2700	3,100,000	0.12
2700-4700	2,890,000	0.21
4700-6600	---	---

Notes: Test specimen tested at the approximate as-received moisture content and at standard laboratory temperature.
The axial load was applied continuously at a stress rate that produced failure in a test time between 2 and 15 minutes.
Young's Modulus and Poisson's Ratio calculated using the tangent to the line in the stress range listed.
Calculations assume samples are isotropic, which is not necessarily the case.

Client:	Haley & Aldrich, Inc.	Test Date:	9/27/2018
Project Name:	I-95 SB Bridge Over Webb Rd	Tested By:	tlm
Project Location:	Waterville, ME	Checked By:	jsc
GTX #:	308852		
Boring ID:	BB-WWR-103		
Sample ID:	R2		
Depth:	21.4-22 ft		
Visual Description:	See photographs		

UNIT WEIGHT DETERMINATION AND DIMENSIONAL AND SHAPE TOLERANCES OF ROCK CORE SPECIMENS BY ASTM D4543

BULK DENSITY

	1	2	Average		
Specimen Length, in:	4.26	4.25	4.26		
Specimen Diameter, in:	1.99	1.99	1.99		
Specimen Mass, g:	591.23				
Bulk Density, lb/ft^3	170			**Minimum Diameter Tolerence Met?**	**YES**
Length to Diameter Ratio:	2.1			**Length to Diameter Ratio Tolerance Met?**	**YES**

DEVIATION FROM STRAIGHTNESS (Procedure S1)

Maximum gap between side of core and reference surface plate:

Is the maximum gap $\leq$ 0.02 in.? YES

Maximum difference must be < 0.020 in.

Straightness Tolerance Met? **YES**

END FLATNESS AND PARALLELISM (Procedure FP1)

END 1	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00020	-0.00020	-0.00030	-0.00030	-0.00030
Diameter 2, in (rotated 90°)	-0.00030	-0.00020	-0.00020	-0.00010	-0.00010	0.00000	0.00000	0.00000	-0.00010	-0.00020	-0.00030	-0.00040	-0.00040	-0.00050	-0.00060

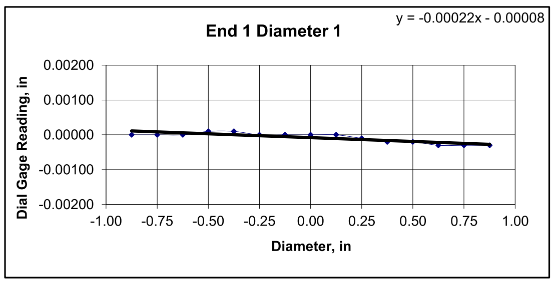
Difference between max and min readings, in:
0° = 0.00040 90° = 0.00060

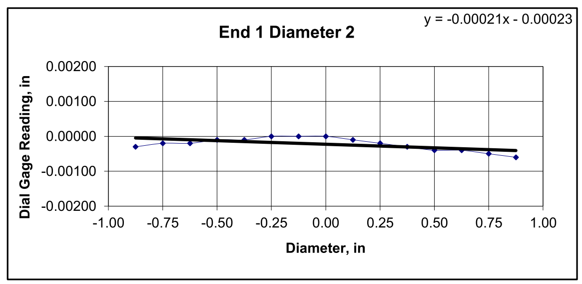
END 2	-0.875	-0.750	-0.625	-0.500	-0.375	-0.250	-0.125	0.000	0.125	0.250	0.375	0.500	0.625	0.750	0.875
Diameter 1, in	0.00000	0.00000	0.00000	0.00010	0.00010	0.00000	0.00000	0.00000	0.00000	-0.00010	-0.00020	-0.00020	-0.00030	-0.00030	-0.00030
Diameter 2, in (rotated 90°)	-0.00030	-0.00020	-0.00020	-0.00010	-0.00010	0.00000	0.00000	0.00000	-0.00010	-0.00020	-0.00030	-0.00040	-0.00040	-0.00050	-0.00050

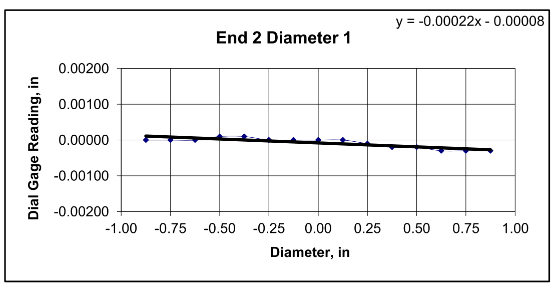
Difference between max and min readings, in:
0° = 0.0004 90° = 0.0005

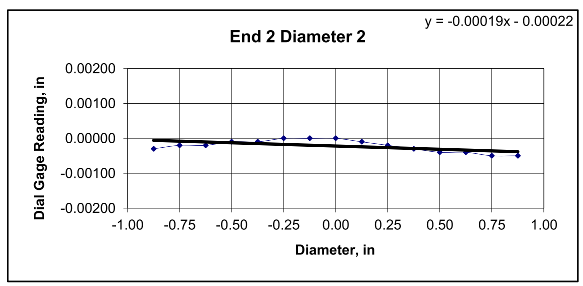
Maximum difference must be < 0.0020 in. Difference = $\pm$ 0.00030

Flatness Tolerance Met? **YES**









DIAMETER 1

End 1:	Slope of Best Fit Line	0.00022
	Angle of Best Fit Line:	0.01261
End 2:	Slope of Best Fit Line	0.00022
	Angle of Best Fit Line:	0.01261
Maximum Angular Difference:		0.00000

Parallelism Tolerance Met? **YES**
Spherically Seated

DIAMETER 2

End 1:	Slope of Best Fit Line	0.00021
	Angle of Best Fit Line:	0.01179
End 2:	Slope of Best Fit Line	0.00019
	Angle of Best Fit Line:	0.01064
Maximum Angular Difference:		0.00115

Parallelism Tolerance Met? **YES**
Spherically Seated

PERPENDICULARITY (Procedure P1) (Calculated from End Flatness and Parallelism measurements above)

END 1	Difference, Maximum and Minimum (in.)	Diameter (in.)	Slope	Angle°	Perpendicularity Tolerance Met?
Diameter 1, in	0.00040	1.990	0.00020	0.012	YES
Diameter 2, in (rotated 90°)	0.00060	1.990	0.00030	0.017	YES
END 2					
Diameter 1, in	0.00040	1.990	0.00020	0.012	YES
Diameter 2, in (rotated 90°)	0.00050	1.990	0.00025	0.014	YES

Maximum angle of departure must be $\leq$ 0.25°

Perpendicularity Tolerance Met? **YES**

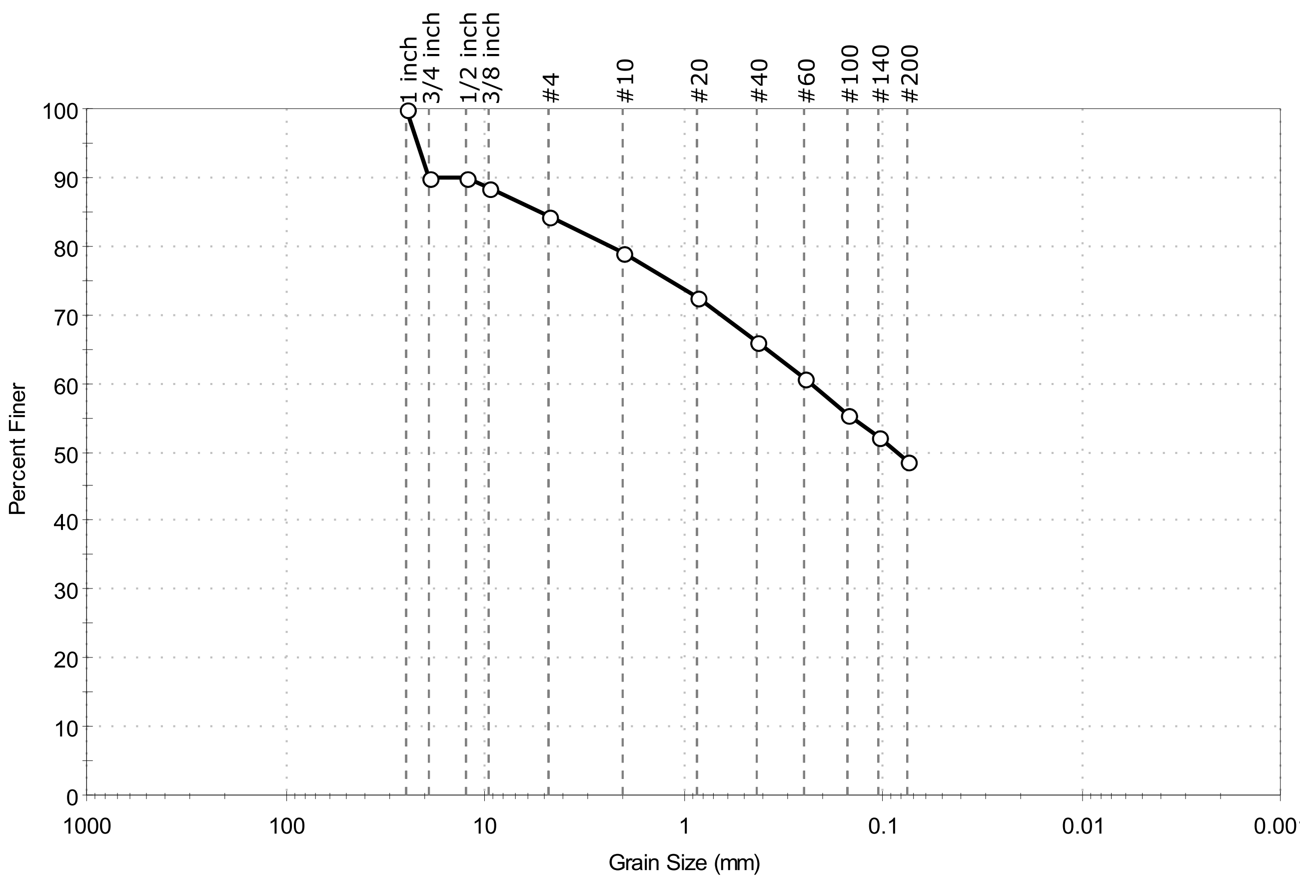
Client:	Haley & Aldrich, Inc.
Project Name:	I-95 SB Bridge Over Webb Rd
Project Location:	Waterville, ME
GTX #:	308852
Test Date:	10/1/2018
Tested By:	cmh
Checked By:	jsc
Boring ID:	BB-WWR-103
Sample ID:	R2
Depth, ft:	21.4-22

After cutting and grinding

After break

Client:	Haley & Aldrich, Inc.		
Project:	Replace I-95 Bridges over Webb Rd		
Location:	Waterville, ME	Project No:	GTX-314703
Boring ID: BB-WWR-201	Sample Type: tube	Tested By:	ckg
Sample ID: 4D	Test Date: 12/06/21	Checked By:	jsc
Depth : 10-12	Test Id: 644201		
Test Comment:	---		
Visual Description:	Moist, olive gray silty sand with gravel		
Sample Comment:	---		

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	15.7	35.6	48.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 inch	25.00	100		
3/4 inch	19.00	90		
1/2 inch	12.50	90		
3/8 inch	9.50	88		
#4	4.75	84		
#10	2.00	79		
#20	0.85	73		
#40	0.42	66		
#60	0.25	61		
#100	0.15	56		
#140	0.11	52		
#200	0.075	49		

Coefficients

D_{85} =5.3563 mm D_{30} =N/A

D_{60} =0.2348 mm D_{15} =N/A

D_{50} =0.0854 mm D_{10} =N/A

C_u =N/A C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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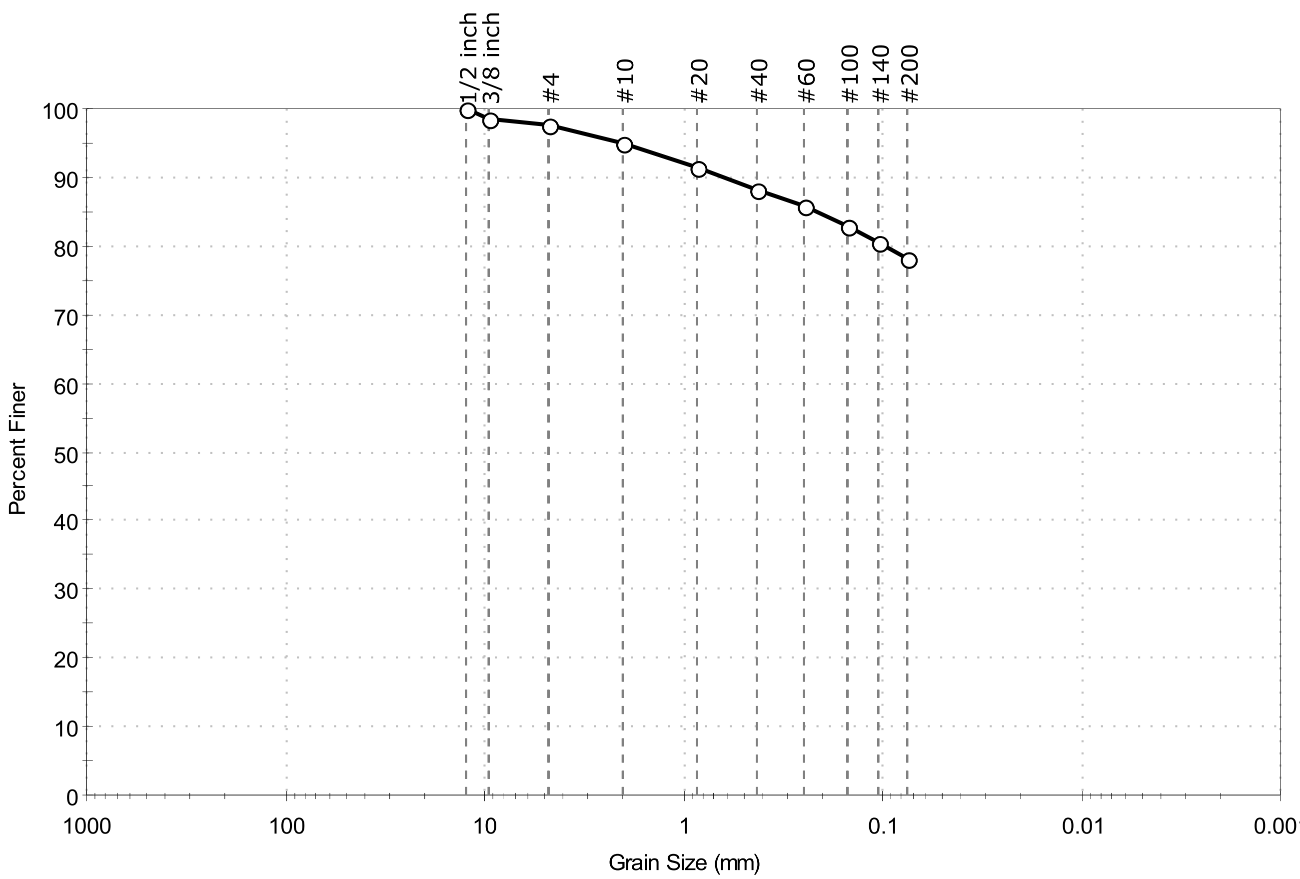
Client:	Haley & Aldrich, Inc.				
Project:	Replace I-95 Bridges over Webb Rd				
Location:	Waterville, ME			Project No:	GTX-314703
Boring ID:	BB-WWR-202	Sample Type:	tube	Tested By:	ckg
Sample ID:	1DB	Test Date:	12/06/21	Checked By:	jsc
Depth :	0-2	Test Id:	644202		
Test Comment:	---				
Visual Description:	Moist, dark olive brown clay with sand				
Sample Comment:	contains glass				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	2.5	19.5	78.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1/2 inch	12.50	100		
3/8 inch	9.50	98		
#4	4.75	98		
#10	2.00	95		
#20	0.85	91		
#40	0.42	88		
#60	0.25	86		
#100	0.15	83		
#140	0.11	81		
#200	0.075	78		

Coefficients

D_{85} =0.2164 mm	D_{30} =N/A
D_{60} =N/A	D_{15} =N/A
D_{50} =N/A	D_{10} =N/A
C_u =N/A	C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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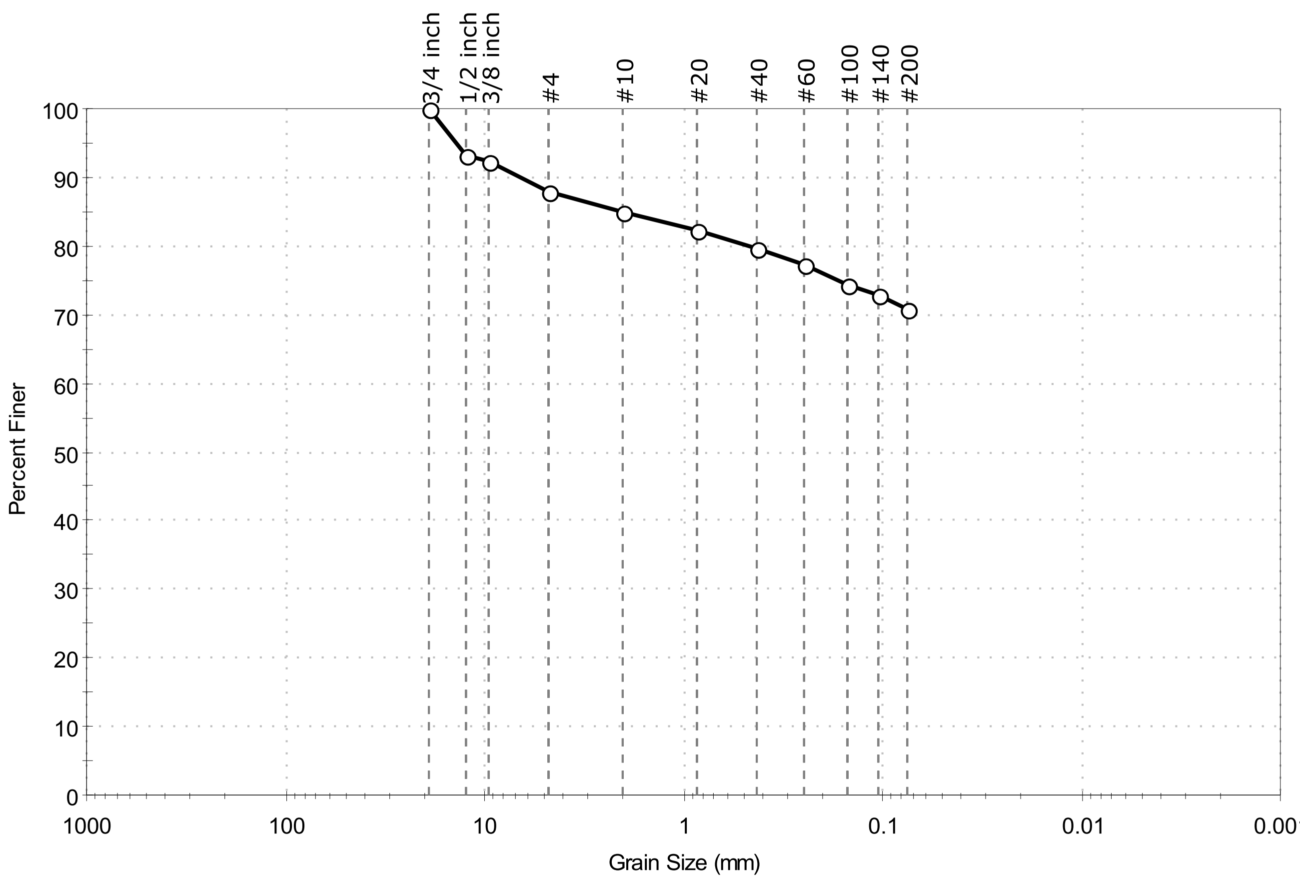
GeoTesting EXPRESS

Client: Haley & Aldrich, Inc.			
Project: Replace I-95 Bridges over Webb Rd			
Location: Waterville, ME			Project No: GTX-314703
Boring ID: BB-WWR-203	Sample Type: tube		Tested By: ckg
Sample ID: 2DB	Test Date: 12/06/21		Checked By: jsc
Depth : 2-4	Test Id: 644203		
Test Comment: ---			
Visual Description: Moist, olive gray clay with sand			
Sample Comment: ---			

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	12.2	17.1	70.7

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/4 inch	19.00	100		
1/2 inch	12.50	93		
3/8 inch	9.50	92		
#4	4.75	88		
#10	2.00	85		
#20	0.85	82		
#40	0.42	80		
#60	0.25	77		
#100	0.15	74		
#140	0.11	73		
#200	0.075	71		

Coefficients

D_{85} =2.0866 mm D_{30} =N/A

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

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

C_u =N/A C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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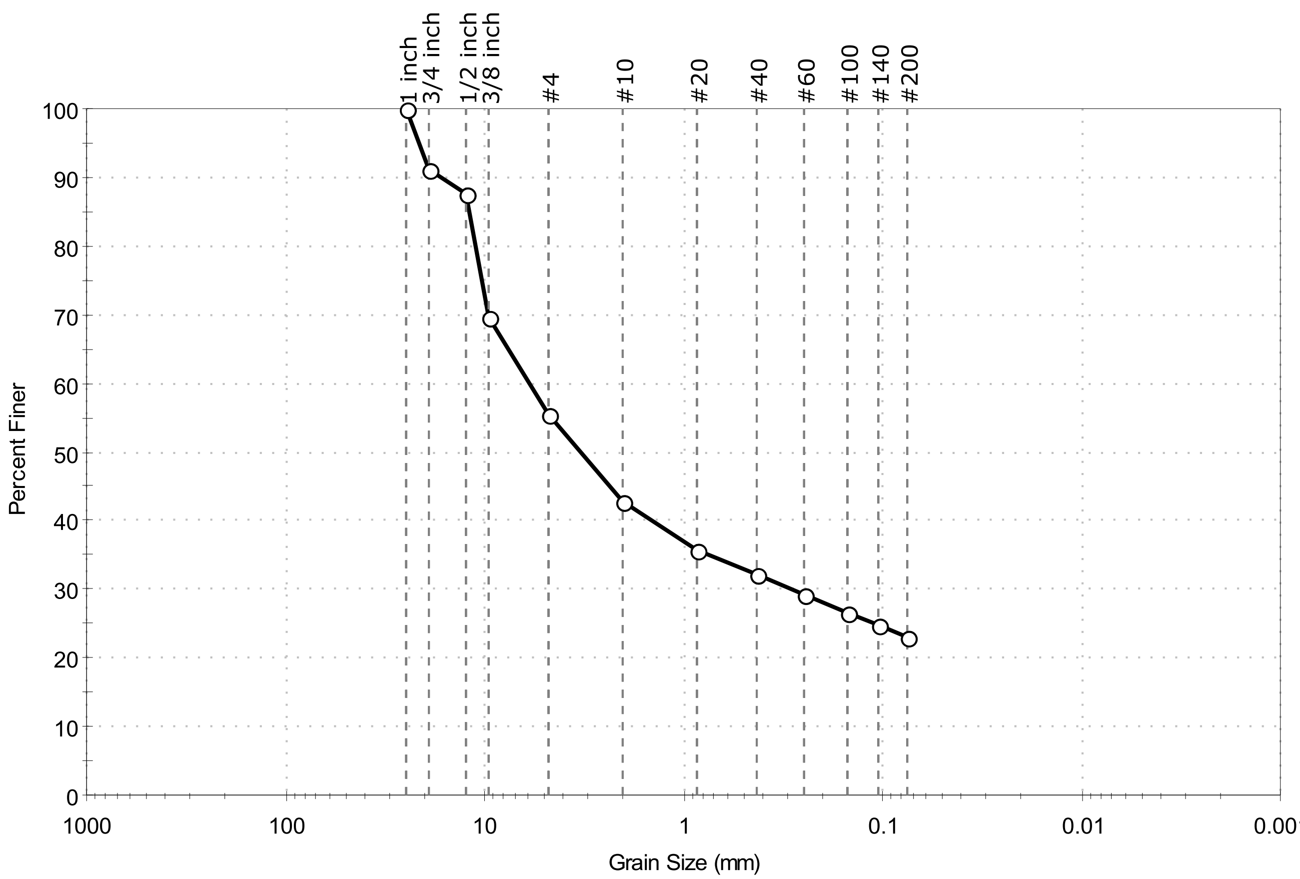
Client:	Haley & Aldrich, Inc.		
Project:	Replace I-95 Bridges over Webb Rd		
Location:	Waterville, ME	Project No:	GTX-314703
Boring ID: BB-WWR-204	Sample Type: tube	Tested By:	ckg
Sample ID: 3DB	Test Date: 12/06/21	Checked By:	jsc
Depth : 4-6	Test Id: 644204		

