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GEOTECHNICAL DESIGN REPORT
PLEASANT RIVER BRIDGE NO. 3244
PLEASANT STREET OVER PLEASANT RIVER
MAINE DOT WIN 22627.01
MILO, MAINE

August 2020
09.0025972.01

Prepared for:
HNTB Corporation
Westbrook, Maine

Prepared by:
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VIA EMAIL

August 7, 2020
File No. 09.0025972.01

Ms. Lori Driscoll, P.E.
HNTB Corporation
340 Country Road, Suite 6C
Westbrook, Maine 04092

Re: Geotechnical Design Report
Replacement of Pleasant River Bridge No. 3244
Pleasant Street over Pleasant River
MaineDOT WIN 22627.01
Milo, Maine

Dear Lori:

We are pleased to provide this Geotechnical Design Report, which includes geotechnical design recommendations for the replacement of Pleasant River Bridge No. 3244, Pleasant Street over Pleasant River in Milo, Maine. Our work was completed in accordance with GZA GeoEnvironmental, Inc.'s Project Contract for Task Order No. 001.02 which incorporates our October 2, 2019 proposal, HNTB File No. 75772-DS-001-001-E008, dated October 4, 2019, our Master/Task Order Agreement dated October 4, 2019, and the attached Limitations contained in **Appendix A** of this report.

It has been a pleasure serving HNTB on this phase of the project, and we look forward to our continued work with you through project completion. If you have any questions regarding the report, please do not hesitate to contact the undersigned.

Very truly yours,

GZA GEOENVIRONMENTAL, INC.

Blaine M. Cardali, P.E.
Assistant Project Manager

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Attachment: Geotechnical Design Report



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1.0 INTRODUCTION

This report presents the results of the geotechnical evaluation by GZA GeoEnvironmental, Inc. (GZA) for the replacement of Pleasant River Bridge No. 3244, Pleasant Street over Pleasant River in Milo, Maine. Our services were completed in accordance with GZA GeoEnvironmental, Inc.'s Project Contract for Task Order No. 001.02 which incorporates our October 2, 2019 proposal, HNTB File No. 75772-DS-001-001-E008, dated October 4, 2019, our Master/Task Order Agreement dated October 4, 2019, and the attached Limitations contained in **Appendix A** of this report.

GZA is providing geotechnical engineering services as a Subconsultant to HNTB, who is under contract with Maine Department of Transportation (MaineDOT) for design of the proposed bridge replacement.

1.1 BACKGROUND

The project includes replacement of the Pleasant River Bridge No. 3244 carrying Pleasant Street over Pleasant River in Milo, Maine, the location of which is shown on **Figure 1**. Our understanding of the existing bridge is based on bridge rehabilitation drawings, dated July 1936. The Pleasant River Bridge is a scour-critical, 300-foot-long, two-span, flat steel through-truss bridge with a concrete deck on full-height concrete abutments and a mass concrete pier supported by timber piles.

We understand plans are to construct a new replacement bridge consisting of an approximately 345-foot-long, 37-foot-wide, two-span bridge, supported by integral abutments and a single river pier, with abutments and pier bearing on driven piles. The integral abutments will be 13.5 feet high at the baseline and will be constructed on a 25-degree skew. The wingwalls will be constructed in a U-back configuration, oriented parallel to the roadway, with a stepped bottom elevation following the exterior finish grade. Approach slabs will be constructed approximately 2 feet below the proposed roadway. Two layers of polyethylene sheeting will be placed beneath each approach slab to limit friction on the bottom of the slab. Heavy riprap-covered 1.75 horizontal to 1 vertical (1.75H:1V) slopes will be constructed in front of the toe of each abutment, extending down to river level. The proposed replacement bridge will be constructed off-alignment, with the baseline shifted approximately 75 feet up-river (northwest) of the current roadway centerline.

Considering the length and skew of the proposed bridge, HNTB elected to utilize the structural finite element software package CSiBridge® to model the bridge. Soil-structure interaction between the foundation elements and soil are modeled using multi-linear load-deformation or pressure-deformation springs in CSiBridge®.

New approach embankments are proposed for the realignment of Pleasant Street, requiring fill up to 16 feet above existing grades. The new southerly approach roadway will tie into the existing Pleasant Street baseline approximately 600 feet south of the proposed south abutment. The intersection of Pleasant Street, Pleasant Hill Road, Medford Road and Lakeview Road will be realigned to form two T-intersections of Pleasant Street and Pleasant Hill Road approximately 100 feet north of the north abutment, and of Pleasant Street, Lakeview Road and Medford Road approximately 325 feet north of the north abutment. The new northerly approach roadway will tie into the existing Lakeview Road baseline approximately 600 feet north of the proposed north abutment. The proposed fills for the



realigned roadways more than 200 feet away from the proposed bridge are up to 7 feet above existing grade. New embankment slopes are generally proposed to be constructed at 3H:1V, except within 100 feet of the bridge, where they are proposed as steep as 2H:1V.

1.2 OBJECTIVES AND SCOPE OF SERVICES

The objectives of our work were to evaluate subsurface conditions and to provide geotechnical engineering recommendations for the proposed bridge and highway improvements. To meet these objectives, GZA completed the following Scope of Services:

- Conducted a site visit to observe surficial conditions and reviewed mapped surficial and bedrock geology of the site;
- Reviewed subsurface data collected by GZA during the preliminary subsurface exploration program, which consisted of four test borings;
- Coordinated and observed two supplemental subsurface exploration programs, consisting of two additional bridge test borings and six highway test borings, to further evaluate subsurface conditions for the bridge and new roadways;
- Conducted a laboratory testing program to evaluate engineering and index properties of the site soils and bedrock;
- Conducted geotechnical engineering analyses for soil and bedrock properties; stability and settlement of approach/highway embankments; frost susceptibility and drainage of approach embankments; AASHTO LRFD load and resistance factors associated with geotechnical design elements; nominal resistance of pile foundations; pile drivability; multilinear spring development for structural finite element analyses performed by HNTB; and seismic design considerations;
- Developed geotechnical engineering recommendations including foundation design recommendations for driven piles, lateral earth pressures, springs to represent soil reactions for use in HNTB's finite element analyses, seismic design parameters; recommended construction considerations; and
- Prepared this report summarizing our findings and design recommendations.

2.0 SUBSURFACE EXPLORATIONS

GZA completed a preliminary design exploration program in 2018 consisting of four test borings, a final design bridge exploration program in 2019 for the bridge consisting of two borings, and a final design highway exploration program in 2020 consisting of six test borings. The as-drilled boring locations were surveyed by MaineDOT and provided to GZA and are shown on the logs and in **Figures 2, 4, 5, and 6**. Elevations referenced in this report are in feet and refer to North American Vertical Datum of 1988 (NAVD 88).

New England Boring Contractors of Hermon, Maine provided drilling services and coordinated utility clearance. Bridge borings were drilled using 3-, 4- and 5-inch casing, and drive- or spin-and-wash drilling



techniques, as noted on the boring logs. Highway borings were drilled using 2.5-inch outside-diameter (OD) solid stem augers and 6-inch OD hollow stem augers. Standard penetration testing (SPT) and split spoon sampling were performed continuously or at standard 5-foot intervals using a 24-inch-long, 1-3/8-inch inside-diameter sampler. Bedrock cores were obtained using NX or NQ2 wire-line coring equipment in each final design bridge boring. GZA personnel monitored the drilling work and prepared logs of each boring that are included in **Appendix B**. Additional details of each program are described below.

2.1 PRELIMINARY BORINGS

Borings BB-MPR-101 through BB-MPR-103 and BB-MPR-103A were drilled between April 30 and May 21, 2018. The test borings were completed using a Mobile B-53 drill carried on a CME track rig and were drilled to depths of 127 to 178 feet below ground surface (bgs). The borings were terminated upon roller bit advancement interpreted by GZA to be 2 to 4 feet into bedrock. No bedrock cores were taken during this drilling program because the casing either became damaged or bent, preventing advancement of the core barrel to the bottom of the borehole.

SPTs were conducted using automatic hammer NEBC No. 2, which had a rated hammer energy transfer ratio of 0.677 at the time of drilling. The borings were generally backfilled with ¾-inch crushed stone and/or soil cuttings and topped with asphalt cold patch in roadway areas.

2.2 FINAL DESIGN PHASE BORINGS

Bridge Borings

Borings BB-MPR-201 and BB-MPR-202 were drilled between October 10 and October 24, 2019. One boring was drilled at each of the proposed abutment locations. The borings were drilled using a track-mounted Mobile B-53 drill rig.

The borings were drilled to depths of approximately 143 to 155 feet bgs and terminated approximately 18 to 29 feet into bedrock. SPTs were conducted using automatic hammer NEBC D-20, which had a rated hammer efficiency factor of 0.931 at the time of drilling.

Highway Borings

Borings HB-MPR-201 through HB-MPR-206 were drilled between March 3 and March 4, 2020 using a track-mounted Mobile B-53 drill rig. Their locations were as follows:

- HB-MPR-201 and -202: Proposed Pleasant Street alignment south of the bridge
- HB-MPR-203 and -204: Proposed Pleasant Street alignment north of the bridge
- HB-MPR-205 and -206: Proposed Medford Road and Lakeview Road alignments, respectively, north of the bridge



The borings were drilled to depths of approximately 11 to 34 feet bgs and terminated in natural sand deposits. SPTs were conducted using automatic hammer NEBC D-20, which had a rated hammer efficiency factor of 0.931 at the time of drilling.

3.0 LABORATORY TESTING

GZA retained Thielsch Engineering of Cranston, Rhode Island to complete a laboratory testing program to assess the gradation and index properties of the soil and bedrock. The testing program included:

- 34 gradation analysis / MaineDOT Frost Classification / Unified Soil Classification System (USCS) assessments;
- 13 moisture content tests; and
- One (1) Atterberg limits analysis.

Results of the testing are included in **Appendix C**.

4.0 SUBSURFACE CONDITIONS

4.1 SURFICIAL AND BEDROCK GEOLOGY

Based on available geologic mapping¹, the surficial units in the vicinity of the site include sand and gravel alluvium and glacial till deposits, described as sand, gravel and minor amounts of silt.

The available bedrock geologic mapping² shows the site is mapped as the Sangerville Formation (Ss), described as thickly bedded, fine- to coarse-grained, light gray, calcareous, graywacke metasandstone with thinly interlaminated gray metasiltstone or dark grey metapelite and beds of variable thickness of light gray quartz-wacke. The Waterville Formation (Sw) was mapped to the north of the site and is described as greenish gray to dark gray metapelite.

4.2 SUBSURFACE PROFILE

Three soil units were encountered beneath 6 to 12 inches of asphalt pavement or 3 to 12 inches of topsoil and above bedrock at the site: Fill, Alluvium, and Glacial Till. The approximate thicknesses and generalized descriptions of the subsurface units are presented in the following table, in descending order from existing ground surface. Detailed descriptions of the materials encountered at specific locations are provided in the boring logs in **Appendix B**. An interpretive subsurface profile based on the

¹ Thompson, W.B. and Borns, Jr., H.W., 1985. Surficial Geologic Map of Maine: Maine Geological Survey, map, scale 1:500,000.

² Griffin, R., John, 1971, Reconnaissance bedrock geology of the Schoodic [15-minute] quadrangle, Maine: Maine Geological Survey, Open-File Map 71-2, map, scale 1:62,500.



test boring results is presented as **Figure 3**, Interpretive Subsurface Profile. The encountered thicknesses and elevations of each stratum are summarized on the attached **Table 1**.

Soil Unit	Approximate Encountered Thickness (ft)	Generalized Description
Fill	19 to 23	Variable <u>from</u> brown, loose to medium dense, fine to coarse SAND, little gravel; <u>to</u> GRAVEL, some sand, trace silt. Probable cobbles and boulders throughout. (USCS: SP, SW, SW-SM, SP-SM, GW, GP). Typical MaineDOT Frost Classification = II, Range = 0 to III <i>Encountered in borings BB-MPR-101 and BB-MPR-103.</i>
Alluvium	78 to 84	Variable <u>from</u> brown to brown-black, medium dense to very dense, Silty fine to coarse SAND; <u>to</u> fine to medium SAND, trace to some gravel, little silt; <u>to</u> Sandy GRAVEL, trace silt, possible cobbles and boulders. (USCS: SM, SP, SP-SM, SW, SW-SM, GW-GM). Gravel content increased with depth. Typical MaineDOT Frost Classification = II, Range = 0 to III <i>Encountered in all borings.</i> A 6-foot (BB-MPR-101) to 20-foot layer (HB-MPR-206) ranging <u>from</u> olive-grey, medium stiff to stiff, Clayey SILT, little fine sand and grey; <u>to</u> medium dense Clayey SAND was encountered at the top of the Alluvium in the two noted roadway borings. (USCS: ML, SC, CL)
Glacial Till	41 to 75	Variable <u>from</u> grey and brown, dense to very dense, Sandy GRAVEL, little silt; <u>to</u> fine to coarse SAND, some to trace silt, little gravel, with cobbles and boulders. (USCS: SM, SP, SW-SM, GW, GP, GP-GM, GM). Increased roller cone resistance in lower 8 to 13 feet of stratum indicates probable cobbles and boulders. MaineDOT Frost Classification = I to II <i>Encountered in all borings.</i>
Estimated Top of Possible Bedrock	Approx. El. 152 to 155 (125 to 126 feet bgs)	

4.2.1 Bedrock

Bedrock cored in each of the BB-MPR-200 series borings was identified as Slate and was generally described as very hard to hard, fresh to slightly weathered, aphanitic to fine grained, and grey, with calcite stringers. The joints are extremely close to moderately spaced, vertical to low angle, fresh to discolored, planar to undulating, rough, and very tight to wide. The Rock Quality Designation (RQD) in the Slate ranged from 0 to 80 percent, corresponding to a Rock Mass Quality of Very Poor to Good.

Due to difficult drilling conditions in the Glacial Till stratum, drill casing could not be advanced to bedrock and no bedrock cores were obtained in the -100 series borings. GZA interpreted the top of bedrock in these borings as the depth at which the rate of roller cone advancement under constant rig down pressure (200 psi) decreased to approximately 5 minutes per foot or slower.



4.2.2 Groundwater

Groundwater depth was measured in borings BB-MPR-201 and -202 at approximately 6.7 and 7.9 feet bgs, respectively, corresponding to El. 271.1 and 272.2, which is the approximate river level at the time the borings were conducted. Groundwater levels in the borings were measured during or immediately after drilling and may have been affected by drilling procedures, which included introduction of water for drilling purposes.

The groundwater observations were made at the times and under the conditions stated in the boring logs. Fluctuations in groundwater level occur due to variations in season, precipitation, river levels and construction activities in the area. Consequently, water levels during construction are likely to vary from those encountered at the time the observations were made.

5.0 ENGINEERING EVALUATIONS

5.1 GENERAL

GZA conducted geotechnical engineering evaluations in accordance with *2017 AASHTO LRFD Bridge Design Specifications, 8th Edition* (herein designated as AASHTO) and the *MaineDOT Bridge Design Guide, 2003 Edition*, with updates through 2018 (MaineDOT BDG). The sections that follow describe the evaluations and the geotechnical basis for each element. Supporting calculations are included in **Appendices D and E**.

5.2 APPROACH AND HIGHWAY EMBANKMENTS

The proposed bridge approaches will be constructed with typical side slope angles of approximately 2H:1V adjacent to the bridge and 3H:1V for the majority of the new roadway. We estimate that up to 16 feet of new fill will be placed at the bridge approaches within 250 feet of the abutments, and up to 7 feet of new fill will be placed in the remaining new roadway alignments, to facilitate the proposed new bridge and realigned roadways.

We anticipate that the approach embankments within 250 feet of the bridge will primarily be constructed over granular alluvium. Due to the alluvium's medium dense to dense consistency and low compressibility, embankment settlement and global stability in this portion of the site are not expected to be a concern for the project.

We anticipate the remaining approach embankments for the realigned roadways will be constructed over either medium to dense granular alluvium or medium stiff to stiff cohesive alluvium. A 20-foot stiff to medium stiff layer of sandy clay was encountered in HB-MPR-206, located at approximately station 25+00 to the north of the new intersection of Pleasant Street and Medford Road. Based on the recorded SPT N-values, we estimate the undrained shear strength of this layer is at least 1,000 psf, and it is also likely overconsolidated. The 98 percent plans indicate that up to 5 feet of new fill will be placed at this area. We anticipate that less than 1 inch of post-construction settlement will occur due to the new fill



loads, which is considered acceptable for the performance of the roadway. Fill slopes in this area are proposed to be 3H:1V or flatter, and do not pose a global stability concern bearing on the stiff clay.

5.3 SCOUR CONSIDERATIONS

Laboratory testing of the soil at and near riverbed elevations was assessed to estimate D₅₀ values, as summarized in the table below.

Boring & Sample ID	Depth (feet)	Approximate Elevation (ft NAVD 88)	Water Content (%)	D ₅₀ (mm)	Classification	
					USCS	AASHTO
BB-MPR-101, 6D	25-27	264-262	--	0.15	SM	A-2-4
BB-MPR-101, 7D	30-32	259-257	--	0.1	SM	A-2-4
BB-MPR-103, 7D	30-32	259-257	--	0.17	SM	A-2-4

5.4 EVALUATION OF FOUNDATION TYPES

5.4.1 Abutment Foundations

H-piles driven to very dense Glacial Till or refusal on or near bedrock are the preferred foundation type for the proposed integral abutments. Very dense glacial till that caused split spoon refusals was encountered starting at approximately 100 to 105 feet below bottom of abutment level in borings BB-MPR-201 and -202. Probable bedrock was encountered at depths of approximately 127 and 125 feet below the bottom of abutment level at Abutments 1 and 2, respectively.

5.4.2 Pier Foundation

A driven pile foundation, constructed in a cofferdam with a tremie seal, was identified in preliminary design as the preferred alternative for support of the pier based on the encountered conditions. Based on the data from borings BB-MPR-201 and -202, we estimate the top of very dense glacial till at the central pier is likely to be on the order of 85 to 95 feet below mudline, and the top of rock is likely to be approximately 115 to 125 feet below mudline.

5.5 LOAD AND RESISTANCE FACTORS

In GZA's experience, piles gaining a significant portion of their geotechnical resistance in very dense soil or on bedrock typically have the drivability resistance control their geotechnical resistance. For this condition, the piles will be driven to a nominal resistance calculated by dividing the maximum factored pile load (Strength load case) by a resistance factor of 0.65, per AASHTO Table 10.5.5.2.3-1. Resistance factors for service and extreme limit state design should be taken as 1.0.

Structural resistance of the piles should be checked at the strength limit state considering a resistance factor $\phi_c=0.50$, per AASHTO LRFD Article 10.7.3.2.3 for hard driving conditions. Since the abutment piles will be subject to lateral loading, the piles should also be checked for resistance to combined axial compression and flexure per AASHTO LRFD Articles 6.9.2.2 and 6.15.2. Per LRFD Article 6.5.4.2, the axial



resistance factor $\phi_{cc}=0.75$ and the flexural resistance factor $\phi_f=1.0$ should be applied to the combined axial and flexural resistance of the pile in the interaction equation (AASHTO LRFD Eq. 6.9.2.2-1).

AASHTO LRFD load factors should be applied to horizontal earth pressure (EH), vertical earth pressure (EV), earth surcharge (ES), live load surcharge (LS) loads, and components and attachments (DC) loads using the load factors for permanent loads (γ_p) provided in LRFD Table 3.4.1-2 for strength limit state foundation design.

5.6 PILE DESIGN CONSIDERATIONS

5.6.1 Pile Type and Loading

The abutments and pier are planned to be supported on ASTM A572, Grade 50 ($f_y=50$ ksi) HP14x117 steel H-piles. HNTB evaluated combined bending on the abutment piles and recommended HP14x117 piles be used to resist the anticipated stresses. A single row of ten plumb piles are planned to support each abutment. Two rows of eight plumb and battered piles are planned to support the central pier. HNTB provided maximum factored axial loads of 235 kips and 435 per pile for the Strength load case for the abutments and pier, respectively. Therefore, piles should be installed to a nominal axial resistance of at least 362 kips for the abutments and 669 kips for the pier, calculated by dividing the maximum factored axial load by a geotechnical resistance factor of 0.65. The resistance factor assumes dynamic pile testing with signal matching analysis will be conducted during construction in accordance with AASHTO requirements to assess nominal geotechnical pile resistance.

5.6.2 Estimated Pile Length

GZA estimated static axial compressive geotechnical resistance of the piles using the analytical software A-Pile by Ensoft and the U.S. Army Corp of Engineers method (Nordlund with effective stress cut-off at a critical depth [10B]). We anticipate that the abutment piles will be driven through a predrilled hole extending 15 feet below the bottom of the abutment (approximately El. 264.5 at Abutment 1 and 2), and the pier piles will be driven within a cofferdam after excavating to the bottom of seal (El. 254).

The resistance estimates were made assuming uniform soil properties in the Alluvium and Glacial Till strata. However, there is a significant chance that the tip of an H-pile will become plugged when driven into very dense till containing silt, sand and gravel, cobbles and boulders. In order to assess the impacts of this variable condition, GZA evaluated two scenarios, unplugged (end area equal to pile steel area) and half-plugged (50 percent of box area). Using these assumptions, GZA prepared the Pile Resistance Chart included in **Appendix E**. It is our opinion that the piles at this site are likely to develop at least a partially plugged condition in the very dense glacial till.

The curves suggest that even if half-plugged, the pier piles will need to be driven on or near bedrock to achieve the required axial resistance. We note that the closest boring was drilled 50 feet from the pier and the top of rock may vary over that distance. As a result, we anticipate total pile lengths of 105 to 125 feet below cut off elevation at the pier (estimated 115 feet from cutoff to top of rock at BB-MPR-102).



The curves for the abutment piles suggest that the nominal resistance may be achieved as shallow as 15 to 20 feet above the top of rock. If a full plug develops in the piles, they could stop as high as about 30 feet above the top of rock. As a result, we anticipate total pile lengths of 100 to 130 feet below cut off elevation at the abutments.

It is our understanding that it is MaineDOT's preference to conservatively predict pile lengths to limit the potential that insufficient pile will be available to complete the project. Therefore, we recommend the plans show pile lengths extending to the top of rock at both abutments and the pier.

By utilizing steel H-piles for support of the abutments and pier driven to very dense Glacial Till or near/to bedrock, total and differential settlement will be limited to elastic compression of the piles and should be less than ½ inch.

The piles will be fully embedded after installation. Therefore, corrosion was not considered in the design.

Axial tensile geotechnical (uplift) resistance was not evaluated because the structural loads provided by HNTB do not include uplift loading on the piles.

5.6.3 Preliminary Wave Equation Analysis

GZA completed preliminary wave equation analyses to assess the drivability of an HP 14x117 pile with a nominal geotechnical resistance of 362 kips at the abutments and 669 kips at the pier. The preliminary analyses used a single pile hammer for the pier and abutments, a Delmag D36-32 diesel hammer with a ram weight of 7,930 pounds and a maximum rated energy of 90,561 foot-pounds (ft-lbs). The geotechnical side resistance described in the previous section was used to estimate the percent side friction for the analysis.

We modeled a pile length of 132 feet for the abutments including 115 feet through overburden materials, 15 feet through the open temporary casing, and 2 feet of additional stick up. For this length, we anticipate the pile will derive most of its resistance in side friction, and we estimated 95 percent side friction. We modeled the pier piles with a length of 105 feet including 103 feet through overburden materials and a 2-foot stick up. We anticipate 60 percent side friction for the pier piles. We used a toe quake of 0.143 for both scenarios, which is considered appropriate to assess drivability of a long friction pile driven in sand, where it may be difficult getting energy to the tip during driving. The results are summarized below.



SUMMARY OF WEAP ANALYSES					
Pile Analysis and Type	Embedded Pile Length	Driving System	Required Nominal Geotechnical Resistance (kips)	Max Driving Stress (ksi)	Final Penetration Resistance (blows per inch)
Abutment 1 & 2 HP 14x117	115 feet	Delmag D 36-32 (Fuel setting 4, minimum)	362	25	4
Pier 1 HP 14x117	103 feet	Delmag D 36-32 (Fuel setting 1, maximum)	669	37	11

Since the driving stresses do not exceed the limiting driving stress of 45 ksi for ASTM A572 steel (50 ksi yield stress), and the calculated penetration resistance for the pier piles is within the MaineDOT preferred range of 3 to 15 blows per inch, the analyzed hammer system is judged acceptable to install the pier piles to the required nominal resistance noted.

The selected hammer system is larger than would typically be selected for the abutment piles, due to the difference in required nominal resistance between the abutments and pier. Our analyses utilize a single pile hammer system capable of installing piles at all substructures for the project, but a smaller hammer would be capable of installing the abutment piles. Results of the preliminary wave equation analyses are provided in **Appendix E**.

5.6.4 Lateral Pile Analysis

GZA developed a soil profile for lateral pile evaluations. The subsurface stratum encountered near the top of the piles includes primarily Alluvial Sand, but the uppermost portion of the piles may be within the bottom of the new embankment fill. We developed upper and lower bound conditions for the Alluvial Sand that should both be evaluated for the pile design, as the lower bound likely controls fixity and the upper bound condition likely controls pile stress. A single set of parameters was provided for glacial till, considering that this stratum is unlikely to influence lateral pile evaluations.

In addition, we provided parameters for loosely placed, cushion sand which is anticipated to be placed in a 30-inch diameter zone around the upper portion of the piles. The cushion sand was proposed to provide a looser material that would reduce bending stress in the piles caused by thermal bridge deck expansion. The following soil profiles were developed for lateral pile evaluations. These values were input into LPile and Group by Ensoft to develop various pile spring values for use in HNTB's CSiBridge® model, which are discussed in **Section 5.8**.



Abutment 1 and Abutment 2							
Stratum	Soil Model	Top of Layer Elevation (NAVD88 ft)	k (pci)		ϕ' (deg)		γ_e (pcf)
			Upper Bound	Lower Bound	Upper Bound	Lower Bound	
Cushion Sand	Reese Sand	279.5	K=40	--	32	--	120
New Fill/Alluvial Deposit	Reese Sand	279.5	k=210	k=85	38	32	125
Alluvial Deposit	Reese Sand	271/264.5	k=120	k=55	38	32	63
Glacial Till	Reese Sand	175	k=260		40		68
Top of Rock	--	155	--	--	--	--	--

Pier							
Stratum	Soil Model	Top of Layer Elevation (NAVD88 ft)	k (pci)		ϕ' (deg)		γ_e (pcf)
			Upper Bound	Lower Bound	Upper Bound	Lower Bound	
Alluvial Deposit	Reese Sand	253	k=120	k=55	38	32	63
Glacial Till	Reese Sand	175	k=260		40		68
Top of Rock	--	155	--	--	--	--	--

Notes:

1. Soil strata were modelled after BB-MPR-201 & 202.
2. Lateral pile evaluations should include both upper and lower bound values to assess impacts on pile deflections/fixity and stress.
3. Recommended modulus and unit weight values assume groundwater level at El. 271.
4. pci = pounds per cubic inch, deg = degrees, psf = pounds per square foot,
 - a. γ_T = total unit weight (used above anticipated groundwater level),
 - b. γ_e = effective unit weight (used below anticipated groundwater), pcf = pounds per square foot.
5. These parameters do not include reductions for group interaction. Reduction Factors should be applied in accordance with AASHTO 10.7.2.4 for spacing of 3 to 5 pile diameters.
6. At the abutments, top of alluvial deposit is at El. 271, but if cushion sand extends to El. 264.5, top of alluvial is lowered to El. 264.5

We understand that HNTB has evaluated pile stress and fixity as part of the CSiBridge® model in conjunction with the structural design.

5.7 LATERAL EARTH PRESSURE

5.7.1 Soil Backfill

Thermal expansion of the bridge will cause the backwalls and wingwalls of the integral abutment to move toward and away from the backfill in translation and/or rotation, which will result in earth pressures ranging from active to passive earth pressure. The material properties will be controlled by the backfill material, which is proposed to consist of BDG Type 4 soil.

Based on an assumed thermal bridge expansion of 1.5 inches and the abutment height of 13 feet, the calculated abutment rotation is 0.0096 feet/foot. In accordance with the requirements of the BDG Section 5.4.2.11, integral abutment reinforcement is to be designed for full Coulomb passive



pressure if the wall rotation is greater than 0.005 feet/foot. Therefore, we conclude that lateral earth pressure based on full Coloumb passive resistance should be used for design. HNTB's CSiBridge® model also requires active earth pressure, therefore GZA developed active earth pressure using Coulomb theory based on Article 3.6.4 of the BDG.

5.7.2 Elastic Inclusion

Following initial bridge modeling by HNTB using soil springs corresponding to the full passive earth pressure recommendations above, HNTB requested that GZA evaluate methods to reduce the lateral earth pressure acting on the abutments and wingwalls. We found that several states use elasticized expanded polystyrene (EPS) as a compressible inclusion on abutments and wingwalls for integral abutment bridges to reduce earth pressure on the structure and also to limit the ratcheting densification effect on the backfill caused by cycling lateral movement of the abutments.

We utilized a paper by Horvath (2000)³ to evaluate pressure reduction characteristics and thickness of an elasticized EPS layer behind the abutments. The elasticized properties of the material allow it to expand and contract nearly elastically within an axial compressive strain range of about 30 percent or less. At higher strains, the material experiences minor strain hardening which may not be recoverable. Based on Horvath's study, it was estimated that the maximum earth pressure coefficient in the thermal expansion phase is equal to or less than an at-rest condition. This represents a significant reduction in comparison to full passive pressure.

With a 2-foot-thick elastic inclusion, deflection of 0.9 inches at the bottom of the approach slab represents the end of the linear elastic range. We understand that the calculated maximum abutment movement based on thermal expansion from HNTB's CSiBridge® model is less than this value. Therefore, we conclude that at-rest earth pressures can be used for design, and that the deformation imposed in the elasticized EPS should fully recover after each expansion-contraction cycle. GZA's elasticized EPS evaluation and corresponding linear springs are presented in **Appendix D**.

5.8 SPRING DEVELOPMENT

In addition to the springs developed for lateral earth pressure on abutments described previously, HNTB requested that GZA develop springs to model the abutment piles and vertical soil reaction against the bottom of abutments and wingwalls for their CSiBridge® model. The springs provided to HNTB are presented in **Appendix D** of this report.

GZA developed the following pile springs based on the material properties and soil profile presented in **Section 5.6.4**, and using:

- Mobilized side resistance (T-Z) curves and mobilized tip resistance (Q-z) developed from Ensoft Apile output using properties consistent with axial pile resistance calculations;

³ Horvath, J. (2000). "Integral-Abutment Bridges: Problems and Innovative Solutions using EPS Geofoam and Other Geosynthetics," Manhattan College Research Report No. CE/GE-00-2.



- Lateral pile resistance (P-Y) curves developed from Ensoft LPILE using soil models and properties presented in **Section 5.6.4**, which we understand were modified by HNTB to account for group effects due to abutment pile spacing (i.e., p-multiplier effect);
- Torsion versus rotation (T- θ) curves developed from Ensoft Group using soil models and properties presented in **Section 5.6.4**; and
- Vertical soil reaction to abutment/wingwall deflection developed using methodology from the Washington State Department of Transportation Bridge Design Manual.

Tabulated spring values were presented to HNTB in PDF and Excel format, allowing direct input into their software.

5.9 SEISMIC DESIGN CONSIDERATIONS

The subsurface profile for seismic design includes Alluvium and Glacial Till overlying bedrock. Seismic site class was determined in general accordance with LRFD Table C3.10.3.1, considering the average SPT N-values in granular soils which encompasses most of the soil encountered in the borings. The average SPT N-value is generally between 15 and 50 blows per foot in the abutment borings, which is the range defining Site Class D. Therefore, based on this criterion, the bridge is assigned to Site Class D.

The available subsurface data indicates that the natural materials encountered at the site are sufficiently cohesive or dense that the potential for liquefaction is low.

5.10 FROST PROTECTION

New fill and alluvial sands are anticipated to be present at the abutments and embankments. Based on the MaineDOT BDG, Section 5.2.1, the Freezing Index for the site is 1,980, and with low-moisture content (<10 percent) soils, the estimated depth of frost penetration is approximately 7.9 feet. However, the BDG indicates that integral abutments should be embedded to a depth of 4 feet for frost protection.

5.11 CUSHION SAND FILTER COMPATIBILITY

As previously stated, a 30-inch diameter zone of cushion sand will be placed around each abutment pile to reduce bending stress in the piles caused by thermal bridge deck expansion. GZA completed a filter compatibility evaluation to assess the potential migration of soil particles between cushion sand material and the native Alluvial deposit, based on laboratory sieve results on the upper samples of borings BB-MPR-201 and -202. The assessment was to determine whether the cushion sand could be directly adjacent to in-situ soils, without migration of fines into or out of the cushion sand that would eventually make it stiffer than modelled. Evaluations were based on the methodology presented in the Naval Facilities Engineering Command DM 7.1-273 (Chapter 6, Section 4). We evaluated the potential for the cushion sand material to be either finer or coarser than the natural soils by evaluating the cushion sand as either a filter or a base material. We selected a cushion sand gradation that is generally consistent with material used on past MaineDOT projects and is filter compatible with all available alluvial deposit gradations in the elevation range that the material will be placed in, as presented in **Appendix E**. We concluded that the cushion sand and alluvial deposits are compatible and may be



placed in direct contact without risk of particle migration. The recommended cushion sand gradation is presented in **Section 6.4.2** of this report.

6.0 RECOMMENDATIONS

6.1 EMBANKMENT DESIGN CONSIDERATIONS

Embankment side slopes should be designed with MaineDOT-typical slope angles of 2H:1V or flatter, except in front of abutments where the 1.75H:1V slope angle will be used with an appropriate riprap surface treatment. Earth slopes should be provided with loam and seed for permanent erosion protection. Riprap should also be provided for scour protection where the embankment side slope angle will be 2H:1V and the slopes will be near or below typical water levels in the Pleasant River.

6.2 SEISMIC DESIGN

The peak ground acceleration coefficient, short- and long-period spectral acceleration coefficients were interpolated from the AASHTO design guide maps (3.10.2.1-1 through -21 as appropriate). Based on the site coordinates, the recommended AASHTO Response Spectra (Site Class D) for a 7 percent probability of exceedance in 75 years are summarized for the site are as follows:

SITE CLASS D SEISMIC DESIGN PARAMETERS	
Parameter	Design Value
Fpga	1.6
Fa	1.6
Fv	2.4
As (Period = 0.0 sec)	0.115 g
SDs (Period = 0.2 sec)	0.248 g
SD1 (Period = 1.0 sec)	0.113 g

6.3 ABUTMENT AND WINGWALL DESIGN

- Backfill between new abutments and wingwalls and a 1.5H:1V plane extending up from the bottom of the abutment to the pavement subgrade should consist of MaineDOT 703.19 Granular Borrow for Underwater Backfill, MaineDOT BDG Type 4 soil. Recommended soil properties for Type 4 soils are as follows:
 - Internal Friction Angle of Soil = 32°
 - Soil Total Unit Weight = 125 pcf
- Lateral earth pressure springs included in **Appendix D** were developed using the following earth pressure coefficients:
 - At-Rest Earth Pressure, $K_0 = 0.47$ (use for design of abutment and wingwalls in conjunction with a 2-foot-thick elasticized EPS compressible inclusion on the backfill side of the walls)



- Coulomb Passive Earth Pressure, $K_p = 6.73$ (use for design of abutment and wingwalls where there is no compressible inclusion)
- Coulomb Active Earth Pressure, $K_a = 0.28$ (use for design of abutment and wingwalls where there is no compressible inclusion)
- Live load surcharge should be applied as a uniform lateral surcharge pressure using the equivalent fill height (H_{eq}) values developed in accordance with LRFD Section 3.11.6.4, based on the abutment/wingwall height and distance from the wall backface to the edge of traffic. A minimum H_{eq} of 2 feet is recommended. Springs are included in **Appendix D** that include and exclude the live load surcharge, for evaluation of different modeling scenarios.
- Foundation drainage should be provided in accordance with Section 5.4.1.9 of the MaineDOT BDG. We recommend the use of French drains on the uphill side of abutments and wing walls to prevent buildup of differential hydrostatic pressure. The drains should be sloped to drain by gravity and should either outlet through a series of 4-inch-diameter weep holes, spaced approximately 10 feet center-to-center, or the French drain material should extend below the bottom of the structure elevation and daylight in front of the foundations.