Test Comment: ---
Visual Description: Moist, olive gray silty gravel with sand
Sample Comment: ---

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	44.7	32.3	23.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1 inch	25.00	100		
3/4 inch	19.00	91		
1/2 inch	12.50	88		
3/8 inch	9.50	69		
#4	4.75	55		
#10	2.00	43		
#20	0.85	36		
#40	0.42	32		
#60	0.25	29		
#100	0.15	26		
#140	0.11	25		
#200	0.075	23		

Coefficients

D_{85} =12.0061 mm　　D_{30} =0.2849 mm
D_{60} =5.9719 mm　　D_{15} =N/A
D_{50} =3.2835 mm　　D_{10} =N/A
C_u =N/A　　C_c =N/A

Classification

ASTM　N/A

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

Sample/Test Description

Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

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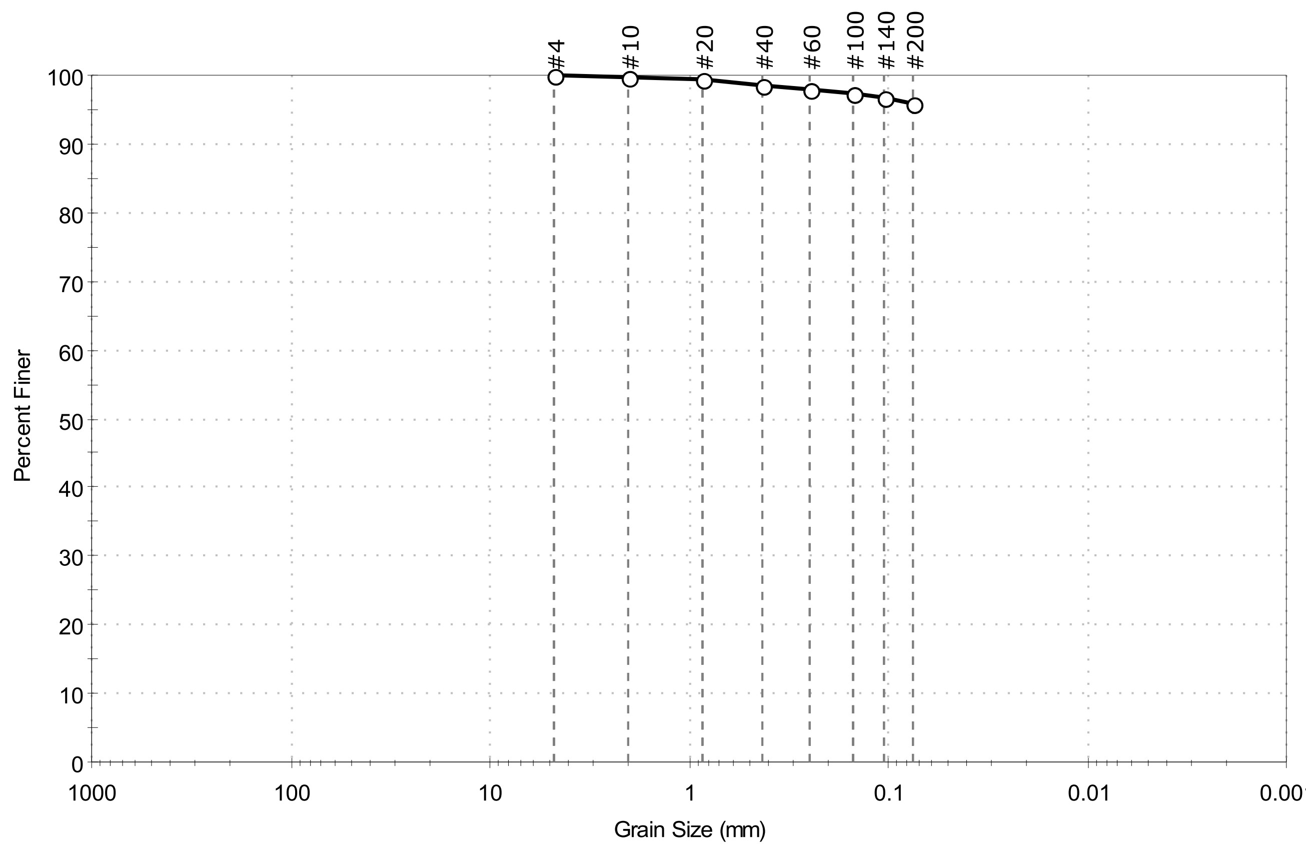
Client:	Haley & Aldrich, Inc.		
Project:	Replace I-95 Bridges over Webb Rd		
Location:	Waterville, ME	Project No:	GTX-314703
Boring ID: BB-WWR-205	Sample Type: tube	Tested By:	ckg
Sample ID: 2D	Test Date: 12/06/21	Checked By:	jsc
Depth : 2-4	Test Id: 644205		

Test Comment: ---
Visual Description: Moist, olive gray clay
Sample Comment: ---

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	4.1	95.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	99		
#60	0.25	98		
#100	0.15	97		
#140	0.11	97		
#200	0.075	96		

Coefficients

D_{85} =N/A D_{30} =N/A
D_{60} =N/A D_{15} =N/A
D_{50} =N/A D_{10} =N/A
C_u =N/A C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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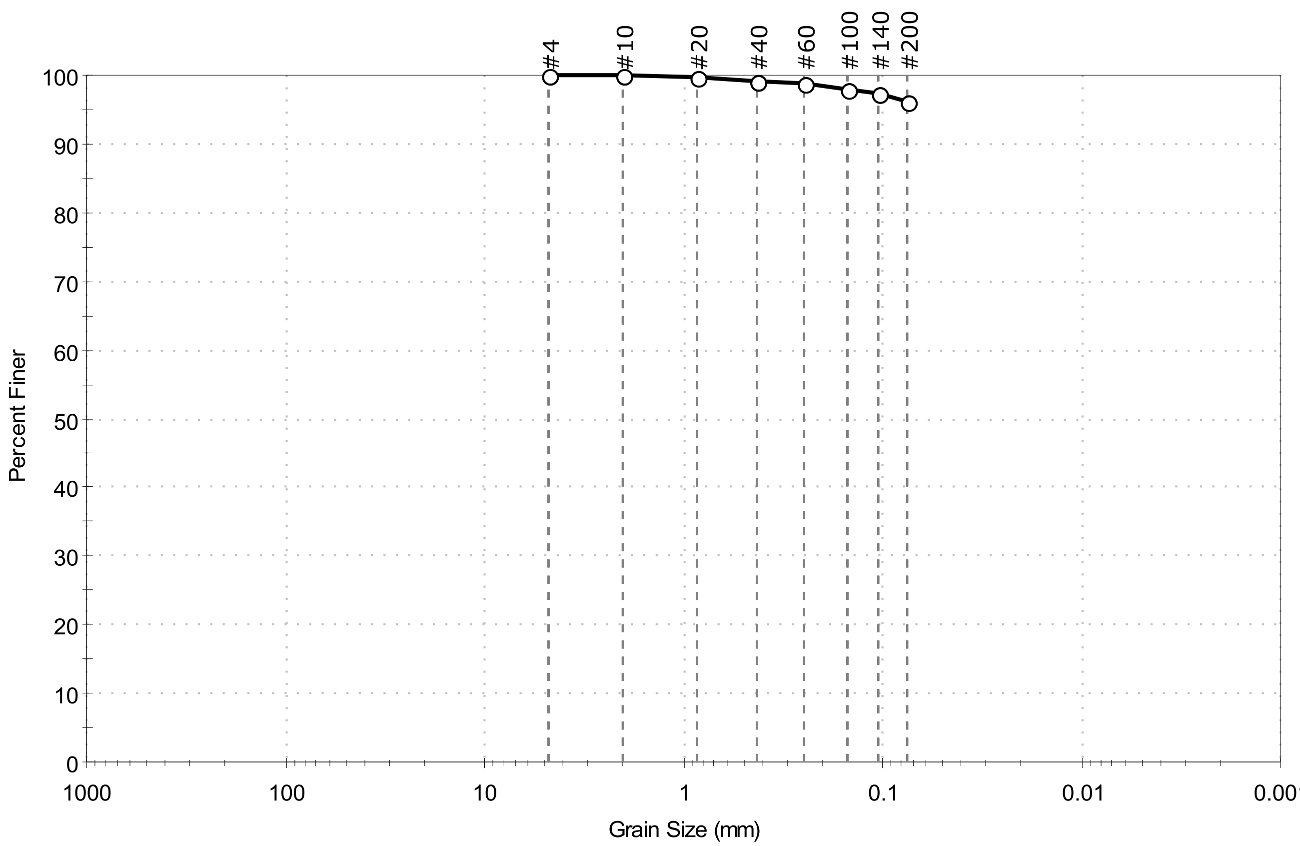
Client:	Haley & Aldrich, Inc.		
Project:	Replace I-95 Bridges over Webb Rd		
Location:	Waterville, ME	Project No:	GTX-314703
Boring ID: BB-WWR-206	Sample Type: tube	Tested By:	ckg
Sample ID: 2D	Test Date: 12/06/21	Checked By:	jsc
Depth : 2-4	Test Id: 644206		

Test Comment: ---
Visual Description: Moist, olive gray clay
Sample Comment: ---

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	3.9	96.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	99		
#100	0.15	98		
#140	0.11	97		
#200	0.075	96		

Coefficients

D_{85} =N/A | D_{30} =N/A
D_{60} =N/A | D_{15} =N/A
D_{50} =N/A | D_{10} =N/A
C_u =N/A | C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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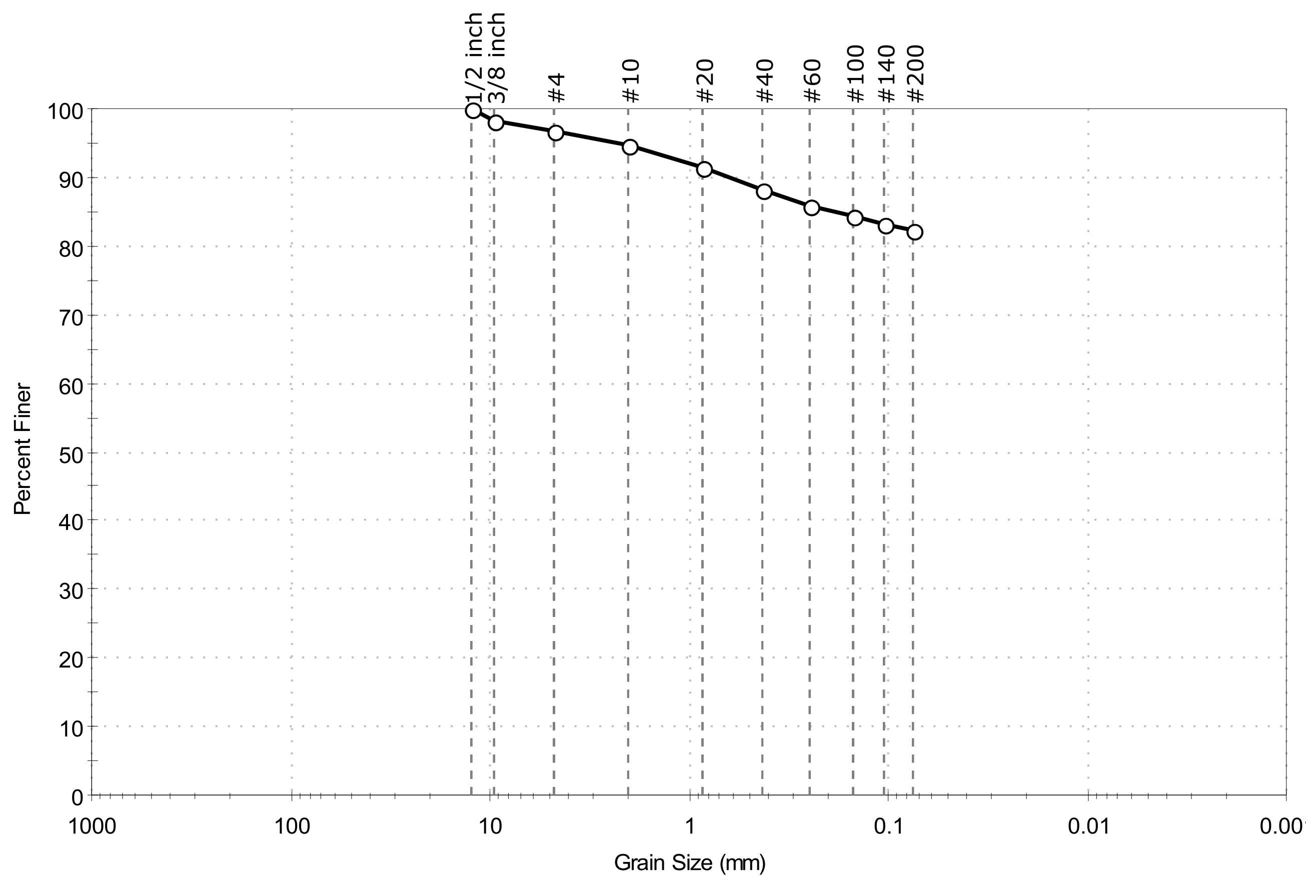
GeoTesting EXPRESS

Client:	Haley & Aldrich, Inc.				
Project:	Replace I-95 Bridges over Webb Rd				
Location:	Waterville, ME			Project No:	GTX-314703
Boring ID:	BB-WWR-207	Sample Type:	tube	Tested By:	ckg
Sample ID:	2D	Test Date:	12/06/21	Checked By:	jsc
Depth :	2-4	Test Id:	644207		
Test Comment:	---				
Visual Description:	Moist, olive gray clay with sand				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	3.2	14.6	82.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
1/2 inch	12.50	100		
3/8 inch	9.50	98		
#4	4.75	97		
#10	2.00	95		
#20	0.85	91		
#40	0.42	88		
#60	0.25	86		
#100	0.15	84		
#140	0.11	83		
#200	0.075	82		

Coefficients

D_{85} =0.1854 mm D_{30} =N/A

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

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

C_u =N/A C_c =N/A

Classification

ASTM   N/A

AASHTO   Silty Soils (A-4 (0))

Sample/Test Description

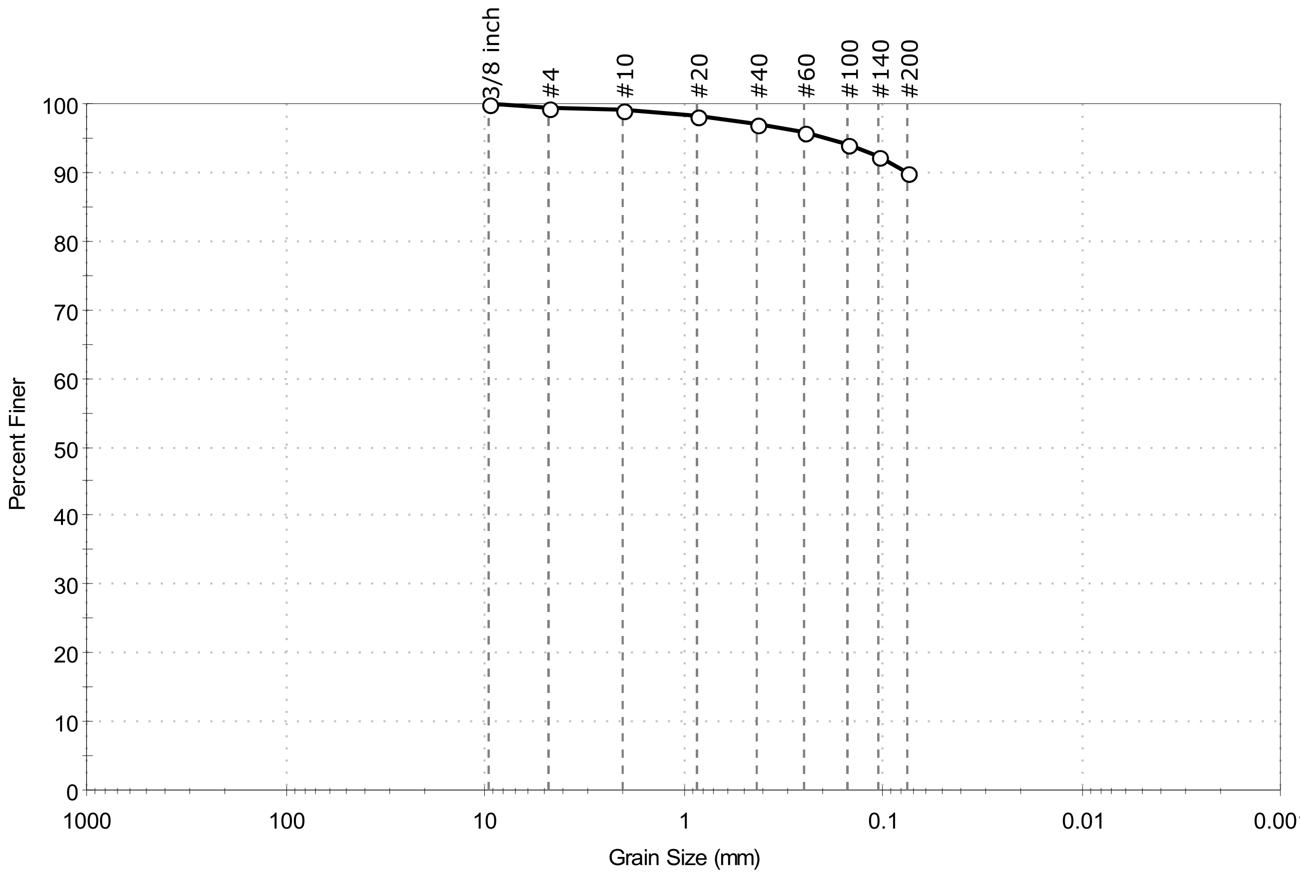
Sand/Gravel Particle Shape : ANGULAR

Sand/Gravel Hardness : HARD

printed 12/8/2021 5:13:23 PM

Client:	Haley & Aldrich, Inc.		
Project:	Replace I-95 Bridges over Webb Rd		
Location:	Waterville, ME	Project No:	GTX-314703
Boring ID: BB-WWR-208	Sample Type: tube	Tested By:	ckg
Sample ID: 2D	Test Date: 12/06/21	Checked By:	jsc
Depth : 2-4	Test Id: 644208		
Test Comment:	---		
Visual Description:	Moist, olive gray clay		
Sample Comment:	---		

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.7	9.2	90.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/8 inch	9.50	100		
#4	4.75	99		
#10	2.00	99		
#20	0.85	98		
#40	0.42	97		
#60	0.25	96		
#100	0.15	94		
#140	0.11	92		
#200	0.075	90		

Coefficients

D_{85} =N/A　　D_{30} =N/A

D_{60} =N/A　　D_{15} =N/A

D_{50} =N/A　　D_{10} =N/A

C_u =N/A　　C_c =N/A

Classification

ASTM　N/A

AASHTO　Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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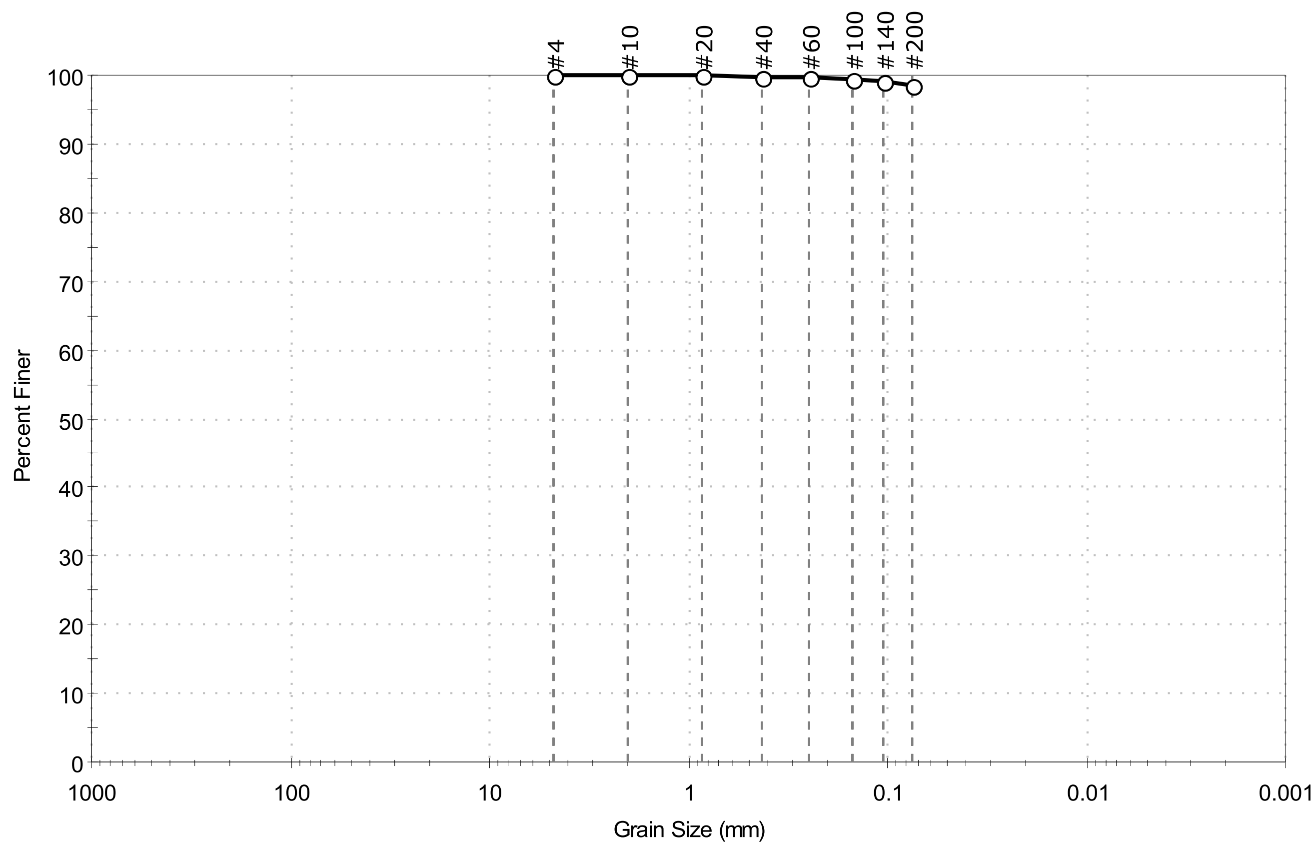
Client:	Haley & Aldrich, Inc.				
Project:	Replace I-95 Bridges over Webb Rd				
Location:	Waterville, ME			Project No:	GTX-314703
Boring ID:	BB-WWR-209	Sample Type:	tube	Tested By:	ckg
Sample ID:	2D	Test Date:	12/06/21	Checked By:	jsc
Depth :	2-4	Test Id:	644209		
Test Comment:	---				
Visual Description:	Moist, olive gray clay				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	1.4	98.6