6.4 RECOMMENDATIONS FOR FOUNDATIONS

6.4.1 Pile and Pile Cap Design

- The proposed abutments and piers may be supported on HP14x117 ASTM A572, Grade 50 steel (50 ksi yield stress) H-piles driven to the required nominal resistance, anticipated to be developed through a combination of skin friction and end-bearing near or on bedrock.
- To limit pile damage during driving, cast steel pile points should be provided in accordance with MaineDOT Standard Specification Section 501.10 – Pile Tips.
- Pile installation should be controlled using wave equation analysis and field logging of the pile installation with final penetration resistance based on dynamic pile testing with signal matching analysis.
- The abutment piles should be driven to a nominal resistance of 362 kips, calculated by dividing the maximum factored axial load of 235 kips by a resistance factor of 0.65.
- The pier piles should be driven to a nominal resistance of 669 kips, calculated by dividing the maximum factored axial load of 435 kips by a resistance factor of 0.65.
- Preliminary wave equation analyses indicate that the piles could be driven to the required nominal resistance using a diesel hammer with a maximum rated energy of about 90,561 ft-lbs for the anticipated 105- to 125-foot long (pier) and 100- to 130- foot long (abutment), ASTM A572 Grade 50 HP14x117 piles without exceeding the allowable driving stress of 45 ksi ($0.9F_y$ for 50 ksi steel), and with a final penetration resistance of approximately 4 to 11 blows per inch.
- We recommend that the pile tip elevations shown on the drawings at the abutments correspond to the bedrock elevations encountered in the borings (approximately El. 152 at Abutment 1, and approximately El. 155 at Abutment 2). Actual lengths could be up to 30 feet shorter depending on whether the piles plug. Pile tip elevations at the pier should correspond to the top of rock elevation estimated from boring BB-MPR-102, drilled on the existing bridge alignment (approximately El. 152).



Actual lengths could vary by 10 feet shorter or longer, or more, depending on the variability in top of rock near the pier and depending on the accuracy of the interpreted rock depth in boring BB-MPR-102, where rock was not cored.

- We recommend that one pile at each abutment and a battered pier pile be dynamically tested at the end of initial drive to assess driving stress and establish the penetration resistance criteria to achieve the required nominal resistance for the production piles. The plans should also require a restrike test on each test pile.
- Piles shall be spliced in accordance with MaineDOT Section 501.047.
- The structural engineer should complete structural evaluation of the piles, checking for combined stresses by incorporating the Lateral Input Parameters summarized in **Section 5.4.3** in accordance with the design steps listed in BDG Section 5.4.2.4.C, or following an equivalent procedure based on springs presented in **Appendix D** and the CSiBridge® modeling.
- Approach slabs should be constructed at each abutment to smooth the transition from the approach embankment to the bridge.

6.4.2 Cushion Sand

As discussed previously, a minimum 30-inch-diameter zone of cushion sand is proposed to limit bending stress in the upper portion of abutment piles. We understand that HNTB has established the required cushion sand limits to extend 15 feet below the bottom of the pile cap. Cushion sand should consist of clean, hard, durable, uncoated particles free of clay and deleterious substances meeting the proposed gradation presented below:

RECOMMENDED CUSHION SAND GRADATION	
Sieve Designation	Percentage by Weight Passing Square Mesh Sieves
1/4-inch	100
No. 20	20 - 60
No. 60	0 - 30
No. 100	0 - 10

The contractor should submit a material sample and gradation to the Resident for review and acceptance. The cushion sand should be loosely placed in the temporary casing and around the piles after the piles are driven to the required nominal resistance, as described in **Section 7.1**.

6.4.3 Elasticized EPS Compressible Inclusion

We recommend that a 2-foot-thick elasticized EPS layer be placed against the back of abutments and wingwalls where the corresponding springs provided in **Appendix D** have been used, which we understand is for all abutments and wingwalls. The material should have a compressive strength of 720 psf plus or minus 60 psf at 10 percent strain, and should have linear-elastic stress strain behavior up to 10 percent strain and linear proportional stress-strain behavior up to 30 percent strain. Special Provision Section 203 – Excavation and Embankment (Elastic Inclusion for Integral Abutment) will be



included in the contract documents and contains additional material requirements as well as required submittals, independent testing, and placement. Where EPS is used, the wall drainage materials need to be placed/constructed between the EPS and the backfill.

7.0 CONSTRUCTION CONSIDERATIONS

This section provides guidance regarding quality control during pile installation, excavation, dewatering, and foundation subgrade preparation and protection.

7.1 PILE & CUSHION SAND INSTALLATION

We anticipate that it will be necessary to use temporary casing to keep the holes open until the piles and cushion sand are installed. One feasible installation sequence is as follows:

1. Excavate to the bottom of abutment level;
2. Advance minimum 30-inch inside diameter temporary casings to the required depth;
3. Remove material from the inside of the temporary casings;
4. Install piles, driving them to achieve the nominal driving resistance;
5. Loosely place cushion sand inside of the temporary casing slightly above the approximate bottom of pile cap elevation;
6. Extract temporary casing;
7. Place additional cushion sand at the top of pile to replace material that settles when the casing is removed, as needed, and
8. Construct abutment.

7.2 PILE INSTALLATION CONTROL

We recommend that the H-pile installation be controlled using wave equation analysis of the contractor's proposed driving system, field logging of the pile installation, and determination of final penetration resistance based on dynamic pile testing with signal matching analysis. As previously noted, the piles should be driven to a nominal resistance calculated by dividing the maximum factored pile load by a resistance factor of 0.65, per AASHTO Table 10.5.5.2.3-1.

AASHTO Table 10.5.5.2.3-1 requires that at least one load test with signal matching be performed per substructure in conjunction with the resistance factor of 0.65. We recommended that one PDA test with Signal Matching be completed at each abutment and at a battered pier pile, including at least one restrike test for each tested pile, resulting in a total of three PDA tests.



7.3 EXCAVATION, TEMPORARY LATERAL SUPPORT AND DEWATERING

Excavations for abutment foundations are anticipated to be within a few feet of the existing ground surface. It is our understanding that Pleasant Street traffic or construction traffic will remain on the existing roadway during construction of the new bridge. In areas where sufficient space is available and water conditions permit, the excavation slopes may consist of sloped, open cuts. Where space is limited or if river levels require it, braced steel sheeting may be used to support excavation slopes. In all cases, temporary excavations should comply with OSHA excavation safety requirements.

We anticipate that the inflow of groundwater or surface water to abutment excavations can be handled by open pumping from sumps installed at the bottoms of excavations. The contractor should be responsible for controlling groundwater, surface runoff, infiltration, and water from all other sources by methods which preserve the undisturbed condition of the subgrade and permit foundation construction in-the-dry. Discharge of pumped groundwater and river water should comply with all local, State, and federal regulations.

We anticipate that a temporary sheet pile cofferdam with a tremie seal will be necessary for the construction of the pier. Sheets are anticipated to be installed into the alluvial deposit. Cobbles and boulders may be present within the depth of the sheet piles, which could result in difficult driving conditions and may require local spudding or excavation.



08/07/2020

GEOTECHNICAL DESIGN REPORT
PLEASANT RIVER BRIDGE NO. 3244 - MILO
HNTB Corporation
09.0025972.01

TABLES



TABLE 1
Summary of Subsurface Explorations
 Pleasant River Bridge #3244, Pleasant Street over Pleasant River
 Milo, ME
 WIN 22627.01

Boring ID	Ground Surface El. (ft)	Top of Stratum Elevation (ft)						Stratum Thickness (ft)					Depth to Top of Possible Bedrock ⁶ (ft)	Bottom of Boring Depth (ft)	Bottom of Boring El. (ft)	Groundwater	
		Pavement	Topsoil	Fill	Alluvial Deposit	Glacial Till	Possible Bedrock	Pavement	Topsoil	Fill	Alluvial Deposit	Glacial Till				El. (ft)	Depth (ft)
BB-MPR-101	288.6	288.6	NE	288.1	269.6	185.1	152.6	0.5	NE	18.5	84.5	32.5	136.0	147.0	141.6	NM	NM
BB-MPR-102	269.7	NE	NE	NE	269.7	186.2	151.7	NE	NE	NE	83.5	34.5	118.0	129.0	140.7	269.7	0.0
BB-MPR-103	288.8	288.8	NE	287.8	265.0	187.3	NE	1	NE	22.8	77.7	>25.8	NE	127.3	161.5	274.2	14.6
BB-MPR-103A	288.9	NM	NE	NM	NM	187.3	124.9	NE	NE	NM	NM	62.4	164.0	178.0	110.9	NM	NM
BB-MPR-201	277.8	NE	277.8	NE	276.8	173.3	152.2	NE	1.0	NE	103.5	21.1	125.6	155.0	122.8	271.1	6.7
BB-MPR-202	280.1	NE	280.1	NE	279.7	177.1	155.0	NE	0.4	NE	102.6	22.1	125.1	143.2	136.9	272.2	7.9
HB-MPR-201	280.0	NE	NE	280.0	276.0	NE	NE	NE	NE	4.0	>7.0	NE	NE	11.0	269.0	274.0	6.0
HB-MPR-202	279.3	NE	279.3	NE	278.8	NE	NE	NE	0.5	NE	>11.5	NE	NE	12.0	267.3	275.3	4.0
HB-MPR-203	279.6	NE	279.6	NE	279.3	NE	NE	NE	0.3	NE	>11.7	NE	NE	12.0	267.6	273.0	6.6
HB-MPR-204	278.2	NE	278.2	NE	277.9	NE	NE	NE	0.3	NE	>11.7	NE	NE	12.0	266.2	NM	NM
HB-MPR-205	277.5	NE	277.5	NE	277.0	NE	NE	NE	0.5	NE	>11.5	NE	NE	12.0	265.5	272.5	5.0
HB-MPR-206	278.3	NE	278.3	NE	278.0	NE	NE	NE	0.3	NE	>33.7	NE	NE	34.0	244.3	275.8	2.5

El. = Elevation, NE = Not Encountered, NM = Not Measured, NP = Not Penetrated, > = Boring Terminated in Stratum

Notes:

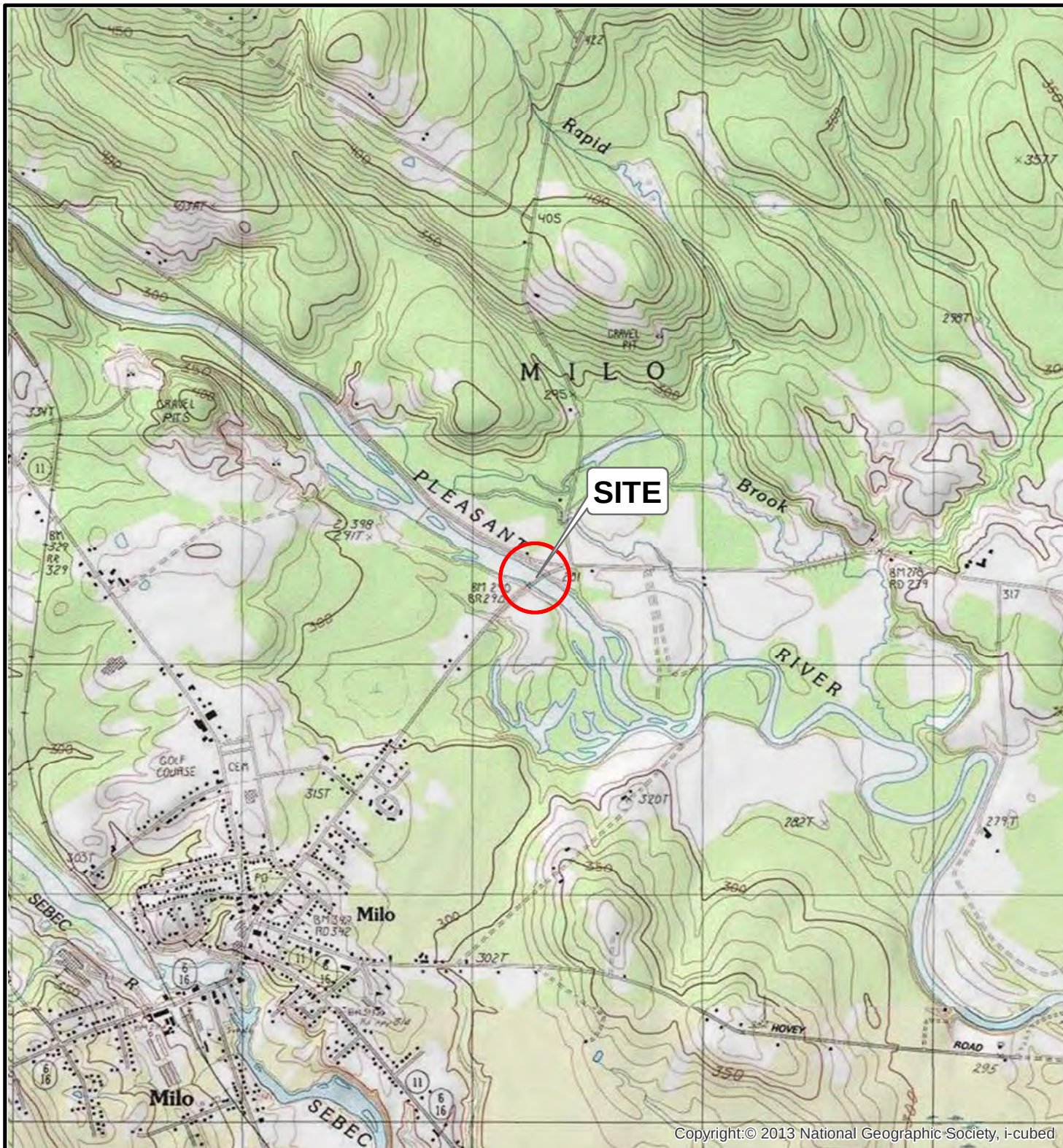
1. Refer to the boring logs in Appendix B for additional information.
2. Project elevation datum is North American Vertical Datum (NAVD 88), unless noted otherwise.
3. As-drilled elevations and locations were surveyed by MaineDOT and provided to GZA by HNTB.
4. Stratum depths, thickness and elevations are rounded to the nearest 0.1 foot as interpreted on the boring logs, but this does not represent the precision of the data.
5. Top of bedrock was estimated in the BB-MPR-100 series borings based on roller cone advancement characteristics; No coring was conducted. Top of bedrock was evaluated based on bedrock coring results in the BB-MPR-200 series borings.



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HNTB Corporation
09.0025972.01

FIGURES



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SOURCE : THIS MAP CONTAINS THE ESRI ARCGIS ONLINE USA TOPOGRAPHIC MAP SERVICE, PUBLISHED DECEMBER 12, 2009 BY ESRI ARCMS SERVICES AND UPDATED AS NEEDED. THIS SERVICE USES UNIFORM NATIONALLY RECOGNIZED DATUM AND CARTOGRAPHY STANDARDS AND A VARIETY OF AVAILABLE SOURCES FROM SEVERAL DATA PROVIDERS. THIS MAP ALSO CONTAINS THE ESRI ARCGIS ONLINE USA COUNTIES WHICH PROVIDES DETAILED BOUNDARIES THAT ARE CONSISTENT WITH THE TRACT, BLOCK GROUP, AND STATE DATA SETS AND ARE EFFECTIVE AT REGIONAL AND STATE LEVELS.

Data Supplied by :

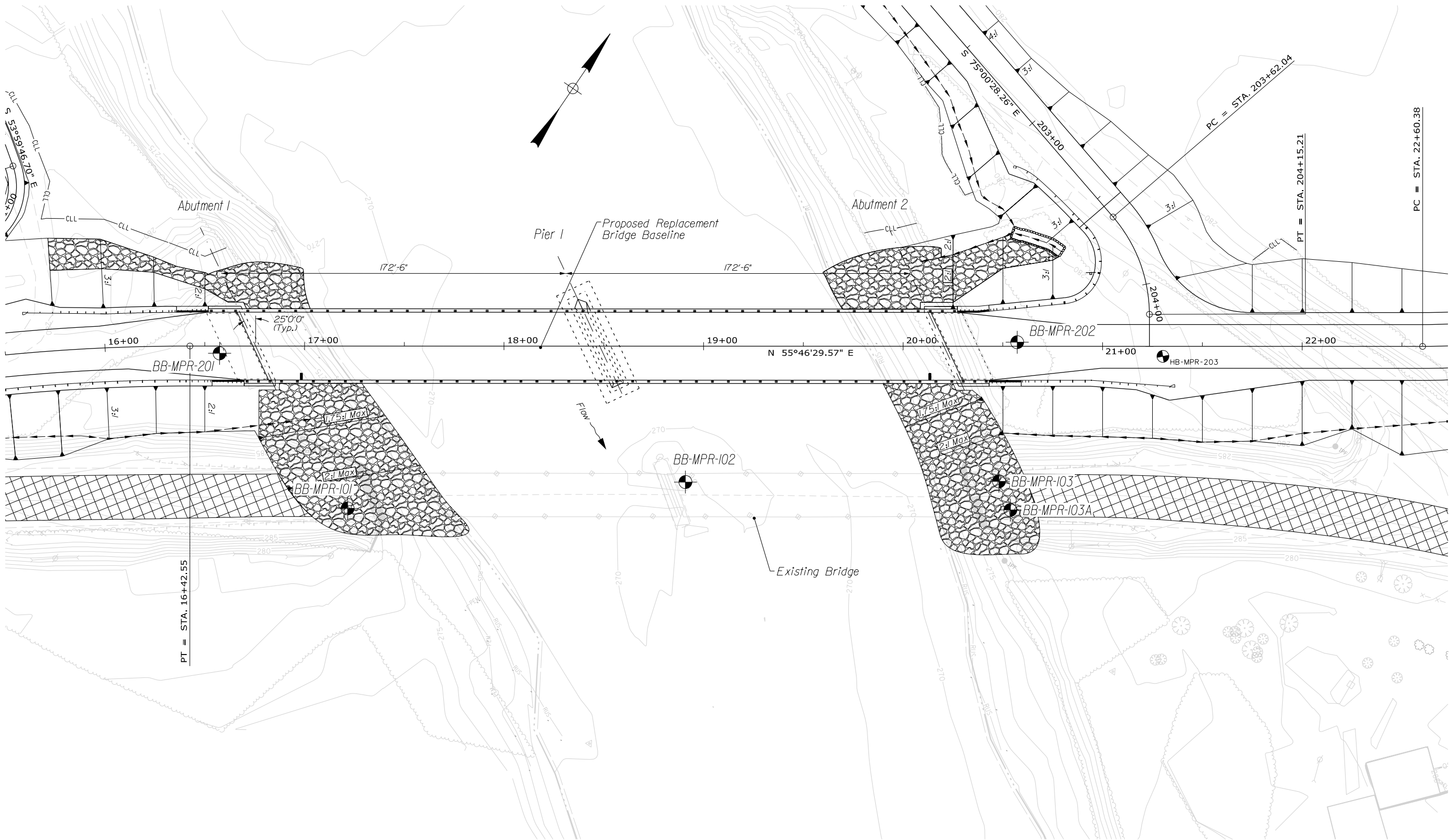


PROJ. MGR.: BMC
DESIGNED BY: BMC
REVIEWED BY: ARB
OPERATOR: ADM
DATE: 06-24-2020

LOCUS PLAN

PLEASANT RIVER BRIDGE NO. 3244
PLEASANT STREET, MILO, MAINE

JOB NO.
09.0025972.01
FIGURE NO.
1

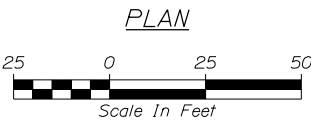


NOTES

- 1) Base map developed from electronic files (Files included Alignments.dgn, 3DContours.dgn, 3DTopo_20May19.dgn, and Wetlands.dgn) provided by HNTB on January 31, 2020 and electronic files (Files included Bridge.dgn and Highway.dgn) provided by HNTB on August 5, 2020.
- 2) The as-drilled boring locations were surveyed by a MaineDOT survey crew and provided to GZA in an electronic file (Borings.dgn).

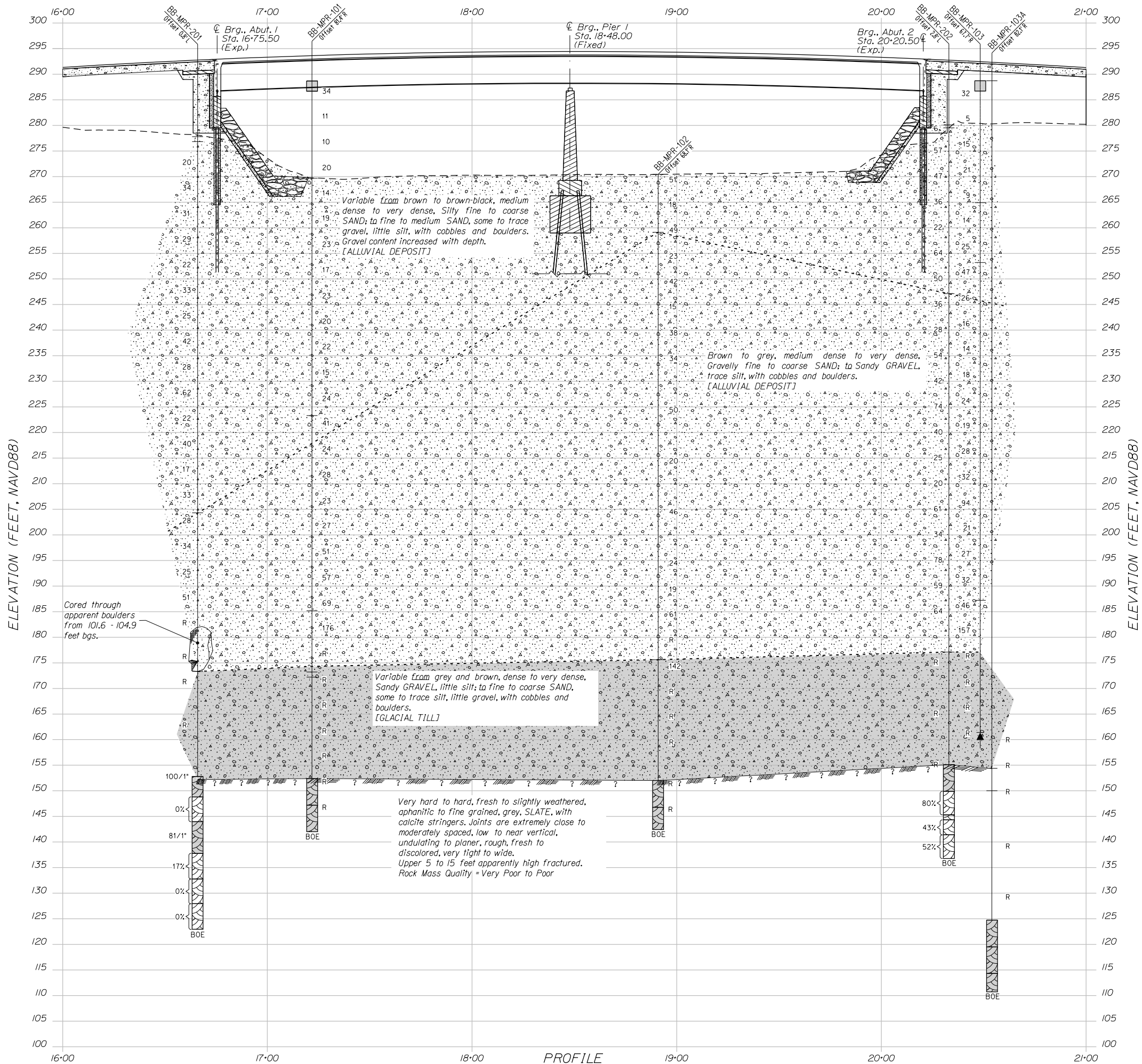
LEGEND

- BB-MPR-103 Location and designation of 100-Series Bridge borings performed by New England Boring Contractors between April 30, 2018 and May 21, 2018.
- BB-MPR-202 Location and designation of 200-Series Bridge borings performed by New England Boring Contractors between October 8, 2019 and October 24, 2019.
- BB-MPR-206 Location and designation of 200-Series Highway borings performed by New England Boring Contractors between March 3, 2020 and March 4, 2020.



PLEASANT RIVER BRIDGE NO. 3244 MAINEDOT WIN 22627.01 MILO, ME			
BRIDGE BORING LOCATION PLAN			
PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		PREPARED FOR: HNTB	
PROJ MGR: BMC	REVIEWED BY: ARB	CHECKED BY: CLS	FIG
DESIGNED BY: BMC	DRAWN BY: BMC	SCALE: AS SHOWN	2
DATE: 6/24/2020	PROJECT NO. 09.0025972.01	REVISION NO. 0	
SHEET NO. 2 OF 6			

STATE OF MAINE DEPARTMENT OF TRANSPORTATION		BRIDGE PLANS	
PLEASANT RIVER BRIDGE NO. 3244 PLEASANT STREET OVER PLEASANT RIVER MILO, ME		BORING LOCATION PLAN	
SHEET NUMBER		12	
DATE		OF 91	
BRIDGE NO. 3244		WIN 22627.01	



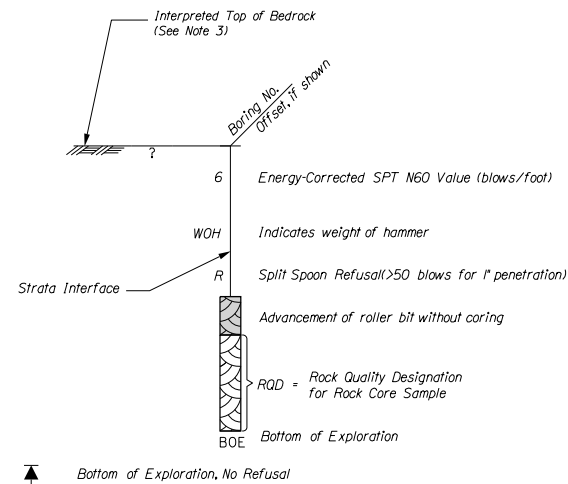
NOTES

1) Base map developed from electronic files provided by HNTB on August 5, 2020 (File included Profile.dgn)

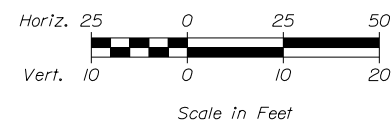
2) The as-drilled boring locations were surveyed by a MaineDOT survey crew and provided to GZA in an electronic file (Borings.dgn).

3) This generalized interpretive soil profile is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and have been developed by interpretations of widely spaced explorations and samples. Actual soil and rock transitions may vary and are probably more erratic. For more specific information refer to the exploration logs.

LEGEND



PROFILE



PLEASANT RIVER BRIDGE NO. 3244 MAINEDOT WIN 22627.01 MILO, ME			
INTERPRETIVE SUBSURFACE PROFILE			
PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		PREPARED FOR: HNTB	
PROJ MGR: BMC	REVIEWED BY: ARB	CHECKED BY: CLS	FIG 3
DESIGNED BY: BMC	DRAWN BY: BMC	SCALE: AS SHOWN	
DATE: 6/24/2020	PROJECT NO. 09.0025972.01	REVISION NO. 0	SHEET NO. 3 OF 6

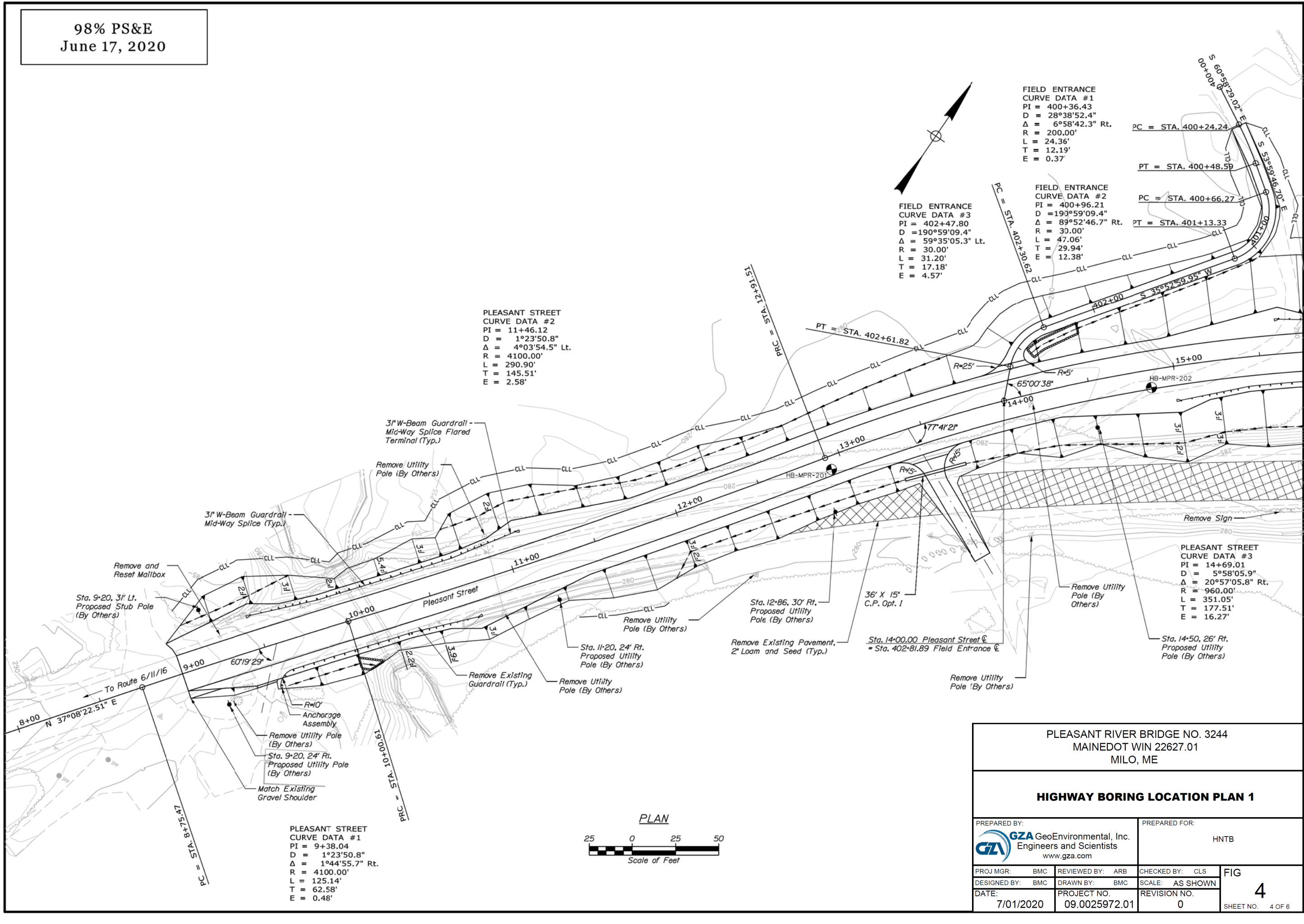
STATE OF MAINE DEPARTMENT OF TRANSPORTATION				BRIDGE NO. 3244 WIN 22627.01 BRIDGE PLANS			
PLEASANT RIVER BRIDGE NO. 3244 PLEASANT STREET OVER PLEASANT RIVER PISCATAQUIS COUNTY MILO, ME				SIGNATURE			
INTERPRETIVE SUBSURFACE PROFILE				P.E. NUMBER			
SHEET NUMBER 13 OF 91				DATE			

Date: 6/16/2020

Username:

Division:

Filename: 004_BDPlan_01.dgn



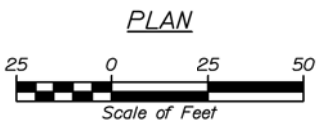
FIELD ENTRANCE
CURVE DATA #1
PI = 400+36.43
D = 28°38'52.4" Rt.
Δ = 6°58'42.3" Rt.
R = 200.00'
L = 24.36'
T = 12.19'
E = 0.37'

FIELD ENTRANCE
CURVE DATA #2
PI = 400+96.21
D = 190°59'09.4"
Δ = 89°52'46.7" Rt.
R = 30.00'
L = 47.06'
T = 29.94'
E = 12.38'

PLEASANT STREET
CURVE DATA #2
PI = 11+46.12
D = 1°23'50.8"
Δ = 4°03'54.5" Lt.
R = 4100.00'
L = 290.90'
T = 145.51'
E = 2.58'

PLEASANT STREET
CURVE DATA #3
PI = 14+69.01
D = 5°58'05.9" Rt.
Δ = 20°57'05.8" Rt.
R = 960.00'
L = 351.05'
T = 177.51'
E = 16.27'

PLEASANT STREET
CURVE DATA #1
PI = 9+38.04
D = 1°23'50.8"
Δ = 1°44'55.7" Rt.
R = 4100.00'
L = 125.14'
T = 62.58'
E = 0.48'



PLEASANT RIVER BRIDGE NO. 3244 MAINEDOT WIN 22627.01 MILO, ME			
HIGHWAY BORING LOCATION PLAN 1			
PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		PREPARED FOR: HNTB	
PROJ MGR: BMC	REVIEWED BY: ARB	CHECKED BY: CLS	FIG 4
DESIGNED BY: BMC	DRAWN BY: BMC	SCALE: AS SHOWN	
DATE: 7/01/2020	PROJECT NO. 09.0025972.01	REVISION NO. 0	SHEET NO. 4 OF 6

SHEET NUMBER 4 OF 89		PLEASANT RIVER BRIDGE PLEASANT RIVER PISCATAQUIS MILO		PROJ. MANAGER A. Lethe DESIGN-DETAILED C. Helmick CHECKED-REVIEWED L. Driscoll DESIGN-DETAILED DESIGN-DETAILED DESIGN-DETAILED REVISIONS 1 REVISIONS 2 REVISIONS 3 REVISIONS 4 FIELD CHANGES		BY P. Bishop R. Hart <	
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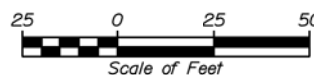
98% PS&E
June 17, 2020

PLEASANT RIVER ROAD
CURVE DATA #1
PI = 200+99.78
D = 4°46'28.7"
Δ = 7°38'30.1" Lt.
R = 1200.00'
L = 160.05'
T = 80.14'
E = 2.67'

PLEASANT RIVER RD.
CURVE DATA #2
PI = 203+89.79
D = 76°23'39.7"
Δ = 40°37'03.1" Rt.
R = 75.00'
L = 53.17'
T = 27.76'
E = 4.97'

PLEASANT STREET
CURVE DATA #3
PI = 14+69.01
D = 5°58'05.9"
Δ = 20°57'05.8" Rt.
R = 960.00'
L = 351.05'
T = 177.51'
E = 16.27'

PLAN



PLEASANT RIVER BRIDGE NO. 3244
MAINEDOT WIN 22627.01
MILO, ME

HIGHWAY BORING LOCATION PLAN 2

PREPARED BY:
GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:
HNTB

PROJ MGR: BMC
DESIGNED BY: BMC
DATE: 7/01/2020

REVIEWED BY: ARB
DRAWN BY: BMC
PROJECT NO.: 09.0025972.01

CHECKED BY: CLS
SCALE: AS SHOWN
REVISION NO.: 0

FIG
5
SHEET NO. 5 OF 6

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
2262701
WIN
022627.01
BRIDGE NO. 3244
BRIDGE PLANS

DATE	BY	PROJ. MANAGER	CHECKED-REVIEWED	DESIGNED-DETAILED	REVISIONS 1	REVISIONS 2	REVISIONS 3	REVISIONS 4	FIELD CHANGES
06/20	A. Lete	A. Lete	C. Helmick	L. Driscoll					
06/20	P. Bishop								
06/20	R. Hart								

PLEASANT RIVER BRIDGE
PLEASANT RIVER
PISCATAQUIS
MILO
GENERAL PLAN 2

SHEET NUMBER
5
OF 89

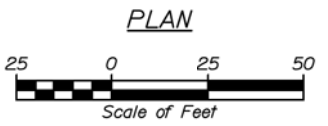
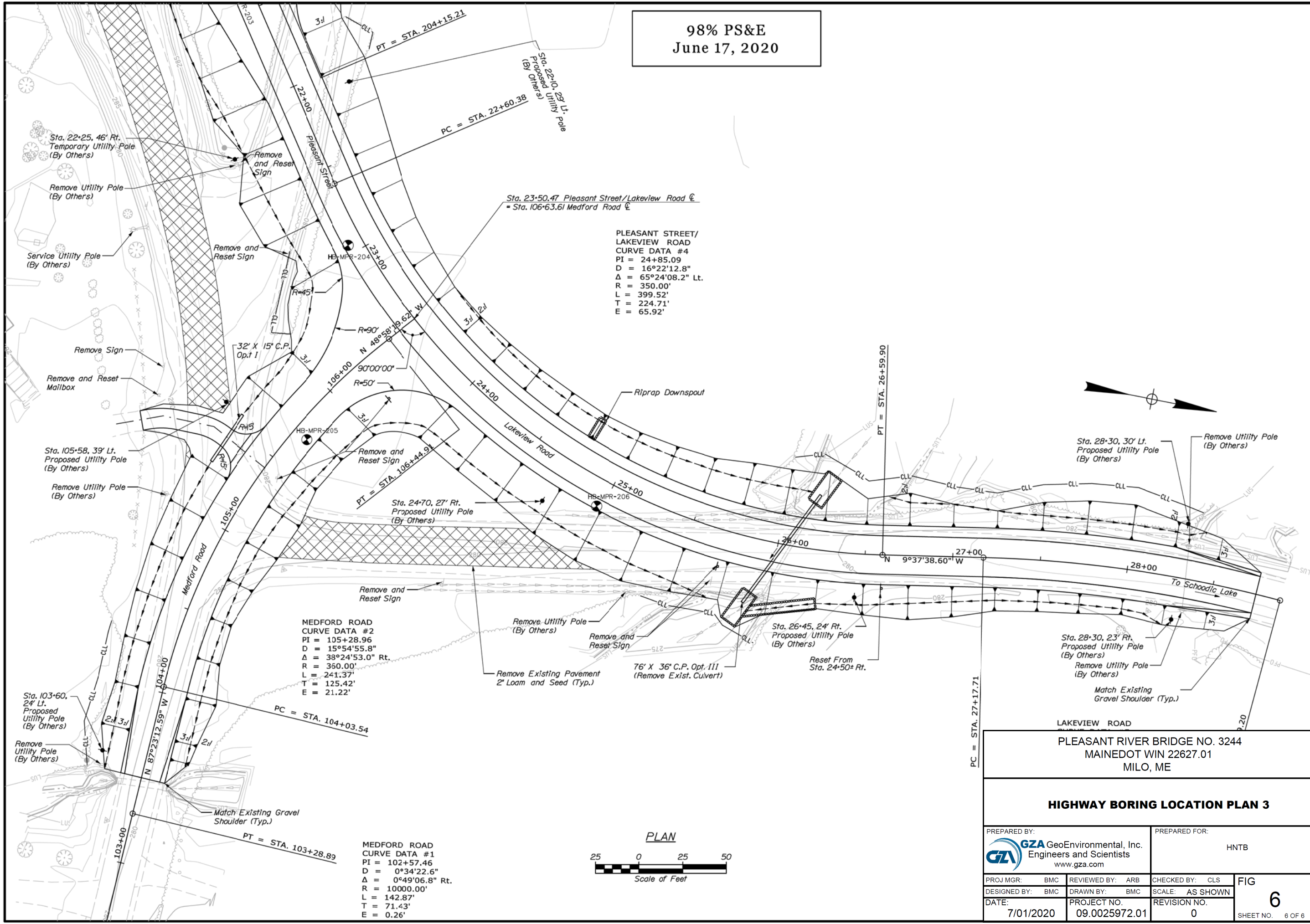
Date: 6/16/2020

Username:

Division:

Filename: 006_BDPPlan_03.dgn

98% PS&E
June 17, 2020



PLEASANT RIVER BRIDGE NO. 3244
MAINEDOT WIN 22627.01
MILO, ME

HIGHWAY BORING LOCATION PLAN 3

PREPARED BY:
 GZA GeoEnvironmental, Inc.
Engineers and Scientists
www.gza.com

PREPARED FOR:

HNTB

PROJ MGR: BMC	REVIEWED BY: ARB	CHECKED BY: CLS	FIG
DESIGNED BY: BMC	DRAWN BY: BMC	SCALE: AS SHOWN	6
DATE: 7/01/2020	PROJECT NO. 09.0025972.01	REVISION NO. 0	SHEET NO. 6 OF 6

STATE OF MAINE DEPARTMENT OF TRANSPORTATION		2262701		WIN 022627.01		BRIDGE NO. 3244 BRIDGE PLANS	
PLEASANT RIVER BRIDGE PLEASANT RIVER		PISCATAQUIS		MILO		GENERAL PLAN 3	
PROJECT MANAGER A. Lete		DESIGNED BY C. Hainick		CHECKED BY P. Bishop		DATE 06/20	
DESIGNED BY C. Hainick		CHECKED BY P. Bishop		DATE 06/20		SIGNATURE	
DESIGNED BY C. Hainick		CHECKED BY P. Bishop		DATE 06/20		P.E. NUMBER	
DESIGNED BY C. Hainick		CHECKED BY P. Bishop		DATE 06/20		DATE	
DESIGNED BY C. Hainick		CHECKED BY P. Bishop		DATE 06/20		FIELD CHANGES	



08/07/2020

GEOTECHNICAL DESIGN REPORT
PLEASANT RIVER BRIDGE NO. 3244 - MILO
HNTB Corporation
09.0025972.01

APPENDIX A – LIMITATIONS



GEOTECHNICAL LIMITATIONS

Use of Report

1. GZA GeoEnvironmental, Inc. (GZA) prepared this report on behalf of, and for the exclusive use of our Client for the stated purpose(s) and location(s) identified in the Proposal for Services and/or Report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not expressly identified in the contract documents, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

Standard of Care

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in Proposal for Services and/or Report, and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. If conditions other than those described in this report are found at the subject location(s), or the design has been altered in any way, GZA shall be so notified and afforded the opportunity to revise the report, as appropriate, to reflect the unanticipated changed conditions .
3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made.
4. In conducting our work, GZA relied upon certain information made available by public agencies, Client and/or others. GZA did not attempt to independently verify the accuracy or completeness of that information. Inconsistencies in this information which we have noted, if any, are discussed in the Report.

Subsurface Conditions

5. The generalized soil profile(s) provided in our Report are based on widely-spaced subsurface explorations and are intended only to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and were based on our assessment of subsurface conditions. The composition of strata, and the transitions between strata, may be more variable and more complex than indicated. For more specific information on soil conditions at a specific location refer to the exploration logs. The nature and extent of variations between these explorations may not become evident until further exploration or construction. If variations or other latent conditions then become evident, it will be necessary to reevaluate the conclusions and recommendations of this report.
6. In preparing this report, GZA relied on certain information provided by the Client, state and local officials, and other parties referenced therein which were made available to GZA at the time of our evaluation. GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this evaluation.



7. Water level readings have been made in test holes (as described in this Report) and monitoring wells at the specified times and under the stated conditions. These data have been reviewed and interpretations have been made in this Report. Fluctuations in the level of the groundwater however occur due to temporal or spatial variations in areal recharge rates, soil heterogeneities, the presence of subsurface utilities, and/or natural or artificially induced perturbations. The water table encountered in the course of the work may differ from that indicated in the Report.
8. GZA's services did not include an assessment of the presence of oil or hazardous materials at the property. Consequently, we did not consider the potential impacts (if any) that contaminants in soil or groundwater may have on construction activities, or the use of structures on the property.
9. Recommendations for foundation drainage, waterproofing, and moisture control address the conventional geotechnical engineering aspects of seepage control. These recommendations may not preclude an environment that allows the infestation of mold or other biological pollutants.

Compliance with Codes and Regulations

10. We used reasonable care in identifying and interpreting applicable codes and regulations. These codes and regulations are subject to various, and possibly contradictory, interpretations. Compliance with codes and regulations by other parties is beyond our control.

Cost Estimates

11. Unless otherwise stated, our cost estimates are only for comparative and general planning purposes. These estimates may involve approximate quantity evaluations. Note that these quantity estimates are not intended to be sufficiently accurate to develop construction bids, or to predict the actual cost of work addressed in this Report. Further, since we have no control over either when the work will take place or the labor and material costs required to plan and execute the anticipated work, our cost estimates were made by relying on our experience, the experience of others, and other sources of readily available information. Actual costs may vary over time and could be significantly more, or less, than stated in the Report.

Additional Services

12. GZA recommends that we be retained to provide services during any future: site observations, design, implementation activities, construction and/or property development/redevelopment. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.



08/07/2020

GEOTECHNICAL DESIGN REPORT
PLEASANT RIVER BRIDGE NO. 3244 - MILO
HNTB Corporation
09.0025972.01

APPENDIX B – TEST BORING LOGS

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Pleasant River Bridge #3244 Pleasant Street over Pleasant River Location: Milo, Maine				Boring No.: BB-MPR-101-1 WIN: 22627.00									
Driller: New England Boring Contractors				Elevation (ft.) 288.6				Auger ID/OD: 4.25" SSA									
Operator: Brad Enos				Datum: NAVD 88				Sampler: Standard Splitspoon									
Logged By: B. Woodman				Rig Type: Mobile B53				Hammer Wt./Fall: 140#/30"									
Date Start/Finish: 4-30-18 / 5-3-18				Drilling Method: Drive & Wash				Core Barrel: --									
Boring Location: N644016.1, E1680092.1				Casing ID/OD: 4"/4.5", 3"/3.5"				Water Level*: Not Measured									
Hammer Efficiency Factor: 0.6				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 Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.					
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows										
	25	6D	24/11	25.0 - 27.0	8-10-9-17	19	19	81					263.5	25.1-	Top 1": Olive-grey, medium stiff, Clayey SILT, little fine sand, (Alluvial Deposit).	G#4 A-2-4(0) SM	
								113							Bottom 10": Brown, wet, medium dense, fine SAND, little silt, (Alluvial Deposit).		
								129									
								138									
	30												143	253.5	35.1-	Grey and brown, wet, medium dense, Silty fine SAND, trace gravel, (Alluvial Deposit).	G#5 A-4(0) SM
		7D	24/13	30.0 - 32.0	9-9-14-20	23	23	97					151				
													161				
													161				
	35												170	35.1-	35.1-	Top 1": Grey and brown, wet, medium dense, fine to medium SAND, little silt, (Alluvial Deposit).	
		8D	24/13	35.0 - 37.0	11-7-10-12	17	17	103					112			Bottom 12": Brown, wet, medium dense, fine to medium SAND, (Alluvial Deposit).	
													127				
													134				
	40												142	35.1-	35.1-	Dark brown, wet, medium dense, fine to coarse SAND, (Alluvial Deposit).	
		9D	24/8	40.0 - 42.0	12-11-12-14	23	23	109					100				
													113				
													136				
	45												145	35.1-	35.1-	Dark brown, wet, medium dense, medium to coarse SAND, little gravel, (Alluvial Deposit).	
		10D	24/8	45.0 - 47.0	14-11-9-14	20	20	95					121				
													159				
													169				
	50												183				
	Remarks: 1. Roller cone grinding at 18.1' bgs, roller cone ahead to 20.0'. 2. Switched from rope & cathead / safety hammer to automatic hammer at 100.0', see log BB-MPR-101-2. 3. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterburg Limit tests if available, rather than the MaineDOT Standard based percentages passing specific grain sizes.																
	Stratification lines represent approximate boundaries between soil types; transitions may be gradual.												Page 2 of 5				
* 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.										Boring No.: BB-MPR-101-1							

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS					Project: Pleasant River Bridge #3244 Pleasant Street over Pleasant River Location: Milo, Maine			Boring No.: BB-MPR-101-1 WIN: 22627.00					
Driller: New England Boring Contractors		Elevation (ft.) 288.6		Auger ID/OD: 4.25" SSA									
Operator: Brad Enos		Datum: NAVD 88		Sampler: Standard Splitspoon									
Logged By: B. Woodman		Rig Type: Mobile B53		Hammer Wt./Fall: 140#/30"									
Date Start/Finish: 4-30-18 / 5-3-18		Drilling Method: Drive & Wash		Core Barrel: --									
Boring Location: N644016.1, E1680092.1		Casing ID/OD: 4"/4.5", 3"/3.5"		Water Level*: Not Measured									
Hammer Efficiency Factor: 0.6		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 Information								Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.		
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)					
50	11D	24/10	50.0 - 52.0	15-11-11-11	22	22		238.2		Top 4": Olive-brown, wet, medium dense, Silty SAND, (Alluvial Deposit). Bottom 6": Brown, fine to coarse SAND, some gravel, (Alluvial Deposit). Dark brown/grey, wet, medium dense, fine to medium SAND, trace gravel, trace silt, (Alluvial Deposit). Minimal recovery, fine to medium gravel. Top 4": Brown, wet, dense, fine to medium SAND, trace silt, (Alluvial Deposit). Bottom 4" Brown, wet, dense, GRAVEL, little fine to coarse sand, (Alluvial Deposit). Brown, wet, medium dense, fine to coarse SAND, some gravel, (Alluvial Deposit).	G#6 A-1-b SP-SM		
						115		50.4					
						121							
						126							
						137							
55	12D	24/8	55.0 - 57.0	10-8-7-12	15	15	111						
							117						
							153						
							176						
							168						
60	13D	24/<1	60.0 - 62.0	8-12-12-13	24	24	148						
							146						
							RC						
65	14D	24/8	65.0 - 67.0	19-20-21-23	41	41	176	223.2					
							176						
							186						
							195						
							227						
70	15D	24/6	70.0 - 72.0	9-11-13-15	24	24	RC						
75													
Remarks: 1. Roller cone grinding at 18.1' bgs, roller cone ahead to 20.0'. 2. Switched from rope & cathead / safety hammer to automatic hammer at 100.0', see log BB-MPR-101-2. 3. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterburg Limit tests if available, rather than the MaineDOT Standard based percentages passing specific grain sizes.													
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.									Page 3 of 5				
* 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.									Boring No.: BB-MPR-101-1				

[illegible]

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS					Project: Pleasant River Bridge #3244 Pleasant Street over Pleasant River Location: Milo, Maine			Boring No.: BB-MPR-103 WIN: 22627.00																																																																																																																																																																																																																									
Driller: New England Boring Contractors				Elevation (ft.) 288.8			Auger ID/OD: 4.25" SSA																																																																																																																																																																																																																										
Operator: Brad Enos				Datum: NAVD 88			Sampler: Standard Splitspoon																																																																																																																																																																																																																										
Logged By: B. Woodman				Rig Type: Mobile B53 Rubber-Track			Hammer Wt./Fall: 140#/30"																																																																																																																																																																																																																										
Date Start/Finish: 5-9-18 / 5-11-18				Drilling Method: Drive & Wash			Core Barrel: --																																																																																																																																																																																																																										
Boring Location: N644211.1, E1680354.3				Casing ID/OD: 4"/4.5", 3"/3.5"			Water Level*: 14.6' bgs																																																																																																																																																																																																																										
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																																																																																																																																																																																																																										
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Boring No.: BB-MPR-103																																																																																																																																																																																																																																	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Pleasant River Bridge #3244 Pleasant Street over Pleasant River Location: Milo, Maine		Boring No.: BB-MPR-103 WIN: 22627.00					
Driller: New England Boring Contractors		Elevation (ft.) 288.8		Auger ID/OD: 4.25" SSA							
Operator: Brad Enos		Datum: NAVD 88		Sampler: Standard Splitspoon							
Logged By: B. Woodman		Rig Type: Mobile B53 Rubber-Track		Hammer Wt./Fall: 140#/30"							
Date Start/Finish: 5-9-18 / 5-11-18		Drilling Method: Drive & Wash		Core Barrel: --							
Boring Location: N644211.1, E1680354.3		Casing ID/OD: 4"/4.5", 3"/3.5"		Water Level*: 14.6' bgs							
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							
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	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)			
75	16D	24/0	75.0 - 77.0	4-14-14-14	28	32	71	211.3		No recovery, drove 3" spoon through interval. Brown/black, wet, dense, medium to coarse SAND, some fine gravel, trace silt, (Alluvial Deposit).	G#22 A-1-a SW-SM
							86				
							99				
							116				
							138				
80	17D	24/10	80.0 - 82.0	32-43-40-35	83	94	RC	208.4		Top 4": Brown, wet, very dense, fine SAND, little silt, (Alluvial Deposit). Bottom 6": Brown, wet, very dense, Gravelly fine to coarse SAND, trace silt, (Alluvial Deposit).	
85	18D	24/1	85.0 - 87.0	12-9-10-11	19	21	190			Minimal recovery, Sandy GRAVEL.	
							198				
							192				
							263				
							216				
90	19D	24/6	90.0 - 92.0	14-12-12-12	24	27	125			Brown/black, wet, medium dense, GRAVEL, some sand, (Alluvial Deposit).	
							149				
							153				
							141				
							140				
95	20D	24/6	95.0 - 97.0	19-17-11-17	28	32	152			Brown/black, wet, dense, GRAVEL, some sand, (Alluvial Deposit).	
							146				
							168				
							319				
							269				
100											
Remarks: 1. Auto hammer NEBC #2, ETR = 0.677. 2. Casing driven with 140 lb to 65', then 300 lb hammer to 95', then auto hammer below 85'. 3. 4" Casing refusal at 114.9'; telescope and begin driving 3" casing. Roller cone ahead of casing. 4. 26D: piece of casing shoe broke off at 125.0'; grind through with roller cone and sample at 127.0'-127.3'. Stratification lines represent approximate boundaries between soil types; transitions may be gradual.											
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Boring No.: BB-MPR-103											

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Pleasant River Bridge #3244 Pleasant Street over Pleasant River Location: Milo, Maine				Boring No.: BB-MPR-103 WIN: 22627.00																								
Driller: New England Boring Contractors				Elevation (ft.): 288.8				Auger ID/OD: 4.25" SSA																								
Operator: Brad Enos				Datum: NAVD 88				Sampler: Standard Splitspoon																								
Logged By: B. Woodman				Rig Type: Mobile B53 Rubber-Track				Hammer Wt./Fall: 140#/30"																								
Date Start/Finish: 5-9-18 / 5-11-18				Drilling Method: Drive & Wash				Core Barrel: --																								
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Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks		Laboratory Testing Results/ AASHTO and Unified Class.																			
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows																									
100	21D	20/4	100.3 - 102.0	32-17-24-48/.2	41	46	RC		187.3		Brown, wet, dense, fine to coarse SAND, some gravel, little silt, (Alluvial Deposit). Spoon refusal at 102.2'.	—101.5'	Increased roller cone resistance/grinding at 101.5'.	G#23 A-1-b SM																		
105	22D	24/6	105.0 - 107.0	61-80-59-98	139	157						Brown, wet, very dense, Sandy GRAVEL, little silt, (Glacial Till). Increased roller cone resistance at 107.5'. Losing water at 107.5'-110.4'.																				
110	23D	14/7	110.4 - 111.6	81-57-55/.2					178.1			Top 3": Grey/black, wet, very dense, fine to coarse GRAVEL, (Glacial Till). Possible cobble.	—110.7'		Bottom 4": Brown, wet, very dense, Gravelly fine to coarse SAND, little silt, (Glacial Till).																	
115	24D	14/10	115.0 - 116.2	53-69-44/.2								Brown, wet, very dense, fine to coarse SAND, some fine gravel, little silt, (Glacial Till).																				
120	25D	17/10	120.0 - 121.4	111-115-100/.4							Brown, wet, very dense, Gravelly fine to coarse SAND, little silt, (Glacial Till).																					
125																																

Remarks: 1. Auto hammer NEBC #2, ETR = 0.677. 2. Casing driven with 140 lb to 65', then 300 lb hammer to 95', then auto hammer below 85'. 3. 4" Casing refusal at 114.9'; telescope and begin driving 3" casing. Roller cone ahead of casing. 4. 26D: piece of casing shoe broke off at 125.0'; grind through with roller cone and sample at 127.0'-127.3'.											
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 5 of 6	
* 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.										Boring No.: BB-MPR-103	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS										Project: Pleasant River Bridge #3244 Pleasant Street over Pleasant River Location: Milo, Maine				Boring No.: BB-MPR-103-A WIN: 22627.00										
Driller: New England Boring Contractors					Elevation (ft.) 288.9					Auger ID/OD: 4.25" SSA														
Operator: Brad Enos					Datum: NAVD 88					Sampler: Standard Splitspoon														
Logged By: E. Friede					Rig Type: Mobile B53 Rubber-Track					Hammer Wt./Fall: 140#/30"														
Date Start/Finish: 5-16-18 / 5-21-18					Drilling Method: Spin & Wash					Core Barrel: --														
Boring Location: N644202.4, E1680367.1					Casing ID/OD: 5"/5.5", 4"/4.5", 3"/3.5"					Water Level*: Not Measured														
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				
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	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)																
0								SPIN		Boring advanced to 129' without sampling, stratification assumed to be the same as BB-MPR-103.														
5																								
10																								
15																								
20																								
25																								
Remarks: 1. Auto hammer NEBC #2, ETR = 0.677. 2. Spun casing beyond bottom of BB-MPR-103 prior to sampling. 3. Roller cone ahead from 141-160.1' while advancing casing prior to retrieving each sample. 4. Unable to advance the casing beyond 160.1'. Roller coned ahead without casing advancement. 5. Fine-Grained Soil Descriptions on this log are based on plasticity estimated using visual-manual classification techniques or laboratory Atterburg Limit tests if available, rather than the																								
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 1 of 8														
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[illegible]

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Pleasant River Bridge #3244 Pleasant Street over Pleasant River Location: Milo, Maine				Boring No.: BB-MPR-103-A WIN: 22627.00				
Driller: New England Boring Contractors				Elevation (ft.): 288.9				Auger ID/OD: 4.25" SSA				
Operator: Brad Enos				Datum: NAVD 88				Sampler: Standard Splitspoon				
Logged By: E. Friede				Rig Type: Mobile B53 Rubber-Track				Hammer Wt./Fall: 140#/30"				
Date Start/Finish: 5-16-18 / 5-21-18				Drilling Method: Spin & Wash				Core Barrel: --				
Boring Location: N644202.4, E1680367.1				Casing ID/OD: 5"/5.5", 4"/4.5", 3"/3.5"				Water Level*: Not Measured				
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 N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N₆₀ = (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 Information									Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (1/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)				
50										Boring advanced to 129' without sampling, stratification assumed to be the same as BB-MPR-103.		
55												
60												
65												
70												
75												
Remarks: 1. Auto hammer NEBC #2, ETR = 0.677. 2. Spun casing beyond bottom of BB-MPR-103 prior to sampling. 3. Roller cone ahead from 141-160.1' while advancing casing prior to retrieving each sample. 4. Unable to advance the casing beyond 160.1'. Roller coned ahead without casing advancement.												
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 3 of 8		
* 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.										Boring No.: BB-MPR-103-A		

[illegible]

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Pleasant River Bridge #3244 Pleasant Street over Pleasant River Location: Milo, Maine				Boring No.: BB-MPR-201 WIN: 22627.00							
Driller: New England Boring Contractors				Elevation (ft.) 277.8				Auger ID/OD: SSA 4.25" OD							
Operator: Mike Porter				Datum: NAVD 88				Sampler: Standard Splitspoon							
Logged By: B. Woodman				Rig Type: ATV Mobile B53				Hammer Wt./Fall: 140#/30"							
Date Start/Finish: 10/8/19-10/17/19				Drilling Method: Drive & Wash				Core Barrel: NX							
Boring Location: N644044.3, E1679995.3				Casing ID/OD: 5/5.5", 4/4.5", 3/3.5"				Water Level*: 6.7'							
Hammer Efficiency Factor: 0.931				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 Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.			
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows								
25	6D	24/7	25.0 - 27.0	7-7-7-11	14	22	59			Grey and brown, wet, medium dense, fine to medium SAND, little silt, trace gravel, (Alluvial Deposit).					
							63								
							82								
							93								
							105								
30	7D	24/16	30.0 - 32.0	12-11-10-17	21	33	80			Grey and brown, wet, dense, fine to medium SAND, little silt, (Alluvial Deposit).					
							73								
							100								
							97								
							98								
35	8D	24/1	35.0 - 37.0	7-8-8-10	16	25				Grey and brown, wet, medium dense, fine to coarse SAND, little silt, (Alluvial Deposit).					
							65								
							80								
							106								
							119								
40	9D	24/11	40.0 - 42.0	17-15-12-11	27	42	91			Grey and brown, wet, dense, Gravelly fine to coarse SAND, trace silt, (Alluvial Deposit).	G#20-S-058 A-1-a SW-SM				
							82								
							97								
							110								
							100								
45	10D	24/9	45.0 - 47.0	7-9-9-13	18	28	80			Grey and brown, wet, medium dense, fine to coarse SAND, little gravel, trace silt, (Alluvial Deposit).					
							108								
							121								
							142								
							187								
50															
Remarks: 1. Automatic hammer NEBC #D-20 Energy Transfer Ratio = 0.931. 2. Water level measured after 14 hours, with borehole and casing at 95 feet deep within casing. 3. 5" casing installed to 70.5'. Sample 15D from 70.5'-72.5' and advance 4" casing. 4. Soil came up into casing 1.0' after washout for samples 16D-20D, re-wash, and attempt sample again.															
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 2 of 7					
* 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.										Boring No.: BB-MPR-201					

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS					Project: Pleasant River Bridge #3244 Pleasant Street over Pleasant River Location: Milo, Maine					Boring No.: BB-MPR-201 WIN: 22627.00																																																																																																																																																																																																																																																													
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Wash material similar to bottom 4" of 12D.</td><td rowspan="15"></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>157</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>170</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>160</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>167</td></tr><tr><td rowspan="5">65</td><td>14D</td><td>24/13</td><td>65.0 - 67.0</td><td>3-5-6-9</td><td>11</td><td>17</td><td>145</td><td></td><td rowspan="15"></td><td rowspan="15">Brown, wet, medium dense, fine to medium Silty SAND, trace gravel, (Alluvial Deposit).</td><td rowspan="15">G#20-S-059 A-4(0) SM</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>149</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>196</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>176</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>185</td></tr><tr><td rowspan="5">70</td><td>15D</td><td>24/0</td><td>70.5 - 72.5</td><td>14-9-12-9</td><td>21</td><td>33</td><td>93/5"</td><td></td><td rowspan="15"></td><td rowspan="15">No recovery. Drive 3" spoon; coarse gravel in spoon, <1" recovery.</td><td rowspan="15"></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>35</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>45</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>55</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>79</td></tr><tr><td>75</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>												Depth (ft.)	Sample Information								Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)	50	11D	24/6	50.0 - 52.0	12-23-17-18	40	62	97			Grey and brown, wet, very dense, fine to coarse SAND, trace silt, (Alluvial Deposit).									124								140								149								161	55	12D	24/11	55.0 - 57.0	5-7-7-12	14	22	94			Top 7": Grey and brown, wet, medium dense, fine to coarse SAND, little silt, (Alluvial Deposit). Bottom 4": Brown, wet, Silty fine SAND, (Alluvial Deposit).									133								152								181								190	60	13D	24/0	60.0 - 62.0	15-12-14-16	26	40	152			No recovery with 3" spoon. Wash material similar to bottom 4" of 12D.									157								170								160								167	65	14D	24/13	65.0 - 67.0	3-5-6-9	11	17	145			Brown, wet, medium dense, fine to medium Silty SAND, trace gravel, (Alluvial Deposit).	G#20-S-059 A-4(0) SM								149								196								176								185	70	15D	24/0	70.5 - 72.5	14-9-12-9	21	33	93/5"			No recovery. 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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS					Project: Pleasant River Bridge #3244 Pleasant Street over Pleasant River Location: Milo, Maine					Boring No.: BB-MPR-201 WIN: 22627.00				
Driller: New England Boring Contractors				Elevation (ft.): 277.8				Auger ID/OD: SSA 4.25" OD						
Operator: Mike Porter				Datum: NAVD 88				Sampler: Standard Splitspoon						
Logged By: B. Woodman				Rig Type: ATV Mobile B53				Hammer Wt./Fall: 140#/30"						
Date Start/Finish: 10/8/19-10/17/19				Drilling Method: Drive & Wash				Core Barrel: NX						
Boring Location: N644044.3, E1679995.3				Casing ID/OD: 5/5.5", 4/4.5", 3/3.5"				Water Level*: 6.7'						
Hammer Efficiency Factor: 0.931				Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐										
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Depth (ft.)	Sample Information								Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.			
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows	Elevation (ft.)						
75	16D	24/24	75.0 - 77.0	15-10-8-10	18	28	16			Brown, wet, medium dense, fine to coarse SAND, little gravel, trace silt, (Alluvial Deposit). See Remark 4.	G#20-S-060 A-1-a GW-GM			
							37							
							93							
							82							
							57							
80	17D	24/10	80.5 - 82.5	8-13-9-7	22	34	17			Grey and brown, wet, dense, fine to coarse SAND, little gravel, trace silt, (Alluvial Deposit). See Remark 4.				
							47							
							58							
							59							
							66							
85	18D	24/8	85.0 - 87.0	4-8-8-11	16	25	19			Brown, wet, medium dense, fine to coarse SAND, little gravel, trace silt, (Alluvial Deposit). See Remark 4.				
							69							
							103							
							83							
							114							
90	19D	24/10	90.0 - 92.0	18-16-17-22	33	51	RC			Brown, wet, very dense, GRAVEL, some fine to coarse sand, trace silt, (Alluvial Deposit). See Remark 4.				
							83							
							108							
							131							
							146							
95	20D	12/4	95.0 - 96.0	53-83	83/6"	129	RC		Grey, wet, very dense, fine to coarse SAND, some gravel, trace silt, (Alluvial Deposit). See Remark 4.					
							149							
							206							
							160							
							R/C							
100									Casing refusal at 99.0'. Roller cone ahead to 100.0'. Splitspoon refusal, advance 3" casing and set up to core.					
Remarks: 1. Automatic hammer NEBC #D-20 Energy Transfer Ratio = 0.931. 2. Water level measured after 14 hours, with borehole and casing at 95 feet deep within casing. 3. 5" casing installed to 70.5'. Sample 15D from 70.5'-72.5' and advance 4" casing. 4. Soil came up into casing 1.0' after washout for samples 16D-20D, re-wash, and attempt sample again.														
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 4 of 7				
* 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.										Boring No.: BB-MPR-201				

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Pleasant River Bridge #3244 Pleasant Street over Pleasant River Location: Milo, Maine				Boring No.: BB-MPR-201 WIN: 22627.00				
Driller: New England Boring Contractors				Elevation (ft.) 277.8				Auger ID/OD: SSA 4.25" OD				
Operator: Mike Porter				Datum: NAVD 88				Sampler: Standard Splitspoon				
Logged By: B. Woodman				Rig Type: ATV Mobile B53				Hammer Wt./Fall: 140#/30"				
Date Start/Finish: 10/8/19-10/17/19				Drilling Method: Drive & Wash				Core Barrel: NX				
Boring Location: N644044.3, E1679995.3				Casing ID/OD: 5/5.5", 4/4.5", 3/3.5"				Water Level*: 6.7'				
Hammer Efficiency Factor: 0.931				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 Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
100										R1: Multiple Boulders. -ALLUVIAL DEPOSIT- Rock Core Times (min:sec): 101.6-102.6' (3:45), 102.6-103.6' (4:47), 103.6-104.9' (3:46)		
	R1	35/24	101.6 - 104.5	RQD = 0%				NX				
105										Brown, wet, very dense, fine to coarse SAND, little silt, trace gravel, (Glacial Till).		
	21D	11/8	106.5 - 107.4	86-97/5"	97/5"	151		R/C				
115										Brown, wet, very dense, Clayey fine to coarse SAND, little fine gravel, (Glacial Till).	G#20-S-061 A-4(0) SC	
	22D	11/11	115.0 - 115.9	64-184/4"	184/4"	286						
125												
Remarks: 1. Automatic hammer NEBC #D-20 Energy Transfer Ratio = 0.931. 2. Water level measured after 14 hours, with borehole and casing at 95 feet deep within casing. 3. 5" casing installed to 70.5'. Sample 15D from 70.5'-72.5' and advance 4" casing. 4. Soil came up into casing 1.0' after washout for samples 16D-20D, re-wash, and attempt sample again.												
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 5 of 7		
* 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.										Boring No.: BB-MPR-201		

[illegible]

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Pleasant River Bridge #3244 Pleasant Street over Pleasant River Location: Milo, Maine				Boring No.: BB-MPR-202 WIN: 22627.00																								
Driller: New England Boring Contractors				Elevation (ft.) 280.1				Auger ID/OD: SSA 4.25" OD																								
Operator: Mike Porter				Datum: NAVD 88				Sampler: Standard Splitspoon																								
Logged By: B. Woodman/A. Hazard				Rig Type: ATV Mobile B53				Hammer Wt./Fall: 140#/30"																								
Date Start/Finish: 10/17/19-10/24/19				Drilling Method: Drive & Wash				Core Barrel: NX																								
Boring Location: N644273.9, E1680322.6				Casing ID/OD: 5/5.5", 4/4.5"				Water Level*: 7.9'																								
Hammer Efficiency Factor: 0.931				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 N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N₆₀ = (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																				
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25	6D	24/6	25.0 - 27.0	12-21-20-43	41	64	73	253.1		Brown, wet, very dense, fine to coarse SAND, little gravel, little silt, (Alluvial Deposit).	G#20-S-061 A-1-a GP-GM																					
							96																									
							75																									
							88																									
							130																									
30	7D	24/8	30.0 - 32.0	23-17-15-17	32	50	112			Brown, wet, dense, Sandy GRAVEL, trace silt, (Alluvial Deposit).																						
							97																									
							104																									
							111																									
							129																									
35	8D	24/3	35.0 - 37.0	15-10-13-12	23	36	112			Brown, wet, dense, gravelly fine to coarse SAND, trace silt, (Alluvial Deposit).																						
							113																									
							97																									
							92																									
							97																									
40	9D	24/7	40.0 - 42.0	6-9-9-9	18	28	96	Brown, wet, medium dense, gravelly fine to coarse SAND, trace silt, (Alluvial Deposit).																								
							95																									
							97																									
							138																									
							130																									
45	10D	24/8	45.0 - 47.0	15-21-14-15	35	54	120	Brown, wet, very dense, fine to coarse SAND, some gravel, little silt, (Alluvial Deposit).																								
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Boring Location: N644273.9, E1680322.6				Casing ID/OD: 5/5.5", 4/4.5"				Water Level*: 7.9'							
Hammer Efficiency Factor: 0.931				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 N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N₆₀ = (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			
Sample Information															
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.				
75	16D	24/4	75.0 - 77.0	29-24-15-10	39	61	205			Brown, wet, very dense, fine to medium SAND, little gravel, little silt, (Alluvial Deposit).					
							178								
							205								
							200								
							229								
80	17D	24/7	80.0 - 82.0	11-10-12-16	22	34	210			Brown, wet, dense, gravelly fine to coarse SAND, trace silt, (Alluvial Deposit).					
							178								
							197								
							222								
							210								
85	18D	24/6	85.0 - 87.0	26-23-17-18	50	78	226			Brown/grey, wet, very dense, sandy GRAVEL, trace silt, (Alluvial Deposit).					
							344								
							260								
							259								
							278								
90	19D	24/8	90.0 - 92.0	13-16-22-26	38	59	236		Brown/grey, wet, very dense, Gravelly fine to coarse SAND, trace silt, (Alluvial Deposit).						
							255								
							326								
							380								
							365								
95	20D	24/7	95.0 - 97.0	19-21-20-30	41	64	307		Brown/grey, wet, very dense, GRAVEL, some fine to coarse sand, trace silt, (Alluvial Deposit).						
							297								
							393								
							739								
							600								
100															
Remarks: 1. Automatic hammer NEBC #D-20 Energy Transfer Ratio = 0.931. 2. Water level measured within casing after stabilizing overnight with borehole and casing at 120.0' deep.															
Stratification lines represent approximate boundaries between soil types; transitions may be gradual.										Page 4 of 6					
* 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.										Boring No.: BB-MPR-202					

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS				Project: Pleasant River Bridge #3244 Pleasant Street over Pleasant River Location: Milo, Maine				Boring No.: BB-MPR-202 WIN: 22627.00				
Driller: New England Boring Contractors				Elevation (ft.): 280.1				Auger ID/OD: SSA 4.25" OD				
Operator: Mike Porter				Datum: NAVD 88				Sampler: Standard Splitspoon				
Logged By: B. Woodman/A. Hazard				Rig Type: ATV Mobile B53				Hammer Wt./Fall: 140#/30"				
Date Start/Finish: 10/17/19-10/24/19				Drilling Method: Drive & Wash				Core Barrel: NX				
Boring Location: N644273.9, E1680322.6				Casing ID/OD: 5/5.5", 4/4.5"				Water Level*: 7.9'				
Hammer Efficiency Factor: 0.931				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 N₆₀ = SPT N-uncorrected Corrected for Hammer Efficiency N₆₀ = (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 Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N ₆₀	Casing Blows					
100							RC	177.1		Brown/grey, wet, very dense, to coarse SAND, some fine gravel, some silt, (Glacial Till).	G#20-S-067 A-1-b SM	
105	21D	17/5	105.0 - 106.4	29-52-110/3"	110/3"	171						
110												
115	22D	7/2	115.0 - 115.6	19-50/1"	50/1"	78						
120												
125												

Remarks:

1. Automatic hammer NEBC #D-20 Energy Transfer Ratio = 0.931.

2. Water level measured within casing after stabilizing overnight with borehole and casing at 120.0' deep.

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

Page 5 of 6

* 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.

Boring No.: BB-MPR-202

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Boring No.: HB-MPR-201

WIN:	22627.00
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Driller:	New England Boring Contractors	Elevation (ft.)	280.0	Auger ID/OD:	SSA 2.5" OD
Operator:	Mike Porter	Datum:	NAVD 88	Sampler:	Standard Splitspoon
Logged By:	M. Johnescu	Rig Type:	Track-Mounted Mobile Drill B53	Hammer Wt./Fall:	140#/30"
Date Start/Finish:	03/04/2020-03/04/2020	Drilling Method:	SSA	Core Barrel:	NQ
Boring Location:	N643790.1, E1679739.7	Casing ID/OD:	N/A	Water Level*:	6.0'
Hammer Efficiency Factor: 0.931		Hammer Type:	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

[illegible]

1. Automatic hammer NEBC #D-20 Energy Transfer Ratio = 0.931.
2. Water level measured after completion of drilling and after solid stem augers were removed from the borehole.