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	100		
#60	0.25	100		
#100	0.15	99		
#140	0.11	99		
#200	0.075	99		

Coefficients

D_{85} =N/A
D_{30} =N/A
D_{60} =N/A
D_{15} =N/A
D_{50} =N/A
D_{10} =N/A
C_u =N/A
C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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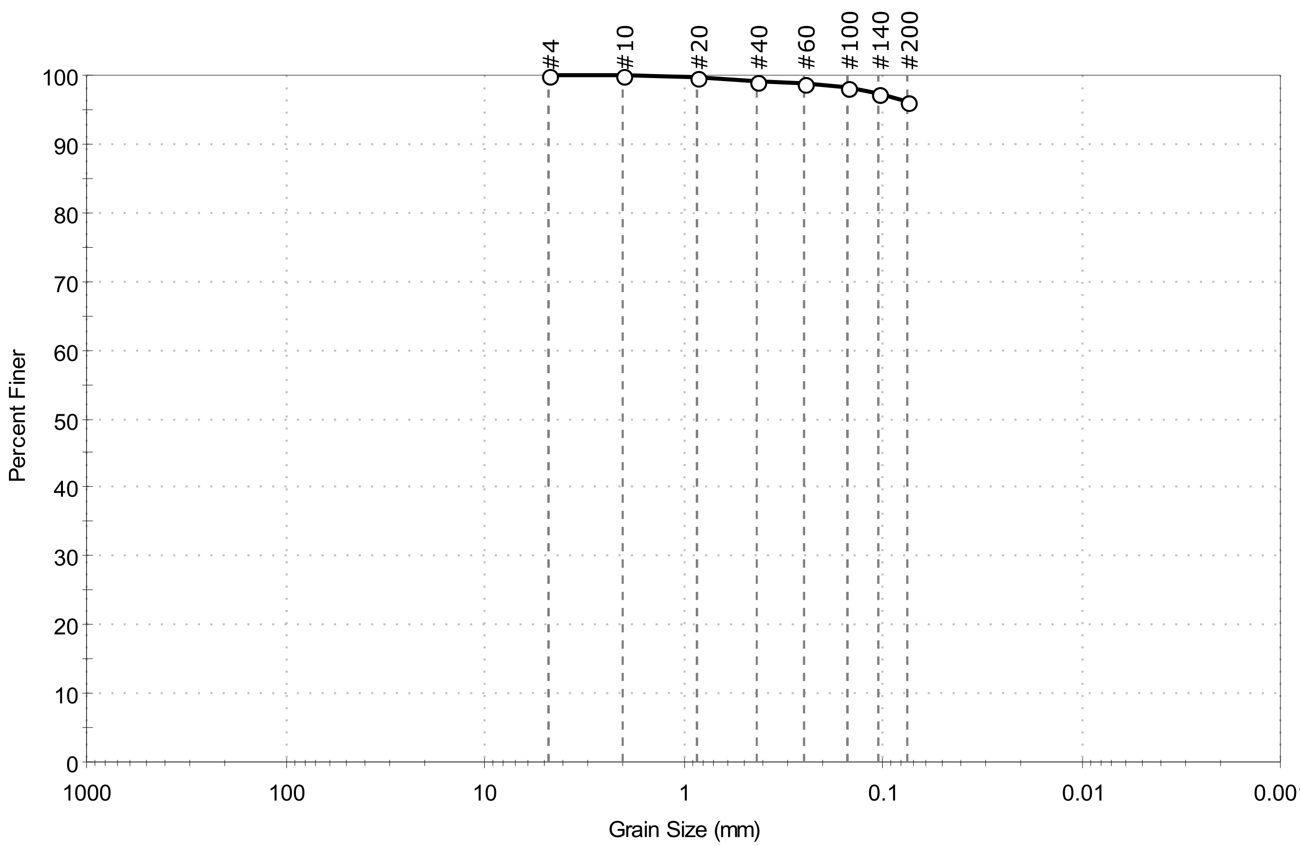
Client:	Haley & Aldrich, Inc.			
Project:	Replace I-95 Bridges over Webb Rd			
Location:	Waterville, ME		Project No:	GTX-314703
Boring ID:	BB-WWR-210	Sample Type: tube	Tested By:	ckg
Sample ID:	2D	Test Date: 12/06/21	Checked By:	jsc
Depth :	2-4	Test Id: 644210		
Test Comment:	---			
Visual Description:	Moist, olive gray clay			
Sample Comment:	contains glass			

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	3.8	96.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	99		
#100	0.15	98		
#140	0.11	97		
#200	0.075	96		

Coefficients

D_{85} =N/A D_{30} =N/A

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

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

C_u =N/A C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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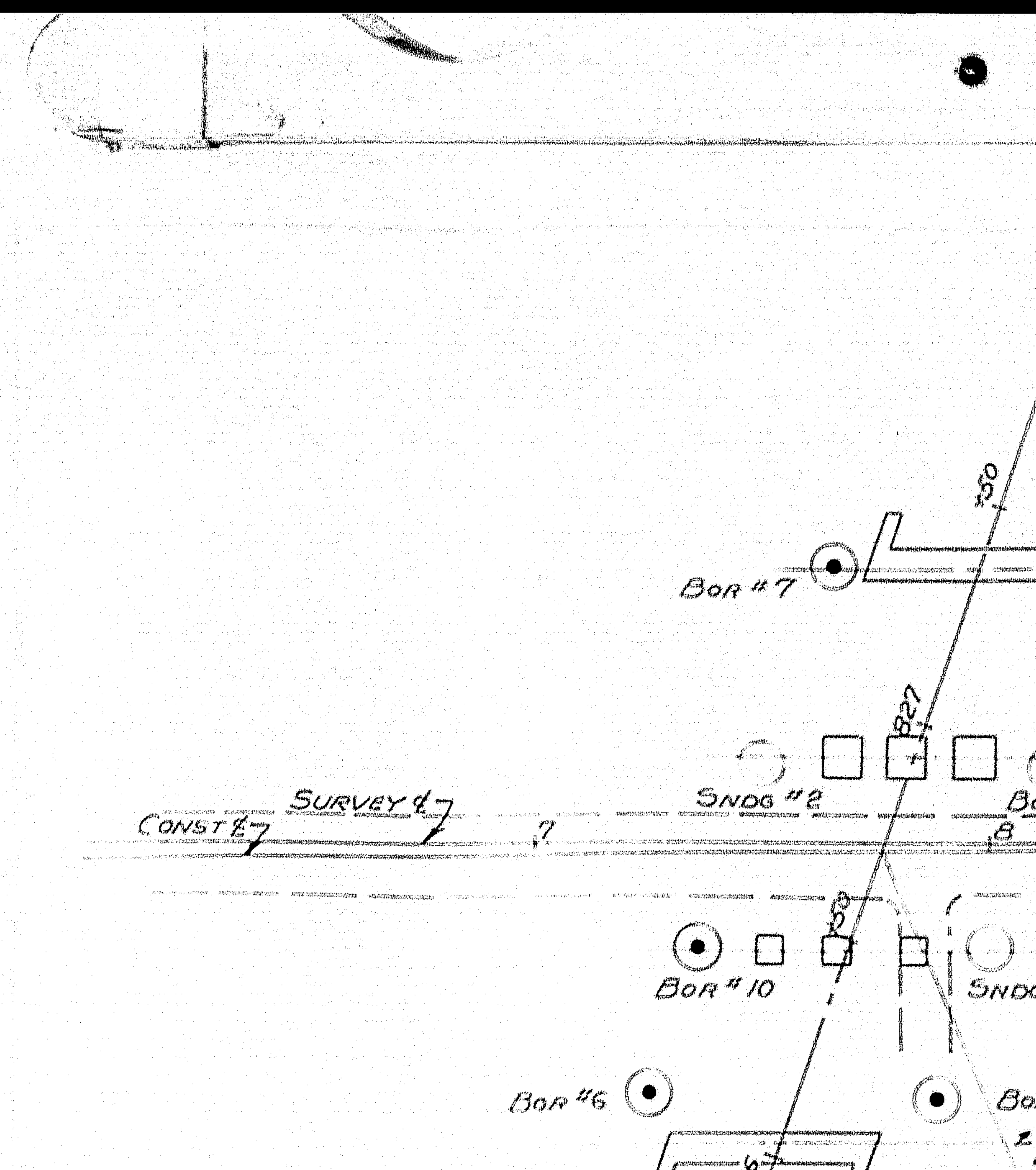
APPENDIX D

Historic Bridge Drawings

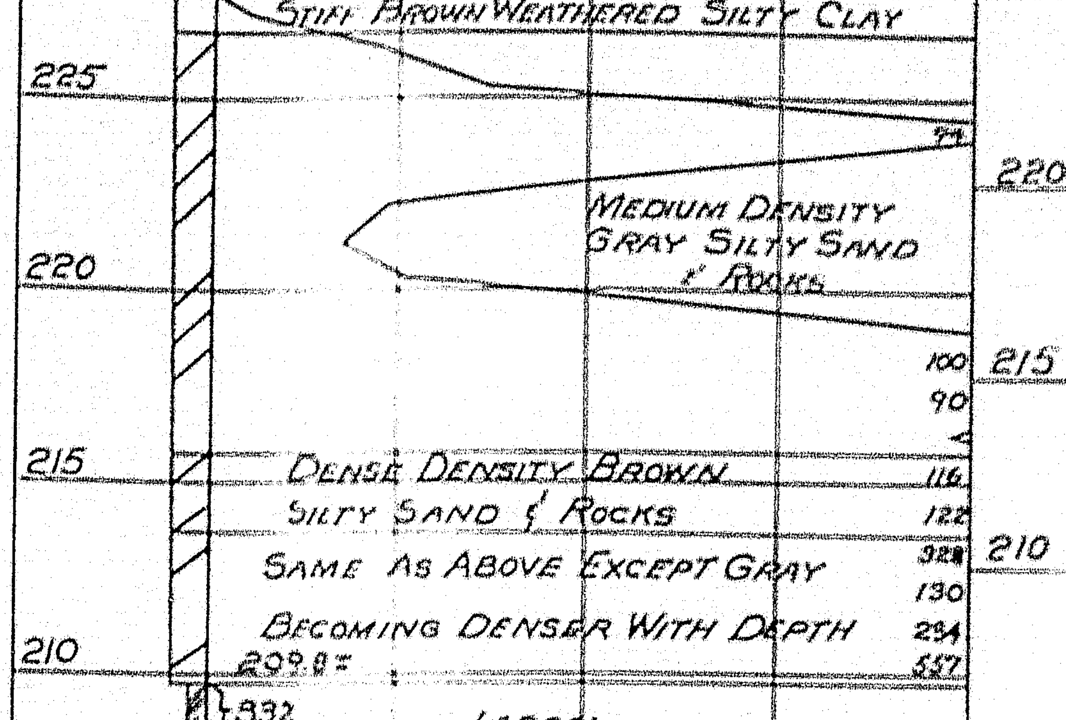
SOUTHBOUND

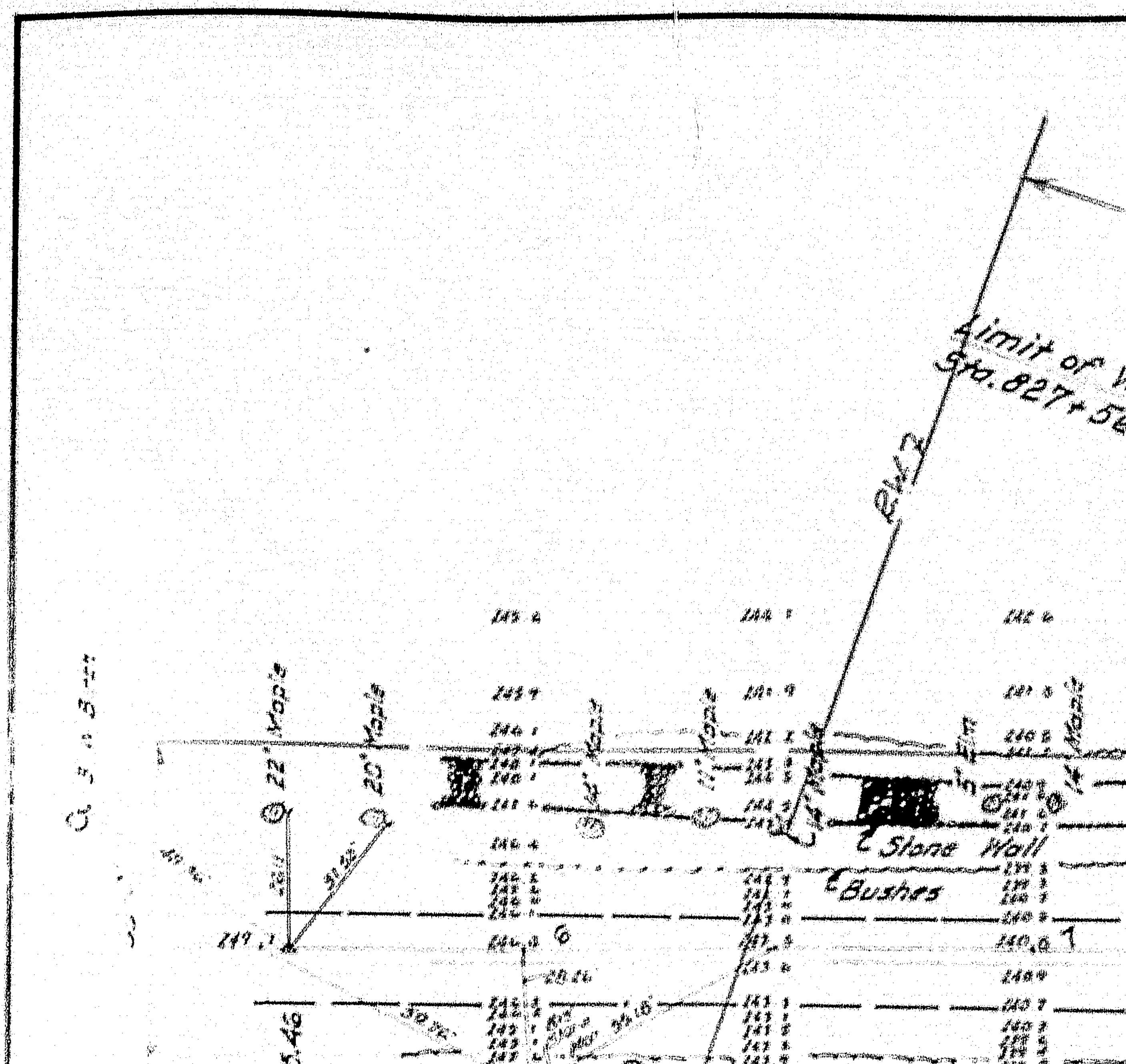


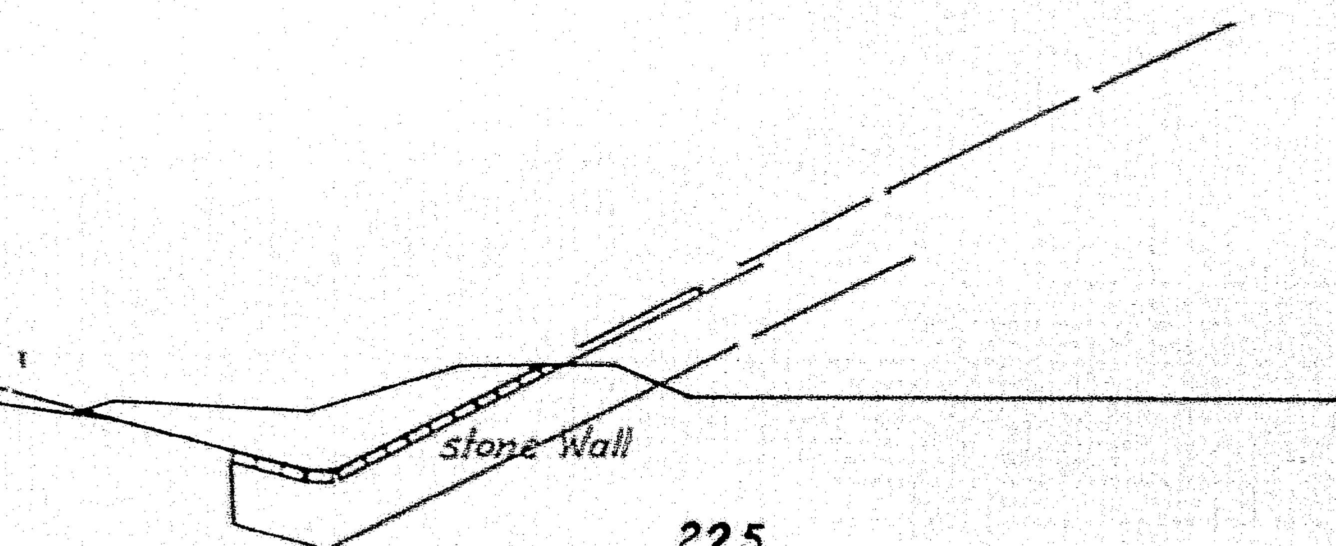
BOR #7
SNDG #2
SURVEY ℄
CONST ℄
BOR #10
BOR #6

DRIVING RESISTANCE
(BLOWS/FT)

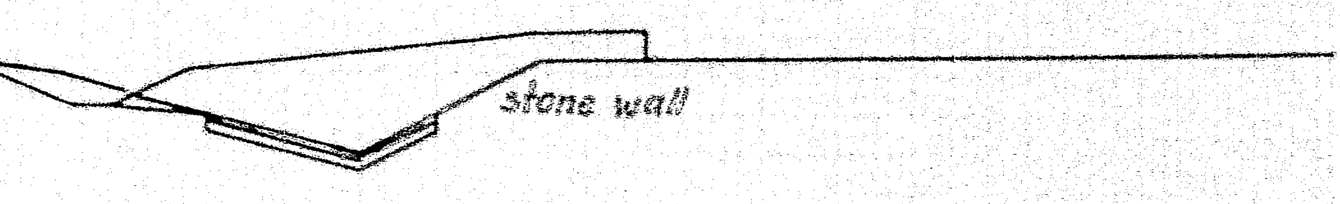
BORING NO 1   2½" CASING
STA 828 +07   30' LT ℄ N.B.L

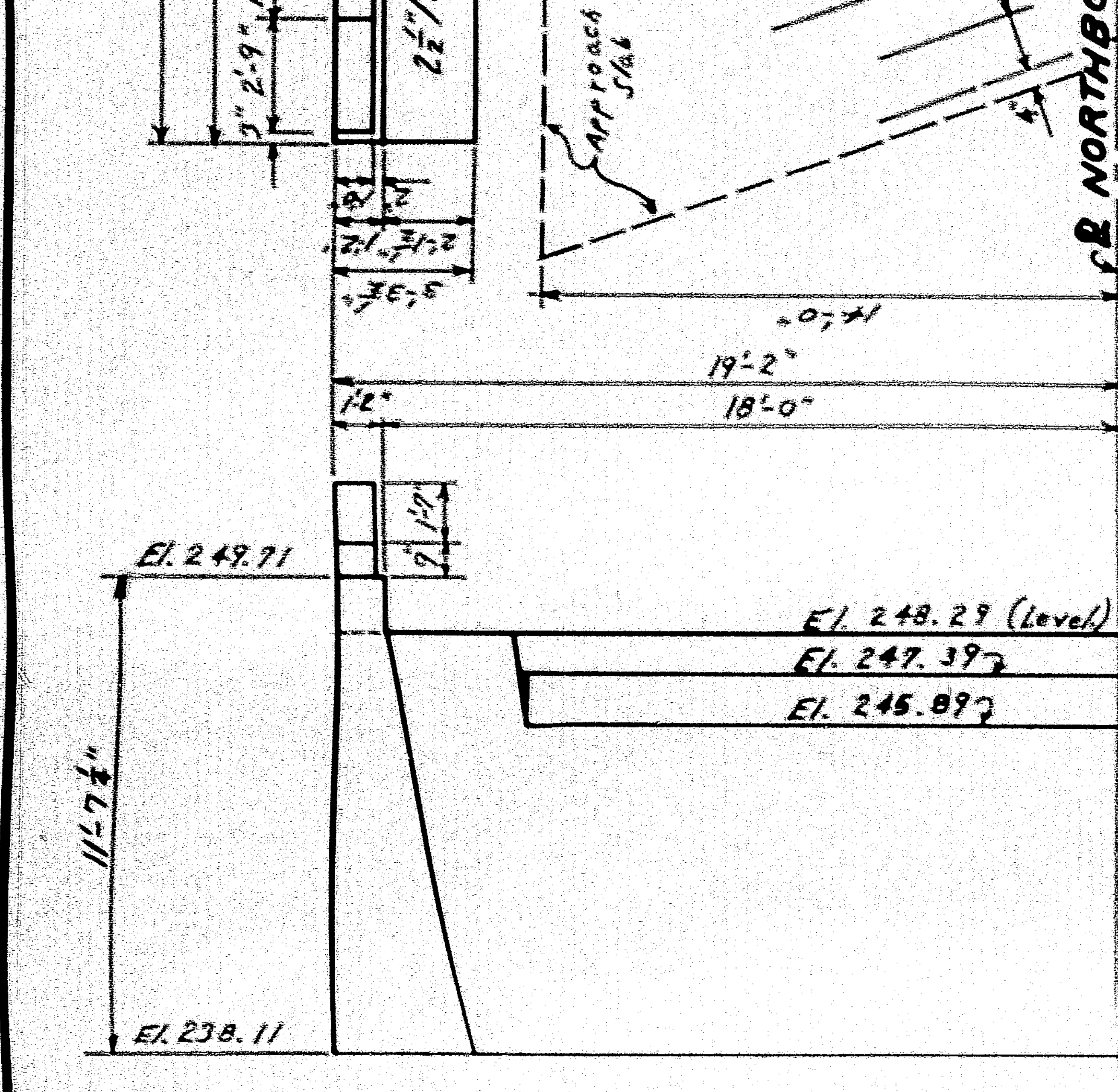



Limit of
Sta. 827+5
BW 2
22" Maple
20" Maple
11" Maple
14" Maple
5" Elm
14" Maple
Stone Wall
Bushes
5.46