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.

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Boring No.: HB-MPR-201

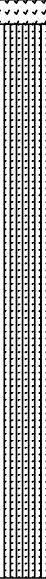
Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Pleasant River Bridge #3244
Pleasant Street over Pleasant River
Location: Milo, Maine

WIN:	22627.00
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Hammer Efficiency Factor: 0.931	Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐
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Definitions:	R = Rock Core Sample	S_u = Peak/Remolded Field Vane Undrained Shear Strength (psf)	T_v = Pocket Torvane Shear Strength (psf)
D = Split Spoon Sample	SSA = Solid Stem Auger	$S_{u(lab)}$ = Lab Vane Undrained Shear Strength (psf)	WC = Water Content, percent
MD = Unsuccessful Split Spoon Sample Attempt	HSA = Hollow Stem Auger	q_p = Unconfined Compressive Strength (ksf)	LL = Liquid Limit
U = Thin Wall Tube Sample	RC = Roller Cone	N-uncorrected = Raw Field SPT N-value	PL = Plastic Limit
MU = Unsuccessful Thin Wall Tube Sample Attempt	WOH = Weight of 140lb. Hammer	Hammer Efficiency Factor = Rig Specific Annual Calibration Value	PI = Plasticity Index
V = Field Vane Shear Test, PP = Pocket Penetrometer	WOR/C = Weight of Rods or Casing	N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency	G = Grain Size Analysis
MV = Unsuccessful Field Vane Shear Test Attempt	WO1P = Weight of One Person	N_{60} = (Hammer Efficiency Factor/60%) * N-uncorrected	C = Consolidation Test

Depth (ft.)	Sample Information								Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class
	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N60	Casing Blows					
0	1D	24/16	0.0 - 2.0	8-6-5-3	11	17	SSA	278.8		0'-0.5': Topsoil.		
										0.5'-2.0': Brown, moist, medium dense, fine to coarse SAND, some gravel, some silt, (Alluvial Deposit).		
	2D	24/14	2.0 - 4.0	4-3-4-4	7	11				Brown, moist, medium dense, fine to coarse SAND, some gravel, trace silt, (Alluvial Deposit).		
5	3D	24/16	4.0 - 6.0	2-2-1-1	3	5				Brown, wet, loose, fine to coarse SAND, little gravel, trace silt, (Alluvial Deposit).		
10	4D	24/12	10.0 - 12.0	17-12-11-10	23	36		267.3		Brown, wet, dense, GRAVEL, some fine to coarse sand, trace silt, (Alluvial Deposit).		
15												
20												
25												
										Bottom of Exploration at 12.0 feet below ground surface.		

Remarks:

1. Automatic hammer NEBC #D-20 Energy Transfer Ratio = 0.931.
2. Water level measured after completion of drilling and after solid stem augers were removed from the borehole.

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.

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Boring No.: HB-MPR-202

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Boring No.:	HB-MPR-204
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WIN:	22627.00
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Driller:	New England Boring Contractors	Elevation (ft.)	278.2	Auger ID/OD:	SSA 2.5" OD
Operator:	Mike Porter	Datum:	NAVD 88	Sampler:	Standard Splitspoon
Logged By:	M. Johnescu	Rig Type:	Track-Mounted Mobile Drill B53	Hammer Wt./Fall:	140#/30"
Date Start/Finish:	03/03/2020-03/03/2020	Drilling Method:	SSA	Core Barrel:	NQ
Boring Location:	N644400.8, E1680524.9	Casing ID/OD:	N/A	Water Level*:	
Hammer Efficiency Factor:	0.931	Hammer Type:	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

[illegible]

1. Automatic hammer NEBC #D-20 Energy Transfer Ratio = 0.931.
2. Water level measured after completion of drilling and after solid stem augers were removed from the borehole.

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.

Page 1 of 1

Boring No.: HB-MPR-204

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Boring No.: HB-MPR-205

WIN:	22627.00
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Driller:	New England Boring Contractors	Elevation (ft.):	277.5	Auger ID/OD:	SSA 2.5" OD
Operator:	Mike Porter	Datum:	NAVD 88	Sampler:	Standard Splitspoon
Logged By:	M. Johnescu	Rig Type:	Track-Mounted Mobile Drill B53	Hammer Wt./Fall:	140#/30"
Date Start/Finish:	03/03/2020-03/03/2020	Drilling Method:	SSA	Core Barrel:	NQ
Boring Location:	N644398.8, E1680638.6	Casing ID/OD:	N/A	Water Level*:	5.0'
Hammer Efficiency Factor: 0.931		Hammer Type: Automatic ☒ Hydraulic ☐ Rope & Cathead ☐			

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

[illegible]

1. Automatic hammer NEBC #D-20 Energy Transfer Ratio = 0.931.
2. Water level measured after completion of drilling and after solid stem augers were removed from the borehole.

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.

Page 1 of 1

Boring No.: HB-MPR-205

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Boring No.:	<u>HB-MPR-206</u>
WIN:	<u>22627.00</u>

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

Remarks: 1. Automatic hammer NEBC #D-20 Energy Transfer Ratio = 0.931. 2. Water level measured after completion of drilling and after solid stem augers were removed from the borehole. 3. Stopped drilling at 34.0'. Driller lowered splitspoon and it was 2.0' above drill depth, indicating running sands. Spoon was pulled out and the borehole sounded with a weighted tape. Sand was measured to be at 26.0', with a water level at 2.5'; possible artesian effect.



08/07/2020

GEOTECHNICAL DESIGN REPORT
PLEASANT RIVER BRIDGE NO. 3244 - MILO
HNTB Corporation
09.0025972.01

APPENDIX C – LABORATORY TEST RESULTS

	195 Frances Avenue Cranston RI, 02910 Phone: (401)-467-6454 Fax: (401)-467-2398 http://www.thielsch.com <i>Let's Build a Solid Foundation</i>	Client Information: GZA GeoEnvironmental Portland, ME PM: Theodore Bair Assigned By: EDF Collected By: EDF	Project Information: Pleasant River Bridge # 3244, WIN 22627.00 Milo, ME GZA Project Number: 09.0025970.00 Summary Page: 1 of 2 Report Date: 06.12.18
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LABORATORY TESTING DATA SHEET

Boring ID	Sample No.	Depth (ft)	Laboratory No.	Identification Tests								Alternative classifications				Laboratory Log and Soil Description
				Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Org. %	G _s	Dry unit wt. pcf	γ_d $\frac{MAX}{(pcf)}$ $W_{opt} (%)$	USCS	AASHTO	
BB-MPR-101	1D	1-3	S-1	8.7			30.6	61.5	7.9					well-graded sand with silt and gravel (SW-SM)	A-1-b	Brown f-c SAND, some fine Gravel, trace Silt
BB-MPR-101	2D	5-7	S-2	4.3			42.6	50.0	7.4					poorly graded sand with silt and gravel (SP-SM)	A-1-a	Grey Gravelly fine to coarse SAND, trace Silt
BB-MPR-101	5Da	20-21.2	S-3	23.3	22	18								clayey silt (ML)	A-4(0)	Brown Clayey SILT
BB-MPR-101	6D	25.1-27	S-4				0.0	84.7	15.3					silty sand (SM)	A-2-4(0)	Brown fine SAND, little Silt
BB-MPR-101	7D	30-32	S-5				2.9	54.4	42.7					silty sand (SM)	A-4(0)	Brown Silty fine SAND, trace fine Gravel
BB-MPR-101	12D	55-57	S-6				8.9	85.1	6.0					poorly graded sand with silt (SP-SM)	A-1-b	Grey f-m SAND, trace fine Gravel, trace Silt
BB-MPR-101	16D	75-77	S-7				0.0	75.5	24.5					silty sand (SM)	A-2-4(0)	Brown fine SAND, some Silt
BB-MPR-101	18D	85-87	S-8				31.4	60.7	7.9					well-graded sand with silt and gravel (SW-SM)	A-1-b	Grey f-c SAND, some f-c Gravel, trace Silt
BB-MPR-102	1D	0-2	S-9	2.8			86.0	13.8	0.2					well-graded gravel (GW)	A-1-a	Grey f-c GRAVEL, little m-c Sand, trace Silt
BB-MPR-102	2D	5-7	S-10	21.0			3.9	47.0	49.1					silty sand (SM)	A-4(0)	Brown Sandy SILT, trace Gravel
BB-MPR-102	3D	10-11.2	S-11	16.1			4.2	89.9	5.9					poorly graded sand with silt (SP-SM)	A-1-b	Grey f-m SAND, trace Silt, trace fine Gravel
BB-MPR-102	4D	15-17	S-12	3.1			65.2	12.1	22.7					silty gravel (GM)	A-1-b	Brown f-c GRAVEL, some Silt, little f-c Sand

Reviewed By SAH

Date Reviewed 06.12.2018

	195 Frances Avenue Cranston RI, 02910 Phone: (401)-467-6454 Fax: (401)-467-2398 http://www.thielsch.com <i>Let's Build a Solid Foundation</i>	Client Information: GZA GeoEnvironmental Portland, ME PM: Theodore Bair Assigned By: EDF Collected By: EDF	Project Information: Pleasant River Bridge # 3244, WIN 22627.00 Milo, ME GZA Project Number: 09.0025970.00 Summary Page: 2 of 2 Report Date: 06.12.18
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LABORATORY TESTING DATA SHEET

Boring ID	Sample No.	Depth (ft)	Laboratory No.	Identification Tests								Alternative classifications				Laboratory Log and Soil Description
				Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Org. %	G _s	Dry unit wt. pcf	γ_d $\frac{MAX}{W_{opt}}$ (pcf) (%)	USCS	AASHTO	
BB-MPR-102	9D	45-47	S-13				59.2	35.8	5.0					well-graded gravel with silt and sand (GW-GM)	A-1-a	Grey Sandy fine GRAVEL, trace Silt
BB-MPR-102	16D	95-97	S-14				53.4	34.7	11.9					poorly graded gravel with silt and sand (GP-GM)	A-1-a	Black f-c GRAVEL, some f-c SAND, little Silt
BB-MPR-102	19D	110-112	S-15				30.6	44.4	25.0					silty sand with gravel (SM)	A-1-b	Grey f-c SAND, some fine Gravel, some Silt
BB-MPR-103	1D	1-3	S-16				39.3	50.3	10.4					poorly graded sand with silt (SP-SM)	A-1-a	Brown Gravelly fine to coarse SAND, little Silt
BB-MPR-103	2D	5-7	S-17	12.4			37.9	46.2	15.9					silty sand with gravel (SM)	A-1-b	Brown Gravelly fine to coarse SAND, little Silt
BB-MPR-103	5D	20-22	S-18	5.8			64.4	35.3	0.3					well-graded gravel with sand (GW)	A-1-a	Brown Sandy fine to coarse GRAVEL, trace Silt
BB-MPR-103	7D	30-32	S-19				0.0	81.7	18.3					silty sand (SM)	A-2-4(0)	Brown f-m SAND, little Silt
BB-MPR-103	10D	45-47	S-20				90.8	9.0	0.2					well-graded gravel (GW)	A-1-a	Grey f-c GRAVEL, trace m-c Sand, trace Silt
BB-MPR-103	12D	55-57	S-21				25.6	73.0	1.4					poorly graded sand with gravel (SP)	A-1-a	Grey f-m SAND, some fine Gravel, trace Silt
BB-MPR-103	16D	75-77	S-22				20.8	73.1	6.1					well-graded sand with silt and gravel (SW-SM)	A-1-a	Brown m-c SAND, some fine Gravel, trace Silt
BB-MPR-103	24D	115-116.2	S-23				24.9	55.6	19.5					silty sand with gravel (SM)	A-1-b	Grey f-c SAND, some fine Gravel, little Silt

Reviewed By SKW

Date Reviewed 06.12.2018



State of Maine - Department of Transportation
Laboratory Testing Summary Sheet

**Pleasant River
 Bridge #3244**

MDOT Project Number: WIN 022627.00

GZA Project Number: 09.0025972.00

Town(s): Milo, ME

Boring & Sample Identification Number	Station (Feet)	Sample No.	Depth (Feet)	Lab Number	Organic %	W.C.	L.L.	P.I.	Classification		
									Unified	AASHTO	Frost
BB-MPR-101		1D	1-3	1		8.7			SW-SM	A-1-b	II
BB-MPR-101		2D	5-7	2		4.3			SP-SM	A-1-a	II
BB-MPR-101		5Da	20-21.2	3		23.3	22	18	ML	A-4(0)	IV
BB-MPR-101		6D	25.1-27	4					SM	A-2-4(0)	II
BB-MPR-101		7D	30-32	5					SM	A-4(0)	III
BB-MPR-101		12D	55-57	6					SP-SM	A-1-b	II
BB-MPR-101		16D	75-77	7					SM	A-2-4(0)	III
BB-MPR-101		18D	85-87	8					SW-SM	A-1-b	II
BB-MPR-102		1D	0-2	9		2.8			GW	A-1-a	0
BB-MPR-102		2D	5-7	10		21.0			SM	A-4(0)	II
BB-MPR-102		3D	10-11.2	11		16.1			SP-SM	A-1-b	II
BB-MPR-102		4D	15-17	12		3.1			GM	A-1-b	III
BB-MPR-102		9D	45-47	13					GW-GM	A-1-a	I
BB-MPR-102		16D	95-97	14					GP-GM	A-1-a	I
BB-MPR-102		19D	110-112	15					SM	A-1-b	II
BB-MPR-103		1D	1-3	16					SP-SM	A-1-a	II
BB-MPR-103		2D	5-7	17		12			SM	A-1-b	II
BB-MPR-103		5D	20-22	18		5.8			GW	A-1-a	0
BB-MPR-103		7D	30-32	19					SM	A-2-4(0)	II
BB-MPR-103		10D	45-47	20					GW	A-1-a	0
BB-MPR-103		12D	55-57	21					SP-SM	A-1-a	0
BB-MPR-103		16D	75-77	22					SW-SM	A-1-a	II
BB-MPR-103		24D	115-116.2	23					SM	A-1-b	II

Classification of these soil samples is in accordance with AASHTO Classification System M-145-40. This classification is followed by the "Frost Susceptibility Rating" from zero (non-frost susceptible) to Class IV (highly frost susceptible).

The "Frost Susceptibility Rating" is based upon the MDOT and Corps of Engineers Classification Systems.

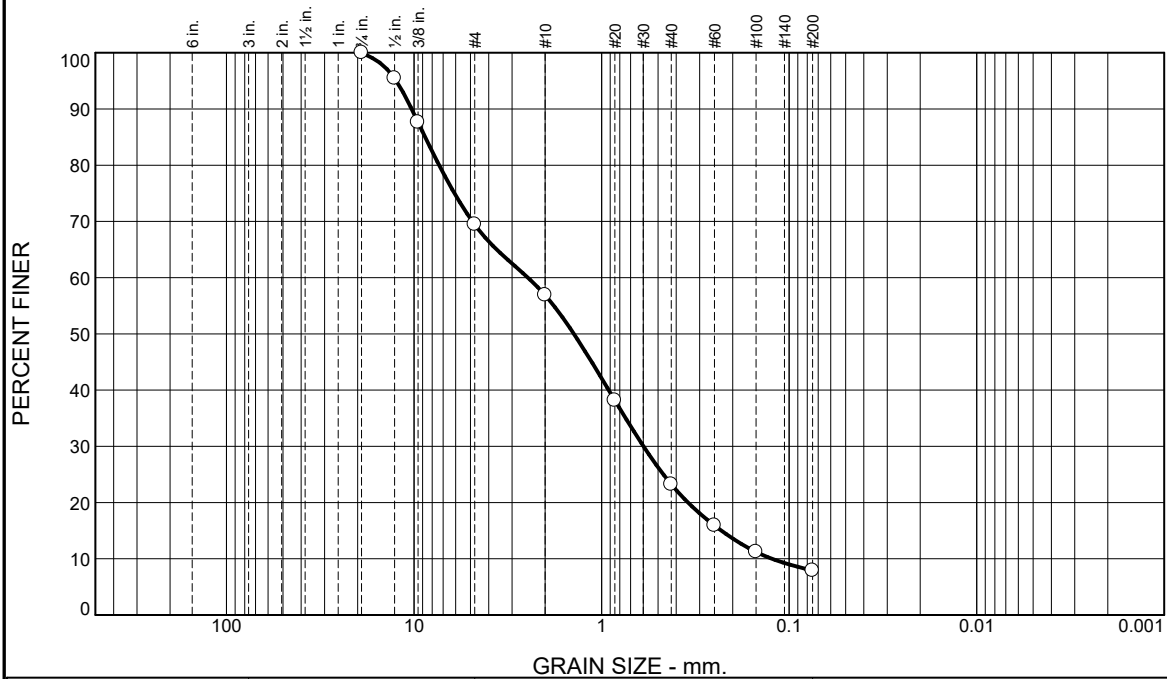
GSDC = Grain Size Distribution Curve as determined by AASHTO T 88-93 (1996) and/or ASTM D 422-63 (Reapproved 1998)

WC = water content as determined by AASHTO T 265-93 and/or ASTM D 2216-98

LL = Liquid limit as determined by AASHTO T 89-96 and/or ASTM D 4318-98

PI = Plasticity Index as determined by AASHTO 90-96 and/or ASTM D4318-98

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	30.6	12.5	33.7	15.3	7.9	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	95.5		
0.375"	87.6		
#4	69.4		
#10	56.9		
#20	38.2		
#40	23.2		
#60	15.9		
#100	11.2		
#200	7.9		

* (no specification provided)

Material Description

Brown f-c SAND, some fine Gravel, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SW-SM AASHTO (M 145)= A-1-b

Coefficients

D₉₀= 10.3080 D₈₅= 8.7264 D₆₀= 2.4726
D₅₀= 1.4049 D₃₀= 0.5978 D₁₅= 0.2296
D₁₀= 0.1232 C_u= 20.07 C_c= 1.17

Remarks

Date Received: 06.05.18 Date Tested: 06.08.18

Tested By: MN

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-101
Sample Number: 1D

Depth: 1-3'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

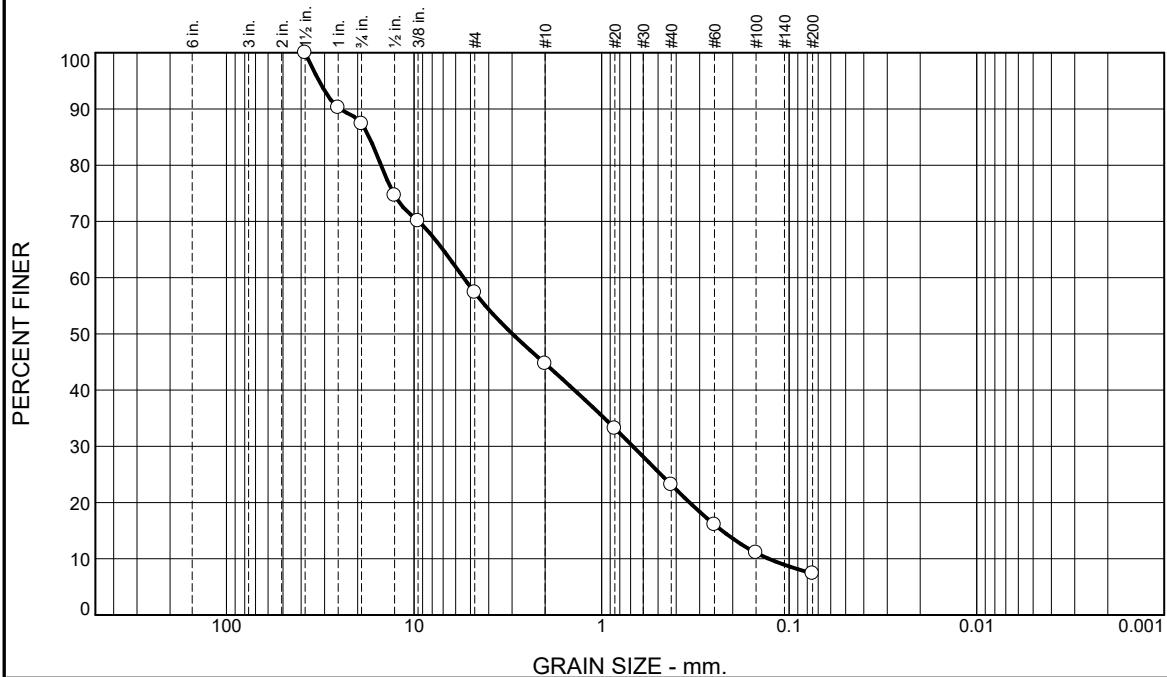
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-1

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.6	30.0	12.7	21.5	15.8	7.4	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	90.2		
0.75"	87.4		
0.5"	74.6		
0.375"	70.1		
#4	57.4		
#10	44.7		
#20	33.2		
#40	23.2		
#60	16.1		
#100	11.1		
#200	7.4		

* (no specification provided)

Material Description

Grey Gravelly fine to coarse SAND, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-1-a

Coefficients

D₉₀= 24.8726 D₈₅= 17.3543 D₆₀= 5.4493
D₅₀= 2.9891 D₃₀= 0.6810 D₁₅= 0.2278
D₁₀= 0.1284 C_u= 42.44 C_c= 0.66

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-101
Sample Number: 2D

Depth: 5-7'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

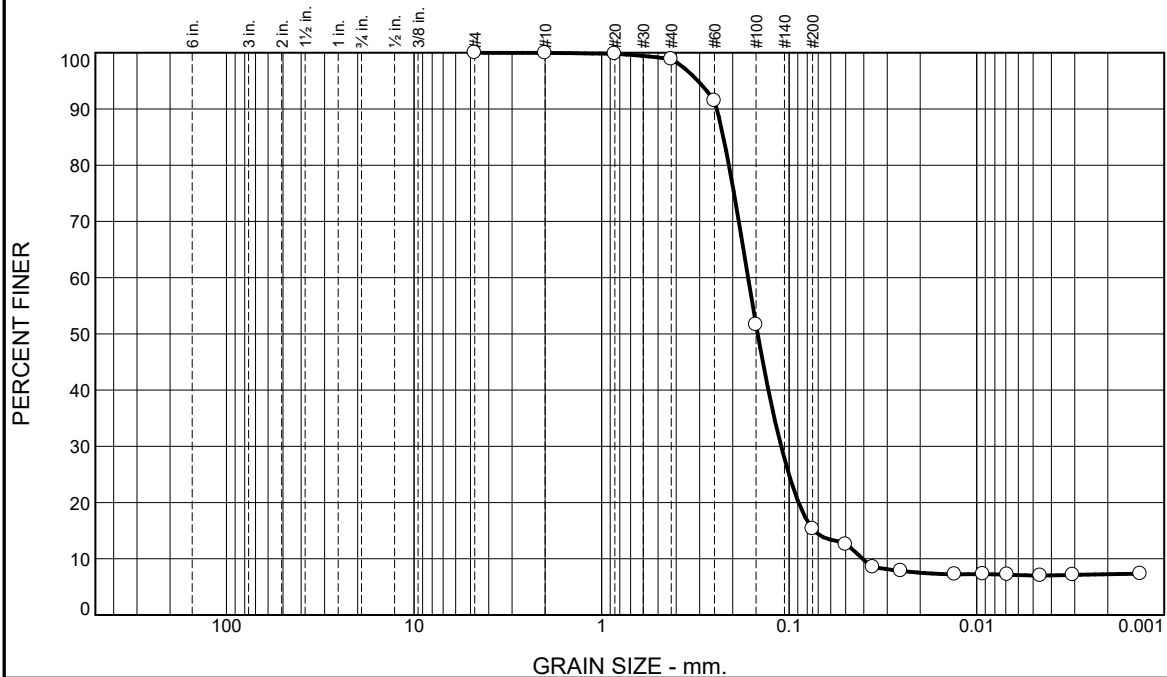
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-2

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.1	83.6	8.0	7.3

Test Results (D7928 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	100.0		
#20	99.8		
#40	98.9		
#60	91.5		
#100	51.6		
#200	15.3		
0.0499 mm.	12.6		
0.0358 mm.	8.5		
0.0254 mm.	7.8		
0.0131 mm.	7.2		
0.0093 mm.	7.3		
0.0069 mm.	7.2		
0.0046 mm.	7.0		
0.0031 mm.	7.1		
0.0013 mm.	7.3		

* (no specification provided)

Material Description

Brown fine SAND, little Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-2-4(0)

Coefficients

D₉₀= 0.2430 D₈₅= 0.2242 D₆₀= 0.1654
D₅₀= 0.1471 D₃₀= 0.1103 D₁₅= 0.0735
D₁₀= 0.0406 C_u= 4.08 C_c= 1.81

Remarks

Date Received: 06.04.18 Date Tested: 06.11.18

Tested By: MN

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-101
Sample Number: 6D

Depth: 25.1-27'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

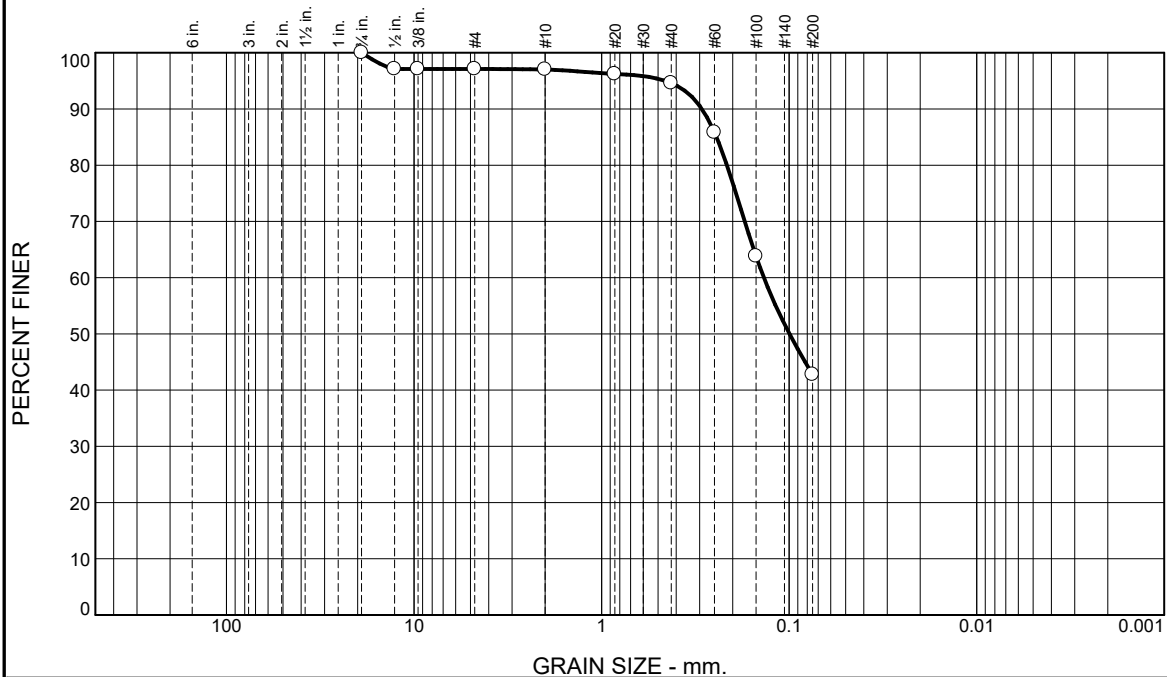
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-4

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.9	0.1	2.4	51.9	42.7	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	97.1		
0.375"	97.1		
#4	97.1		
#10	97.0		
#20	96.2		
#40	94.6		
#60	85.8		
#100	63.8		
#200	42.7		

* (no specification provided)

Material Description

Brown Silty fine SAND, trace fine Gravel

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-4(0)

Coefficients

D₉₀= 0.2917 D₈₅= 0.2438 D₆₀= 0.1363
D₅₀= 0.0996 D₃₀= C_u=
D₁₀= C_c=

Remarks

Sample visually classified as non-plastic.

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-101
Sample Number: 7D

Depth: 30-32'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

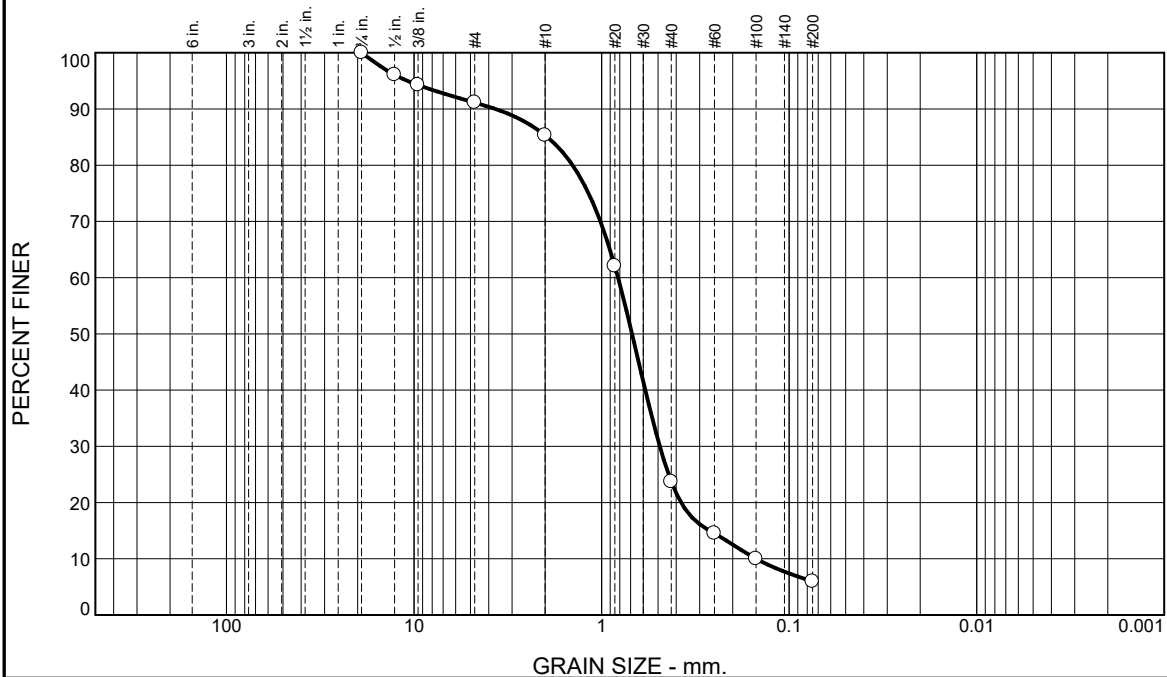
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-5

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.9	5.8	61.6	17.7	6.0	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	96.1		
0.375"	94.3		
#4	91.1		
#10	85.3		
#20	62.0		
#40	23.7		
#60	14.5		
#100	10.0		
#200	6.0		

* (no specification provided)

Material Description

Grey f-m SAND, trace fine Gravel, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-1-b

Coefficients

D₉₀= 3.6798 D₈₅= 1.9473 D₆₀= 0.8175
D₅₀= 0.6884 D₃₀= 0.4895 D₁₅= 0.2651
D₁₀= 0.1500 C_u= 5.45 C_c= 1.95

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-101
Sample Number: 12D

Depth: 55-57'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

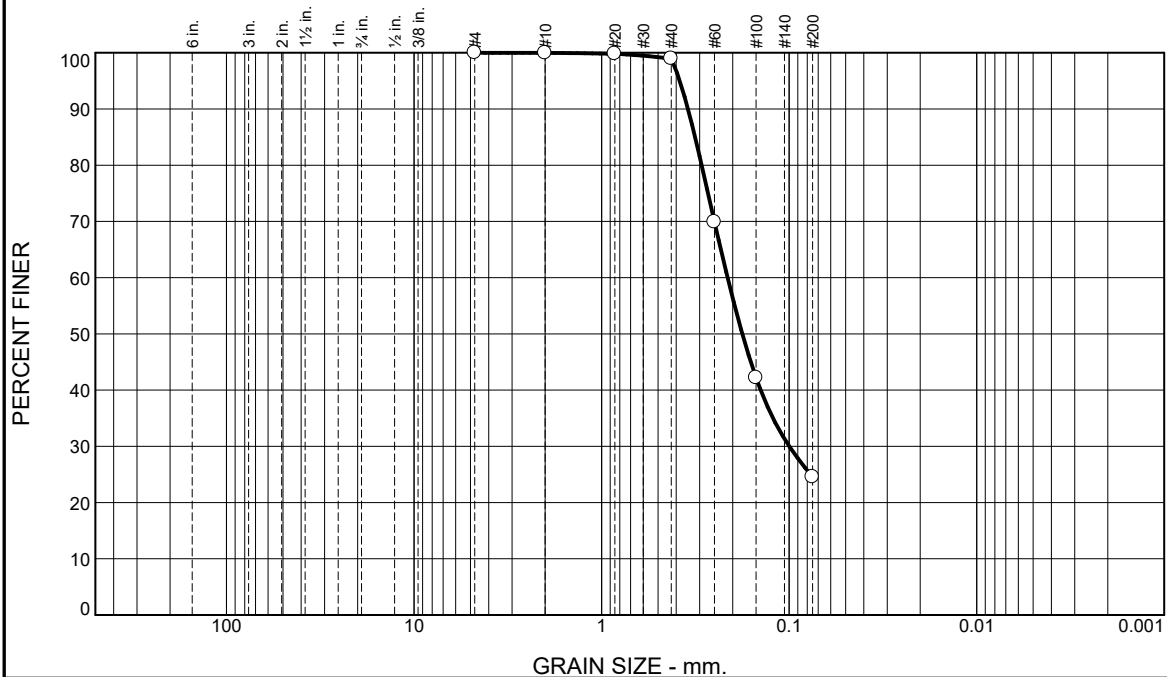
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-6

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.0	74.5	24.5	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	100.0		
#20	99.8		
#40	99.0		
#60	69.9		
#100	42.2		
#200	24.5		

* (no specification provided)

Material Description

Brown fine SAND, some Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-2-4(0)

Coefficients

D₉₀= 0.3462 D₈₅= 0.3173 D₆₀= 0.2128
D₅₀= 0.1776 D₃₀= 0.0998 D₁₅=
D₁₀= C_u= C_c=

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-101
Sample Number: 16D

Depth: 75-77'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

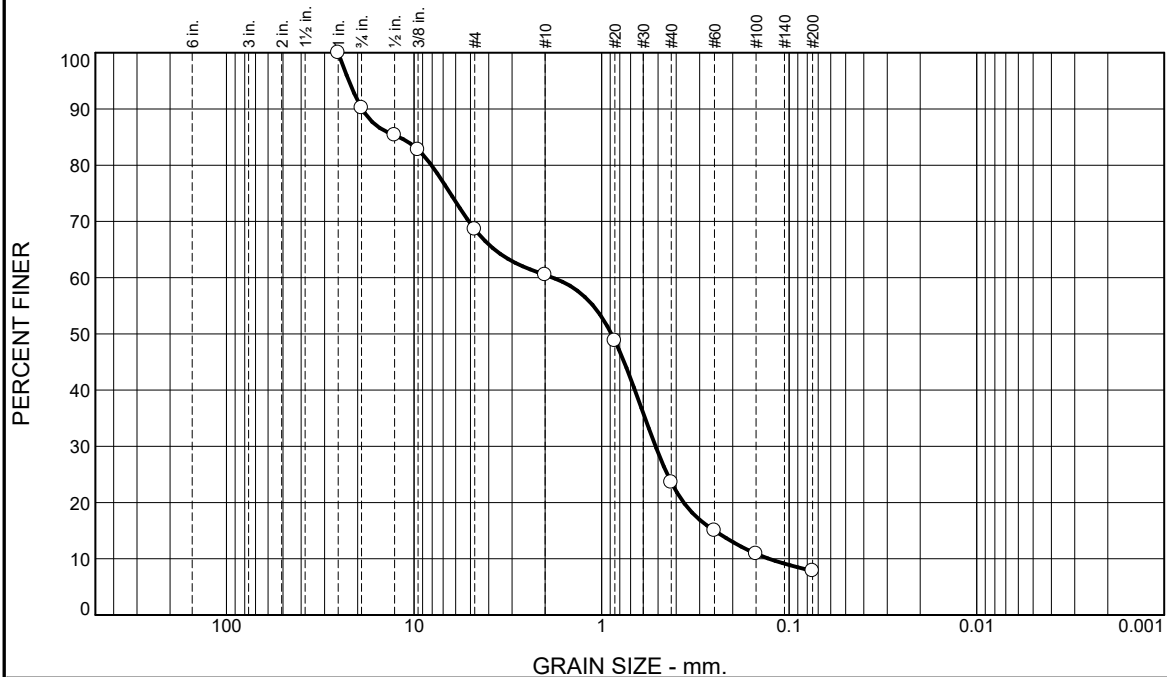
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-7

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.8	21.6	8.1	36.9	15.7	7.9	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	90.2		
0.5"	85.3		
0.375"	82.8		
#4	68.6		
#10	60.5		
#20	48.8		
#40	23.6		
#60	15.0		
#100	10.9		
#200	7.9		

* (no specification provided)

Material Description

Grey f-c SAND, some f-c Gravel, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SW-SM AASHTO (M 145)= A-1-b

Coefficients

D₉₀= 18.9144 D₈₅= 12.0376 D₆₀= 1.8217
D₅₀= 0.8862 D₃₀= 0.5153 D₁₅= 0.2501
D₁₀= 0.1280 C_u= 14.24 C_c= 1.14

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-101
Sample Number: 18D

Depth: 85-87'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

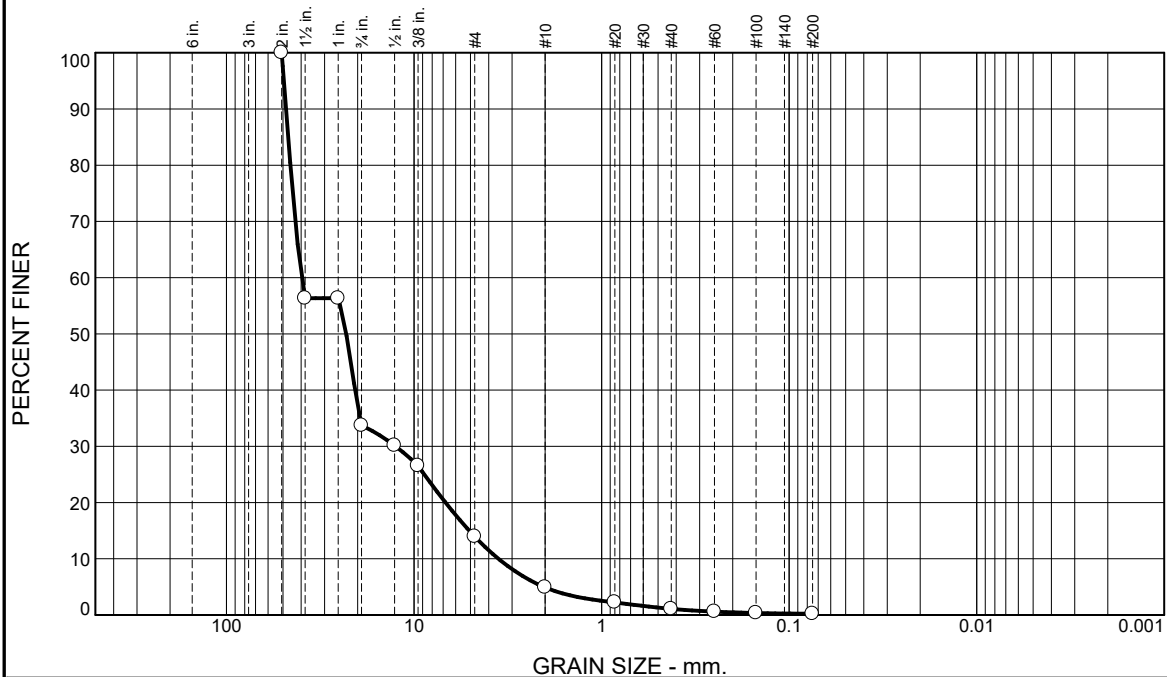
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-8

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	66.3	19.7	9.1	3.8	0.9	0.2	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
2"	100.0		
1.5"	56.3		
1"	56.3		
0.75"	33.7		
0.5"	30.1		
0.375"	26.5		
#4	14.0		
#10	4.9		
#20	2.2		
#40	1.1		
#60	0.6		
#100	0.4		
#200	0.2		

* (no specification provided)

Material Description

Grey f-c GRAVEL, little m-c Sand, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= GW AASHTO (M 145)= A-1-a

Coefficients

D₉₀= 48.2170 D₈₅= 46.9412 D₆₀= 39.7437
D₅₀= 22.9877 D₃₀= 12.5413 D₁₅= 5.0820
D₁₀= 3.5475 C_u= 11.20 C_c= 1.12

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-102
Sample Number: 1D

Depth: 0-2'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

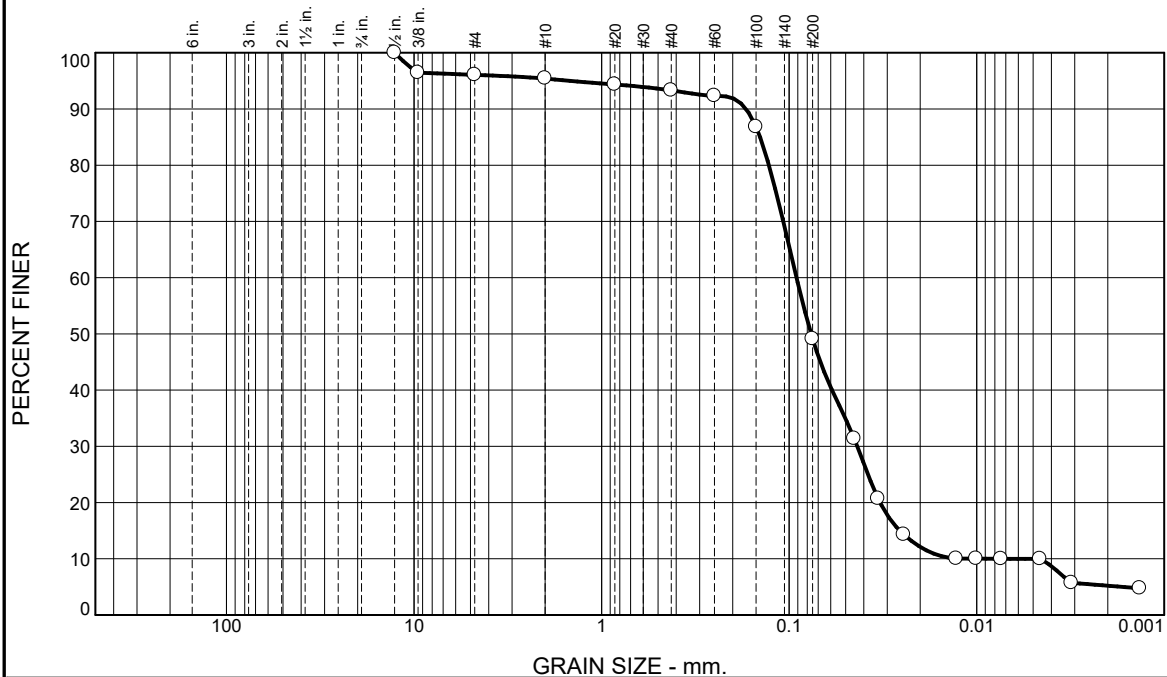
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-9

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.9	0.7	2.1	44.2	43.9	5.2

Test Results (D7928 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.5"	100.0		
0.375"	96.5		
#4	96.1		
#10	95.4		
#20	94.4		
#40	93.3		
#60	92.4		
#100	86.8		
#200	49.1		
0.0450 mm.	31.4		
0.0336 mm.	20.7		
0.0244 mm.	14.3		
0.0129 mm.	10.0		
0.0101 mm.	10.0		
0.0074 mm.	10.0		
0.0046 mm.	10.0		
0.0031 mm.	5.7		
0.0014 mm.	4.8		

* (no specification provided)

Material Description

Brown Sandy SILT, trace Gravel

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-4(0)

Coefficients

D₉₀= 0.1696 D₈₅= 0.1428 D₆₀= 0.0914
D₅₀= 0.0764 D₃₀= 0.0433 D₁₅= 0.0257
D₁₀= 0.0075 C_u= 12.11 C_c= 2.72

Remarks

Sample visually classified as non-plastic.

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-102
Sample Number: 2D

Depth: 5-7'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

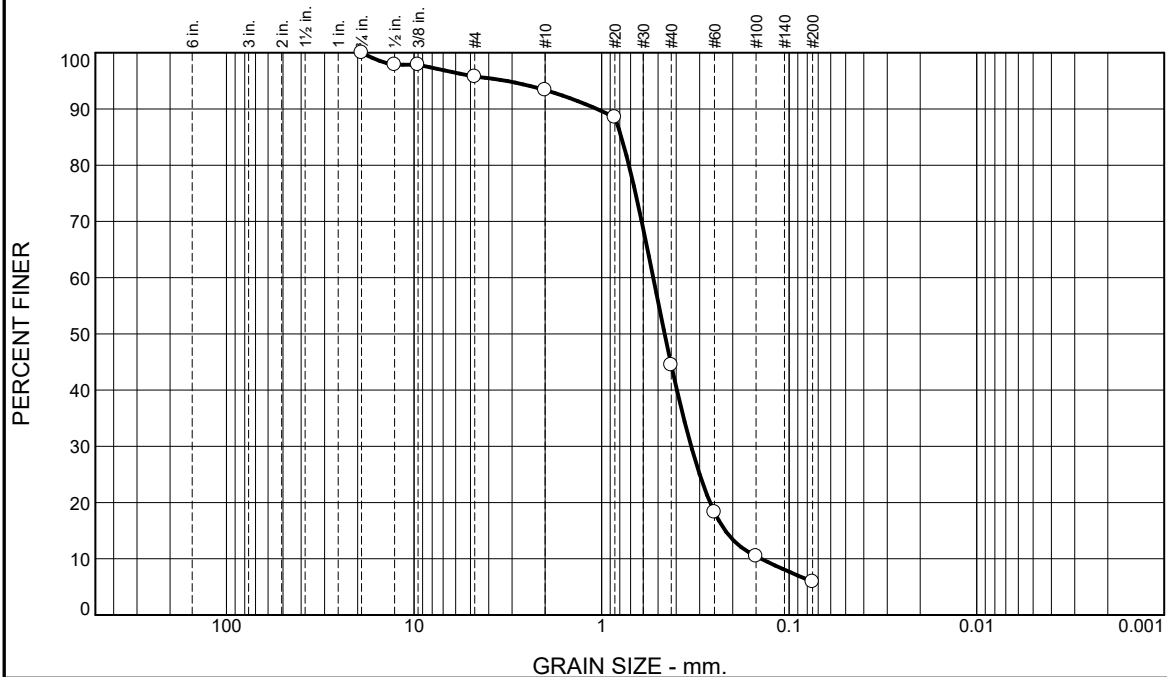
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-10

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.2	2.4	48.9	38.6	5.9	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	97.9		
0.375"	97.9		
#4	95.8		
#10	93.4		
#20	88.5		
#40	44.5		
#60	18.3		
#100	10.5		
#200	5.9		

* (no specification provided)

Material Description

Grey f-m SAND, trace Silt, trace fine Gravel

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-1-b

Coefficients

D₉₀= 1.0588 D₈₅= 0.7850 D₆₀= 0.5305
D₅₀= 0.4610 D₃₀= 0.3328 D₁₅= 0.2191
D₁₀= 0.1409 C_u= 3.77 C_c= 1.48

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-102
Sample Number: 3D

Depth: 10-11.2

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

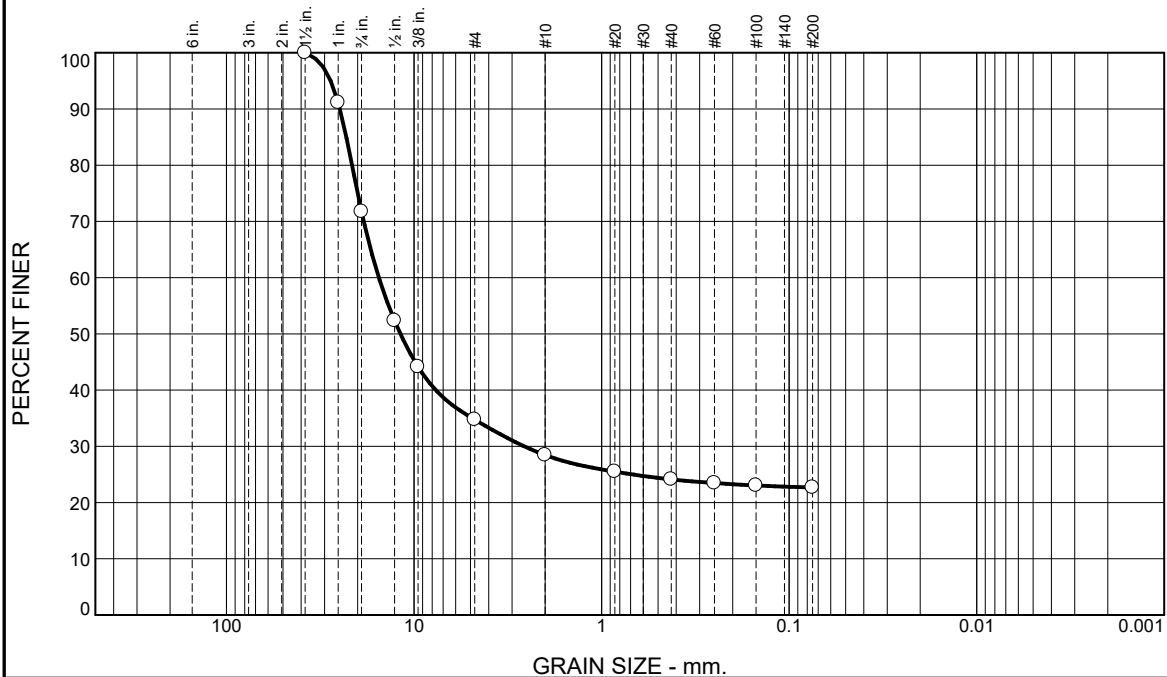
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-11

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	28.2	37.0	6.3	4.4	1.4	22.7	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	91.1		
0.75"	71.8		
0.5"	52.4		
0.375"	44.1		
#4	34.8		
#10	28.5		
#20	25.5		
#40	24.1		
#60	23.5		
#100	23.0		
#200	22.7		

* (no specification provided)

Material Description

Brown f-c GRAVEL, some Silt, little f-c Sand

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= GM AASHTO (M 145)= A-1-b

Coefficients

D₉₀= 24.8676 D₈₅= 22.9652 D₆₀= 15.4127
D₅₀= 11.8204 D₃₀= 2.5858 D₁₅=
D₁₀= C_u= C_c=

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-102
Sample Number: 4D

Depth: 15-17'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

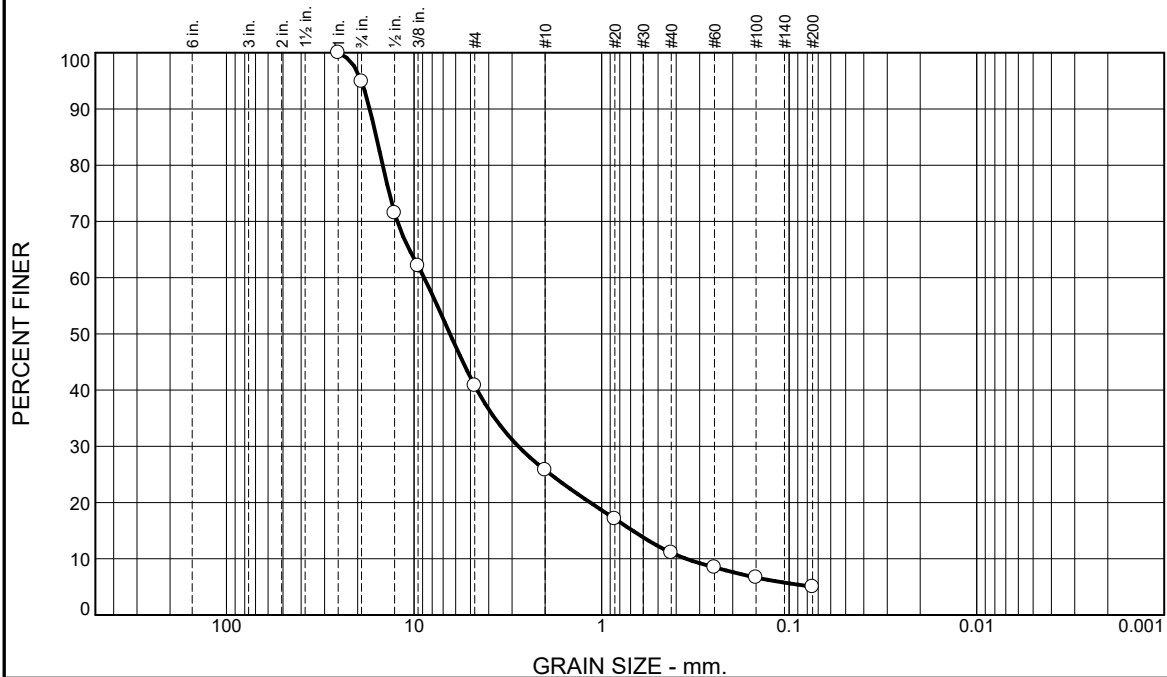
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-12

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.1	54.1	15.0	14.7	6.1	5.0	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	94.9		
0.5"	71.5		
0.375"	62.1		
#4	40.8		
#10	25.8		
#20	17.1		
#40	11.1		
#60	8.5		
#100	6.7		
#200	5.0		

* (no specification provided)

Material Description

Grey Sandy fine GRAVEL, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= GW-GM AASHTO (M 145)= A-1-a

Coefficients

D₉₀= 17.2416 D₈₅= 15.8829 D₆₀= 8.8391
D₅₀= 6.4309 D₃₀= 2.7798 D₁₅= 0.6825
D₁₀= 0.3540 C_u= 24.97 C_c= 2.47

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-102
Sample Number: 9D

Depth: 45-47'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

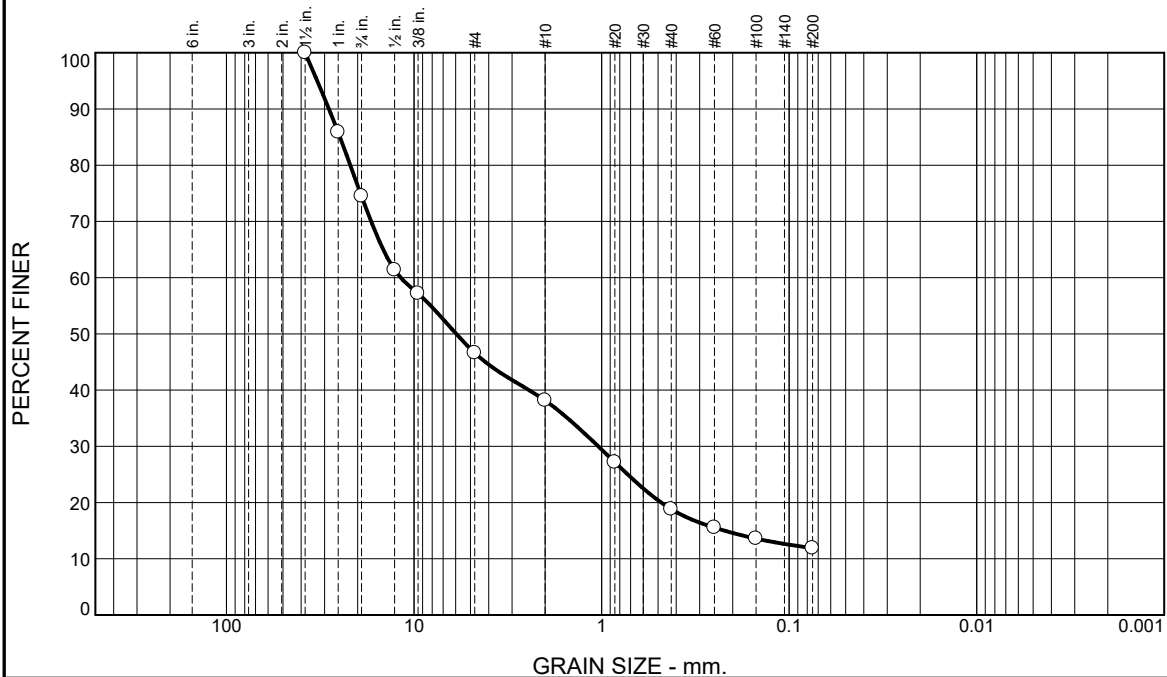
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-13

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	25.5	27.9	8.5	19.3	6.9	11.9	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	85.9		
0.75"	74.5		
0.5"	61.4		
0.375"	57.2		
#4	46.6		
#10	38.1		
#20	27.2		
#40	18.8		
#60	15.5		
#100	13.6		
#200	11.9		

* (no specification provided)

Material Description

Black f-c GRAVEL, some f-c SAND, little Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= GP-GM AASHTO (M 145)= A-1-a

Coefficients

D₉₀= 28.4149 D₈₅= 24.8283 D₆₀= 11.7974
D₅₀= 5.9556 D₃₀= 1.0423 D₁₅= 0.2212
D₁₀= C_u= C_c=

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-102
Sample Number: 16D

Depth: 95-97'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

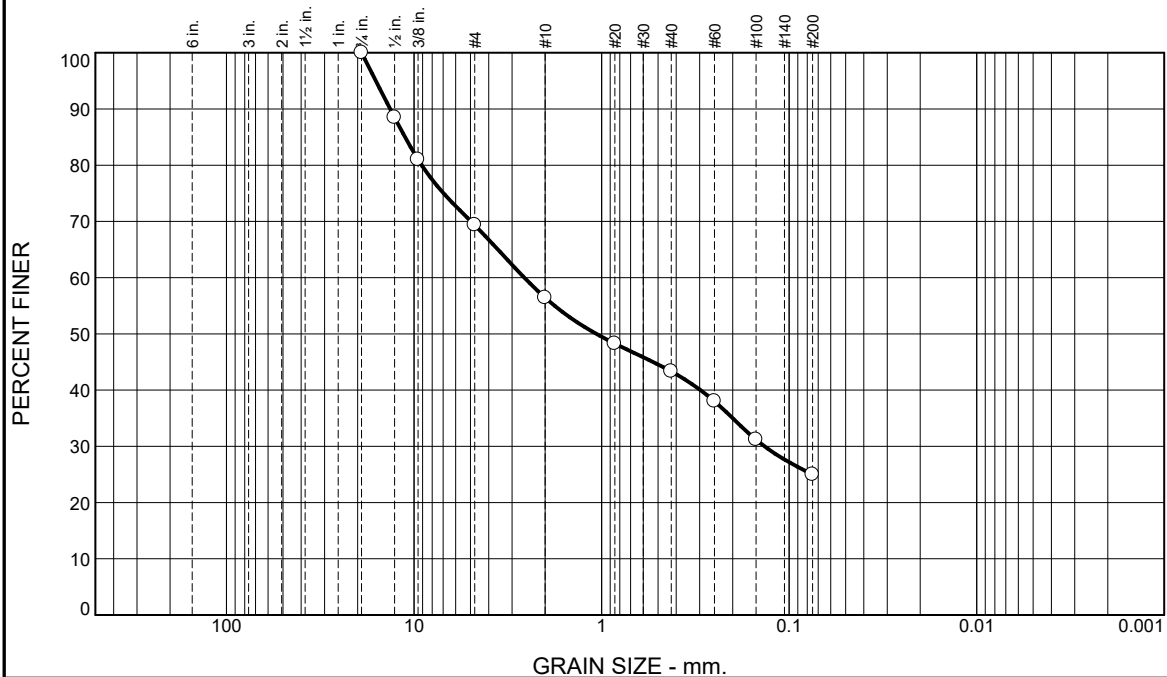
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-14

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	30.6	13.0	13.1	18.3	25.0	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	88.5		
0.375"	81.0		
#4	69.4		
#10	56.4		
#20	48.3		
#40	43.3		
#60	38.0		
#100	31.2		
#200	25.0		

* (no specification provided)

Material Description

Grey f-c SAND, some fine Gravel, some Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-1-b

Coefficients

D₉₀= 13.4060 D₈₅= 11.1768 D₆₀= 2.5821
D₅₀= 1.0661 D₃₀= 0.1353 D₁₅=
D₁₀= C_u= C_c=

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-102
Sample Number: 19D

Depth: 110-112'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

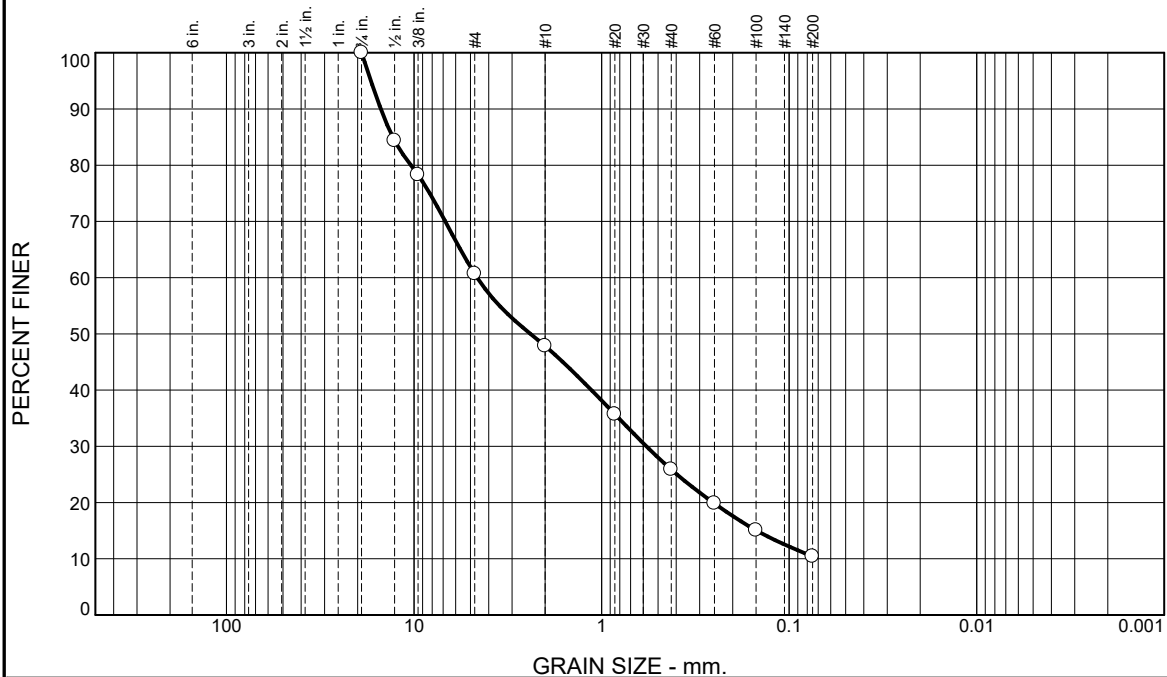
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-15

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	39.3	12.9	21.9	15.5	10.4	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	84.4		
0.375"	78.3		
#4	60.7		
#10	47.8		
#20	35.7		
#40	25.9		
#60	19.8		
#100	15.1		
#200	10.4		

* (no specification provided)

Material Description

Brown Gravelly fine to coarse SAND, little Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-1-a

Coefficients

D₉₀= 15.0389 D₈₅= 12.9929 D₆₀= 4.6059
D₅₀= 2.3924 D₃₀= 0.5770 D₁₅= 0.1489
D₁₀= C_u= C_c=

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-103
Sample Number: 1D

Depth: 1-3'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

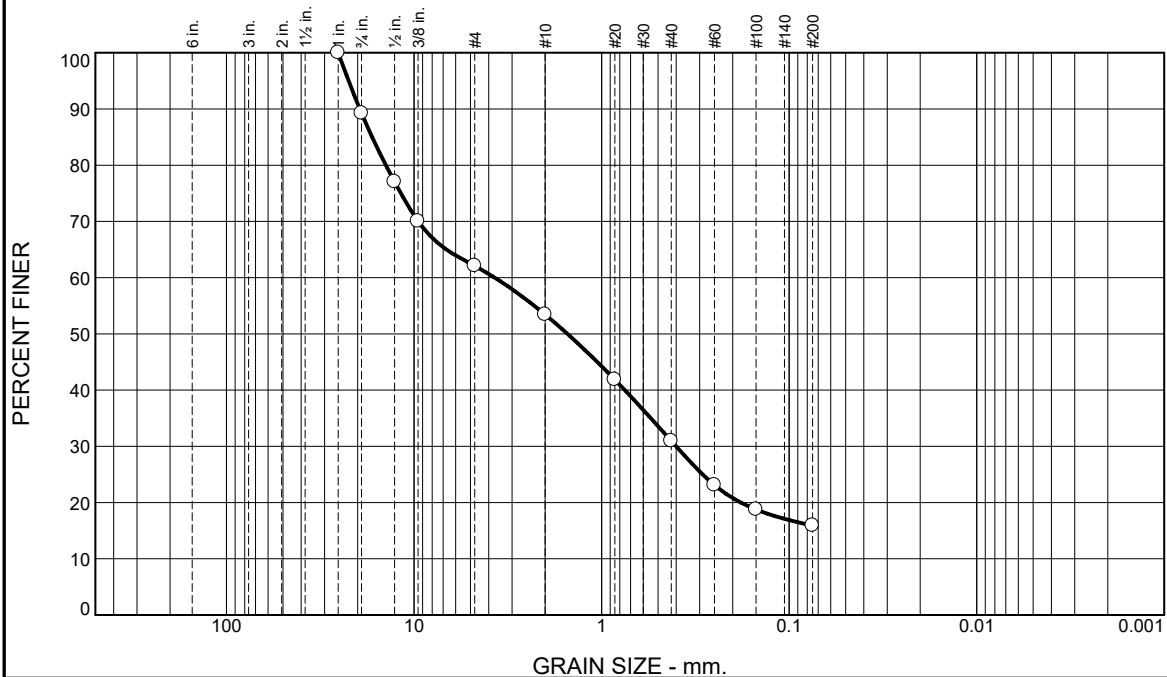
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-16

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.8	27.1	8.7	22.4	15.1	15.9	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	89.2		
0.5"	77.1		
0.375"	70.0		
#4	62.1		
#10	53.4		
#20	41.8		
#40	31.0		
#60	23.1		
#100	18.8		
#200	15.9		

* (no specification provided)

Material Description

Brown Gravelly fine to coarse SAND, little Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-1-b

Coefficients

D₉₀= 19.4752 D₈₅= 16.7439 D₆₀= 3.7114
D₅₀= 1.5192 D₃₀= 0.4003 D₁₅=
D₁₀= C_u= C_c=

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-103
Sample Number: 2D

Depth: 5-7'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

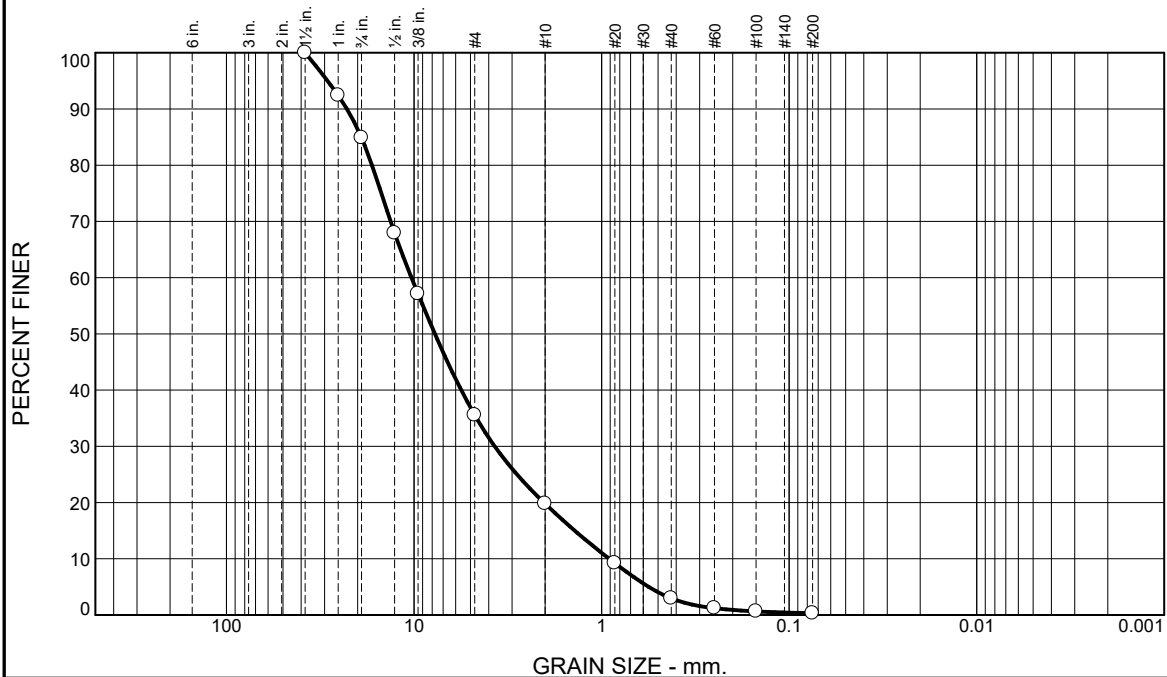
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-17

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	15.1	49.3	15.8	16.8	2.7	0.3	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	92.4		
0.75"	84.9		
0.5"	67.9		
0.375"	57.1		
#4	35.6		
#10	19.8		
#20	9.2		
#40	3.0		
#60	1.2		
#100	0.6		
#200	0.3		

* (no specification provided)

Material Description

Brown Sandy fine to coarse GRAVEL, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= GW AASHTO (M 145)= A-1-a

Coefficients

D₉₀= 22.7952 D₈₅= 19.1232 D₆₀= 10.3313
D₅₀= 7.7352 D₃₀= 3.7146 D₁₅= 1.3896
D₁₀= 0.9112 C_u= 11.34 C_c= 1.47

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-103
Sample Number: 5D

Depth: 20-22'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

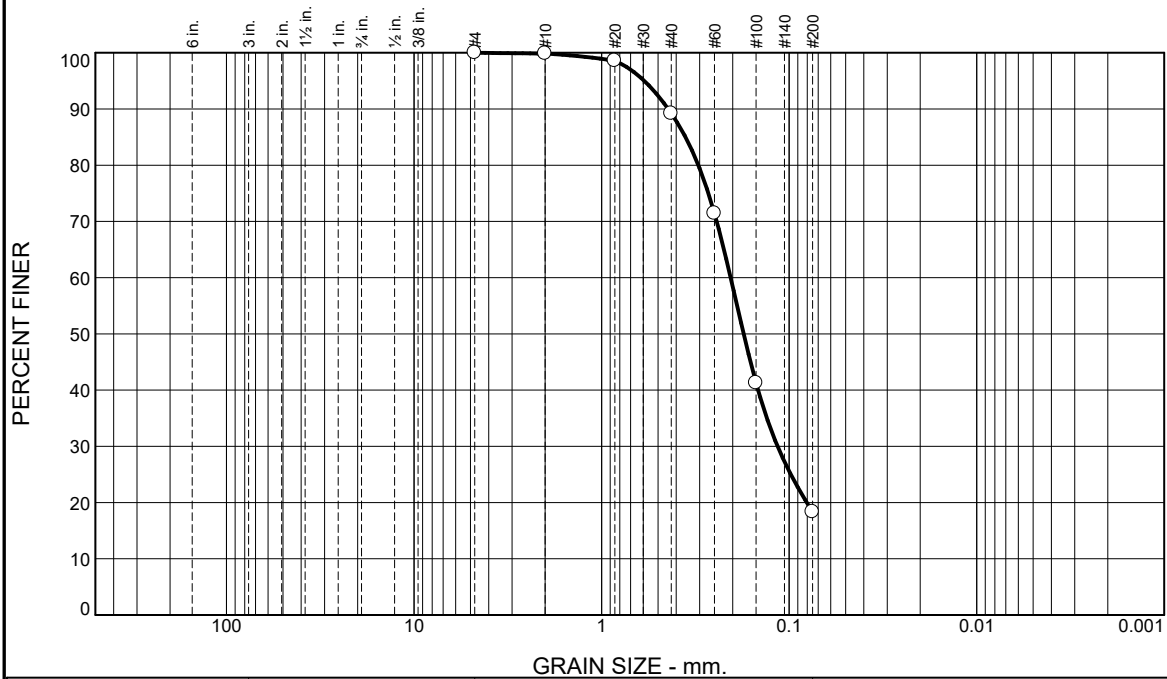
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-18

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	10.7	70.9	18.3	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.9		
#20	98.6		
#40	89.2		
#60	71.4		
#100	41.3		
#200	18.3		

* (no specification provided)

Material Description

Brown f-m SAND, little Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-2-4(0)

Coefficients

D₉₀= 0.4412 D₈₅= 0.3569 D₆₀= 0.2051
D₅₀= 0.1747 D₃₀= 0.1152 D₁₅=
D₁₀= C_u= C_c=

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-103
Sample Number: 7D

Depth: 30-32'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-19

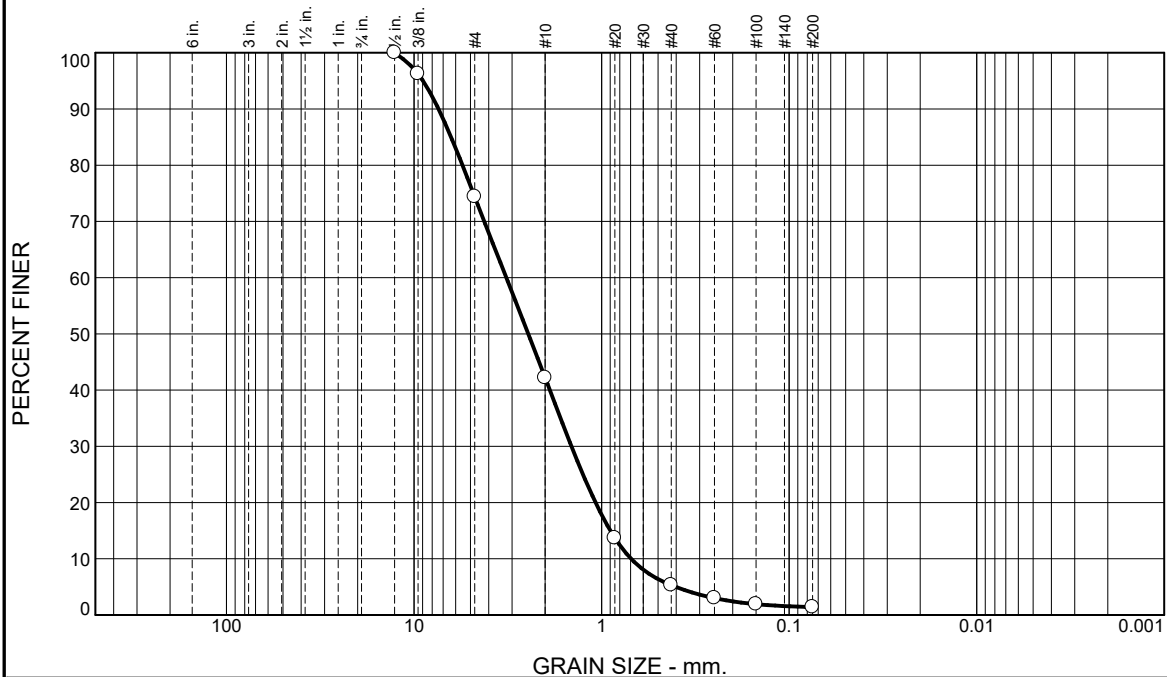
The graph illustrates the grain size distribution of a material. The y-axis represents the percentage of material finer than a given grain size, ranging from 0 to 100. The x-axis represents the grain size in millimeters on a logarithmic scale, ranging from 100 mm down to 0.001 mm. The curve shows that approximately 100% of the material is finer than 6 inches, and about 71% is finer than 1 inch. The distribution is highly skewed towards smaller grain sizes, with the majority of the material being finer than 10 mm.