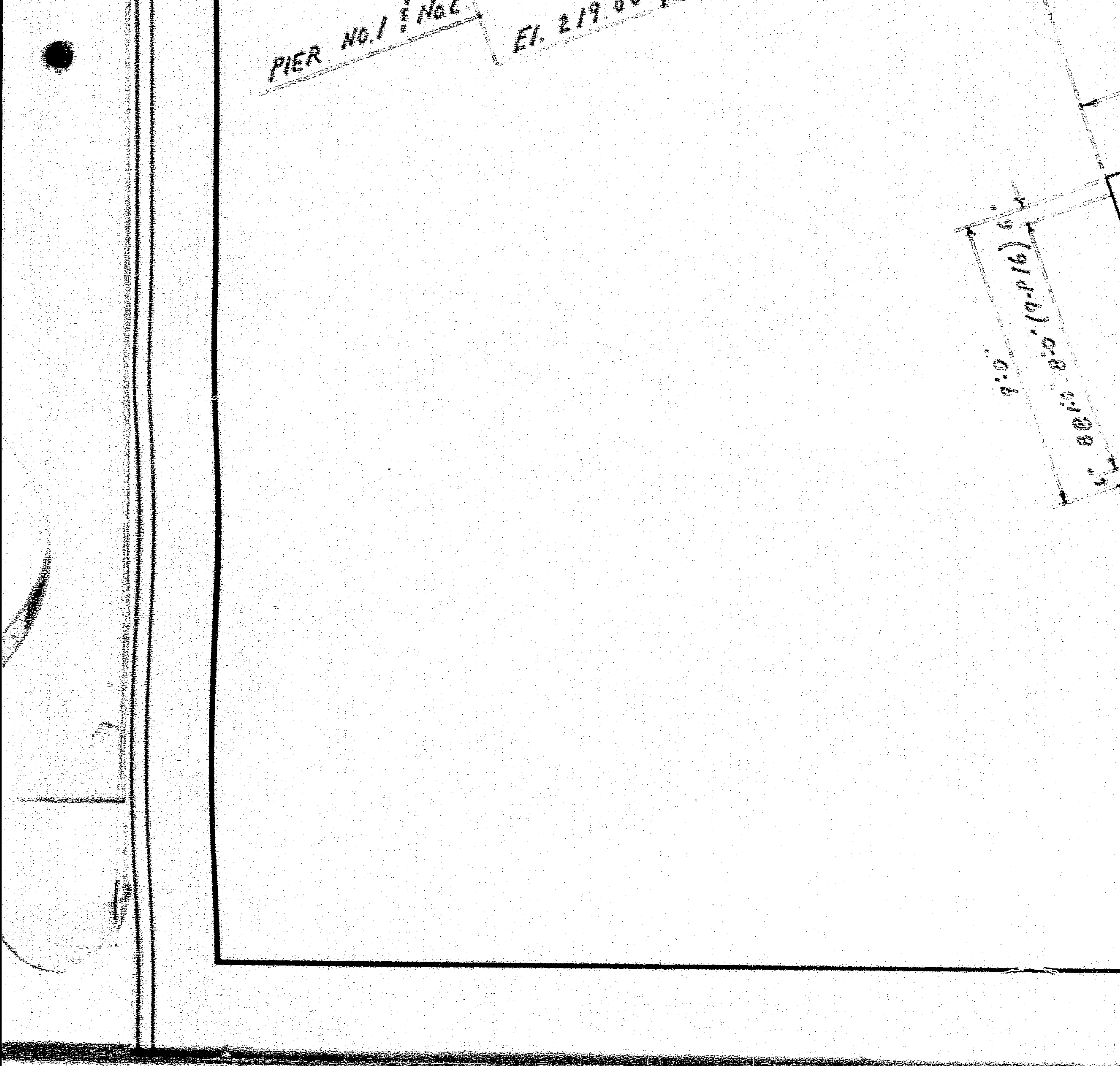


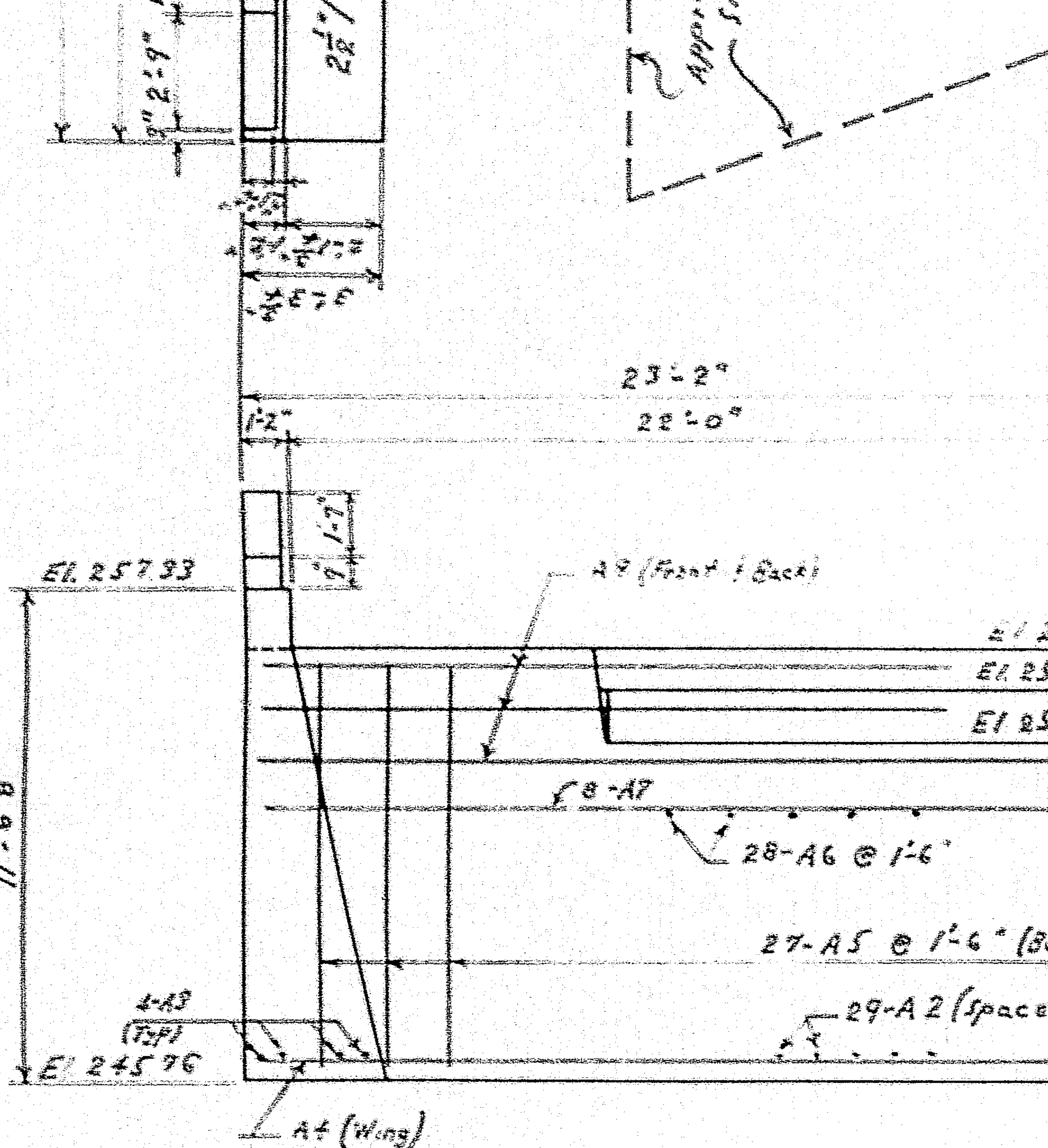
225




Approach Slab
14'-0"
19'-2"
1'-2"
18'-0"
El. 249.71
El. 248.29 (Level)
El. 247.39
El. 245.89
11'-7 1/4"
El. 238.11

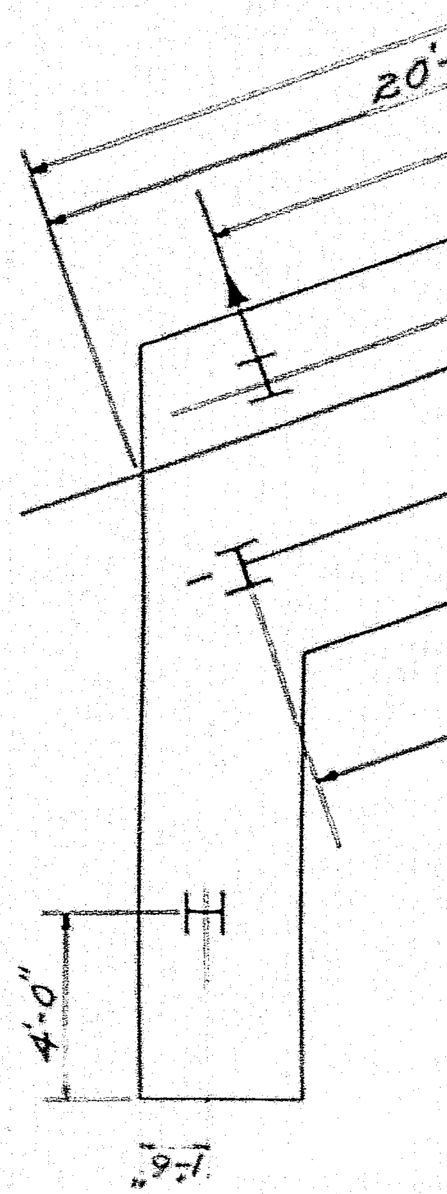
REAR EL

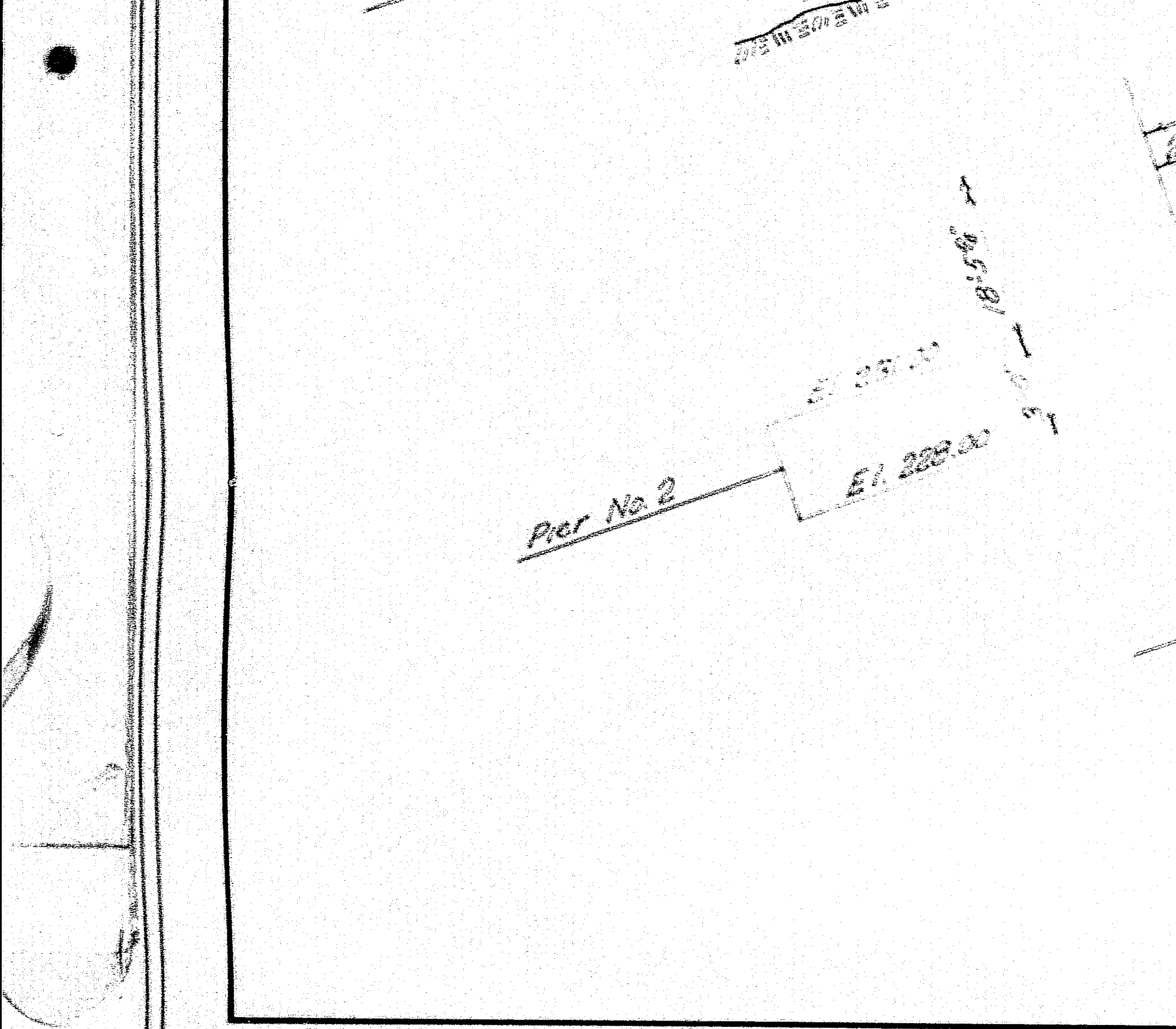

PIER NO.1



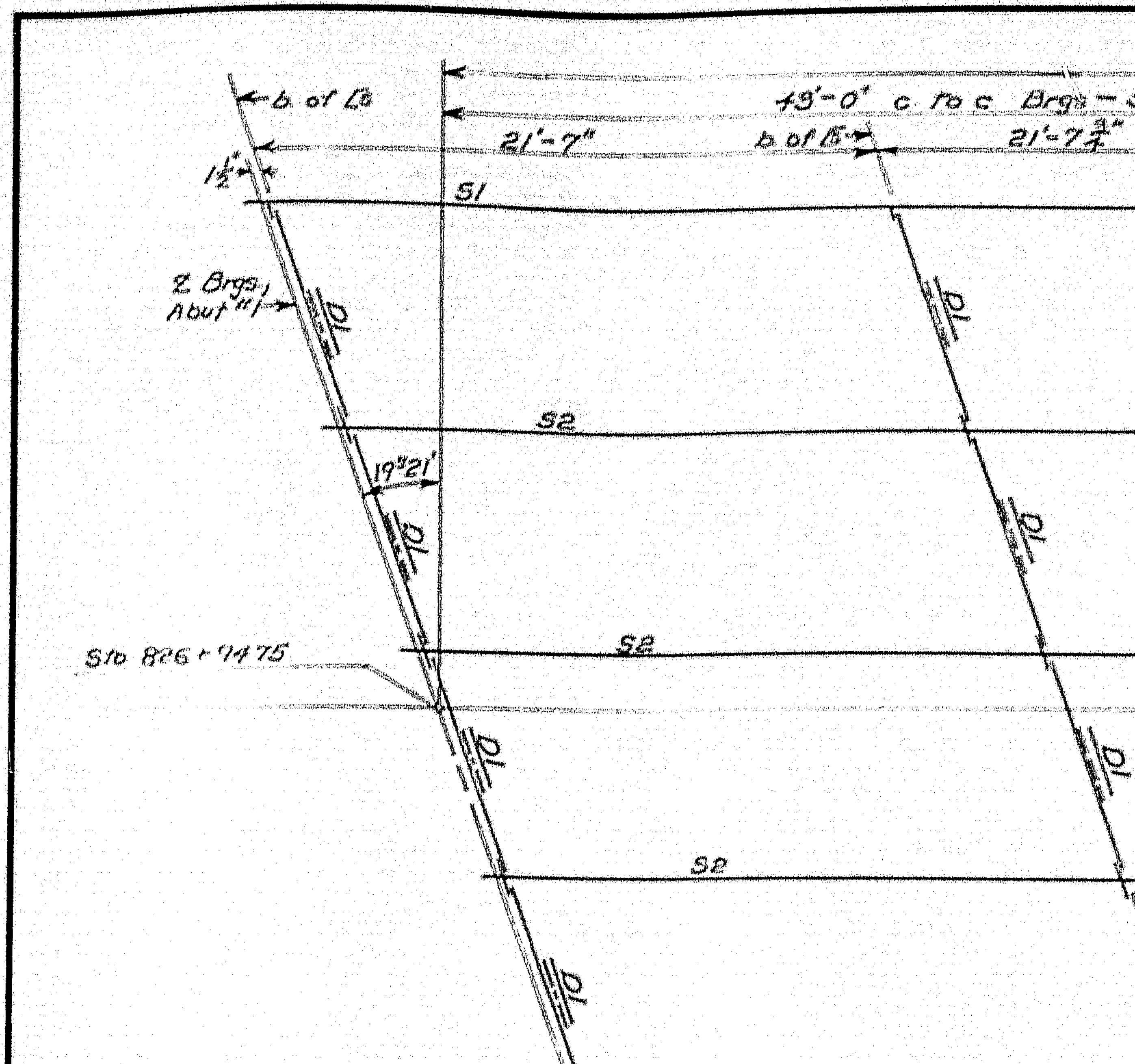
23'-2"
22'-0"
1'-2"
El. 257.93
A9 (Front & Back)
8-A7
28-A6 @ 1'-6"
27-A5 @ 1'-6" (B
29-A2 (Space
4-A3 (Typ)
El. 245.76
A4 (Wing)

REAR E

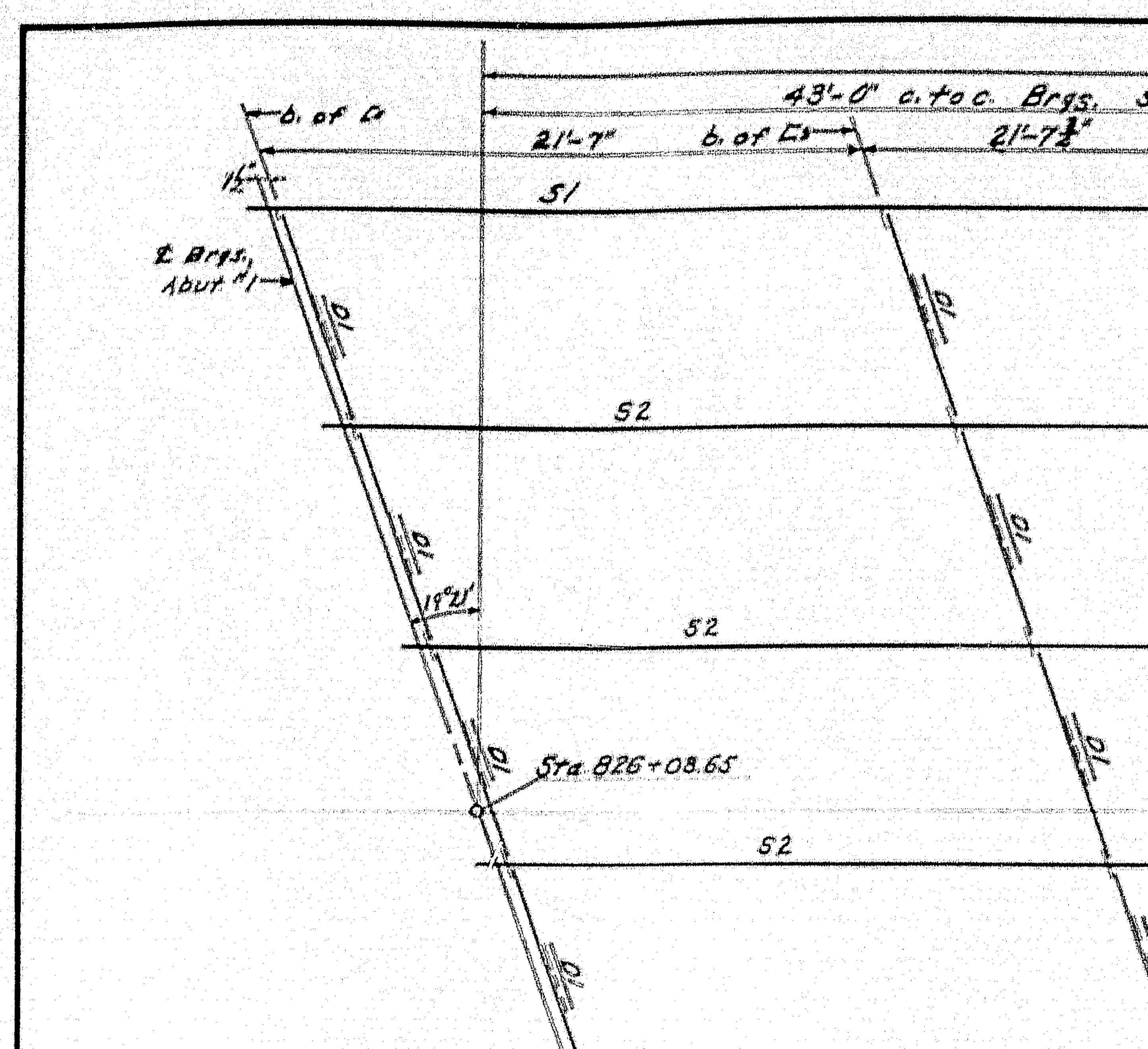

20'-
4'-0"
1'-6"



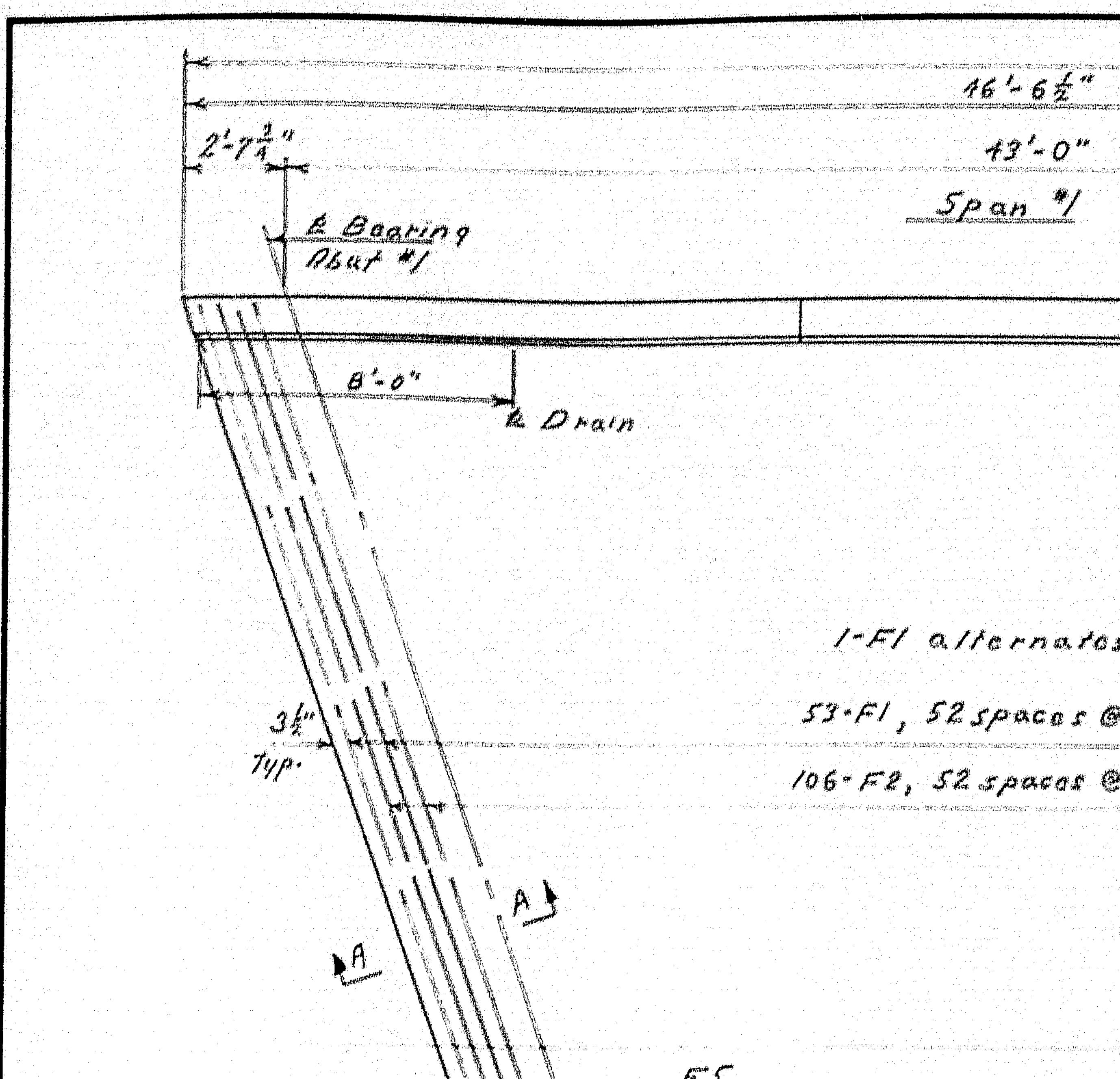
Pier No. 2
El. 228.00



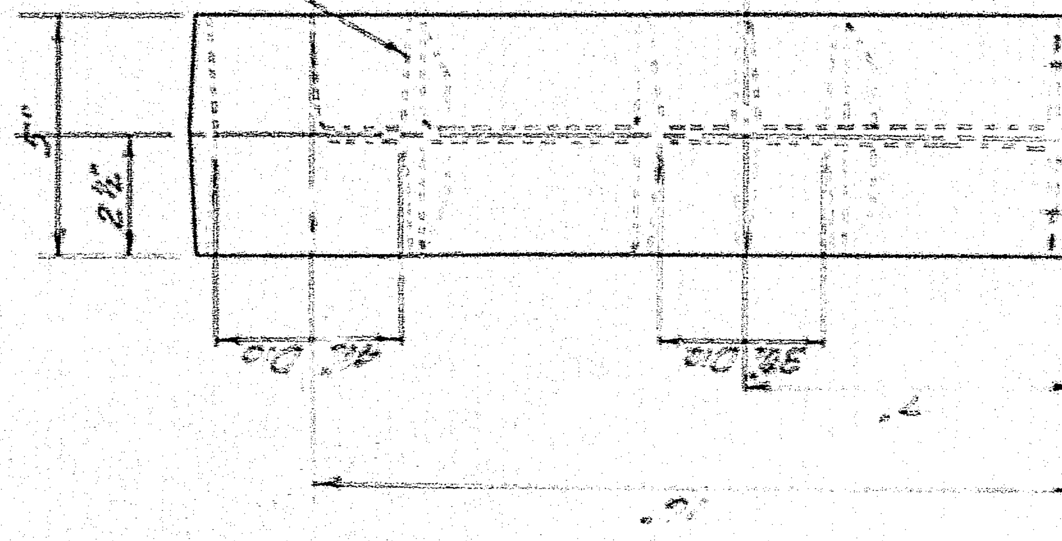
← ℄ of ℄
+9'-0" c. to c. Brgs. –
21'-7"
℄ of ℄
21'-7¾"
1½"
S1
℄ Brgs. Abut. #1
D1
S2
19°21'
Sta 826 + 94.75

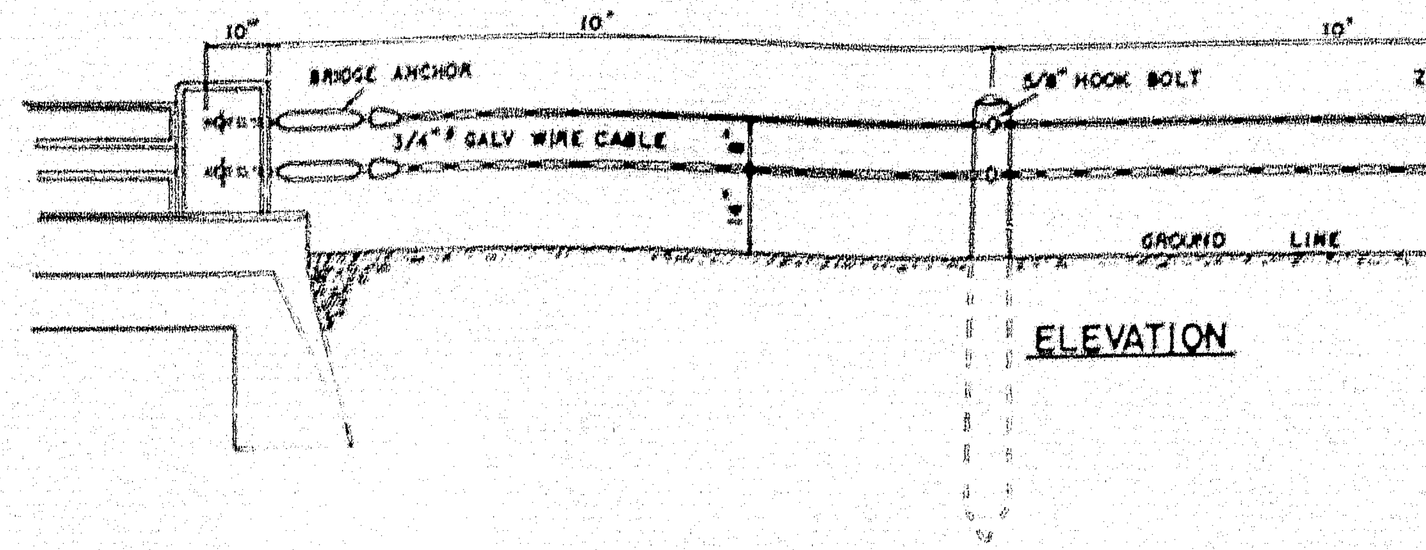


43'-0" c. to c. Brgs.
21'-7"
21'-7½"
b. of C
b. of Cs
1½"
S1
S2
S2
S2
D1
D1
D1
D1
D1
D1
D1
D1
℄ Brgs. Abut #1
19°21'
Sta. 826+08.65



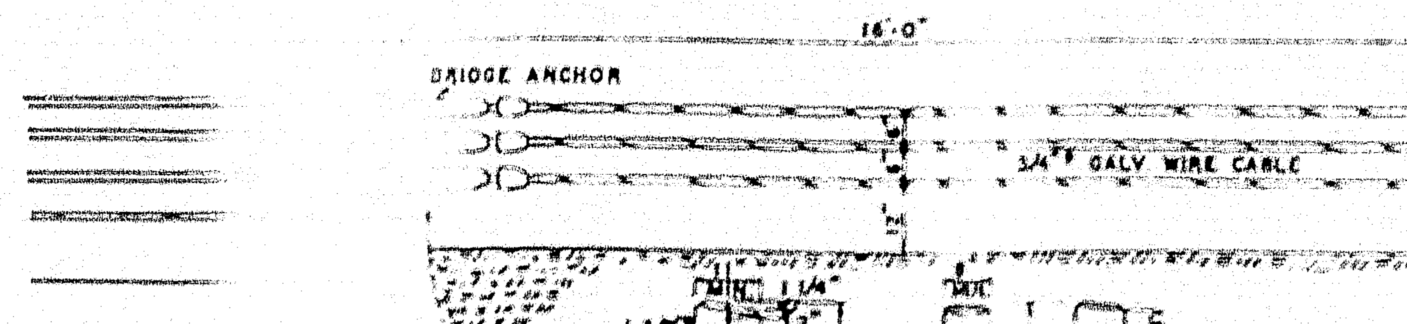
46'-6½"
43'-0"
Span #1
2'-7¾"
℄ Bearing Abut #1
8'-0"
℄ Drain
1-F1 alternate
53-F1, 52 spaces @
106-F2, 52 spaces @
3½" Typ.
A
A


5"
2½"

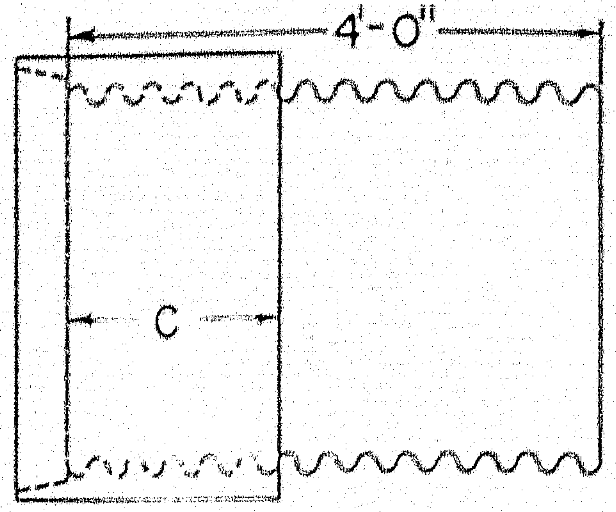


ELEVATION

GUARD RAIL



PIPE CONNECTIONS

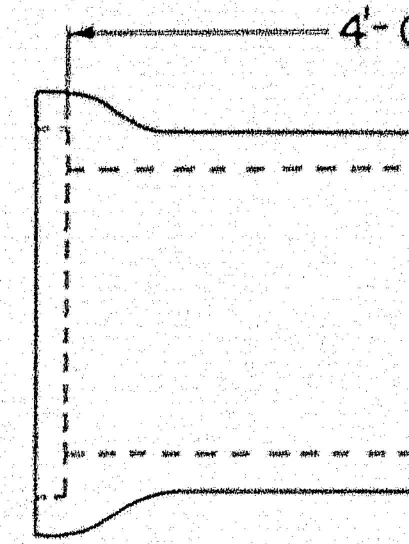


GROOVE END COMBINATION

For 30" to 72", inclusive, diameter connection between concrete and metal pipe

"C" = 17" min. for sizes 30" to 48" incl.
"C" = 23" min. for sizes over 48"

Asphalt coated corrugated metal pipe shall conform to the latest standard specifications



REINFORCED CONC
DOUBL

For 12" to 24", inclusiv
between concret

Reinforced co
conform to the
specifications

APPENDIX E

Geotechnical Design Calculations

Seismic Site Class

PROBLEM STATEMENT & OBJECTIVE

Determine the Seismic Site Class using available subsurface SPT N information.

EXECUTIVE SUMMARY

Based on the subsurface conditions encountered at the eight test borings near the proposed substructures (BB-WWR-101 through BB-WWR-104 and BB-WWR-201 through BB-WWR-204), recommend a Seismic Site Class D.

REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 9th edition, 2020
2. USGS Seismic Design Webpage, http://earthquake.usgs.gov

AVAILABLE INFORMATION

1. Boring logs dated 6-11-2018 to 6-13-2018 and 10-7-2021 to 10-12-2021 by New England Boring Contractors.
2. Other: Phase II Master Planning GDR and Geotech Report by others.
3. Elevations are measured in feet and reference the North American Vertical Datum of 1988 (NAVD 88).

ASSUMPTIONS

1. Where SPT N, Vs or su data was available to depths less than 100 ft, the subsurface profile was extended to 100 ft. The SPT N, Vs or su for the extended profile was then assumed based on the available information.

PROCEDURE

1. Check the site against the three categories of Site Class F (see attached Table 3.10.3.1-1), requiring site-specific ground motion response evaluation. If the site corresponds to any of these categories, classify the site as Site Class F and conduct a site-specific ground motion response evaluation.
2. Categorize the site using one of the following three methods (Method A, B, or C).

Method A
Average shear wave velocity for the upper 100 ft of the soil profile:

$$\bar{V}_s = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{V_{si}}}$$

where

V_{si} = shear wave velocity of *i* th soil (ft/s).
d_i = thickness of *i* th soil layer (ft).
n = total number of distinctive soil layers in the upper 100 ft of the site profile.
i = any one of the layers between 1 and n.

PROCEDURE

Method B
Average standard penetration test (SPT) for the upper 100 ft of the soil profile:

$$\bar{N} = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{N_i}}$$

where

N_i = standard penetration resistance as measured directly in the field, uncorrected blow count, of *i* th soil layer not to exceed 100 ft (blows/ft).
d_i = thickness of *i* th soil layer (ft).
n = total number of distinctive soil layers in the upper 100 ft of the site profile.
i = any one of the layers between 1 and n.

Method C
Average standard penetration test (SPT) for the cohesionless layers in the upper 100 ft of the soil profile:

$$\bar{N}_{ch} = \frac{\sum_{i=1}^{m} d_i}{\sum_{i=1}^{m} \frac{d_i}{N_i}}$$

where

N_i = standard penetration resistance as measured directly in the field, uncorrected blow count, of *i* th cohesionless soil layer (blows/ft).
d_i = thickness of *i* th cohesionless soil layer (ft).
m = total number of distinctive cohesionless soil layers in the upper 100 ft of the site profile.
i = any one of the layers between 1 and m.

Average undrained shear strength for the cohesive layers in the upper 100 ft of the soil profile:

$$\bar{s}_u = \frac{\sum_{i=1}^{k} d_i}{\sum_{i=1}^{k} \frac{d_i}{s_{ui}}}$$

where

s_{ui} = undrained shear strength of *i* th cohesive soil layer (psf), not to exceed 5000 psf
d_i = thickness of *i* th cohesive soil layer (ft).
k = total number of distinctive cohesive soil layers in the upper 100 ft of the site profile.
i = any one of the layers between 1 and k.

Based on the available information, Method B will be used for the seismic Site Class evaluation.

SITE CLASS DEFINITIONS

(Table from AASHTO LRFD Bridge Design Specifications, 9th edition, 2020)

Table 3.10.3.1-1—Site Class Definitions

Site Class	Soil Type and Profile
A	Hard rock with measured shear wave velocity, $\overline{v}_s > 5{,}000$ ft/s
B	Rock with 2,500 ft/sec < $\overline{v}_s$ < 5,000 ft/s
C	Very dense soil and soil rock with 1,200 ft/sec < $\overline{v}_s$ < 2,500 ft/s, or with either $\overline{N}$ > 50 blows/ft, or $\overline{s}_u$ > 2.0 ksf
D	Stiff soil with 600 ft/s < $\overline{v}_s$ < 1,200 ft/s, or with either 15 < $\overline{N}$ < 50 blows/ft, or 1.0 < $\overline{s}_u$ < 2.0 ksf
E	Soil profile with $\overline{v}_s$ < 600 ft/s or with either $\overline{N}$ < 15 blows/ft or $\overline{s}_u$ < 1.0 ksf, or any profile with more than 10.0 ft of soft clay defined as soil with PI > 20, w > 40 percent and $\overline{s}_u$ < 0.5 ksf
F	Soils requiring site-specific evaluations, such as: • Peats or highly organic clays (H > 10.0 ft of peat or highly organic clay where H = thickness of soil) • Very high plasticity clays (H > 25.0 ft with PI > 75) • Very thick soft/medium stiff clays (H >120 ft)

Exceptions: Where the soil properties are not known in sufficient detail to determine the site class, a site investigation shall be undertaken sufficient to determine the site class. Site classes E or F should not be assumed unless the authority having jurisdiction determines that site classes E or F could be present at the site or in the event that site classes E or F are established by geotechnical data.

where:

$\overline{v}_s$ = average shear wave velocity for the upper 100 ft of the soil profile
$\overline{N}$ = average Standard Penetration Test (SPT) blow count (blows/ft) (ASTM D1586) for the upper 100 ft of the soil profile
$\overline{s}_u$ = average undrained shear strength in ksf (ASTM D2166 or ASTM D2850) for the upper 100 ft of the soil profile
PI = plasticity index (ASTM D4318)
w = moisture content (ASTM D2216)

	CALCULATIONS	File No.	132212-002
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Project	I-95 Bridges Over Webb Road - WIN 21900.01 & WIN 21894.01	Computed by	JAD/TPJ
Subject	Seismic Site Class Evaluation	Checked by	MMB

CALCULATIONS - METHOD B

Exploration ID: BB-WWR-101
Ground Surface El.: 227.6

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N
1D	1	226.6	Fill	2.0	1	2.000
2D	3	224.6	Marine Deposits	2.0	12	0.167
3D	5	222.6	Marine Deposits/ Glacial Till	7.5	25	0.300
	11.5	216.1	Top of Rock	88.5	100	0.885
			Totals =	100.0		3.352
					N-bar (blows/ft) =	29.8
					Site Class =	D

CALCULATIONS - METHOD B

Exploration ID: BB-WWR-102 (OW)
Ground Surface El.: 234.1

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N
1D	1	233.1	Fill	2.0	11	0.182
2D	3	231.1	Marine Deposits	2.0	14	0.143
3D	5	229.1	Marine Deposits	1.5	38	0.039
4D	11	223.1	Glacial Till	9.5	28	0.339
5D	16	218.1	Glacial Till	5.0	83	0.060
6D	20.6	213.5	Glacial Till	5.0	82	0.061
7D	25.4	208.7	Glacial Till	0.8	100	0.008
8D	30.05	204.1	Weathered Rock	5.2	100	0.052
	31	203.1	Top of Rock	69.0	100	0.690
			Totals =	100.0		1.575
					N-bar (blows/ft) =	63.5
					Site Class =	C

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Subject	Seismic Site Class Evaluation	Checked by	MMB

CALCULATIONS - METHOD B

Exploration ID: BB-WWR-201
Ground Surface El.: 229.6

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N
1D	1	228.6	Topsoil	2.0	1	2.000
2D	3	226.6	Marine Deposits	2.0	17	0.118
3D	5	224.6	Glacial Till	6.0	23	0.261
4D	11	218.6	Glacial Till	5.0	15	0.333
5D	15.8	213.8	Glacial Till	1.6	64	0.025
	16.6	213	Top of Rock	83.4	100	0.834
			Totals =	100.0		3.571
					N-bar (blows/ft) =	28.0
					Site Class =	D

CALCULATIONS		File No.	132212-002
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Subject	Seismic Site Class Evaluation	Checked by	MMB

CALCULATIONS - METHOD B

Exploration ID: BB-WWR-202
Ground Surface El.: 226.0

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N
1D	1	225	Topsoil	0.4	2	0.200
2D	3	223	Marine Deposits	4.0	14	0.286
3D	5	221	Glacial Till	1.8	16	0.113
4D	11	215	Glacial Till	8.9	37	0.241
5D	15	211	Weathered Rock	0.2	50	0.004
	15.3	210.7	Top of Rock	84.7	100	0.847
			Totals =	100.0		1.690
					N-bar (blows/ft) =	59.2
					Site Class =	C

CALCULATIONS - METHOD B

Exploration ID: BB-WWR-103
Ground Surface El.: 234.2

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N
1D	1	233.2	Fill	1.0	2	0.500
2D	3	231.2	Marine Deposits	2.5	4	0.625
3D	5	229.2	Glacial Till	2.5	39	0.064
4D	7	227.2	Glacial Till	3.0	31	0.097
5D	10	224.2	Glacial Till	2.0	61	0.033
6D	11.7	222.5	Glacial Till/ Weathered Rock	1.3	86	0.015
	14.6	219.6	Top of Rock	87.7	100	0.877
			Totals =	100.0		2.211
					N-bar (blows/ft) =	45.2
					Site Class =	D

CALCULATIONS - METHOD B

Exploration ID: BB-WWR-104 (OW)
Ground Surface El.: 241.4

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N
1D	1	240.4	Fill	2.0	6	0.333
2D	3	238.4	Glacial Till	2.0	22	0.091
3D	5	236.4	Glacial Till	2.0	17	0.118
4D	7	234.4	Glacial Till	4.0	12	0.333
5D	11	230.4	Glacial Till	4.5	21	0.214
6D	15.2	226.2	Weathered Rock	2.4	100	0.024
	16.9	224.5	Top of Rock	83.1	100	0.831
			Totals =	100.0		1.945
					N-bar (blows/ft) =	51.4
					Site Class =	C

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Subject	Seismic Site Class Evaluation	Checked by	MMB

CALCULATIONS - METHOD B

Exploration ID: BB-WWR-203
Ground Surface El.: 237.7

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N
1D	1	236.7	Topsoil/ Marine Deposits	2.2	2	1.100
2D	3	234.7	Glacial Till	1.8	18	0.100
3D	5	232.7	Glacial Till	4.0	14	0.286
4D	11	226.7	Glacial Till	4.5	95	0.047
	12.5	225.2	Top of Rock	87.5	100	0.875
			Totals =	100.0		2.408
					N-bar (blows/ft) =	41.5
					Site Class =	D

HALEY ALDRICH	CALCULATIONS	File No.	132212-002
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Subject	Seismic Site Class Evaluation	Checked by	MMB

CALCULATIONS - METHOD B

Exploration ID: BB-WWR-204
Ground Surface El.: 233.3

Sample Number	Depth (ft)	Elevation (ft)	Description	d (ft)	SPT N (blows/ft)	d/N
1D	1	232.3	Topsoil	1.0	3	0.333
2D	3	230.3	Marine Deposits	2.0	24	0.083
3D	5	228.3	Glacial Till	9.0	27	0.333
4D	12.7	220.6	Glacial Till	1.4	50	0.028
RI	13.4	219.9	Top of Rock	86.6	100	0.866
			Totals =	100.0		1.644
					N-bar (blows/ft) =	60.8
					Site Class =	C

RESULTS SUMMARY

Boring Number	Parameter	Average Value	Site Class
BB-WWR-101	SPT-N	29.8	D
BB-WWR-102 (OW)	SPT-N	63.5	C
BB-WWR-201	SPT-N	28	D
BB-WWR-202	SPT-N	59.2	C
BB-WWR-103	SPT-N	45.2	D
BB-WWR-104 (OW)	SPT-N	51.4	C
BB-WWR-203	SPT-N	41.5	D
BB-WWR-204	SPT-N	60.8	C

CONCLUSIONS & RECOMMENDATIONS

1. Site Class D
2. Use USGS seismic data tool to determine seismic design parameters: Lat. 44.5248 deg. Long. -69.696 deg.

PGA=	0.077
FPGA=	1.6
Ss =	0.161
S1 =	0.046
Fa =	1.6
Fv =	2.4
Sds =	0.257
Sd1 =	0.111
As =	0.123

Footing Bearing Resistance

PROBLEM STATEMENT & OBJECTIVE

Calculate the Strength, Service and Extreme Event Limit bearing resistance of the proposed northbound and southbound, abutments 1 & 2, bridge crossing for Interstate 95 over Webb Road in Waterville, Maine

REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020.

AVAILABLE INFORMATION

1. Boring logs dated 6-11-2018 to 6-13-2018 and 10-6-2021 to 10-14-2021 by New England Boring Contractors, Inc., (monitored by Haley & Aldrich, Inc.).
2. Draft plan set prepared by McFarland Johnson dated 12/13/21.