Grain Size (mm)	Percent Finer (%)
6 in. (152.4 mm)	100
3 in. (76.2 mm)	100
2 in. (50.8 mm)	100
1 1/2 in. (38.1 mm)	100
1 in. (25.4 mm)	71
3/4 in. (19.0 mm)	54
1/2 in. (12.5 mm)	32
3/8 in. (9.5 mm)	22
#4 (4.75 mm)	10
#10 (2.0 mm)	3
#20 (0.85 mm)	1
#30 (0.6 mm)	0.5
#40 (0.425 mm)	0.2
#60 (0.25 mm)	0.1
#100 (0.15 mm)	0.05
#140 (0.106 mm)	0.02
#200 (0.075 mm)	0.01

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	70.8		
0.75"	54.1		
0.5"	31.7		
0.375"	22.3		
#4	9.2		
#10	3.6		
#20	1.4		
#40	0.6		
#60	0.4		
#100	0.3		
#200	0.2		

Figure S-20

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	25.6	32.2	36.9	3.9	1.4	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.5"	100.0		
0.375"	96.3		
#4	74.4		
#10	42.2		
#20	13.7		
#40	5.3		
#60	3.0		
#100	1.9		
#200	1.4		

* (no specification provided)

Material Description

Grey f-m SAND, some fine Gravel, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP AASHTO (M 145)= A-1-a

Coefficients

D₉₀= 7.4001 D₈₅= 6.3470 D₆₀= 3.2227
D₅₀= 2.4608 D₃₀= 1.4472 D₁₅= 0.8988
D₁₀= 0.6962 C_u= 4.63 C_c= 0.93

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-103
Sample Number: 12D

Depth: 55-57'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

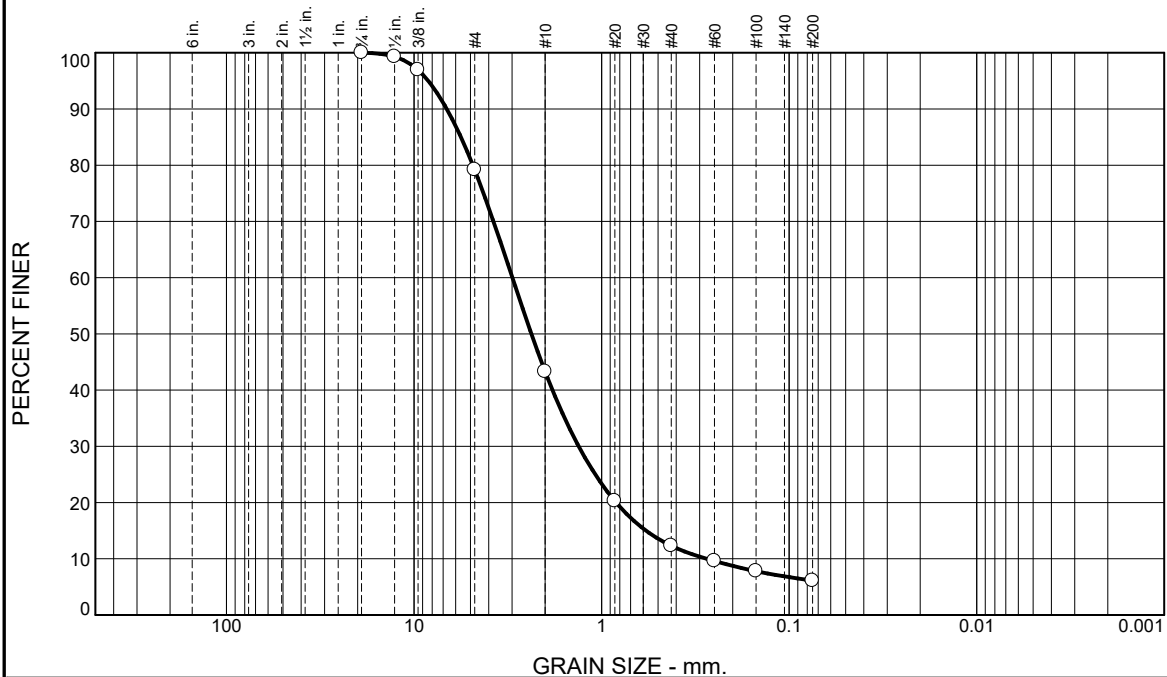
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-21

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	20.8	35.9	31.0	6.2	6.1	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	99.3		
0.375"	97.0		
#4	79.2		
#10	43.3		
#20	20.3		
#40	12.3		
#60	9.6		
#100	7.8		
#200	6.1		

* (no specification provided)

Material Description

Brown m-c SAND, some fine Gravel, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SW-SM AASHTO (M 145)= A-1-a

Coefficients

D₉₀= 6.6863 D₈₅= 5.6257 D₆₀= 2.9907
 D₅₀= 2.3678 D₃₀= 1.3244 D₁₅= 0.5794
 D₁₀= 0.2753 C_u= 10.86 C_c= 2.13

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-103
Sample Number: 16D

Depth: 75-77'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

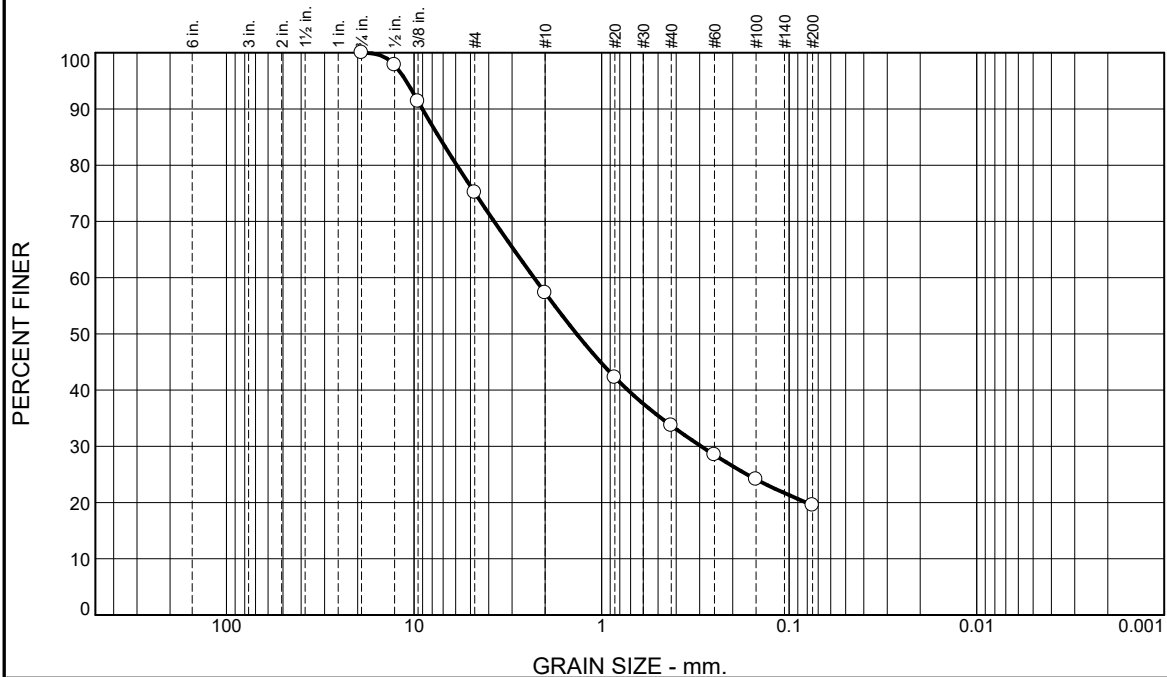
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-22

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	24.9	17.8	23.6	14.2	19.5	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	97.8		
0.375"	91.4		
#4	75.1		
#10	57.3		
#20	42.3		
#40	33.7		
#60	28.5		
#100	24.1		
#200	19.5		

* (no specification provided)

Material Description

Grey f-c SAND, some fine Gravel, little Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-1-b

Coefficients

D₉₀= 9.0263 D₈₅= 7.3472 D₆₀= 2.2940
D₅₀= 1.3578 D₃₀= 0.2944 D₁₅=
D₁₀= C_u= C_c=

Remarks

Date Received: 06.04.18 Date Tested: 06.08.18

Tested By: MN / JS

Checked By: Rebecca Roth

Title: Laboratory Manager

Source of Sample: BB-MPR-103
Sample Number: 24D

Depth: 115-116.2'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

Client: GZA GeoEnvironmental

Project: Pleasant River Bridge #3244, WIN 22627.00
Milo, ME

Project No: 09.0025972.00

Figure S-23

Dashed line indicates the approximate upper limit boundary for natural soils

CH or OH

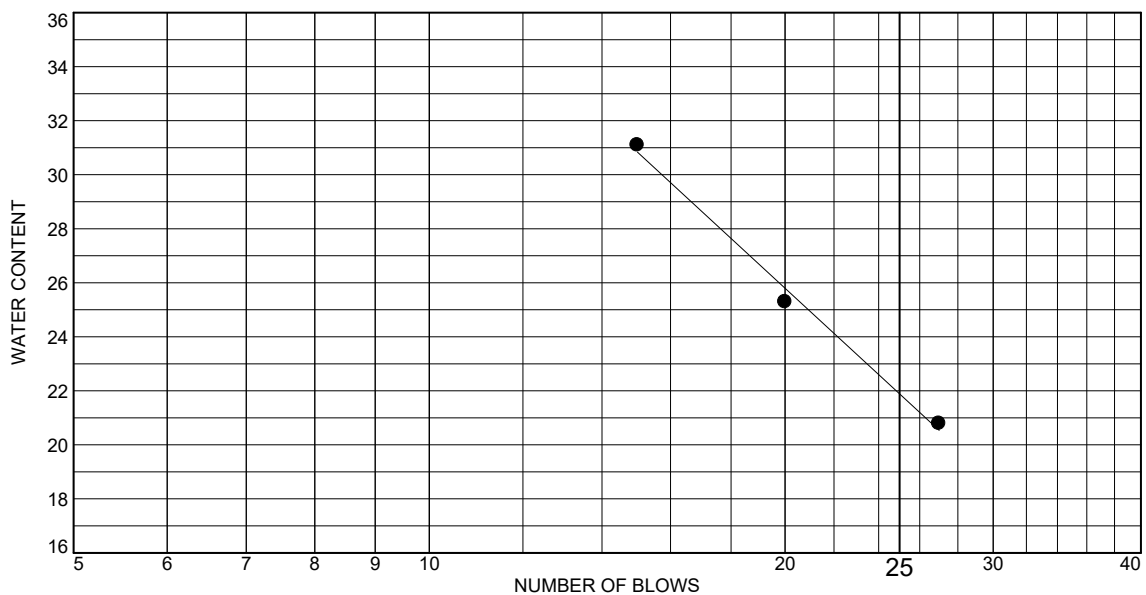
CL or OL

ML or OL

MH or OH

PLASTICITY INDEX

LIQUID LIMIT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown Clayey SILT	22	18	4			

Remarks:

Cranston, RI

Figure L-3

Tested By: MN Checked By: RR

	195 Frances Avenue Cranston RI, 02910 Phone: (401)-467-6454 Fax: (401)-467-2398 thielsch.com <i>Let's Build a Solid Foundation</i>	Client Information: GZA GeoEnvironmental Portland, ME PM: B. Cardali Assigned By: B. Cardali Collected By: B. Cardali	Project Information: Pleasant River Bridge #3244, WIN 22627.00 Milo, ME GZA Project Number: 09.0025972.01 Summary Page: 1 of 1 Report Date: 01.20.2020
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LABORATORY TESTING DATA SHEET, Report No.: 7420-A-110

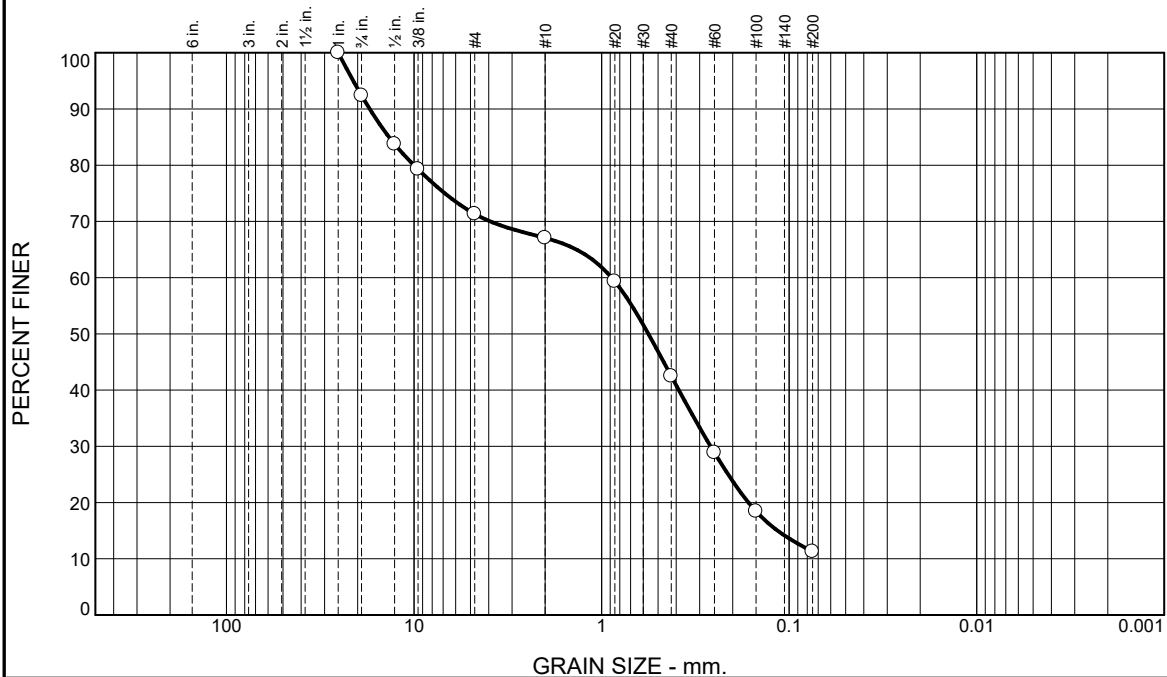
Boring ID	Sample No.	Depth (Ft)	Laboratory No.	Identification Tests								Proctor / CBR / Permeability Tests								Laboratory Log and Soil Description
				As Received Water Content %	LL %	PL %	Gravel %	Sand %	Fines %	Org. %	G _s	Dry unit wt. pcf	Test Water Content %	γ _d <u>MAX</u> (pcf) W _{opt} (%)	γ _d <u>MAX</u> (pcf) W _{opt} (%) (Corr.)	Target Test Setup as % of Proctor	CBR @ 0.1"	CBR @ 0.2"	Permeability cm/sec	
				D2216	D4318		D6913			D2974	D854			D1557						
BB-MPR-201	2D	5-7	20-S-056	9.5			28.7	60.0	11.3											Brown f-m SAND, some f-c Gravel, little Silt
BB-MPR-201	5D	20-22	20-S-057	20.3			0.0	76.5	23.5											Light Brown fine SAND, some Silt
BB-MPR-201	9D	40-42	20-S-058				40.0	51.9	8.1											Brown Gravelly fine to coarse SAND, trace Silt
BB-MPR-201	14D	65-67	20-S-059				9.6	45.1	45.3											Light Brown Sandy SILT, trace coarse Gravel
BB-MPR-201	19D	90-92	20-S-060				60.4	31.9	7.7											Brown f-c GRAVEL, some f-c Sand, trace Silt
BB-MPR-201	22D	115-115.9	20-S-061				13.6	46.3	40.1											Brown Silty Clayey fine to coarse SAND, little fine Gravel
BB-MPR-202	2D	5-7	20-S-062	10.8			8.8	75.5	15.7											Brown f-m SAND, little Silt, fine Gravel
BB-MPR-202	3D	10-12	20-S-063	5.1			69.4	29.6	1.0											Gray f-c Gravel, some f-c Sand, trace Silt
BB-MPR-202	7D	30-32	20-S-064				52.5	41.8	5.7											Gray Sandy fine to coarse GRAVEL, trace Silt
BB-MPR-202	12D	55-57	20-S-065				29.1	59.1	11.8											Gray f-c SAND, some fine Gravel, little Silt
BB-MPR-202	19D	90-92	20-S-066				35.6	56.0	8.4											Gray Gravelly fine to coarse SAND, trace Silt
BB-MPR-202	21D	105-106.4	20-S-067				29.9	47.3	22.8											Brown f-c SAND, some fine Gravel, some Silt

Date Received: 01.13.2020

Reviewed By: SKW

Date Reviewed: 01.20.2020

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.6	21.1	4.2	24.6	31.2	11.3	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	92.4		
0.5"	83.7		
0.375"	79.3		
#4	71.3		
#10	67.1		
#20	59.3		
#40	42.5		
#60	28.9		
#100	18.4		
#200	11.3		

* (no specification provided)

Material Description

Brown f-m SAND, some f-c Gravel, little Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-1-b

Coefficients

D₉₀= 17.2438 D₈₅= 13.6036 D₆₀= 0.8839
D₅₀= 0.5628 D₃₀= 0.2622 D₁₅= 0.1152
D₁₀= C_u= C_c=

Remarks

Date Received: 01.13.2020 Date Tested: 01.15.2020

Tested By: IA / AV

Checked By: Rebecca Roth

Title: Laboratory Coordinator

Source of Sample: BB-MPR-201
Sample Number: 2D

Depth: 5-7'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

Client: GZA GeoEnvironmental

Project: Pleasant River Bridge, #3244, WIN22627.00
Milo, ME

Project No: 09.0025972.01

Figure 20-S-056

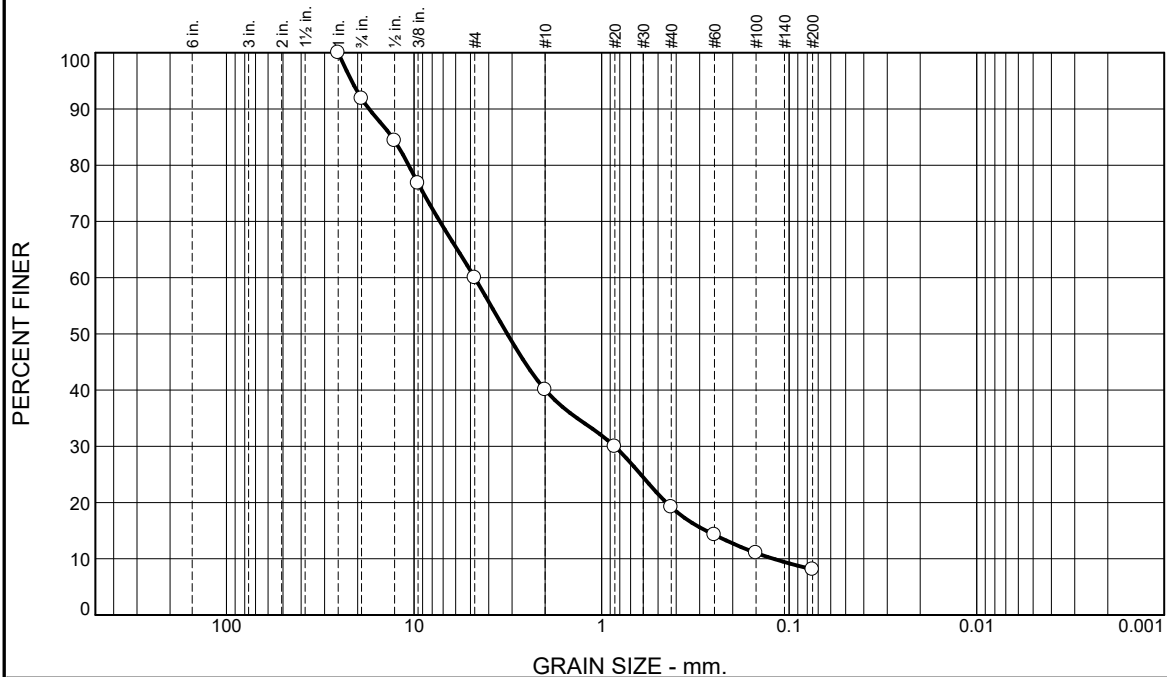
The graph illustrates the grain size distribution of a soil sample. The y-axis represents the percentage of soil finer than a given grain size, ranging from 0 to 100. The x-axis represents the grain size in millimeters on a logarithmic scale, ranging from 100 mm down to 0.001 mm. The curve shows that 100% of the soil is finer than 2.0 mm. The distribution is well-graded, with a significant portion of the soil falling between 0.6 mm and 0.075 mm.

Grain Size (mm)	Percent Finer (%)
6.0	100
3.0	100
2.0	100
1.5	100
1.0	100
0.85	100
0.75	100
0.6	100
0.425	100
0.3	100
0.25	100
0.2	100
0.15	98
0.106	88
0.075	57
0.053	24

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.3		
#20	99.1		
#40	97.4		
#60	87.4		
#100	56.4		
#200	23.5		

Figure 20-S-057

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	8.1	31.9	20.0	20.8	11.1	8.1	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	91.9		
0.5"	84.4		
0.375"	76.8		
#4	60.0		
#10	40.0		
#20	31.9		
#40	19.2		
#60	14.2		
#100	11.0		
#200	8.1		

* (no specification provided)

Material Description

Brown Gravelly fine to coarse SAND, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SW-SM AASHTO (M 145)= A-1-a

Coefficients

D₉₀= 17.3912 D₈₅= 13.0831 D₆₀= 4.7523
D₅₀= 3.1843 D₃₀= 0.8527 D₁₅= 0.2773
D₁₀= 0.1212 C_u= 39.21 C_c= 1.26

Remarks

Date Received: 01.13.2020 Date Tested: 01.15.2020

Tested By: IA / AV

Checked By: Rebecca Roth

Title: Laboratory Coordinator

Source of Sample: BB-MPR-201
Sample Number: 9D

Depth: 40-42'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

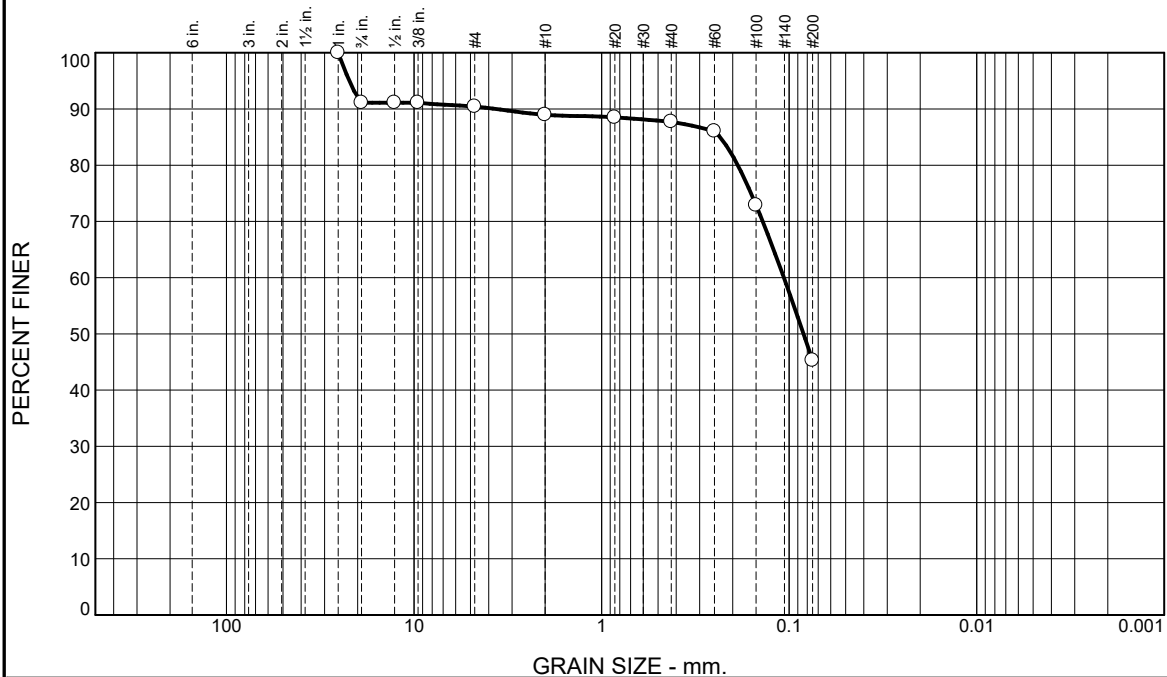
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge, #3244, WIN22627.00
Milo, ME

Project No: 09.0025972.01

Figure 20-S-058

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	8.9	0.7	1.4	1.3	42.4	45.3	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	91.1		
0.5"	91.1		
0.375"	91.1		
#4	90.4		
#10	89.0		
#20	88.5		
#40	87.7		
#60	86.0		
#100	72.9		
#200	45.3		

* (no specification provided)

Material Description

Light Brown Sandy SILT, trace coarse Gravel

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-4(0)

Coefficients

D₉₀= 3.6499 D₈₅= 0.2335 D₆₀= 0.1067
D₅₀= 0.0839 D₃₀= C_u=
D₁₀= C_c=

Remarks

Sample visually classified as non-plastic.

Date Received: 01.13.2020 Date Tested: 01.15.2020

Tested By: IA / AV

Checked By: Rebecca Roth

Title: Laboratory Coordinator

Source of Sample: BB-MPR-201
Sample Number: 14D

Depth: 65-67'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

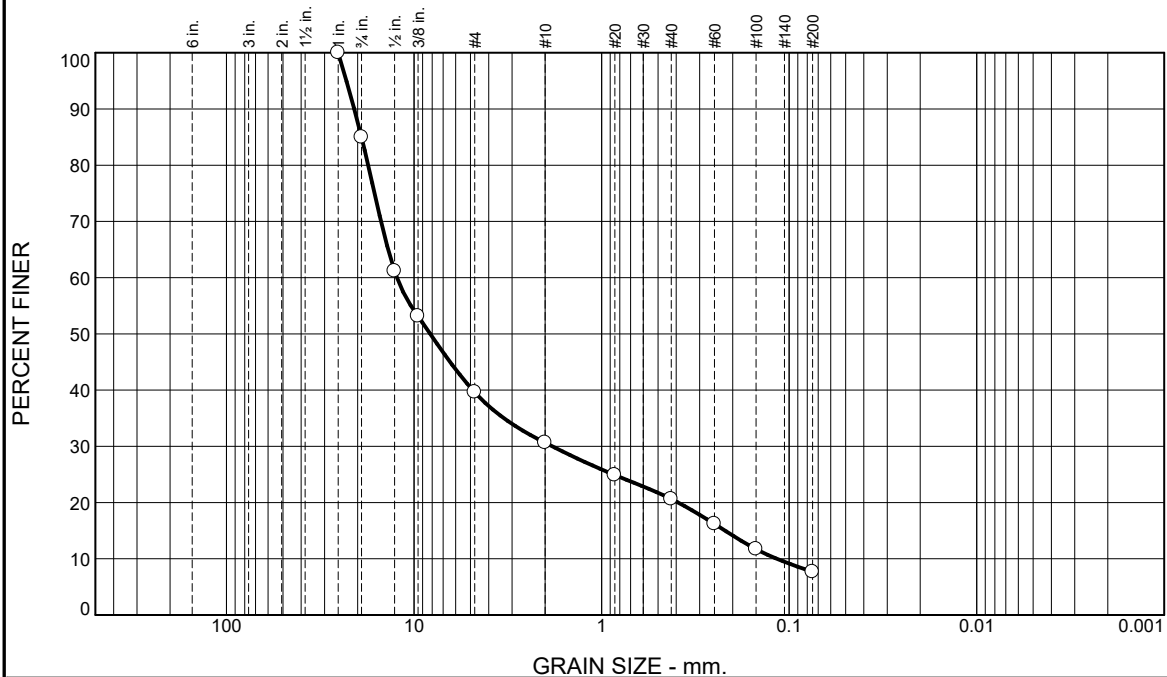
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge, #3244, WIN22627.00
Milo, ME

Project No: 09.0025972.01

Figure 20-S-059

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	15.0	45.4	9.0	10.0	12.9	7.7	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	85.0		
0.5"	61.2		
0.375"	53.1		
#4	39.6		
#10	30.6		
#20	24.9		
#40	20.6		
#60	16.2		
#100	11.7		
#200	7.7		

* (no specification provided)

Material Description

Brown f-c GRAVEL, some f-c Sand, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= GW-GM AASHTO (M 145)= A-1-a

Coefficients

D₉₀= 20.8315 D₈₅= 19.0624 D₆₀= 12.3405
D₅₀= 8.1988 D₃₀= 1.8323 D₁₅= 0.2196
D₁₀= 0.1163 C_u= 106.15 C_c= 2.34

Remarks

Date Received: 01.13.2020 Date Tested: 01.15.2020

Tested By: IA / AV

Checked By: Rebecca Roth

Title: Laboratory Coordinator

Source of Sample: BB-MPR-201
Sample Number: 19D

Depth: 90-92'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

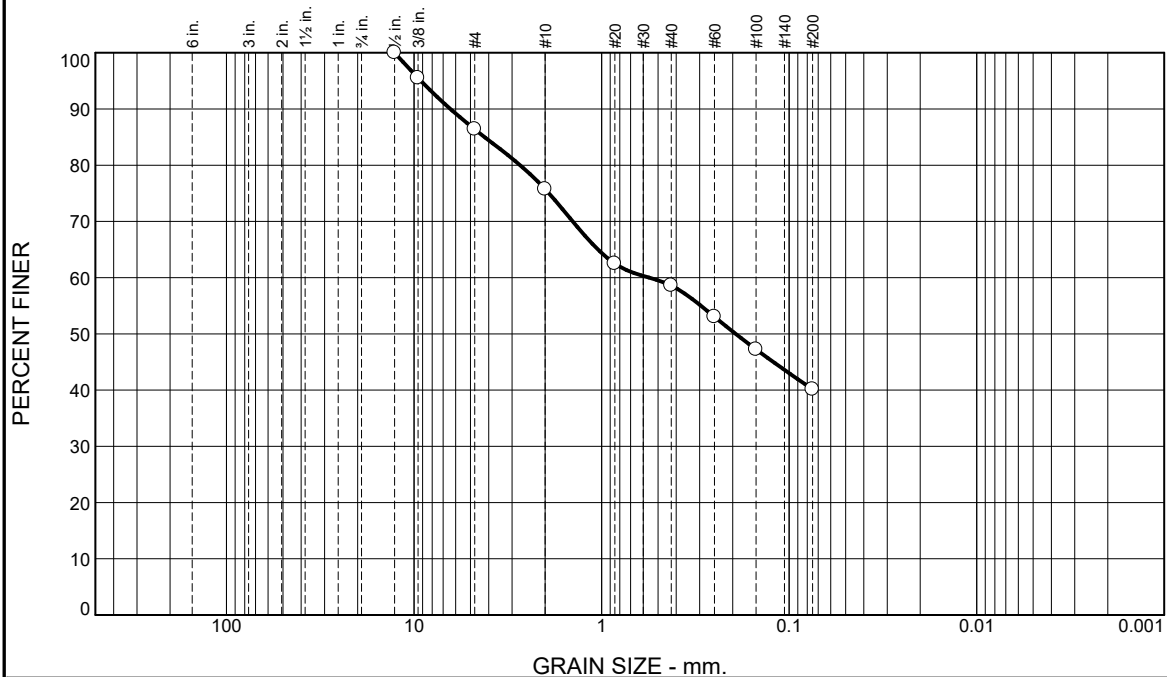
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge, #3244, WIN22627.00
Milo, ME

Project No: 09.0025972.01

Figure 20-S-060

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	13.6	10.7	17.1	18.5	40.1	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.5"	100.0		
0.375"	95.5		
#4	86.4		
#10	75.7		
#20	62.5		
#40	58.6		
#60	53.0		
#100	47.2		
#200	40.1		

* (no specification provided)

Material Description

Brown Silty Clayey fine to coarse SAND, little fine Gravel

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SC AASHTO (M 145)= A-4(0)

Coefficients

D₉₀= 6.3947 D₈₅= 4.2031 D₆₀= 0.5572
D₅₀= 0.1926 D₃₀= C_u=
D₁₀= C_c=

Remarks

Sample visually classified as plastic. Sample rolled to 1/8".