ASSUMPTIONS

1. The vertical load eccentricity only applies in one direction (i.e., overturning moment only in one direction).
2. The maximum eccentricity assumed is B/3 based on AASHTO Section 10.6.3.3.
3. Fully saturated soils beneath footing and fully saturated soils above the footing to evaluate the highest groundwater table expected within the service life of the structure.
4. Subsurface conditions based on borings BB-WWR-101 through BB-WWR-104 and BB-WWR-201 through BB-WWR-204 (test boring logs in Appendix A).
5. Bottom of footings are 7 ft below ground surface.
6. Footing size considered: variable width x 54 ft long.
7. Footing will bear on undisturbed Glacial Till.
8. Soil properties for Glacial Till will be 130 pcf (unit weight) and 38 degrees (phi angle).
9. Soil properties for granular backfill will be 125 pcf (unit weight) and 32 degrees (phi angle).

BACKGROUND INFORMATION FROM AASHTO LRFD

$$q_n = cN_{cm} + \gamma_q D_f N_{qm} C_{wq} + 0.5\gamma_f B N_{\gamma m} C_{w\gamma} \quad (10.6.3.1.2a\text{-}1)$$

in which:

$$N_{cm} = N_c s_c i_c \quad (10.6.3.1.2a\text{-}2)$$

$$N_{qm} = N_q s_q d_q i_q \quad (10.6.3.1.2a\text{-}3)$$

$$N_\gamma m = N_\gamma s_\gamma i_\gamma \quad (10.6.3.1.2a\text{-}4)$$

where:

c = cohesion, taken as undrained shear strength (ksf)
N_c = cohesion term (undrained loading) bearing capacity factor as specified in Table 10.6.3.1.2a-1 (dim)
N_q = surcharge (embedment) term (drained or undrained loading) bearing capacity factor as specified in Table 10.6.3.1.2a-1 (dim)
N_γ = unit weight (footing width) term (drained loading) bearing capacity factor as specified in Table 10.6.3.1.2a-1 (dim)
γ_q = total (moist) unit weight of soil above the bearing depth of the footing (kcf)
γ_f = total (moist) unit weight of soil below the bearing depth of the footing (kcf)
D_f = footing embedment depth (ft)
B = footing width (ft)
$C_{wq}, C_{w\gamma}$ = correction factors to account for the location of the groundwater table as specified in Table 10.6.3.1.2a-2 (dim)
s_c, s_γ, s_q = footing shape correction factors as specified in Table 10.6.3.1.2a-3 (dim)
d_q = depth correction factor to account for the shearing resistance along the failure surface passing through cohesionless material above the bearing elevation determined from Eq. 10.6.3.1.2a-10 (dim)
i_c, i_γ, i_q = load inclination factors determined from Eqs. 10.6.3.1.2a-5 or 10.6.3.1.2a-6, and 10.6.3.1.2a-7 and 10.6.3.1.2a-8 (dim)

For ϕ_f = 0:

$$i_c = 1 - (nH/cBLN_c) \quad (10.6.3.1.2a\text{-}5)$$

For ϕ_f > 0:

$$i_c = i_q - [(1 - i_q)/(N_q - 1)] \quad (10.6.3.1.2a\text{-}6)$$

in which:

$$i_q = \left[1 - \frac{H}{(V + cBL\cot\phi_f)}\right]^n \quad (10.6.3.1.2a\text{-}7)$$

$$i_\gamma = \left[1 - \frac{H}{V + cBL\cot\phi_f)}\right]^{(n+1)} \quad (10.6.3.1.2a\text{-}8)$$

$$n = [(2 + L/B)/(1 + L/B)]\cos^2\theta + [(2 + B/L)/(1 + B/L)]\sin^2\theta \quad (10.6.3.1.2a\text{-}9)$$

where:

B = footing width (ft)
L = footing length (ft)
H = unfactored horizontal load (kips)
V = unfactored vertical load (kips)
θ = projected direction of load in the plane of the footing, measured from the side of length L (degrees)

10.6.3.1.2b—Considerations for Punching Shear

If local or punching shear failure is possible, the nominal bearing resistance shall be estimated using reduced shear strength parameters c^* and ϕ^* in Eqs. 10.6.3.1.2b-1 and 10.6.3.1.2b-2. The reduced shear parameters may be taken as:

$$c^* = 0.67c \quad (10.6.3.1.2b\text{-}1)$$

$$\phi^* = \tan^{-1}(0.67\tan\phi_f) \quad (10.6.3.1.2b\text{-}2)$$

where:

c^* = reduced effective stress soil cohesion for punching shear (ksf)
ϕ^* = reduced effective stress soil friction angle for punching shear (degrees)

Table 10.6.3.1.2a-1—Bearing Capacity Factors N_c (Prandtl, 1921), N_q (Reissner, 1924), and N_γ (Vesic, 1975)

ϕ_f	N_c	N_q	N_γ	ϕ_f	N_c	N_q	N_γ
0	5.14	1.0	0.0	23	18.1	8.7	8.2
1	5.4	1.1	0.1	24	19.3	9.6	9.4
2	5.6	1.2	0.2	25	20.7	10.7	10.9
3	5.9	1.3	0.2	26	22.3	11.9	12.5
4	6.2	1.4	0.3	27	23.9	13.2	14.5
5	6.5	1.6	0.5	28	25.8	14.7	16.7
6	6.8	1.7	0.6	29	27.9	16.4	19.3
7	7.2	1.9	0.7	30	30.1	18.4	22.4
8	7.5	2.1	0.9	31	32.7	20.6	26.0
9	7.9	2.3	1.0	32	35.5	23.2	30.2
10	8.4	2.5	1.2	33	38.6	26.1	35.2
11	8.8	2.7	1.4	34	42.2	29.4	41.1
12	9.3	3.0	1.7	35	46.1	33.3	48.0
13	9.8	3.3	2.0	36	50.6	37.8	56.3
14	10.4	3.6	2.3	37	55.6	42.9	66.2
15	11.0	3.9	2.7	38	61.4	48.9	78.0
16	11.6	4.3	3.1	39	67.9	56.0	92.3
17	12.3	4.8	3.5	40	75.3	64.2	109.4
18	13.1	5.3	4.1	41	83.9	73.9	130.2
19	13.9	5.8	4.7	42	93.7	85.4	155.6
20	14.8	6.4	5.4	43	105.1	99.0	186.5
21	15.8	7.1	6.2	44	118.4	115.3	224.6
22	16.9	7.8	7.1	45	133.9	134.9	271.8

Table 10.6.3.1.2a-2—Coefficients C_{wq} and $C_{w\gamma}$ for Various Groundwater Depths

D_w	C_{wq}	$C_{w\gamma}$
0.0	0.5	0.5
D_f	1.0	0.5
>1.5B + D_f	1.0	1.0

Table 10.6.3.1.2a-3—Shape Correction Factors s_c, s_γ, s_q

Factor	Friction Angle	Cohesion Term (s_c)	Unit Weight Term (s_γ)	Surcharge Term (s_q)
Shape Factors s_c, s_γ, s_q	$\phi_f = 0$	$1 + \left(\frac{B}{5L}\right)$	1.0	1.0
	$\phi_f > 0$	$1 + \left(\frac{B}{L}\right)\left(\frac{N_q}{N_c}\right)$	$1 - 0.4\left(\frac{B}{L}\right)$	$1 + \left(\frac{B}{L}\tan\phi_f\right)$

$$d_q = 1 + 2\tan\phi_f(1 - \sin\phi_f)^2 \arctan\left(\frac{D_f}{B}\right) \quad (10.6.3.1.2a\text{-}10)$$

Eq. 10.6.3.1.2a-10 has been verified to cover a range of friction angle, ϕ_f, of 32 degrees to 42 degrees, and a range of D_f/B of 1 to 8. Depth correction factor values beyond this range have not been verified at this time.

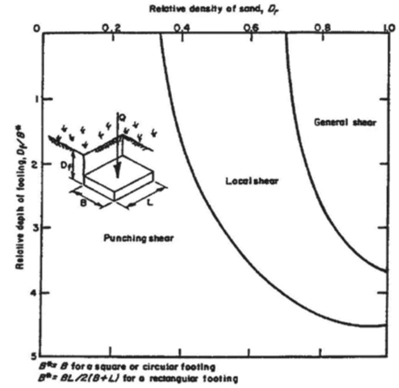

Figure C10.6.3.1.2b-1—Modes of Bearing Capacity Failure for Footings in Sand

HALEY ALDRICH	CALCULATIONS	File No.:	132212-003
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Client:	McFarland Johnson	Date:	22-Feb-2022
Project:	I-95 Bridges Over Webb Road - WIN 21900.01 & WIN 21894.01	Computed by:	JAD
Subject:	Bearing Resistance of Glacial TIll for Abutment Footings	Checked by:	MMB

CALCULATIONS FOR STRENGTH LIMIT STATE

Input Parameters	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
ϕ (deg.) =	38	38	38	38	38	38	38	38
γ_q (pcf) =	125	125	125	125	125	125	125	125
γ_f (pcf) =	130	130	130	130	130	130	130	130
c (psf) =	0	0	0	0	0	0	0	0
D_f (ft) =	7	7	7	7	7	7	7	7
D_w (ft) =	0	0	0	0	0	0	0	0
B (ft) =	14.0	16.0	18.0	20.0	22.0	24.0	26.0	28.6
e_B (ft) =	4.67	5.33	6.00	6.67	7.33	8.00	8.67	9.53
L (ft) =	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0
e_L (ft) =	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RF or 1/FS =	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Depth Corr., (Y/N)?	N	N	N	N	N	N	N	N
Calculations & Output								
B_{eff} = B' (ft) =	4.7	5.3	6.0	6.7	7.3	8.0	8.7	9.5
L_{eff} = L' (ft) =	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0
$N_\phi = f(\phi)$ =	4.2	4.2	4.2	4.2	4.2	4.2	4.2	4.2
$N_c = f_1(\phi)$ =	61.3	61.3	61.3	61.3	61.3	61.3	61.3	61.3
$N_q = f_2(\phi)$ =	48.9	48.9	48.9	48.9	48.9	48.9	48.9	48.9
$N\gamma = f_3(\phi)$ =	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0
s_c =	1.07	1.08	1.09	1.10	1.11	1.12	1.13	1.14
s_q =	1.07	1.08	1.09	1.10	1.11	1.12	1.13	1.14
s_γ =	0.97	0.96	0.96	0.95	0.95	0.94	0.94	0.93
d_q =	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C_{wq} =	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
$C_{w\gamma}$ =	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
N_{cm} =	65.53	66.13	66.73	67.34	67.94	68.54	69.15	69.93
N_{qm} =	52.20	52.67	53.14	53.62	54.09	54.56	55.03	55.64
$N_{\gamma m}$ =	75.30	74.92	74.53	74.15	73.76	73.38	72.99	72.49
q_n or q_{ult} (psf) =	34,259	36,030	37,785	39,523	41,244	42,948	44,636	46,805
q_n or q_{ult} (ksf) =	34.3	36.0	37.8	39.5	41.2	42.9	44.6	46.8
RF×q_n or q_{ult}/FS (ksf) =	15.4	16.2	17.0	17.8	18.6	19.3	20.1	21.1

Notes:

1. Refer to background page for definition of input parameters.
2. Analysis does not consider inclined load and inclined load adjustment factors, nor does it adjust for footings near slopes.
3. RF = resistance factor (e.g., as in AASHTO LRFD); FS is factor of safety if using allowable stress design.
4. e_B and e_L are the vertical load eccentricities in the B and L directions, respectively. Check code guidance for maximum vertical load eccentricities allowed.
5. B_{eff} and L_{eff} are the effective footing dimensions considering vertical load eccentricity and are equal to B-2e_B and L-2e_L, respectively.
6. RF×q_n and q_n/FS are the factored bearing resistance and the allowable bearing capacity, respectively.
7. Footing settlement should be checked separately.

CALCULATIONS		File No.:	132212-003
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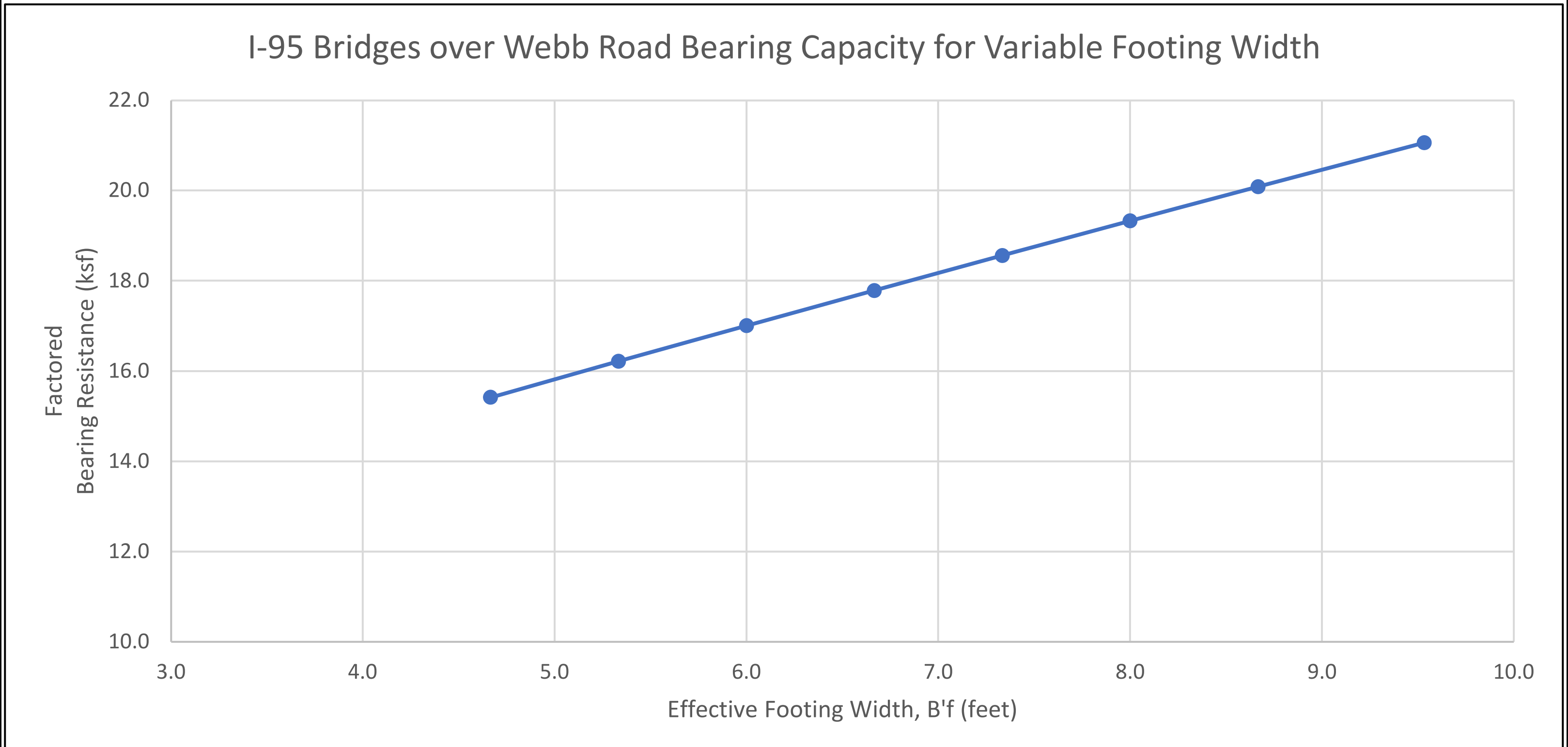
Client:	McFarland Johnson	Date:	22-Feb-2022
Project:	I-95 Bridges Over Webb Road - WIN 21900.01 & WIN 21894.01	Computed by:	JAD
Subject:	Bearing Resistance of Glacial TIll for Abutment Footings	Checked by:	MMB

Figure 1. Variable Footing Width Bearing Capacity



Notes:

1. These values are for the Strength Limit State using a resistance factor or 0.45.

BEARING RESISTANCE AT THE SERVICE LIMIT STATE
Northbound and Southbound Abutments 1 & 2:

AASHTO Section 10.6.2.6 - Bearing Resistance at the Service Limit State

The use of presumptive values shall be based on the knowledge of geological conditions at or near the structure site... These bearing resistances are settlement limited, e.g., 1.0-in., and apply only at the service limit state.'

Table C10.6.2.5.1-1

Type of Bearing Material	Consistency in Place	Bearing Resistance (ksf) Ordinary Range	Bearing Resistance (ksf) Recommended Value of Use
Massive crystalline igneous and metamorphic rock: granite, diorite, basalt, gneiss, thoroughly cemented conglomerate (sound condition allows minor cracks)	Very hard, sound rock	120–200	160
Foliated metamorphic rock: slate, schist (sound condition allows minor cracks)	Hard sound rock	60–80	70
Sedimentary rock: hard cemented shales, siltstone, sandstone, limestone without cavities	Hard sound rock	30–50	40
Weathered or broken bedrock of any kind, except highly argillaceous rock (shale)	Medium hard rock	16–24	20
Compaction shale or other highly argillaceous rock in sound condition	Medium hard rock	16–24	20
Well-graded mixture of fine- and coarse-grained soil: glacial till, hardpan, boulder clay (GW-GC, GC, SC)	Very dense	16–24	20
Gravel, gravel-sand mixture, boulder-gravel mixtures (GW, GP, SW, SP)	Very dense Medium dense to dense Loose	12–20 8–14 4–12	14 10 6
Coarse to medium sand, and with little gravel (SW, SP)	Very dense Medium dense to dense Loose	8–12 4–8 2–6	8 6 3
Fine to medium sand, silty or clayey medium to coarse sand (SW, SM, SC)	Very dense Medium dense to dense Loose	6–10 4–8 2–4	6 5 3
Fine sand, silty or clayey medium to fine sand (SP, SM, SC)	Very dense Medium dense to dense Loose	6–10 4–8 2–4	6 5 3
Homogeneous inorganic clay, sandy or silty clay (CL, CH)	Very dense Medium dense to dense Loose	6–12 2–6 1–2	8 4 1
Inorganic silt, sandy or clayey silt, varved silt-clay-fine sand (ML, MH)	Very stiff to hard Medium stiff to stiff Soft	4–8 2–6 1–2	6 3 1

Presumptive Bearing at Service Limit State: 16 ksf

BEARING RESISTANCE AT THE EXTREME EVENT LIMIT STATE

11.5.8 - Resistance Factors for Extreme Event Limit state

Unless otherwise specified, all resistance factors shall be taken as 1.0 when investigating the extreme event limit state. For overall stability of the retaining wall when earthquake loading is included, a resistance factor, ϕ, of 0.9 shall be used. For bearing resistance, a resistance factor of 0.8 shall be used for gravity and semigravity walls and 0.9 for MSE Walls.

2. Use nominal resistance calculated for the Strength Limit State and apply a resistance factor of 0.8 from AASHTO LRFD 2020 Section 11.5.8 to obtain the factored resistance.

q_n	46.8	ksf	(Strength Limit, B=28.6 ft)
RF	0.8		
q_R	37.4	ksf	(Extreme Event Limit)

CONCLUSIONS AND RECOMMENDATIONS

<u>Northbound and Southbound Abutments 1 & 2:</u>

Strength Limit State

The factored bearing resistance for the Strength Limit State is	21.1	ksf	for B = 28.6 ft

Service Limit State

The factored bearing resistance for the Service Limit State is	16.0	ksf	for 1 in. settlement.

Extreme Event Limit State

The factored bearing resistance for the Extreme Event Limit State is	37.4	ksf	For B = 28.6 ft

Sliding Resistance

PROBLEM STATEMENT AND OBJECTIVE

Determine the coefficient of friction between the footing and Glacial Till, resistance factor for sliding for the Strength Limit State, and resistance factor for sliding for the Extreme Event Limit State for the footing on Glacial Till.

EXECUTIVE SUMMARY

	Glacial Till
The coefficient of friction between the footing and subgrade is =	**0.45**
The resistance factor for sliding at the Strength Limit State is =	**0.8**
The resistance factor for sliding at the Extreme Event Limit State is =	**1.0**

REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 9th edition, 2020
2. MaineDOT Bridge Design Guide, 2003 with interim revisions through June 2018.

AVAILABLE INFORMATION

1. Boring logs dated 6-11-2018 to 6-13-2018 and 10-7-2021 to 10-12-2021 by New England Boring Contractors.

ASSUMPTIONS

1. Abutment footing will bear on Glacial Till which, at the abutment elevations, consists of sand, gravel, and/or silt.

CALCULATIONS

Coefficient of Friction Between Concrete and Glacial Till

Nominal sliding resistance between the cast-in-place concrete footing and Glacial Till is dependent on the coefficient of friction (tanδ) at the interface between the footing and Glacial Till.

Estimated footing-Glacial Till interface friction angle (δ):

24 - 29 deg., friction angle for mass concrete on clean fine to medium sand, silty medium to coars sand, silty or clayey gravel (AASHTO LRFD Table C3.11.5.3-1)

Recommended δ =	24	deg., friction angle between footing/seal Glacial Till
Recommended tanδ =	0.45	coefficient of friction

HALEY ALDRICH	CALCULATIONS	File No.	132212-004
		Sheet	2 of 2
Client	McFarland Johnson	Date	10-Mar-22
Project	I-95 Bridges Over Webb Road - WIN 21900.01 & WIN 21894.01	Computed by	JAD
Subject	Seismic Site Class Evaluation	Checked by	MMB

Resistance Factors

Strength Limit State

AASHTO LRFD does not prescribe a sliding resistance factor for shallow foundations on Glacial Till.
For cast-in-place concrete on sand, the sliding resistance factor is = **0.8** (Table 10.5.5.2.2-1)

Extreme Event Limit State

Section 10.5.5.3.3 of AASHTO LRFD prescribes a resistance factor of **1.0** for the design of foundations against sliding at the Extreme Event Limit State.

Lateral Earth Pressures

HALEY ALDRICH	CALCULATIONS	File No.	132212-003
		Sheet	1 of 2
Client	McFarland Johnson	Date	10-Mar-2022
Project	I-95 Bridges Over Webb Road - WIN 21900.01 & WIN 21894.01	Calculated by	JAD
Subject	Lateral Earth Pressure Coefficients for Northbound Abutments	Checked by	MMB

Objective

-Calculate the active, at-rest, and passive lateral earth pressure coefficients to design the proposed I-95 Northbound bridge Abutment Nos. 1 & 2

Assumptions

-Abutments and wingwalls and their footings are backfilled with Granular Borrow based on H&A recomendations.

-Free draining retaining wall, no hydrostatic pressure, Soil Type 4 from Reference No. 2.

References

1. AASHTO LRFD Bridge Design Specifications, 9th edition, 2020
2. Maine DOT Bridge Design Guide (BDG), August 2003, with interim revisions through June 2018

EARTH PRESSURE COEFFICIENTS FOR PROPOSED ABUTMENT NO. 1 & NO. 2

Soil Properties and Geometry

designates input cell

Total Unit Weight, Υ (pcf) =	125	pcf	Soil Type 4, BDG Table 3-3
Effective Friction Angle, ϕ' =	32	degrees	Soil Type 4, BDG Table 3-3
Backslope Angle, β =	0	degrees	
Backface of Wall Angle to Horizontal, Θ =	90	degrees	
Soil and Wall Friction Angle, δ =	24	degrees	Soil Type 4, BDG Table 3-3

Static Active Lateral Earth Pressure Coefficient, K_a

$K_a = \sin^2(\Theta+\phi')/r(\sin^2\Theta\sin(\Theta-\delta))$ AASHTO LRFD Eq. 3.11.5.3-1

where $r = [1 + \sqrt{(\sin(\phi+\delta)\sin(\phi-\beta)/(\sin(\Theta-\delta)\sin(\Theta+\beta))}]^2$ AASHTO LRFD Eq. 3.11.5.3-2

K_a = 0.27

At-Rest Lateral Earth Pressure Coefficient, K_o

$K_0 = 1-\sin\phi$ AASHTO LRFD Eq. 3.11.5.2-1

K_o = 0.47

Passive Lateral Earth Pressure Coefficient, K_p

Rankine Theory

If the ratio of lateral abutment movement to **abutment height (y/H) is less than 0.005**, we recommend using Rankine theory to calculate the passive lateral earth pressure coefficient

$K_{p,Rankine} = \tan(45 + \phi'/2)^2$ ϕ=30 deg.

$K_{p,Rankine}$ = 3.00 Das, Principles of Geotechnical Engineering, 7th Ed., Eq. 13.22

Coulomb Theory

If the ratio of lateral abutment movement to **abutment height (y/H) is greater than 0.005**, we recommend using Coulomb theory to calculate the passive lateral earth pressure coefficient

$K_p = \sin^2(\Theta-\phi')/r(\sin^2\Theta\sin(\Theta+\delta))$ ϕ=30 deg. BDG Section 3.6.6

where $r = [1 - \sqrt{(\sin(\phi+\delta)\sin(\phi+\beta)/(\sin(\Theta+\delta)\sin(\Theta+\beta))}]^2$ BDG Section 3.6.6

$K_{p,Coulomb}$ = 7.33

HALEY ALDRICH	CALCULATIONS	File No.	132212-003
		Sheet	2 of 2
Client	McFarland Johnson	Date	10-Mar-2022
Project	I-95 Bridges Over Webb Road - WIN 21900.01 & WIN 21894.01	Calculated by	JAD
Subject	Lateral Earth Pressure Coefficients for Southbound Abutments	Checked by	MMB

Objective

-Calculate the active, at-rest, and passive lateral earth pressure coefficients to design the proposed I-95 Southbound bridge Abutment Nos. 1 & 2

Assumptions

-Abutments and wingwalls and their footings are backfilled with Granular Borrow based on H&A recomendations.

-Free draining retaining wall, no hydrostatic pressure, Soil Type 4 from Reference No. 2.

References

1. AASHTO LRFD Bridge Design Specifications, 9th edition, 2020
2. Maine DOT Bridge Design Guide (BDG), August 2003, with interim revisions through June 2018

EARTH PRESSURE COEFFICIENTS FOR PROPOSED ABUTMENT NO. 1 & NO. 2

Soil Properties and Geometry

designates input cell

Total Unit Weight, ϒ (pcf) =	125	pcf	Soil Type 4, BDG Table 3-3
Effective Friction Angle, ϕ' =	32	degrees	Soil Type 4, BDG Table 3-3
Backslope Angle, β =	0	degrees	
Backface of Wall Angle to Horizontal, ϴ =	90	degrees	
Soil and Wall Friction Angle, δ =	24	degrees	Soil Type 4, BDG Table 3-3

Static Active Lateral Earth Pressure Coefficient, K_a

$K_a = \sin^2(\Theta+\phi')/r(\sin^2\Theta\sin(\Theta-\delta))$ AASHTO LRFD Eq. 3.11.5.3-1

where $r = [1 + \sqrt{(\sin(\phi+\delta)\sin(\phi-\beta)/(\sin(\Theta-\delta)\sin(\Theta+\beta))}]^2$ AASHTO LRFD Eq. 3.11.5.3-2

K_a = 0.27

At-Rest Lateral Earth Pressure Coefficient, K_o

$K_0 = 1-\sin\phi$ AASHTO LRFD Eq. 3.11.5.2-1

K_o = 0.47

Passive Lateral Earth Pressure Coefficient, K_p

Rankine Theory

If the ratio of lateral abutment movement to **abutment height (y/H) is less than 0.005**, we recommend using Rankine theory to calculate the passive lateral earth pressure coefficient

$K_{p,Rankine}$ = tan (45 + ϕ'/2)^2 ϕ=30 deg.

$K_{p,Rankine}$ = 3.00 Das, Principles of Geotechnical Engineering, 7th Ed., Eq. 13.22

Coulomb Theory

If the ratio of lateral abutment movement to **abutment height (y/H) is greater than 0.005**, we recommend using Coulomb theory to calculate the passive lateral earth pressure coefficient

$K_p = \sin^2(\Theta-\phi')/r(\sin^2\Theta\sin(\Theta+\delta))$ ϕ=30 deg. BDG Section 3.6.6

where $r = [1 - \sqrt{(\sin(\phi+\delta)\sin(\phi+\beta)/(\sin(\Theta+\delta)\sin(\Theta+\beta))}]^2$ BDG Section 3.6.6

$K_{p,Coulomb}$ = 7.33

Frost Depth

OBJECTIVE:

Evaluate maximum depth of frost penetration based on soil and groundwater conditions, as well as geographic site location.

REFERENCES:

1. MaineDOT Bridge Design Guide, 2003 with interim revisions through June 2018.
1. Boring logs dated 6-11-2018 to 6-13-2018 by New England Boring Contractors for Phase I.
3. Draft plan set prepared by McFarland Johnson dated 3/9/22.

EVALUATION (PHASE I):

1. Gather relevant information from test borings performed near proposed bridge abutment locations:

STRUCTURE	STRUCTURE BEARING ELEVATION	TEST BORING NO./GS EL.	GROUND WATER ELEVATION	SAMPLE No. AND ELEVATION	AASHTO/ USCS	FINES CONTENT	MOISTURE CONDITION
ABUTMENT NO. 1 NORTHBOUND	El. 218.3 approximate	BB-WWR-101 / 227.6	El. 226.6 at time of drilling	2DA El. 225.6 - 224.6	A-1-b(0)/SP	10.0	Wet
ABUTMENT NO. 2 NORTHBOUND	El. 218.3 approximate	BB-WWR-102 / 234.1	El. 226.6 from observation well data	1D El. 234.1 - 232.6	A-4(0)/ML	44.9	Dry
				2D El. 232.1 - 230.1	A-2-4(0)/SP-SM	13.6	Wet
ABUTMENT NO. 1 SOUTHBOUND	El. 226.8 approximate	BB-WWR-103 / 234.2	El. 230.6 at time of drilling	1DA El. 234.2 - 233.2	A-1-b(0)/SW-SM	12.2	Dry
				2D El. 232.2 - 230.7	A-4(0)/ML	42.1	Wet
ABUTMENT NO. 2 SOUTHBOUND	El. 226 approximate	BB-WWR-104 / 241.4	El. 234.4 from observation well data	1D El. 241.4 - 239.4	A-4(0)/SM	42.9	Dry
				3D El. 237.4 - 235.4	A-4(0)/ML	68.7	Moist

Note: Ground water elevations summarized above were determined in the field and may have been influenced by the drilling process. Ground water elevations may vary throughout the year due to seasonal variations and precipitation events.

2. The abutments will bear on undisturbed Glacial Till and/or Weathered Bedrock. Assume the embankment fill consists of granular material.

3. From MaineDOT Bridge Design Guide Figure 5-1, the design freezing index for the site is approximately 1660 °F - days based on site location, see Figure 5-1 presented on Page 3.

4. Estimate range in frost penetration using MaineDOT Bridge Design Guide Table 5-1 and the design freezing index above.

5. For coarse grained soil at the abutments, from Table 5-1, frost penetration depths vary between approximately 5.1 ft (w=30%) to 7.2 ft (w=10%).

6. For fine grained soil at the abutments, from Table 5-1, frost penetration depths vary between approximately 4.0 ft (w=30%) to 5.1 ft (w=10%).

Recommend 6.0 ft at the abutments.

OBJECTIVE:

Evaluate maximum depth of frost penetration based on soil and groundwater conditions, as well as geographic site location.

REFERENCES:

1. MaineDOT Bridge Design Guide, 2003 with interim revisions through June 2018.
1. Boring logs dated 10-6-2021 to 10-14-2021 by New England Boring Contractors for Phase II.
3. Draft plan set prepared by McFarland Johnson dated 3/9/22.

EVALUATION (PHASE II):

1. Gather relevant information from test borings performed near proposed bridge abutment locations:

STRUCTURE	STRUCTURE BEARING ELEVATION	TEST BORING NO./GS EL.	GROUND WATER ELEVATION	SAMPLE No. AND ELEVATION	AASHTO/ USCS	FINES CONTENT	MOISTURE CONDITION
ABUTMENT NO. 1 NORTHBOUND	El. 218.3 approximate	BB-WWR-201 / 229.6	El. 226.8 at time of drilling	4D El. 219.6 - 217.6	A-4(0)/ML	48.7	Wet
ABUTMENT NO. 2 NORTHBOUND	El. 218.3 approximate	BB-WWR-202 / 226.0	El. 225.8 at time of drilling	1DB El. 225.6 - 224.0	A-4(0)/ML	78.0	Wet
ABUTMENT NO. 1 SOUTHBOUND	El. 226.8 approximate	BB-WWR-203 / 237.7	El. 230.4 at time of drilling	2DB El. 235.5 - 233.7	A-4(0)/ML	70.7	Moist
ABUTMENT NO. 2 SOUTHBOUND	El. 226 approximate	BB-WWR-204 / 233.3	El. 232.0 at time of drilling	3DA El. 228.3 - 227.3	A-1-b(0)/GM	23.0	Damp

Note: Ground water elevations summarized above were determined in the field and may have been influenced by the drilling process. Ground water elevations may vary throughout the year due to seasonal variations and precipitation events.

2. The abutments will bear on undisturbed Glacial Till and/or Weathered Bedrock. Assume the embankment fill consists of granular material.

3. From MaineDOT Bridge Design Guide Figure 5-1, the design freezing index for the site is approximately 1660 °F - days based on site location, see Figure 5-1 presented on Page 3.

4. Estimate range in frost penetration using MaineDOT Bridge Design Guide Table 5-1 and the design freezing index above.

5. For coarse grained soil at the abutments, from Table 5-1, frost penetration depths vary between approximately 5.1 ft (w=30%) to 7.2 ft (w=10%).

6. For fine grained soil at the abutments, from Table 5-1, frost penetration depths vary between approximately 4.0 ft (w=30%) to 5.1 ft (w=10%).

Recommend 6.0 ft at the abutments.

	CALCULATIONS	File No.:	132212-003
		Sheet:	3 of 3
Client:	McFarland Johnson	Date:	10-Mar-22
Project:	I-95 Bridges Over Webb Road - WIN 21900.01 & WIN 21894.01	Computed by:	JAD
Subject:	Frost Susceptibility and Maximum Depth of Frost Penetration	Checked by:	MMB

Figure 5-1 Maine Design Freezing Index Map

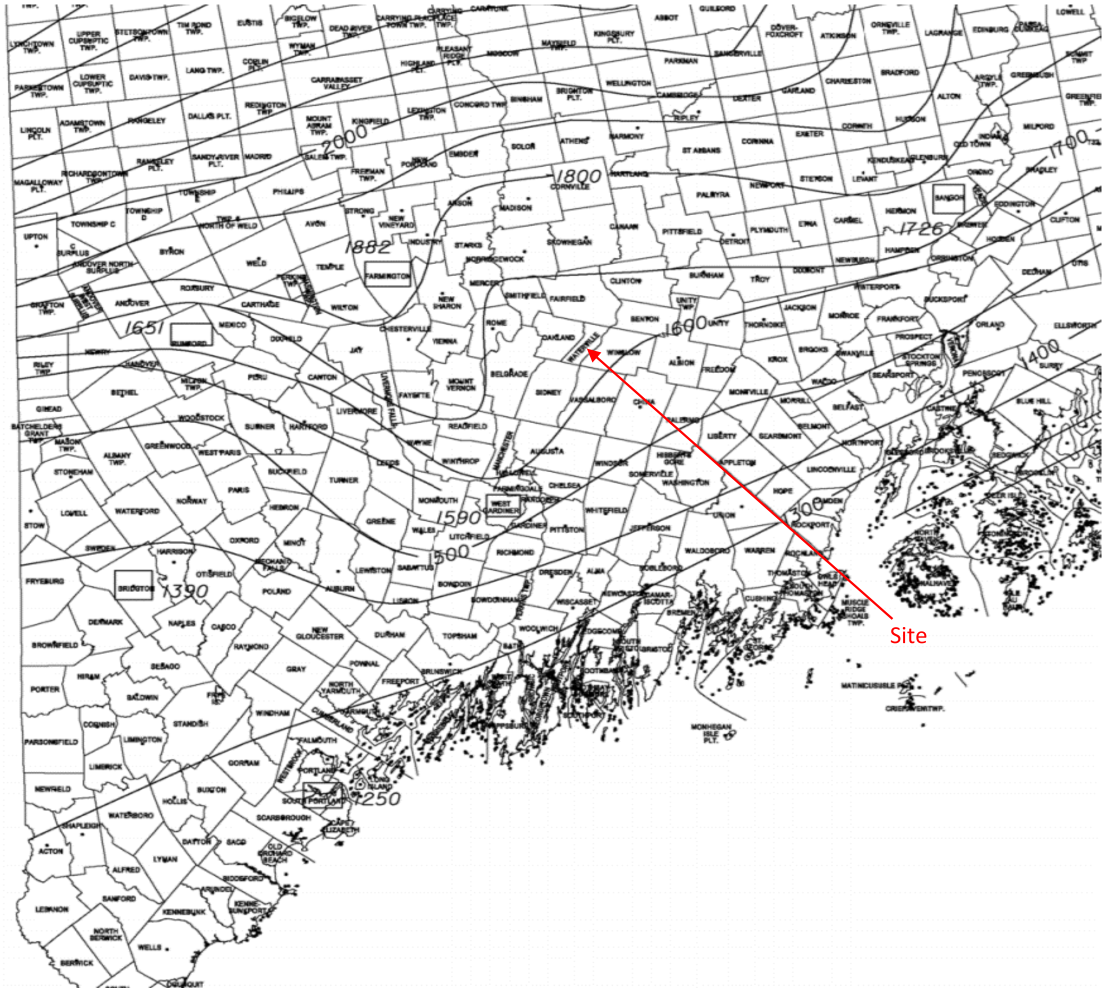


Table 5-1 Depth of Frost Penetration

Design Freezing Index	Frost Penetration (in)					
	Coarse Grained			Fine Grained		
	w=10%	w=20%	w=30%	w=10%	w=20%	w=30%
1000	66.3	55.0	47.5	47.1	40.7	36.9
1100	69.8	57.8	49.8	49.6	42.7	38.7
1200	73.1	60.4	52.0	51.9	44.7	40.5
1300	76.3	63.0	54.3	54.2	46.6	42.2
1400	79.2	65.5	56.4	56.3	48.5	43.9
1500	82.1	67.9	58.4	58.3	50.2	45.4
1600	84.8	70.2	60.3	60.2	51.9	46.9
1700	87.5	72.4	62.2	62.2	53.5	48.4
1800	90.1	74.5	64.0	64.0	55.1	49.8
1900	92.6	76.6	65.7	65.8	56.7	51.1
2000	95.1	78.7	67.5	67.6	58.2	52.5
2100	97.6	80.7	69.2	69.3	59.7	53.8
2200	100.0	82.6	70.8	71.0	61.1	55.1
2300	102.3	84.5	72.4	72.7	62.5	56.4
2400	104.6	86.4	74.0	74.3	63.9	57.6
2500	106.9	88.2	75.6	75.9	65.2	58.8
2600	109.1	89.9	77.1	77.5	66.5	60.0

Global Stability

HALEY ALDRICH	CALCULATIONS	File No.:	132212-004
		Sheet:	1 of 1
Client:	McFarland Johnson	Date:	11-Mar-2022
Project:	I-95 Bridges Over Webb Road - WIN 21900.01 & WIN 21894.01	Computed by:	JAD
Subject:	Global Stability	Checked by:	MMB

PROBLEM STATEMENT AND OBJECTIVE

Calculate the global stability minimum factor of safety for the proposed bridge structures.

REFERENCES

1. AASHTO LRFD Bridge Design Specifications, 9th edition, 2020
2. Slide version 7.0 by RocScience.
3. MaineDOT Bridge Design Guide, 2003 with interim revisions through June 2018.

AVAILABLE INFORMATION

1. Draft plan set prepared by McFarland Johnson dated 12/13/21.
2. Boring logs dated 6-11-2018 to 6-13-2018 and 10-6-2021 to 10-14-2021 by New England Boring Contractors.

ASSUMPTIONS

1. Water level will be modeled at the bottom of the drainage ditch elevation in front of the structure and at the top of native soils behind the structure.
2. Seismic cases will have a seismic force of As/2 (0.123g/2) = 0.06 g based on the seismic site class calculations .
3. A 250 psf traffic surcharge will be modeled for breast walls, no surcharge will be modeled for wingwalls.
4. A 21,100 psf Strenth Limit bearing pressure will be modeled at the abutment footing. A 17,800 psf Strength Limit bearing pressure will be modeled at the wingwall footing.
5. A "worst case scenario" soil profile base on BB-WBB-102 is applied to all substructures.
6. The Northbound Abutment No. 2 and Northbound Abut. No. 2 East Wingwall are representative of the proposed Abutment and Wingwall structures.

SOIL PROPERTIES

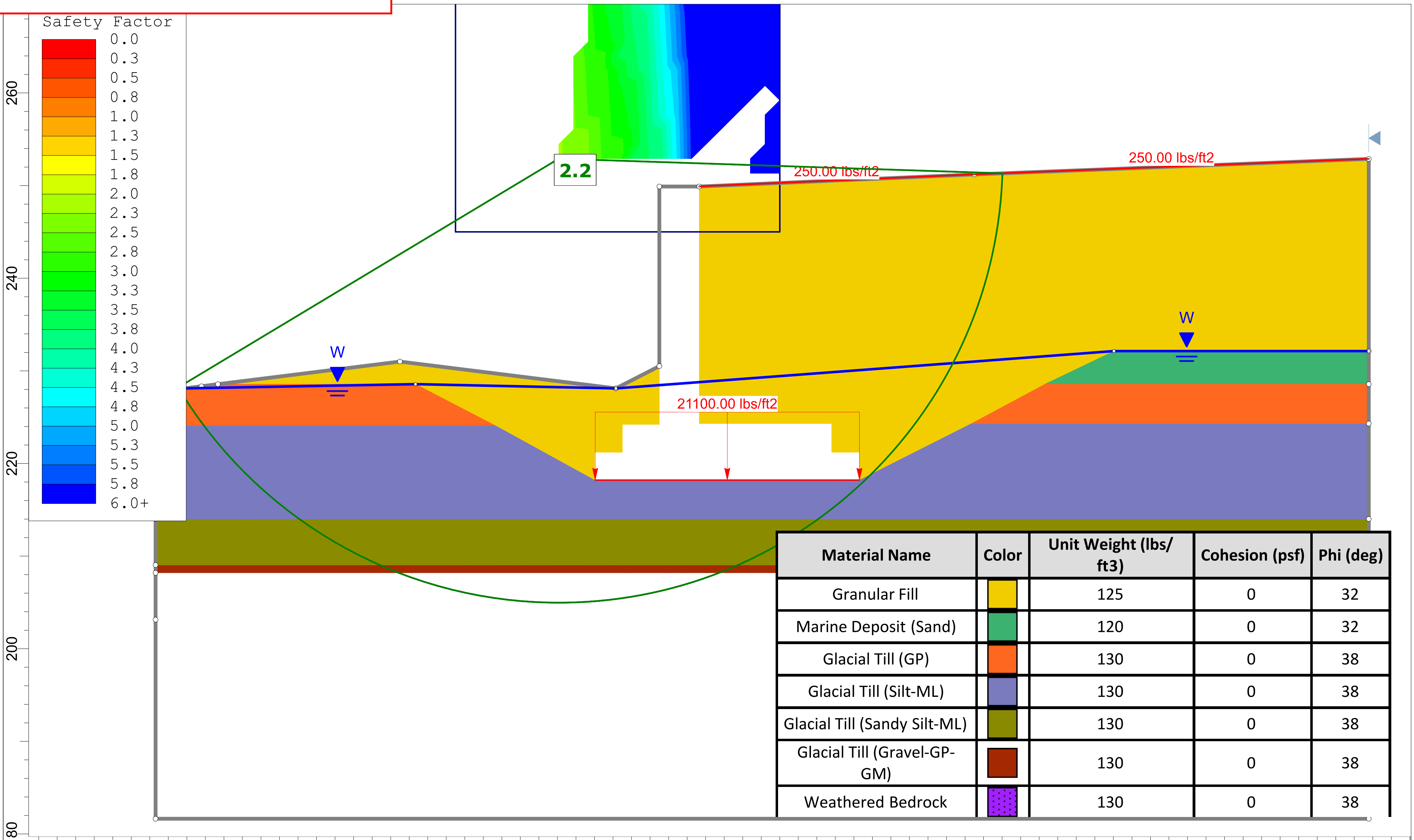
Material	Unit Weight (PCF)	Friction Angle (degrees)	Undrained Shear Strength (PSF)
Granular Borrow	125	32	0
Marine Deposit (Sand)	120	32	0
Glacial Till (Sand)	130	38	0
Glacial Till (Silt-ML)	130	38	0
Glacial Till (Sandy Silt-ML)	130	38	0
Glacial Till (Gravel-GP-GM)	130	38	0
Weathered Bedrock	130	38	0
Bedrock	infinite strength		

RESULTS AND CONCLUSIONS

Structure	F.S.	
	Static	Seismic
NB Abut No. 2	2.2	2.1
Abutment 2 Wingwall Line 1	2.1	2.1
Abutment 2 Wingwall Line 2	2.1	2.0

Based on AASHTO LRFD Section 11.6.2.3, an acceptable resistance factor for where the geotechnical parameters and subsurface stratigraphy are well defined is 0.75 (F.S. = 1/0.75 = 1.3).
Based on Maine DOT Bridge Design Guide Section 5.9.4, a minimum seismic factor of safety of 1.0 is acceptable for slope stability.