Date Received: 01.13.2020 Date Tested: 01.15.2020

Tested By: IA / AV

Checked By: Rebecca Roth

Title: Laboratory Coordinator

Source of Sample: BB-MPR-201
Sample Number: 22D

Depth: 115-115.9'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

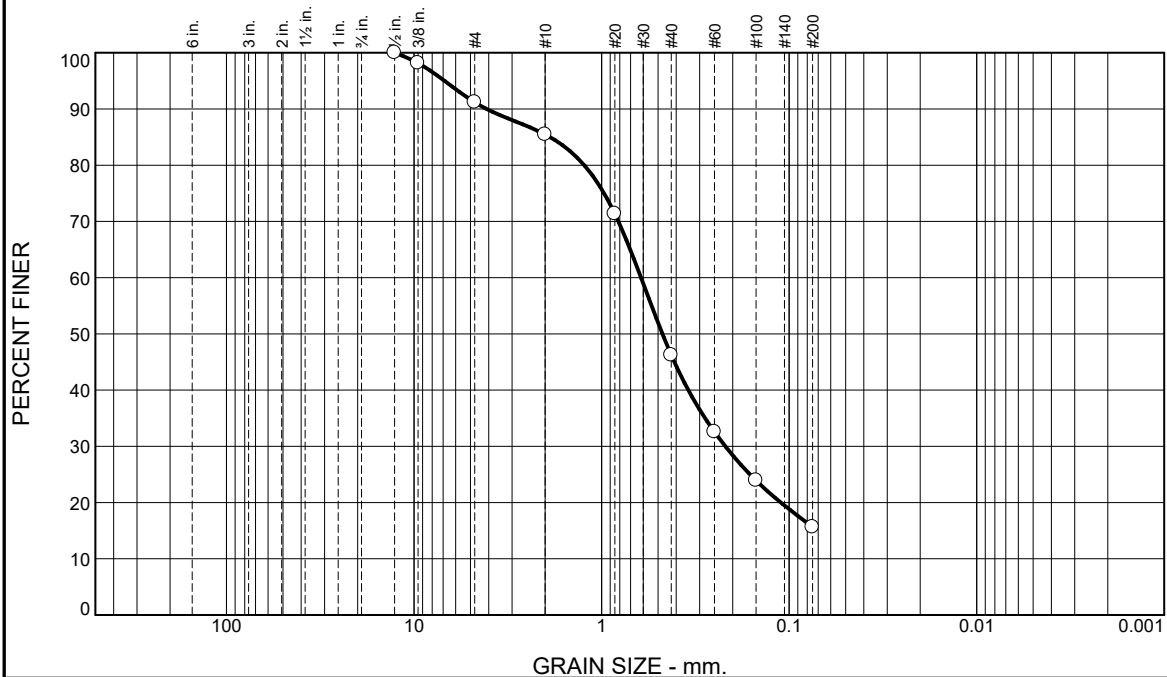
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge, #3244, WIN22627.00
Milo, ME

Project No: 09.0025972.01

Figure 20-S-061

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.8	5.7	39.3	30.5	15.7	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.5"	100.0		
0.375"	98.2		
#4	91.2		
#10	85.5		
#20	71.4		
#40	46.2		
#60	32.6		
#100	23.9		
#200	15.7		

* (no specification provided)

Material Description

Brown f-m SAND, little Silt, fine Gravel

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-1-b

Coefficients

D₉₀= 4.0954 D₈₅= 1.8843 D₆₀= 0.6161
D₅₀= 0.4736 D₃₀= 0.2188 D₁₅=
D₁₀= C_u= C_c=

Remarks

Date Received: 01.13.2020 Date Tested: 01.15.2020

Tested By: IA / AV

Checked By: Rebecca Roth

Title: Laboratory Coordinator

Source of Sample: BB-MPR-202
Sample Number: 2D

Depth: 5-7'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

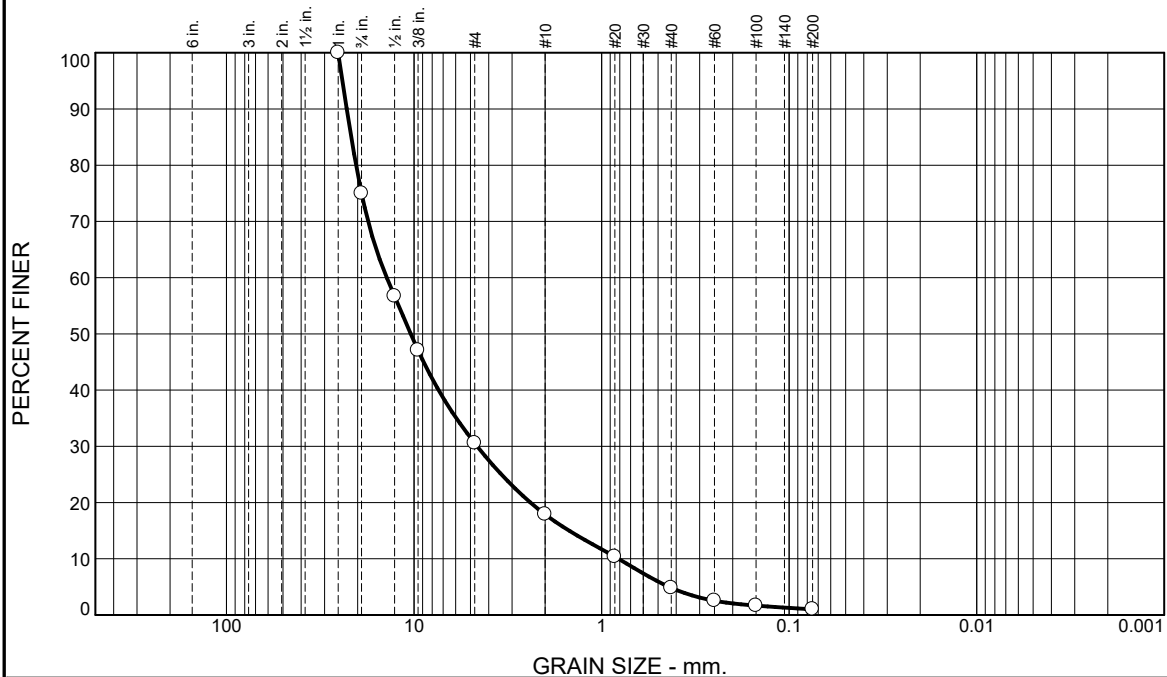
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge, #3244, WIN22627.00
Milo, ME

Project No: 09.0025972.01

Figure 20-S-062

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	25.0	44.4	12.7	13.1	3.8	1.0	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	75.0		
0.5"	56.7		
0.375"	47.1		
#4	30.6		
#10	17.9		
#20	10.4		
#40	4.8		
#60	2.5		
#100	1.7		
#200	1.0		

* (no specification provided)

Material Description

Gray f-c Gravel, some f-c Sand, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= GW AASHTO (M 145)= A-1-a

Coefficients

D₉₀= 22.8514 D₈₅= 21.6162 D₆₀= 13.9787
D₅₀= 10.4236 D₃₀= 4.6032 D₁₅= 1.4890
D₁₀= 0.8141 C_u= 17.17 C_c= 1.86

Remarks

Date Received: 01.13.2020 Date Tested: 01.15.2020

Tested By: IA / AV

Checked By: Rebecca Roth

Title: Laboratory Coordinator

Source of Sample: BB-MPR-202
Sample Number: 3D

Depth: 10-12'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

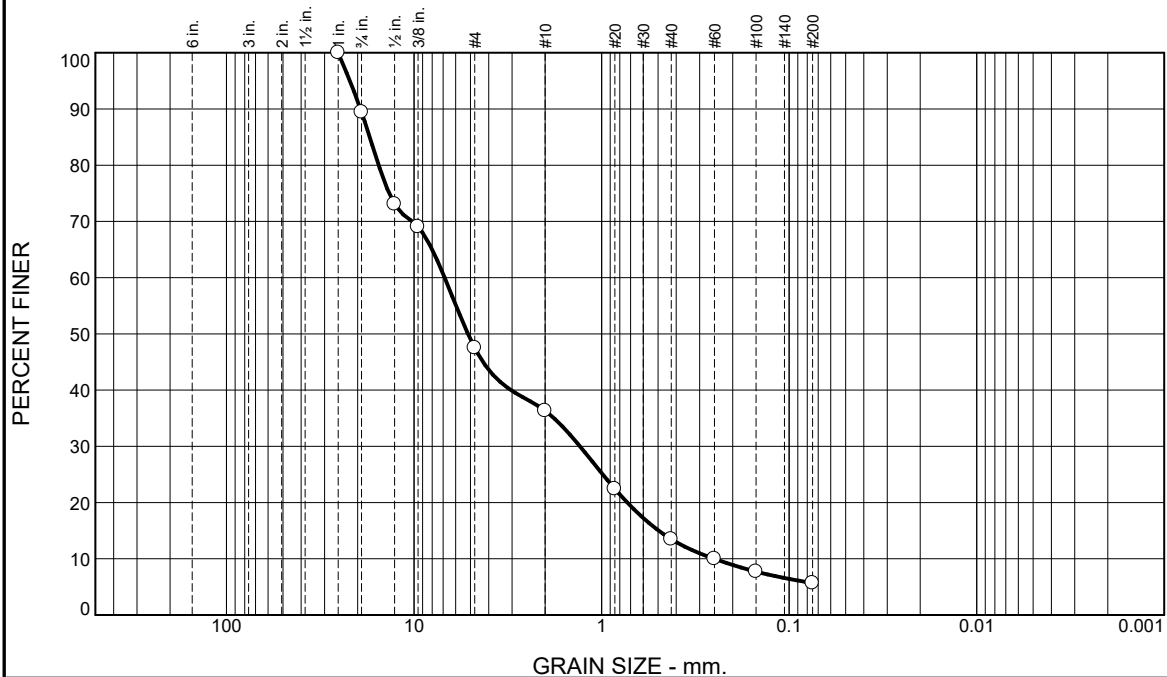
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge, #3244, WIN22627.00
Milo, ME

Project No: 09.0025972.01

Figure 20-S-063

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.6	41.9	11.2	22.8	7.8	5.7	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	89.4		
0.5"	73.1		
0.375"	69.0		
#4	47.5		
#10	36.3		
#20	22.4		
#40	13.5		
#60	10.0		
#100	7.7		
#200	5.7		

* (no specification provided)

Material Description

Gray Sandy fine to coarse GRAVEL, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= GP-GM AASHTO (M 145)= A-1-a

Coefficients

D₉₀= 19.3059 D₈₅= 17.2448 D₆₀= 6.8635
D₅₀= 5.1604 D₃₀= 1.3041 D₁₅= 0.4962
D₁₀= 0.2504 C_u= 27.41 C_c= 0.99

Remarks

Date Received: 01.13.2020 Date Tested: 01.15.2020

Tested By: IA / AV

Checked By: Rebecca Roth

Title: Laboratory Coordinator

Source of Sample: BB-MPR-202
Sample Number: 7D

Depth: 30-32'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

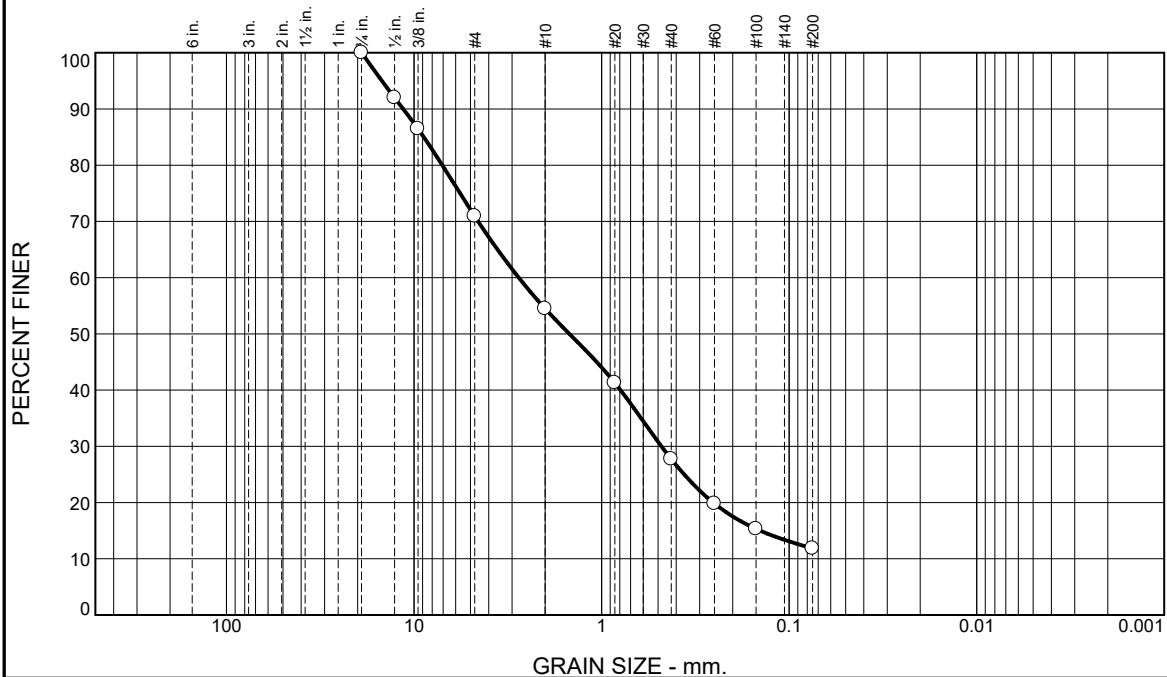
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge, #3244, WIN22627.00
Milo, ME

Project No: 09.0025972.01

Figure 20-S-064

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	29.1	16.4	26.8	15.9	11.8	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	92.0		
0.375"	86.5		
#4	70.9		
#10	54.5		
#20	41.3		
#40	27.7		
#60	19.8		
#100	15.3		
#200	11.8		

* (no specification provided)

Material Description

Gray f-c SAND, some fine Gravel, little Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SP-SM AASHTO (M 145)= A-1-b

Coefficients

D₉₀= 11.4361 D₈₅= 8.8688 D₆₀= 2.7655
D₅₀= 1.4837 D₃₀= 0.4795 D₁₅= 0.1428
D₁₀= C_u= C_c=

Remarks

Date Received: 01.13.2020 Date Tested: 01.15.2020

Tested By: IA / AV

Checked By: Rebecca Roth

Title: Laboratory Coordinator

Source of Sample: BB-MPR-202
Sample Number: 12D

Depth: 55-57'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

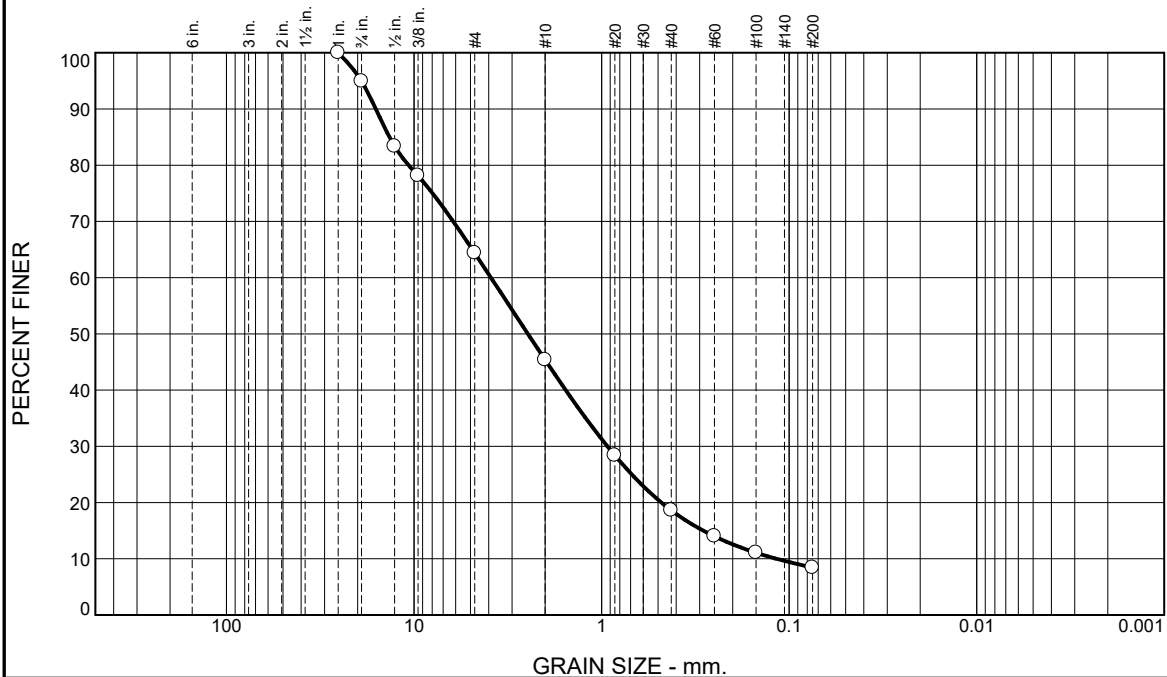
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge, #3244, WIN22627.00
Milo, ME

Project No: 09.0025972.01

Figure 20-S-065

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.1	30.5	19.0	26.8	10.2	8.4	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1"	100.0		
0.75"	94.9		
0.5"	83.4		
0.375"	78.1		
#4	64.4		
#10	45.4		
#20	28.4		
#40	18.6		
#60	14.0		
#100	11.1		
#200	8.4		

* (no specification provided)

Material Description

Gray Gravelly fine to coarse SAND, trace Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SW-SM AASHTO (M 145)= A-1-a

Coefficients

D₉₀= 15.9976 D₈₅= 13.5340 D₆₀= 3.8904
D₅₀= 2.4719 D₃₀= 0.9314 D₁₅= 0.2868
D₁₀= 0.1166 C_u= 33.37 C_c= 1.91

Remarks

Date Received: 01.13.2020 Date Tested: 01.15.2020

Tested By: IA / AV

Checked By: Rebecca Roth

Title: Laboratory Coordinator

Source of Sample: BB-MPR-202
Sample Number: 19D

Depth: 90-92'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

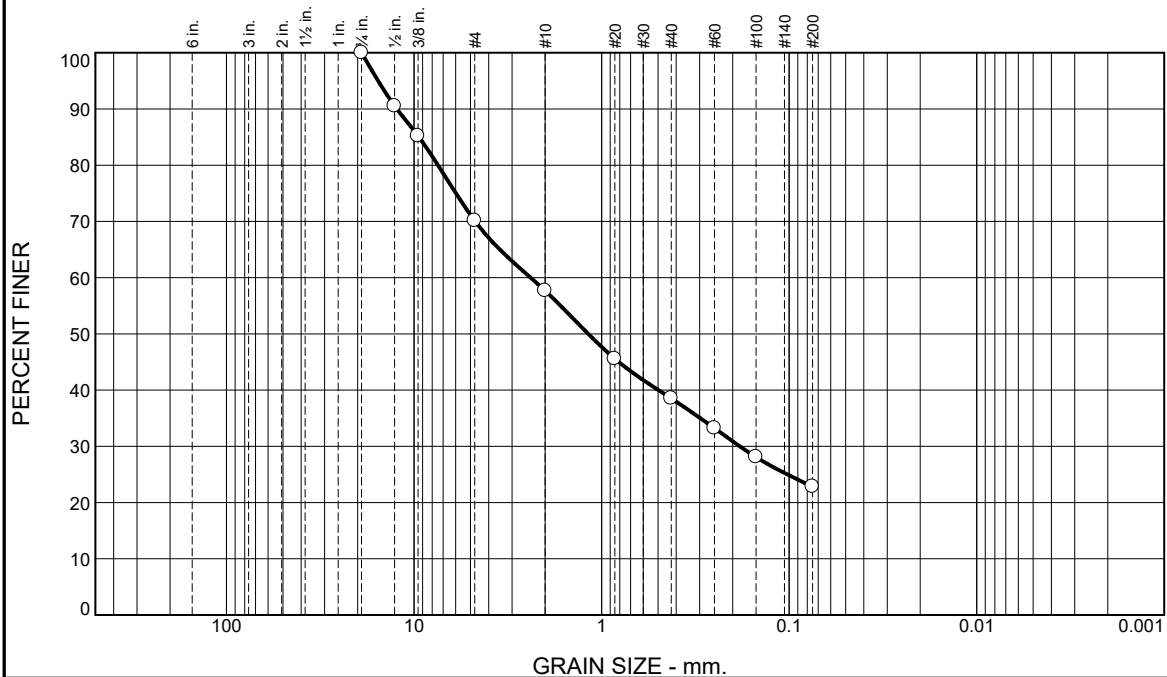
Client: GZA GeoEnvironmental

Project: Pleasant River Bridge, #3244, WIN22627.00
Milo, ME

Project No: 09.0025972.01

Figure 20-S-066

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	29.9	12.4	19.2	15.7	22.8	

Test Results (D6913 & ASTM D 1140)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75"	100.0		
0.5"	90.5		
0.375"	85.2		
#4	70.1		
#10	57.7		
#20	45.6		
#40	38.5		
#60	33.2		
#100	28.1		
#200	22.8		

* (no specification provided)

Material Description

Brown f-c SAND, some fine Gravel, some Silt

Atterberg Limits (ASTM D 4318)

PL= NP LL= NV PI= NP

Classification

USCS (D 2487)= SM AASHTO (M 145)= A-1-b

Coefficients

D₉₀= 12.3570 D₈₅= 9.4169 D₆₀= 2.3892
D₅₀= 1.1778 D₃₀= 0.1831 D₁₅=
D₁₀= C_u= C_c=

Remarks

Date Received: 01.13.2020 Date Tested: 01.15.2020

Tested By: IA / AV

Checked By: Rebecca Roth

Title: Laboratory Coordinator

Source of Sample: BB-MPR-202
Sample Number: 21D

Depth: 105-106.4'

Date Sampled:

Thielsch Engineering Inc.

Cranston, RI

Client: GZA GeoEnvironmental

Project: Pleasant River Bridge, #3244, WIN22627.00
Milo, ME

Project No: 09.0025972.01

Figure 20-S-067



08/07/2020

GEOTECHNICAL DESIGN REPORT
PLEASANT RIVER BRIDGE NO. 3244 - MILO
HNTB Corporation
09.0025972.01

APPENDIX D – SOIL SPRINGS

Passive Earth Pressure Springs

 GZA GeoEnvironmental, Inc. 707 Sable Oaks Drive, Suite 150 South Portland, ME 04106 207-879-9190 http://www.gza.com	JOB 09.0025972.01 - Pleasant River Bridge, Milo			
	SHEET NO. 1		OF 2	
	CALCULATED BY ARB		DATE 5/29/2020	
	CHECKED BY CLS		DATE 5/29/2020	

Objective: Develop lateral springs for abutments with Sand/Gravel Backfill.

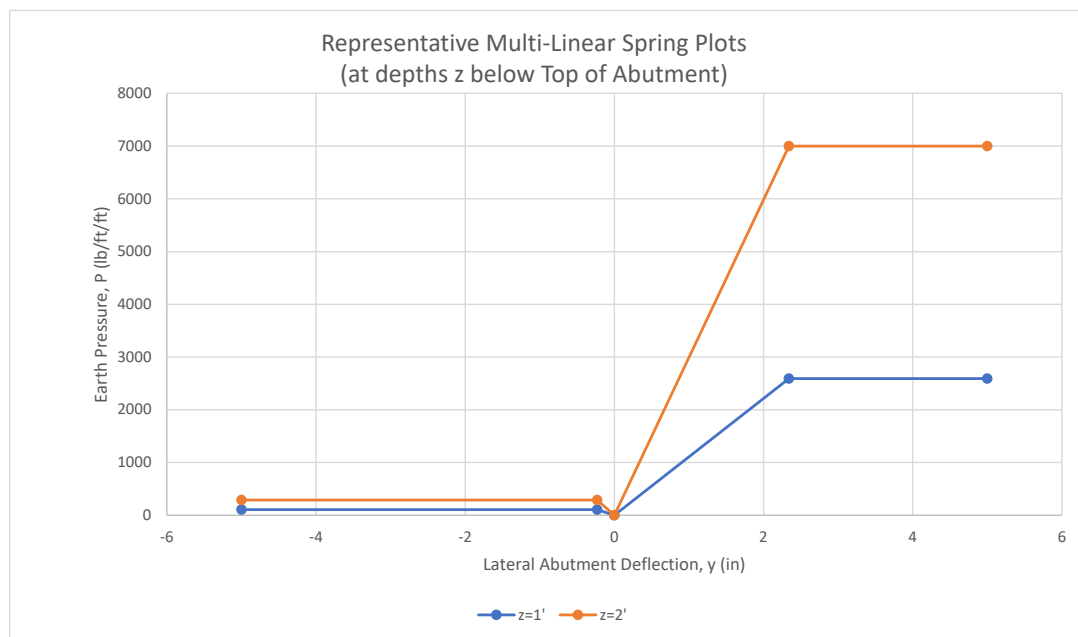
Soil Input

Surcharge 250 psf (Highway Surcharge)
γt 135 pcf (Pavement Section Unit Weight)

See Mathcad Sheet for Basis of Values

- Notes:
1. Calculated pressures do not include highway surcharge as noted.
 2. Springs at z=1' and z=2' are 1 and 2' below top of abutment, and both are above the approach slab.
 3. Grayed cells should not be used for compressible inclusion backfill case.

	Active Earth Pressure (lb/ft/ft)		At-rest Pressure	Origin Coordinate	Passive Earth Pressure (lb/ft/ft)	
	Abutment Moving Away from Backfill		Neutral Movement	for Modeling	Abutment Moving Toward Backfill	
	Ya2	Ya1	Yo	Y1	Yp1	Yp2
Pressure Coefficient (K)	0.276	0.276	0.47	0	6.73	6.73
Y corresponding to Pressure	-5	-0.23	0	0	2.34	5
1	106.3	106.3	181.0	0.0	2591.1	2591.1
2	287.0	287.0	488.8	0.0	6999.2	6999.2
3	542.3	542.3	923.6	0.0	13224.5	13224.5
4	872.2	872.2	1485.2	0.0	21266.8	21266.8
5	1276.5	1276.5	2173.8	0.0	31126.3	31126.3
6	1755.4	1755.4	2989.2	0.0	42802.8	42802.8
7	2308.7	2308.7	3931.6	0.0	56296.5	56296.5
8	2936.6	2936.6	5000.8	0.0	71607.2	71607.2
9	3639.1	3639.1	6197.0	0.0	88735.1	88735.1
10	4416.0	4416.0	7520.0	0.0	107680.0	107680.0
11	5267.5	5267.5	8970.0	0.0	128442.1	128442.1
12	6193.4	6193.4	10546.8	0.0	151021.2	151021.2
13	7193.9	7193.9	12250.6	0.0	175417.5	175417.5



 GZA GeoEnvironmental, Inc. 707 Sable Oaks Drive, Suite 150 South Portland, ME 04106 207-879-9190 http://www.gza.com	JOB 09.0025972.01 - Pleasant River Bridge, Milo			
	SHEET NO. 2		OF 2	
	CALCULATED BY ARB		DATE 5/29/2020	
	CHECKED BY CLS		DATE 5/29/2020	

Objective: Develop lateral springs for abutments with Sand/Gravel Backfill.

Soil Input

Surcharge

γt

0 psf

(No Highway Surcharge)

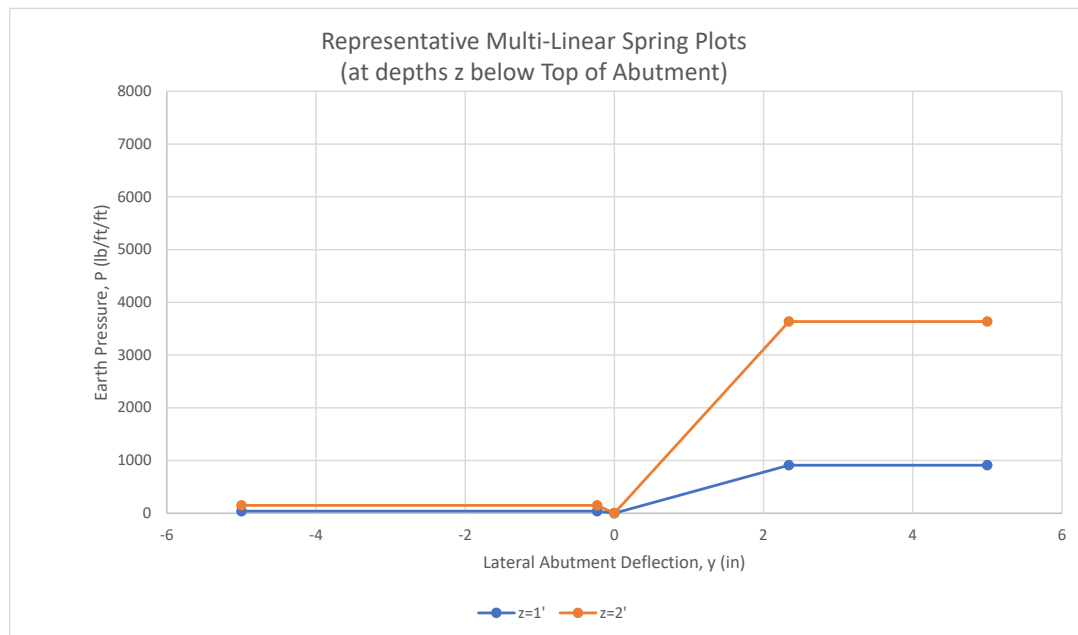
135 pcf

(Pavement SectionUnit Weight)

See Mathcad Sheet for Basis of Values

- Notes: 1. Calculated pressures do not include highway surcharge as noted.
 2. Springs at z=1' and z=2' are 1 and 2' below top of abutment, and both are above the approach slab.
 3. Grayed cells should not be used for compressible inclusion backfill case.

	Active Earth Pressure (lb/ft/ft)		At-rest Pressure	Origin Coordinate	Passive Earth Pressure (lb/ft/ft)	
	Abutment Moving Away from Backfill		Neutral Movement	for Modeling	Abutment Moving Toward Backfill	
	Ya2	Ya1	Yo	Y1	Yp1	Yp2
Pressure Coefficient (K)	0.276	0.276	0.47	0	6.73	6.73
Y corresponding to Pressure	-5	-0.23	0	0	2.34	5
1	37.3	37.3	63.5	0.0	908.6	908.6
2	149.0	149.0	253.8	0.0	3634.2	3634.2
3	335.3	335.3	571.1	0.0	8177.0	8177.0
4	596.2	596.2	1015.2	0.0	14536.8	14536.8
5	931.5	931.5	1586.3	0.0	22713.8	22713.8
6	1341.4	1341.4	2284.2	0.0	32707.8	32707.8
7	1825.7	1825.7	3109.1	0.0	44519.0	44519.0
8	2384.6	2384.6	4060.8	0.0	58147.2	58147.2
9	3018.1	3018.1	5139.5	0.0	73592.6	73592.6
10	3726.0	3726.0	6345.0	0.0	90855.0	90855.0
11	4508.5	4508.5	7677.5	0.0	109934.6	109934.6
12	5365.4	5365.4	9136.8	0.0	130831.2	130831.2
13	6296.9	6296.9	10723.1	0.0	153545.0	153545.0



Elastic Inclusion Springs



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JOB	09.0025972.01 - Pleasant River Bridge, Milo		
SHEET NO.	1	OF	5
CALCULATED BY	ARB	DATE	5/29/2020
CHECKED BY	CLS	DATE	5/29/2020

Objective: Develop lateral springs for abutments considering the use of resilient EPS (compressible inclusion).

Soil Input

Surcharge	250 psf	(Highway Surcharge)
γ_{ab}	135 pcf	(Aggregate Base Unit Weight)
T_{ab}	2 ft	(Aggregate Base Thickness - include pavement)
γ_{slab}	150 pcf	(Approach Slab Unit Weight)
T_{slab}	1 ft	(Approach Slab Thickness)
Ptot	670 psf	(Total Vertical Surcharge above Compressible Inclusion)
γ_s	125 pcf	(Abutment Backfill Unit Weight)

- Notes:**
1. Calculated pressures include highway surcharge, slab self weight and pavement section weight as shown.
 2. Springs at $z=1'$ and $2'$ are no-inclusion springs and are provided separately, springs at $z=3'$ and below consider inclusion and are presented below.
 3. The basis of the earth pressures and springs is use of a 24" thick resilient block molded EPS layer behind each abutment.
 4. Reference: Horvath, 2000, "Integral-Abutment Bridges: Problems and Innovative Solutions using EPS Geofoam and Other Geosynthetics," Manhattan College Research Report No. CE/GE-00-2.

Basis for Springs (per Horvath 2000)

		Initial Condition ($x=0''$)	With 2' Thick Inclusion			
		Average of Active and At-Rest Earth Pressure ($K=0.373$)	Max Earth Pressure Coefficient	Max Lateral Effective Stress	Max Lateral Earth Pressure (At-Rest) (See Note 7)	Deflection at Max Lateral Earth Pressure (in) (See Note 7)
		σ_v' (psf)	K	σ_h' (psf)	F_h (lb/ft/ft)	x (in)
Depth below Top of Abutment, z (ft)	3	670	0.47	315	944.7	1.4
	4	795	0.47	374	1494.6	1.7
	5	920	0.47	432	2162.0	2.0
	6	1045	0.47	491	2946.9	2.3
	7	1170	0.47	550	3849.3	2.5
	8	1295	0.47	609	4869.2	2.8
	9	1420	0.47	667	6006.6	3.1
	10	1545	0.47	726	7261.5	3.3
	11	1670	0.47	785	8633.9	3.6
	12	1795	0.47	844	10123.8	3.9
	13	1920	0.47	902	11731.2	4.1

Linear Springs for Model Input:

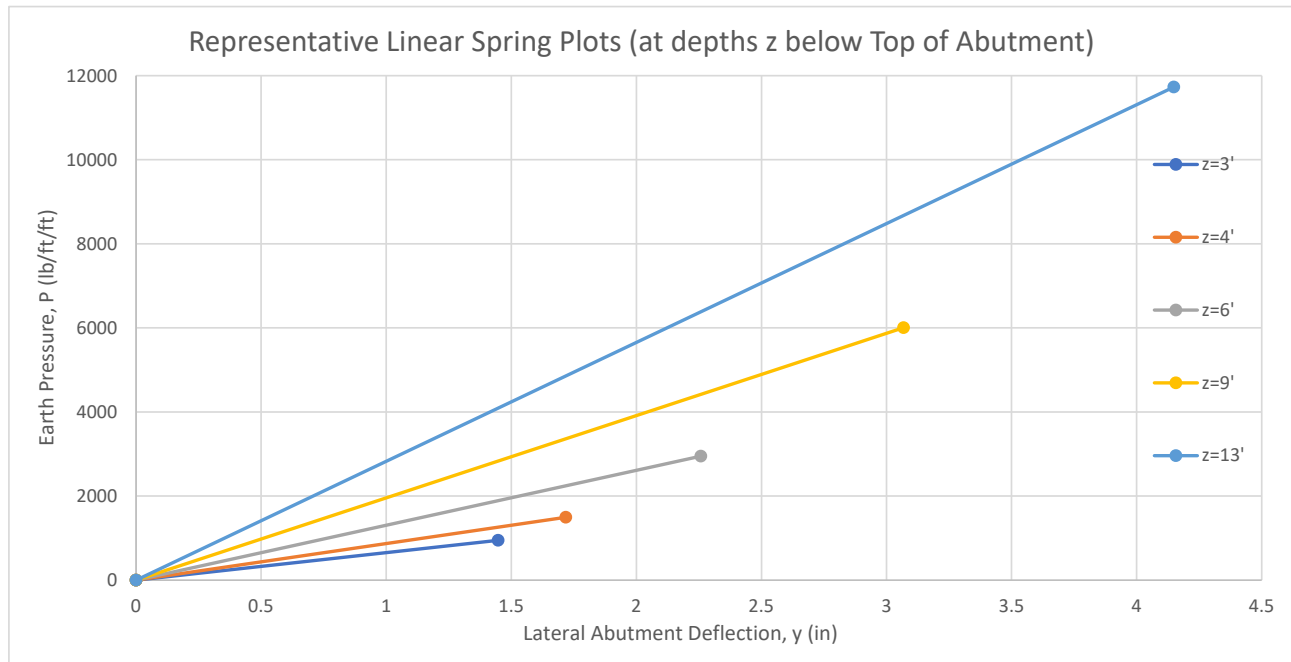
- Notes:**
5. Considering that the maximum wall deflection is less than 1", all springs remain within the linear range, so the springs can be modeled with a single linear segment.
 6. The actual starting value is considered to correspond to $K=0.373$, but due to CSIBridge modeling limitations, the linear spring must pass through the origin.
 7. The end of the linear spring is represented by the Deflection at Max Lateral Earth Pressure, x , as the x-coordinate and the Max Lateral Earth Pressure, F_h , as the y-coordinate.
 8. Select plotted linear springs are presented below.



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SHEET NO.	2	OF	5
CALCULATED BY	ARB	DATE	5/29/2020
CHECKED BY	CLS	DATE	5/29/2020

Select Plotted Linear Spring Curves:



Comparison of Design Earth Pressures with Inclusion to Horvath 2000 FEM Study:

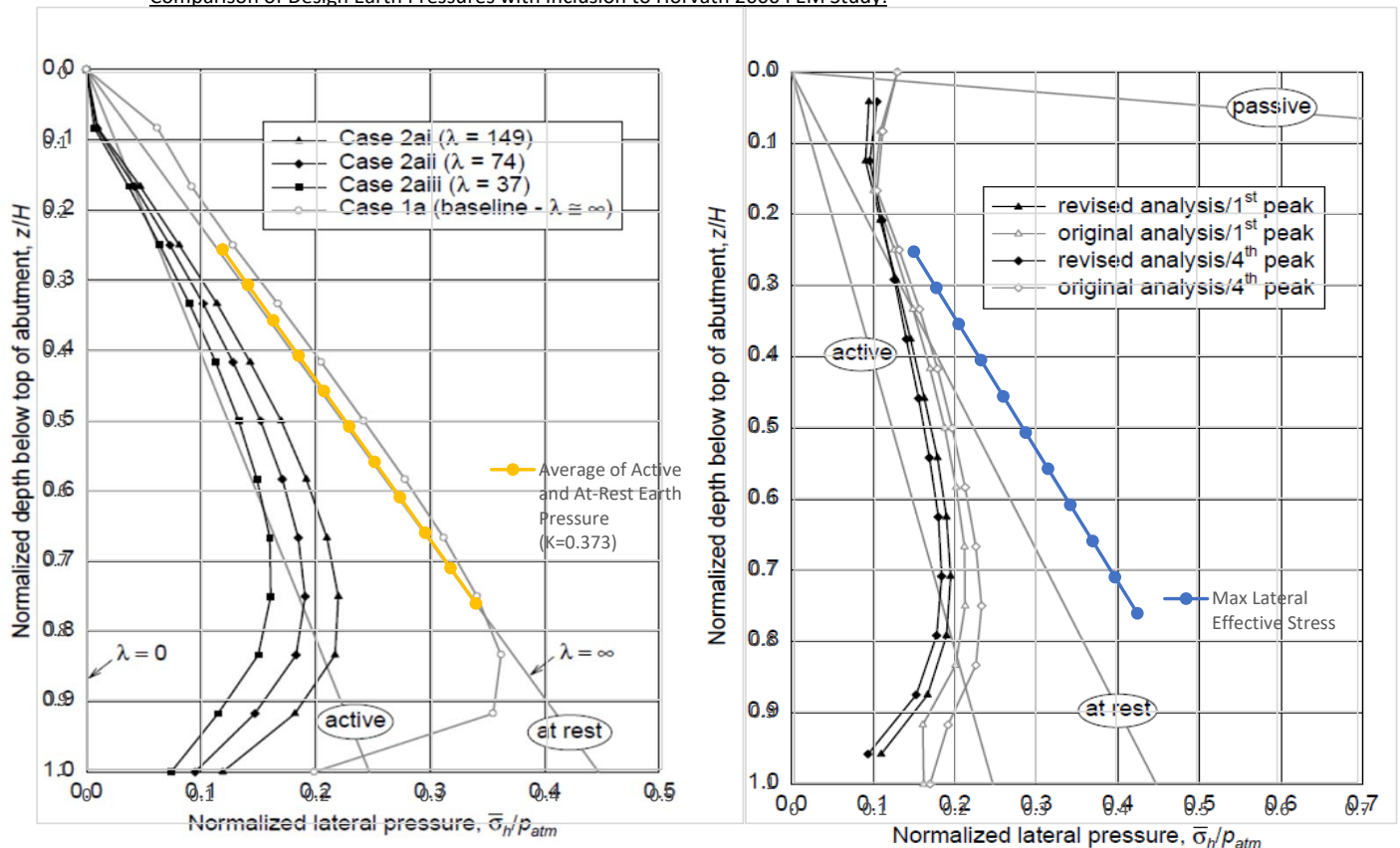


Figure 3.22. Case 2a:
Lateral Pressures at End of Construction

Figure 3.57. Case 2aII: Effect of FEM Model on Calculated
Lateral Pressures at Thermal Expansion Peaks

Basis of Spring in Initial/Contracted Condition

Basis of Spring in Fully Expanded Condition



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SHEET NO.	3	OF	5
CALCULATED BY	ARB	DATE	5/29/2020
CHECKED BY	CLS	DATE	5/29/2020

Objective: Develop lateral springs for abutments considering the use of resilient EPS (compressible inclusion).