NORTHBOUND ABUTMENT 2
STATIC



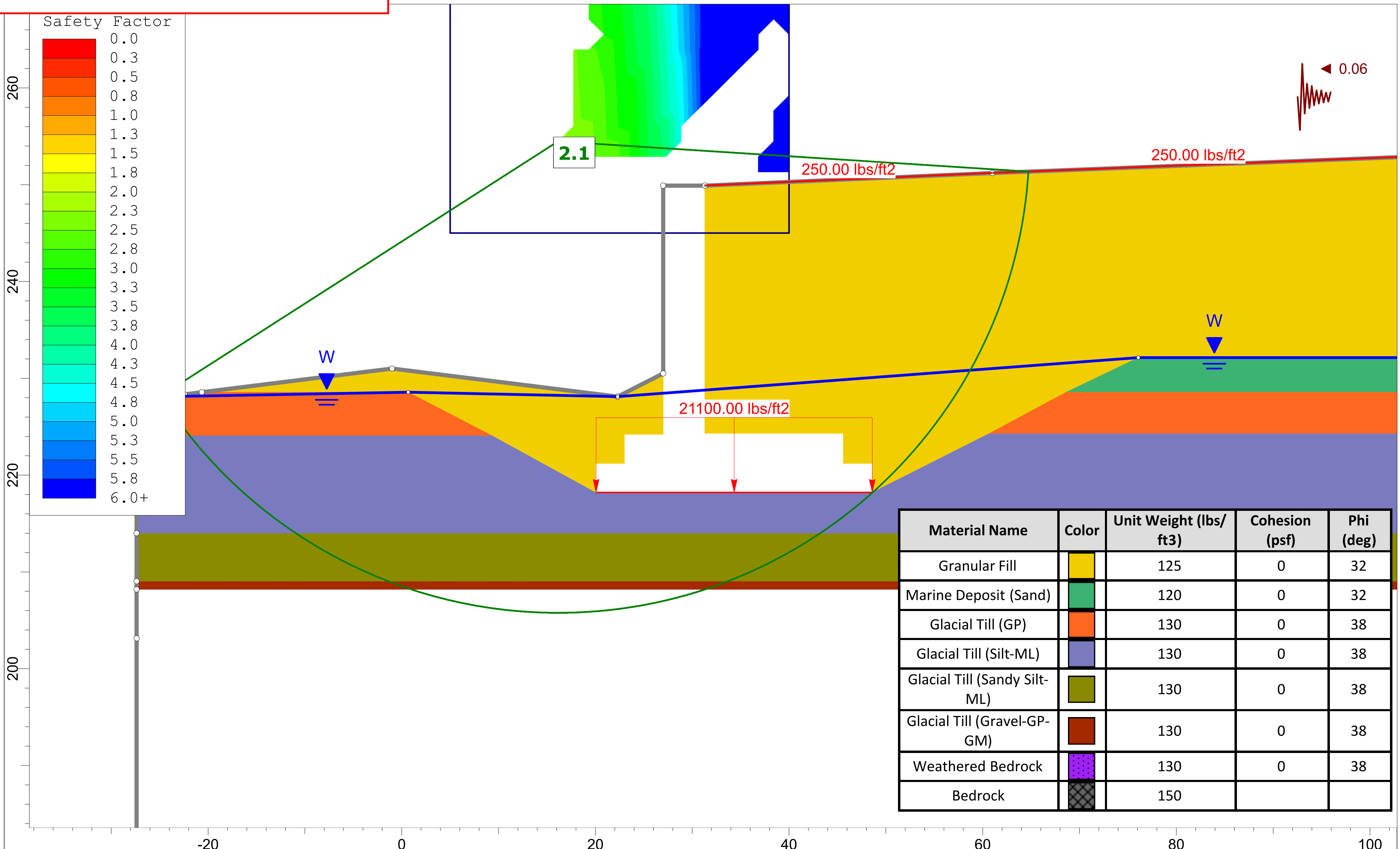
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Granular Fill		125	0	32
Marine Deposit (Sand)		120	0	32
Glacial Till (GP)		130	0	38
Glacial Till (Silt-ML)		130	0	38
Glacial Till (Sandy Silt-ML)		130	0	38
Glacial Till (Gravel-GP-GM)		130	0	38
Weathered Bedrock		130	0	38

rocscience

SLIDEINTERPRET 9.020

Project	I-95 Bridges over Webb Road, Waterville, ME		
Group	2022-0131-HAI-Webb Road-NB Abut 2-Stability.slim	*Scenario*	2022-0131-HAI-Webb Road-NB Abut 2-Stability.slim
Drawn By	J. DuBois	*Company*	Haley & Aldrich, Inc.
Date	2/8/22	*File Name*	2022-0131-HAI-Webb Road-NB Abut 2-Stability.slim

NORTHBOUND ABUTMENT 2
SEISMIC



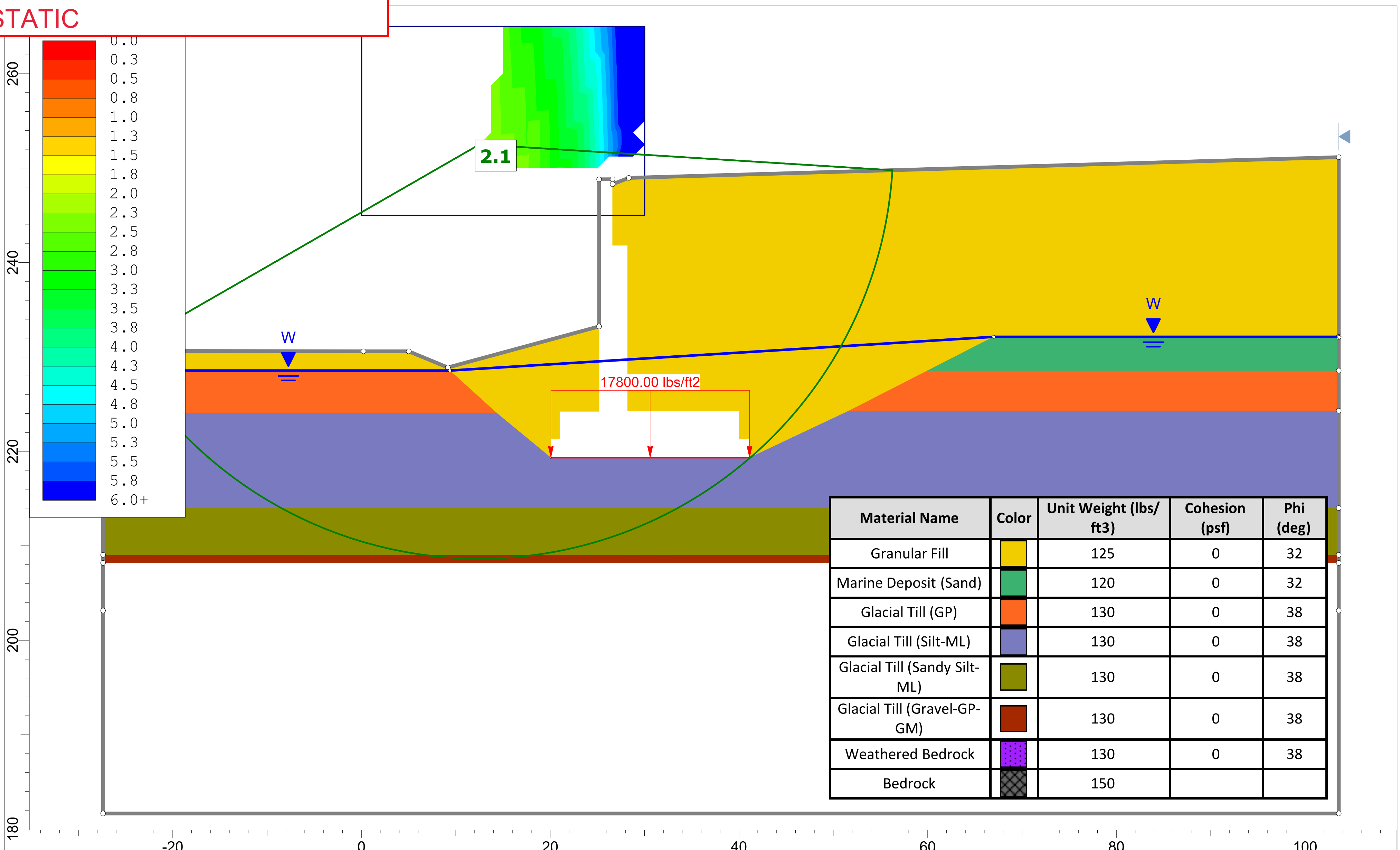
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Granular Fill		125	0	32
Marine Deposit (Sand)		120	0	32
Glacial Till (GP)		130	0	38
Glacial Till (Silt-ML)		130	0	38
Glacial Till (Sandy Silt-ML)		130	0	38
Glacial Till (Gravel-GP-GM)		130	0	38
Weathered Bedrock		130	0	38
Bedrock		150		

rocscience

SLIDEINTERPRET 9.020

Project	I-95 Bridges over Webb Road, Waterville, ME		
Group	2022-0131-HAI-Webb Road-NB Abut 2-Stability-Seismic.slim	*Scenario*	2022-0131-HAI-Webb Road-NB Abut 2-Stability-Seismic.slim
Drawn By	J. DuBois	*Company*	Haley & Aldrich, Inc.
Date	2/8/22	*File Name*	2022-0131-HAI-Webb Road-NB Abut 2-Stability-Seismic.slim

NORTHBOUND ABUTMENT 2
EAST WINGWALL LINE 1
STATIC



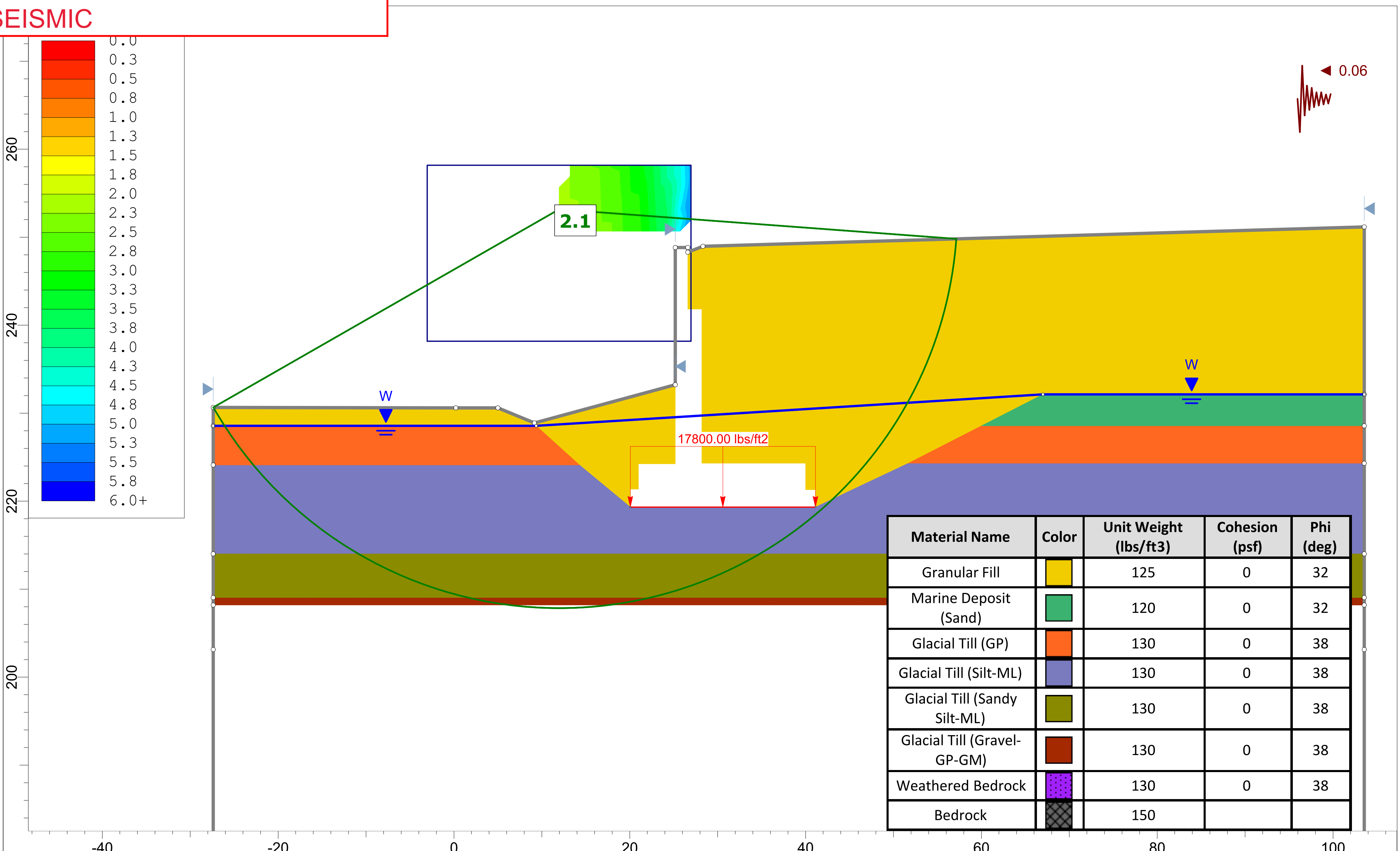
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Granular Fill		125	0	32
Marine Deposit (Sand)		120	0	32
Glacial Till (GP)		130	0	38
Glacial Till (Silt-ML)		130	0	38
Glacial Till (Sandy Silt-ML)		130	0	38
Glacial Till (Gravel-GP-GM)		130	0	38
Weathered Bedrock		130	0	38
Bedrock		150		

rocscience

SLIDEINTERPRET 9.020

Project	I-95 Bridges over Webb Road, Waterville, ME
Group 2022-0131-HAI-Webb Road-NB Abut 2 East Wingwall Line 1-Stability.slim	*Scenario* 2022-0131-HAI-Webb Road-NB Abut 2 East Wingwall Line 1-Stability.slim
Drawn By J. DuBois	*Company* Haley & Aldrich, Inc.
Date 2/8/2022, 5:10:38 AM	*File Name* 2022-0131-HAI-Webb Road-NB Abut 2 East Wingwall Line 1-Stability.slim

NORTHBOUND ABUTMENT 2
EAST WINGWALL LINE 1
SEISMIC



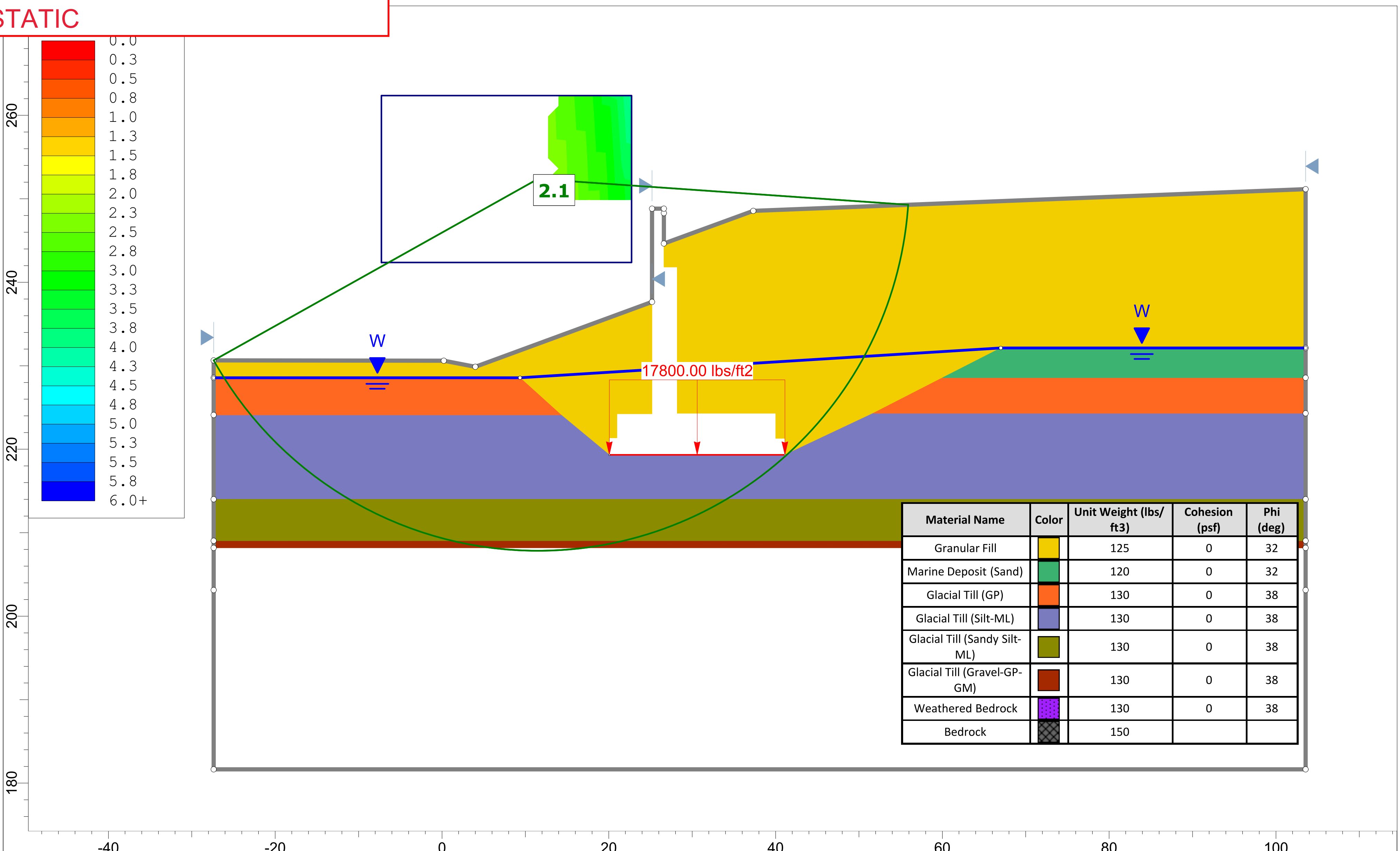
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Granular Fill		125	0	32
Marine Deposit (Sand)		120	0	32
Glacial Till (GP)		130	0	38
Glacial Till (Silt-ML)		130	0	38
Glacial Till (Sandy Silt-ML)		130	0	38
Glacial Till (Gravel-GP-GM)		130	0	38
Weathered Bedrock		130	0	38
Bedrock		150		

rocscience

SLIDEINTERPRET 9.020

Project	I-95 Bridges over Webb Road, Waterville, ME
Group	2022-0131-HAI-Webb Road-NB Abut 2 East Wingwall Line 1-Stability-Seismic.slim
Scenario	2022-0131-HAI-Webb Road-NB Abut 2 East Wingwall Line 1-Stability-Seismic.slim
Drawn By	J. DuBois
Company	Haley & Aldrich, Inc.
Date	2/8/2022, 5:10:38 AM
File Name	2022-0131-HAI-Webb Road-NB Abut 2 East Wingwall Line 1-Stability-Seismic.slim

NORTHBOUND ABUTMENT 2
EAST WINGWALL LINE 2
STATIC



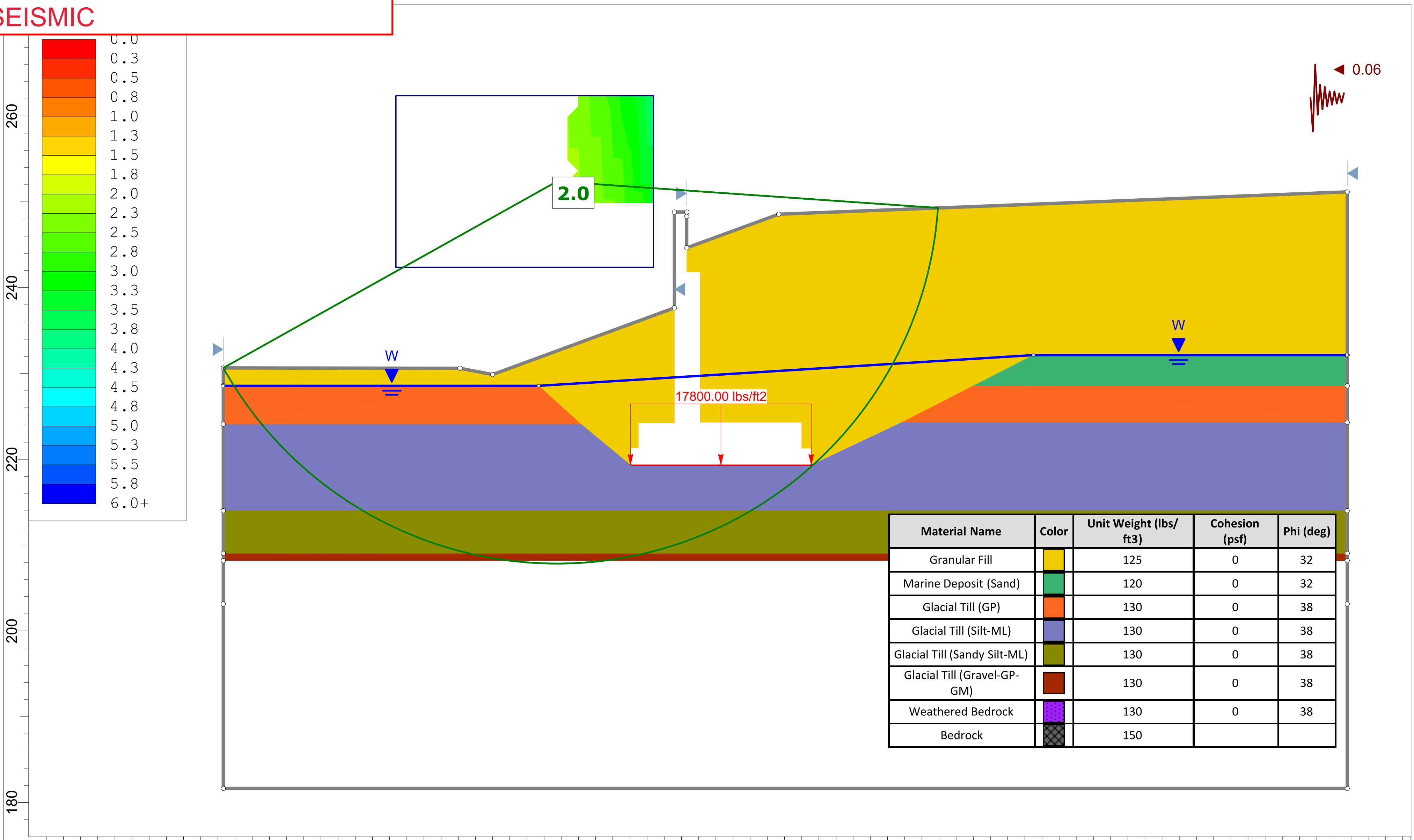
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Granular Fill		125	0	32
Marine Deposit (Sand)		120	0	32
Glacial Till (GP)		130	0	38
Glacial Till (Silt-ML)		130	0	38
Glacial Till (Sandy Silt-ML)		130	0	38
Glacial Till (Gravel-GP-GM)		130	0	38
Weathered Bedrock		130	0	38
Bedrock		150		

rocscience

SLIDEINTERPRET 9.020

Project	I-95 Bridges over Webb Road, Waterville, ME		
Group	2022-0131-HAI-Webb Road-NB Abut 2 East Wingwall Line 2-Stability.slim	*Scenario*	2022-0131-HAI-Webb Road-NB Abut 2 East Wingwall Line 2-Stability.slim
Drawn By	J. DuBois	*Company*	Haley & Aldrich, Inc.
Date	2/8/2022, 5:10:38 AM	*File Name*	2022-0131-HAI-Webb Road-NB Abut 2 East Wingwall Line 2-Stability.slim

NORTHBOUND ABUTMENT 2
EAST WINGWALL LINE 2
SEISMIC



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Granular Fill		125	0	32
Marine Deposit (Sand)		120	0	32
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rocscience

SLIDEINTERPRET 9.020

Project	I-95 Bridges over Webb Road, Waterville, ME
Group	2022-0131-HAI-Webb Road-NB Abut 2 East Wingwall Line 2-Stability-Seismic.slim
Scenario	2022-0131-HAI-Webb Road-NB Abut 2 East Wingwall Line 2-Stability-Seismic.slim
Drawn By	J. DuBois
Company	Haley & Aldrich, Inc.
Date	2/8/2022, 5:10:38 AM
File Name	2022-0131-HAI-Webb Road-NB Abut 2 East Wingwall Line 2-Stability-Seismic.slim