Soil Input

Surcharge	0 psf	(Highway Surcharge)
γ_{ab}	135 pcf	(Aggregate Base Unit Weight)
T_{ab}	2 ft	(Aggregate Base Thickness - include pavement)
γ_{slab}	150 pcf	(Approach Slab Unit Weight)
T_{slab}	1 ft	(Approach Slab Thickness)
Ptot	420 psf	(Total Vertical Surcharge above Compressible Inclusion)
γ_s	125 pcf	(Abutment Backfill Unit Weight)

- Notes:**
1. Calculated pressures do not include highway surcharge and include slab self weight and pavement section weight as shown.
 2. Springs at $z=1'$ and $2'$ are no-inclusion springs and are provided separately, springs at $z=3'$ and below consider inclusion and are presented below.
 3. The basis of the earth pressures and springs is use of a 24" thick resilient block molded EPS layer behind each abutment.
 4. Reference: Horvath, 2000, "Integral-Abutment Bridges: Problems and Innovative Solutions using EPS Geofoam and Other Geosynthetics," Manhattan College Research Report No. CE/GE-00-2.

Basis for Springs (per Horvath 2000)

		Initial Condition (x=0")	With 2' Thick Inclusion				
	Vertical Effective Stress	Average of Active and At Rest Earth Pressure (K=0.373)	Max Earth Pressure Coefficient	Max Lateral Effective Stress	Max Lateral Earth Pressure (At-Rest) (See Note 7)	Deflection at Max Lateral Earth Pressure (in) (See Note 7)	
	σ_v' (psf)	F _o (lb/ft/ft)	K	σ_h' (psf)	F _h (lb/ft/ft)	x (in)	
Depth below Top of Abutment, z (ft)	3	420	470.0	0.47	197	592.2	0.9
	4	545	813.1	0.47	256	1024.6	1.2
	5	670	1249.6	0.47	315	1574.5	1.4
	6	795	1779.2	0.47	374	2241.9	1.7
	7	920	2402.1	0.47	432	3026.8	2.0
	8	1045	3118.3	0.47	491	3929.2	2.3
	9	1170	3927.7	0.47	550	4949.1	2.5
	10	1295	4830.4	0.47	609	6086.5	2.8
	11	1420	5826.3	0.47	667	7341.4	3.1
	12	1545	6915.4	0.47	726	8713.8	3.3
	13	1670	8097.8	0.47	785	10203.7	3.6

Linear Springs for Model Input:

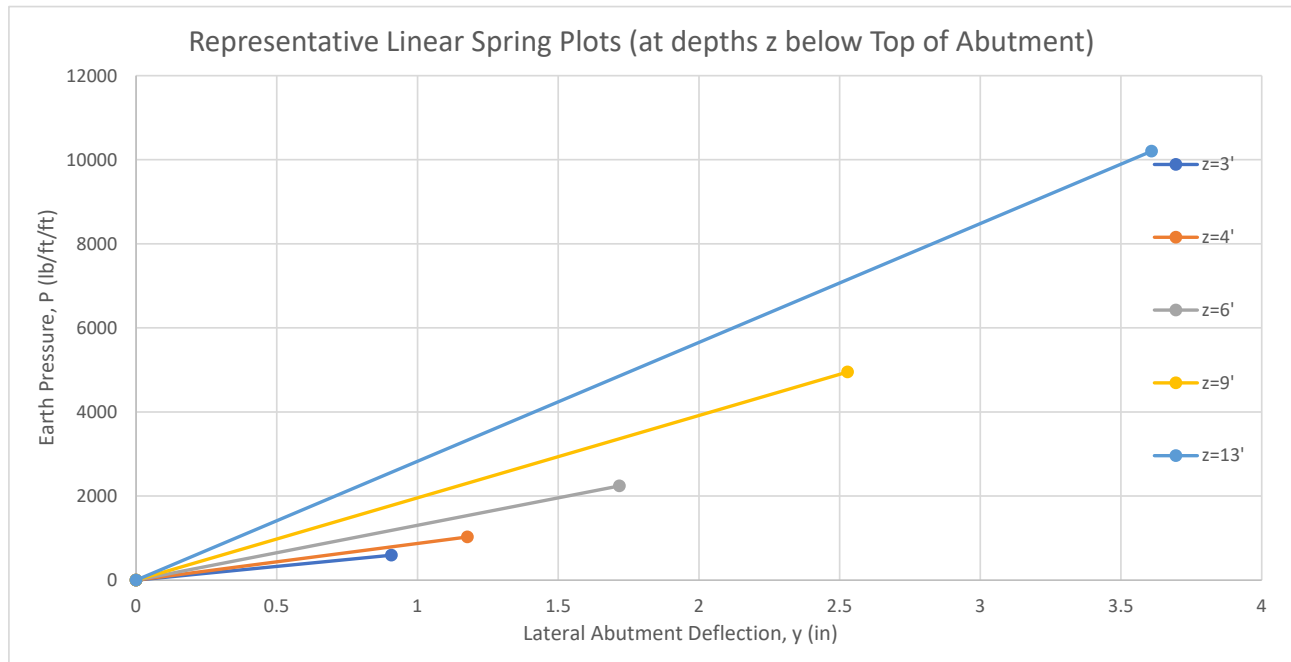
- Notes:**
5. Considering that the maximum wall deflection is less than 1", all springs remain within the linear range, so the springs can be modeled with a single linear segment.
 6. The actual starting value is considered to correspond to $K=0.373$, but due to CSIBridge modeling limitations, the linear spring must pass through the origin.
 7. The end of the linear spring is represented by the Deflection at Max Lateral Earth Pressure, x , as the x-coordinate and the Max Lateral Earth Pressure, F_h , as the y-coordinate.
 8. Select plotted linear springs are presented below.



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SHEET NO.	4	OF	5
CALCULATED BY	ARB	DATE	5/29/2020
CHECKED BY	CLS	DATE	5/29/2020

Select Plotted Linear Spring Curves:



Comparison of Design Earth Pressures with Inclusion to Horvath 2000 FEM Study:

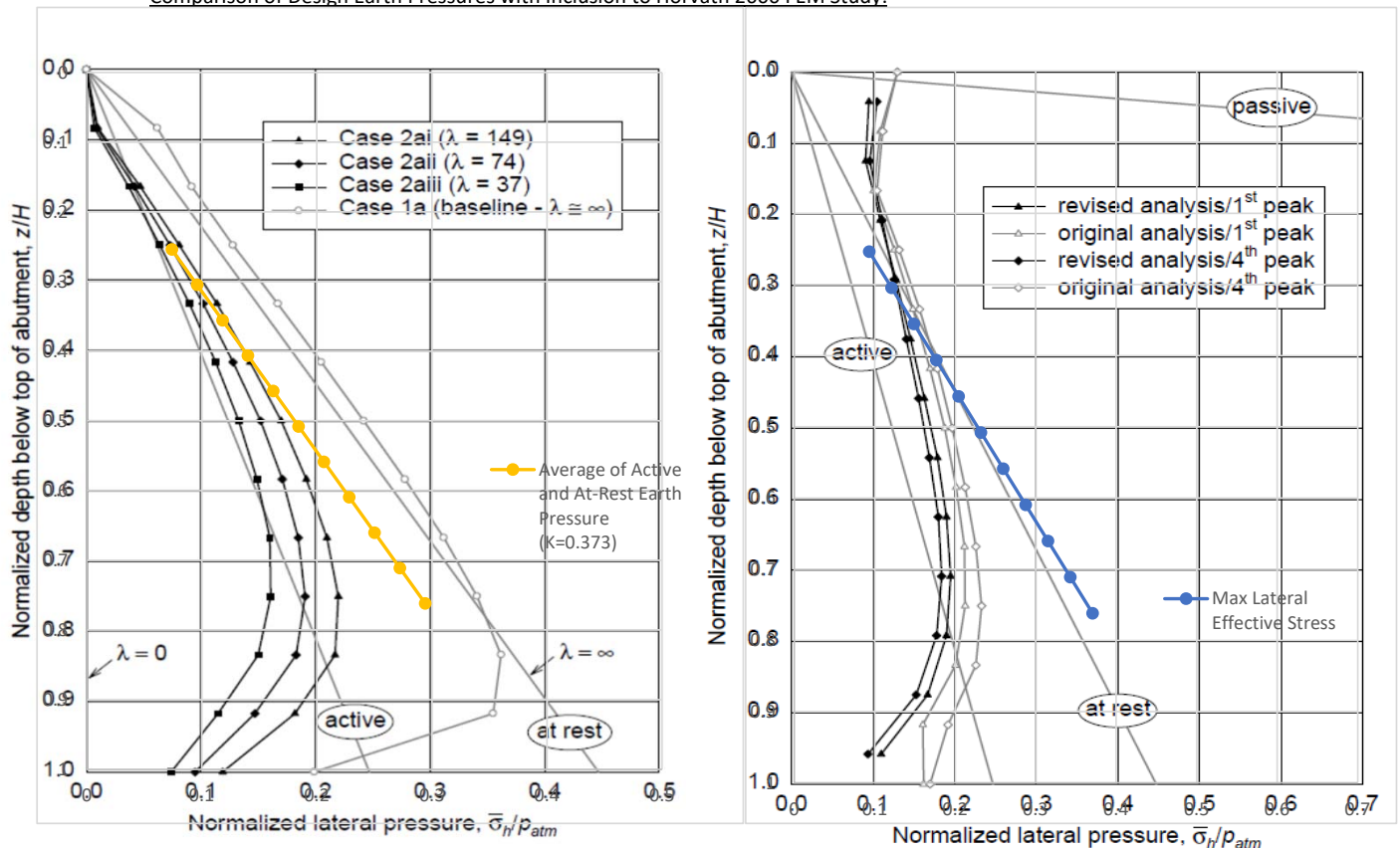


Figure 3.22. Case 2a:
Lateral Pressures at End of Construction

Figure 3.57. Case 2a: Effect of FEM Model on Calculated
Lateral Pressures at Thermal Expansion Peaks

Basis of Spring in Initial/Contracted Condition

Basis of Spring in Fully Expanded Condition



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SHEET NO.	5	OF	5
CALCULATED BY	ARB	DATE	5/29/2020
CHECKED BY	CLS	DATE	5/29/2020

Stress-Strain Behavior of Resilient Block Molded EPS:

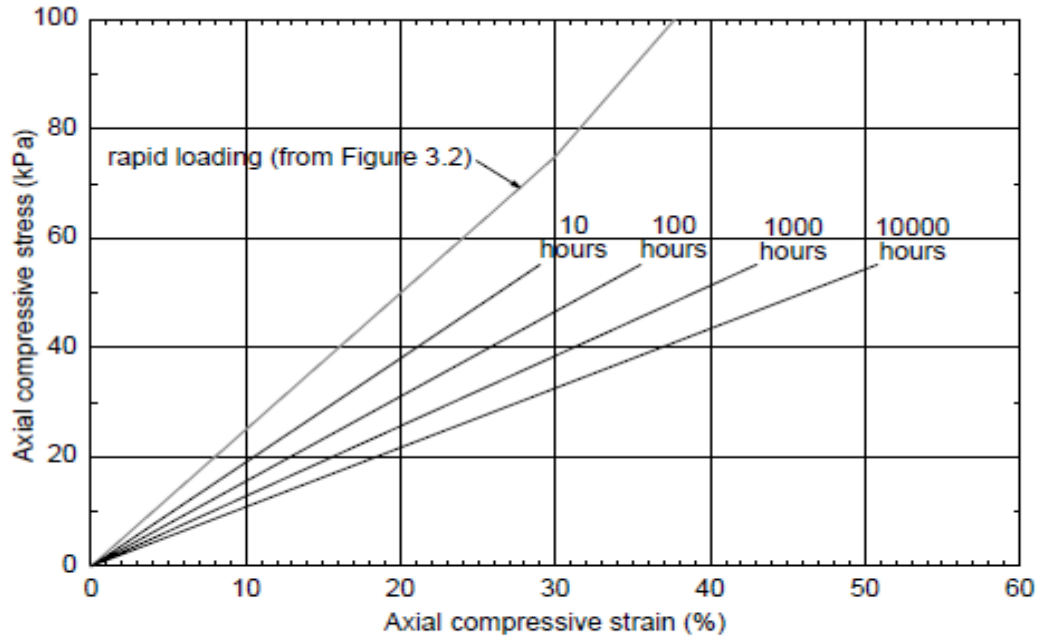


Figure 3.4. Isochronous Stress-Strain Curves for Resilient Block-Molded EPS
(initial molded density = 12 kg/m^3 (0.75 lb/ft^3))
[data courtesy of GeoTech Systems Corporation]

Estimated deflection at maximum lateral earth pressure is based on the slope of the rapid loading curve. Axial compressive strain in the range of applied pressures ranges from 6 to 17% for a 24" thick resilient block-molded EPS layer.

Vertical Springs



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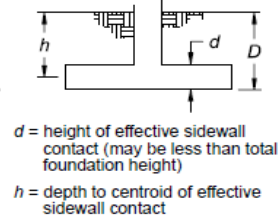
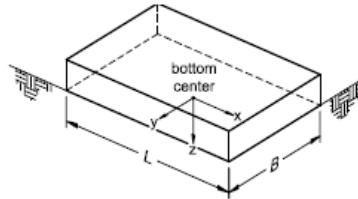
JOB	09.0025972.01 - Pleasant River Bridge, Milo		
SHEET NO.		OF	
CALCULATED BY	ARB	DATE	4/15/2020
CHECKED BY	CLS	DATE	4/15/2020

Objective: Estimate Vertical Spring Values for site soils, to be used in bridge models.

ABUTMENT VERTICAL SPRING VALUES

Input Data:

Foundation Length, L =	41.5000	ft.
Foundation Width, B =	3.5000	ft.
Foundation Thk., d =	13.0000	ft.
Soil Unit Weight, γ =	125.000	kcf
Embedment Depth, D =	5.000	ft.
Soil Shear Modulus, G =	5000	psi
Poisson's Ratio, μ =	0.30	



d = height of effective sidewall contact (may be less than total foundation height)

h = depth to centroid of effective sidewall contact

For each degree of freedom, calculate
 $K_{emb} = \beta K_{sur}$

Results:

Nomenclature

Foundation Area and Effective Embedment:

Foundation Area, A_f =	145.25	ft. ²	$A_f = L \cdot B$
Eff. Embed. Depth, h =	0.000	ft.	$h = D - d/2$, for $D \geq d/2$ (Note: for $D < d/2$, neglect embedment)

Correction Factors for Embedment:

Embedment Factor, β_z =	2.083	$\beta_z = (1 + 1/21 \cdot D/B \cdot (2 + 2.6 \cdot B/L)) \cdot (1 + 0.32 \cdot (d \cdot (B+L)/(B \cdot L))^{2/3})$
-------------------------------	-------	---

Soil Spring Constants of Entire Foundation at Surface:

Stiff. @ Surface, $K_z(sur)$ =	38534.9	k/ft.	$K_z(sur) = G \cdot B / (1 - \mu) \cdot (1.55 \cdot (L/B)^{0.75} + 0.8)$
--------------------------------	---------	-------	--

Unit Soil Spring Constants at Surface (in pci):

Z-dir. Spring Stiff., $k_z(sur)$ =	153.53	pci	$k_z(sur) = K_z(sur) / A_f \cdot (1000/1728)$
------------------------------------	--------	-----	---

Soil Spring Constants of Entire Foundation Considering Embedment:

Stiff. using Emb., K_{ze} =	80280.2	k/ft.	$K_{ze} = \beta_z \cdot K_z(sur)$
-------------------------------	---------	-------	-----------------------------------

Unit Values of Soil Spring Constants:

Z-dir. Spring Stiff., k_{z1} =	552.70	kcf	$k_{z1} = K_{ze} / A_f$ (Z-dir. spring constant per square foot of foundation)
----------------------------------	--------	-----	--

References:

1. Washington State Dept. of Transportation (WSDOT) - Bridge Design Manual - M 23-50.13 (Feb. 2014)
2. Federal Emergency Management Agency (FEMA) Report No. 356 (Nov. 2000) - "Prestandard and Commentary for the Seismic Rehabilitation of Buildings" - Section 4.4.2.1.2
 (Note: FEMA 356 supercedes FEMA 273 - "NEHRP Guidelines for the Seismic Rehabilitation of Buildings" - Oct
 (continued:))



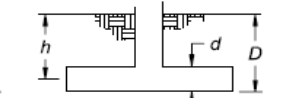
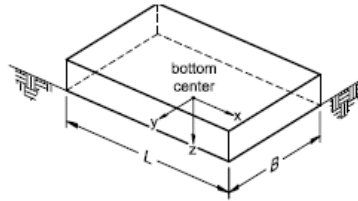
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JOB	09.0025972.01 - Pleasant River Bridge, Milo		
SHEET NO.		OF	
CALCULATED BY	ARB	DATE	4/15/2020
CHECKED BY	CLS	DATE	4/15/2020

Objective: Estimate Vertical Spring Values for site soils, to be used in bridge models.
WINGWALL VERTICAL SPRING VALUES

Input Data:

Foundation Length, L =	14.5000	ft.
Foundation Width, B =	1.6667	ft.
Foundation Thk., d =	10.0000	ft.
Soil Unit Weight, γ =	125.000	kcf
Embedment Depth, D =	4.000	ft.
Soil Shear Modulus, G =	5000	psi
Poisson's Ratio, μ =	0.30	



d = height of effective sidewall contact (may be less than total foundation height)
 h = depth to centroid of effective sidewall contact

For each degree of freedom, calculate
 $K_{emb} = \beta K_{sur}$

Results:

Nomenclature

Foundation Area and Effective Embedment:

Foundation Area, A_f =	24.17	ft. ²	$A_f = L \cdot B$
Eff. Embed. Depth, h =	0.000	ft.	$h = D - d/2$, for $D \geq d/2$ (Note: for $D < d/2$, neglect embedment)

Correction Factors for Embedment:

Embedment Factor, β_z =	2.697	$\beta_z = (1 + 1/21 \cdot D/B \cdot (2 + 2.6 \cdot B/L)) \cdot (1 + 0.32 \cdot (d \cdot (B+L)/(B \cdot L))^{2/3})$
-------------------------------	-------	---

Soil Spring Constants of Entire Foundation at Surface:

Stiff. @ Surface, $K_z(sur)$ =	14831.7	k/ft.	$K_z(sur) = G \cdot B / (1 - \mu) \cdot (1.55 \cdot (L/B)^{0.75} + 0.8)$
--------------------------------	---------	-------	--

Unit Soil Spring Constants at Surface (in pci):

Z-dir. Spring Stiff., $k_z(sur)$ =	355.17	pci	$k_z(sur) = K_z(sur) / A_f \cdot (1000/1728)$
------------------------------------	--------	-----	---

Soil Spring Constants of Entire Foundation Considering Embedment:

Stiff. using Emb., K_{ze} =	40005.8	k/ft.	$K_{ze} = \beta_z \cdot K_z(sur)$
-------------------------------	---------	-------	-----------------------------------

Unit Values of Soil Spring Constants:

Z-dir. Spring Stiff., k_{z1} =	1655.41	kcf	$k_{z1} = K_{ze} / A_f$ (Z-dir. spring constant per square foot of foundation)
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References:

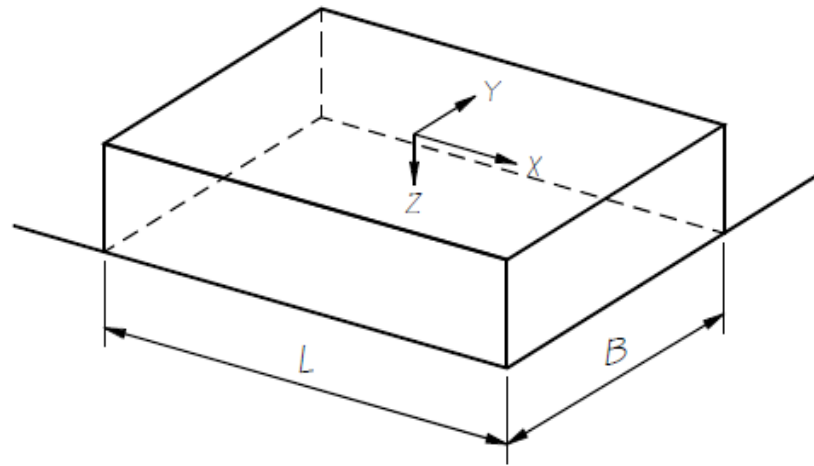
1. Washington State Dept. of Transportation (WSDOT) - Bridge Design Manual - M 23-50.13 (Feb. 2014)
2. Federal Emergency Management Agency (FEMA) Report No. 356 (Nov. 2000) - "Prestandard and Commentary for the Seismic Rehabilitation of Buildings" - Section 4.4.2.1.2
 (Note: FEMA 356 supercedes FEMA 273 - "NEHRP Guidelines for the Seismic Rehabilitation of Buildings" - Oct
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SHEET NO.		OF	
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CHECKED BY	CLS	DATE	4/15/2020

From Reference 1:



Orient axes such that $L > B$.
 If $L = B$ use x-axis equations for both x-axis and y-axis.

Figure 7.2.7-1

Where:

- $K = \beta K_{sur}$
 K = Translation or rotational spring
 K_{sur} = Stiffness of foundation at surface, see Table 7.2.7-1
 β = Correction factor for embedment, see Table 7.2.7-2

Degree of Freedom	K_{sur}
Translation along x-axis	$\frac{GB}{2-v} \left[3.4 \left(\frac{L}{B} \right)^{0.65} + 1.2 \right]$
Translation along y-axis	$\frac{GB}{2-v} \left[3.4 \left(\frac{L}{B} \right)^{0.65} + 0.4 \frac{L}{B} + 0.8 \right]$
Translation along z-axis	$\frac{GB}{1-v} \left[1.55 \left(\frac{L}{B} \right)^{0.75} + 0.8 \right]$

Stiffness of Foundation at Surface

Table 7.2.7-1

Degree of Freedom	β
Translation along x-axis	$\left(1 + 0.21 \sqrt{\frac{D}{B}} \right) \left[1 + 1.6 \left(\frac{hd(B+L)}{BL^2} \right)^{0.4} \right]$
Translation along y-axis	$\left(1 + 0.21 \sqrt{\frac{D}{L}} \right) \left[1 + 1.6 \left(\frac{hd(B+L)}{LB^2} \right)^{0.4} \right]$
Translation along z-axis	$\left[1 + \frac{1}{21} \frac{D}{B} \left(2 + 2.6 \frac{B}{L} \right) \right] \cdot \left[1 + 0.32 \left(\frac{d(B+L)}{BL} \right)^{\frac{2}{3}} \right]$

Correction Factor for Embedment

Table 7.2.7-2

Pile Springs



Pile Spring Evaluation

Project: Pleasant Street Bridge #3244 **Project No.:** 09.0025972.01
Location: Milo, ME
Calculated By: B. Cardali **Date:** 4/16/2020
Checked By: A.Blaissdell/C. Snow **Date:** 4/16/2020

Objective: Develop vertical, lateral and torsion soil springs for pile analysis, to be utilized by HNTB for structural finite element modeling.

**Basis of Spring
Development:**

Spring Type	Basis
T-z (Mobilized Side Resistance) <i>Page 1</i>	*Developed from Ensoft Apile run based on average soil profile properties (automatically generated). *Tabulated values were calculated, apply to appropriate depth ranges for each scour condition based on notes below table. *Not specific to pile type (same for all pile sizes).
Q-z (Mobilized Tip Resistance) <i>Page 2</i>	*Glacial Till: Taken from Ensoft Apile run based on design soil profile properties (automatically generated). *Rock: Assumed 20 ksi tip resistance on steel end area, mobilize full tip resistance in 0.1" deflection. *Properties are a function of pile size, different values provided for each pile type.
T-θ (Torsion vs Rotation) <i>Page 3</i>	*Developed from Ensoft Group runs based on design soil profiles (automatically generated). *Upper bound and lower bound values correspond to range in possible friction angle for the upper soil stratum to bracket pile response. *Match UB/LB torsion parameters with UB/LB p-y parameters, perform structural design based on worst case of both sets of parameters.
P-y (Lateral pile resistance) <i>Page 4-51</i>	*Developed from Ensoft LPile runs based on design soil profiles (automatically generated). *Upper bound and lower bound values correspond to range in possible friction angle for the upper soil stratum to bracket pile response. *Match UB/LB torsion parameters with UB/LB p-y parameters, perform structural design based on worst case of both sets of parameters. *Single set of design values in Glacial Till. *p-y curves are a function of overburden; therefore, a single p-y curve is applied for different scour conditions at different depths below bottom of pile in accordance with the top rows of the table. *p-y curves for upper 3' of pile for unscoured condition consider a 2-foot diameter concrete section around the pile.

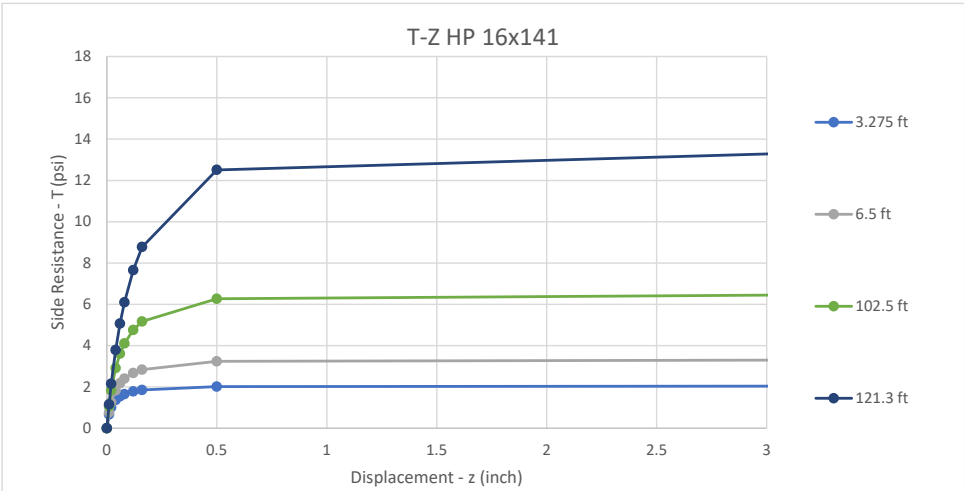
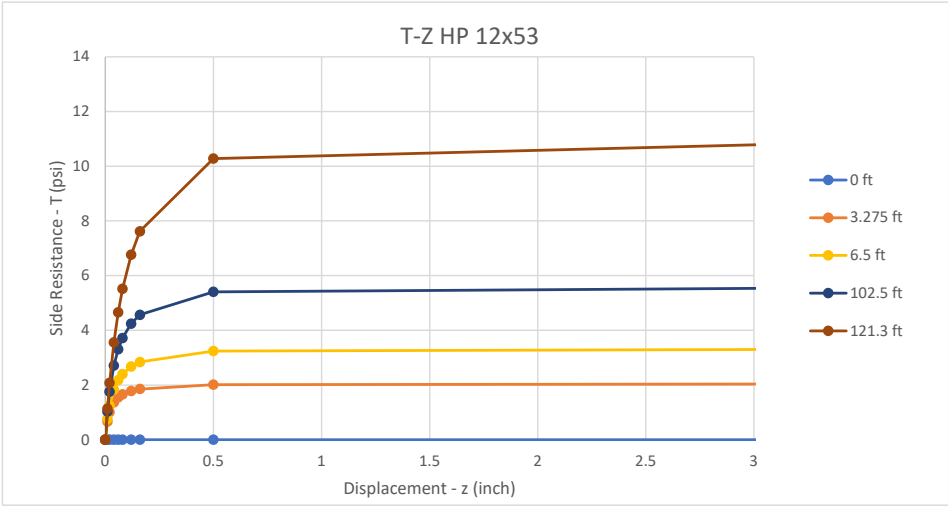


Unit Side Resistance vs Displacement (T-z)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 3/31/2020
CHECKED BY ARB 4/2/2020

Pile Section	Displacement, z (in)	Unit Load Transfer, T (lbs/in^2) at Specified Depth				
		0 ft	3.275 ft	6.5 ft	102.5 ft	121.3 ft
HP 12 x 53	0	0	0	0	0	0
	0.01	0	0.6649	0.7595	1.032	1.135
	0.02	0	1.01	1.246	1.757	2.078
	0.04	0	1.365	1.834	2.71	3.556
	0.06	0	1.546	2.177	3.308	4.66
	0.08	0	1.656	2.401	3.717	5.517
	0.12	0	1.782	2.676	4.243	6.761
	0.16	0	1.853	2.839	4.566	7.619
	0.5	0	2.016	3.241	5.405	10.28
	10	0	2.099	3.46	5.889	12.19
HP 14 x 117	0	0	0	0	0	0
	0.01	0	0.6649	0.7595	1.051	1.151
	0.02	0	1.01	1.246	1.813	2.132
	0.04	0	1.365	1.834	2.845	3.715
	0.06	0	1.546	2.177	3.511	4.939
	0.08	0	1.656	2.401	3.976	5.912
	0.12	0	1.782	2.676	4.583	7.363
	0.16	0	1.853	2.839	4.962	8.393
	0.5	0	2.016	3.241	5.969	11.74
	10	0	2.099	3.46	6.565	14.3
HP 16 x 141	0	0	0	0	0	0
	0.01	0	0.6649	0.7595	1.06	1.157
	0.02	0	1.01	1.246	1.84	2.155
	0.04	0	1.365	1.834	2.912	3.789
	0.06	0	1.546	2.177	3.614	5.069
	0.08	0	1.656	2.401	4.108	6.1
	0.12	0	1.782	2.676	4.76	7.657
	0.16	0	1.853	2.839	5.17	8.776
	0.5	0	2.016	3.241	6.273	12.51
	10	0	2.099	3.46	6.935	15.45

Notes: 1. Model 1 to 6' below top of pile for non-scour conditions using 3.275 ft T values.
2. Model 7 to 102' below top of pile for non-scour condition using 6.5 ft T values.
5. Model from scoured ground surface to 102' below top of pile for all scour conditions using 6.5' T values.

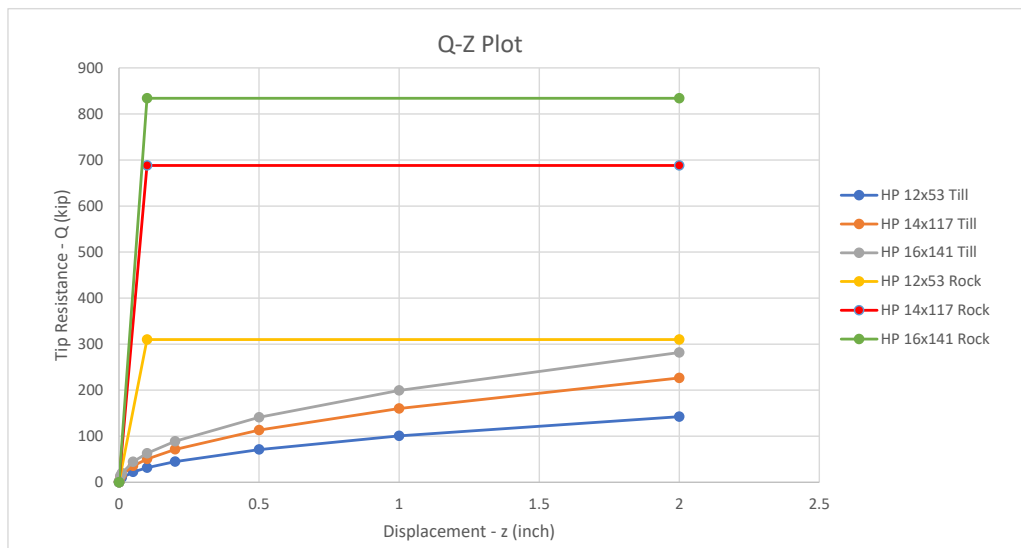




Tip Resistance vs Displacement (Q-Z)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 3/31/2020
CHECKED BY ARB 4/6/2020

Bearing in Glacial Till					
HP 12 x 53		HP 14 x 117		HP 16 x 141	
Tip Resistance (Q) kips	Tip Displacement (z) Inch	Tip Resistance (Q) kips	Tip Displacement (z) Inch	Tip Resistance (Q) kips	Tip Displacement (z) Inch
0	0	0	0	0	0
1.007	0.0001	1.601	0.0001	1.994	0.0001
7.118	0.005	11.32	0.005	14.1	0.005
10.07	0.01	16.01	0.01	19.94	0.01
22.51	0.05	35.81	0.05	44.59	0.05
31.83	0.1	50.64	0.1	63.06	0.1
45.02	0.2	71.61	0.2	89.18	0.2
71.18	0.5	113.2	0.5	141	0.5
100.7	1	160.1	1	199.4	1
142.4	2	226.5	2	282	2
Bearing on Rock					
HP 12 x 53		HP 14 x 117		HP 16 x 141	
0	0	0	0	0	0
310	0.1	688	0.1	834	0.1
310	2	688	2	834	2



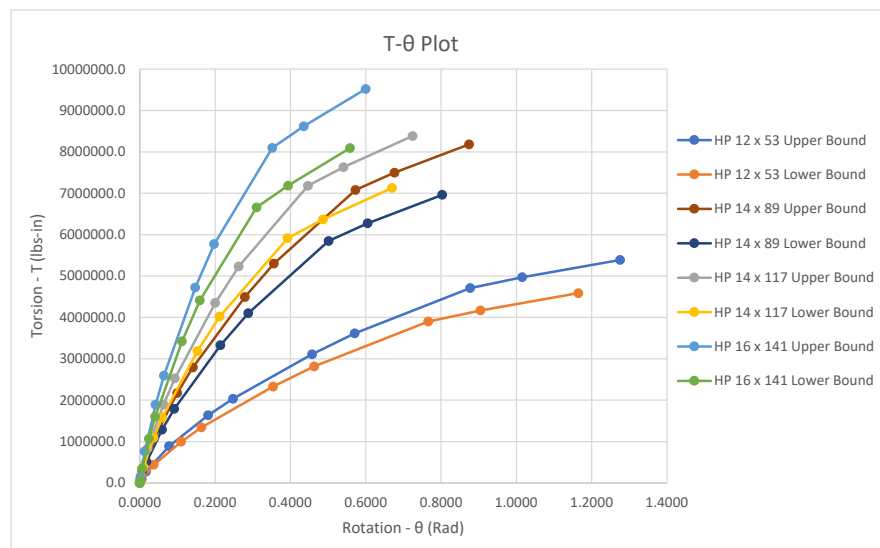


Torsion vs Rotation (T-θ)

HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/16/2020
CHECKED BY ARB 4/16/2020

Torsion vs Rotation															
HP 12 x 53				HP 14 x 89				HP 14 x 117				HP 16 x 141			
Upper Bound		Lower Bound		Upper Bound		Lower Bound		Upper Bound		Lower Bound		Upper Bound		Lower Bound	
Torque (lbs-in)	Rotation (rad)	Torque (lbs-in)	Rotation (rad)	Torque (lbs-in)	Rotation (rad)	Torque (lbs-in)	Rotation (rad)	Torque (lbs-in)	Rotation (rad)	Torque (lbs-in)	Rotation (rad)	Torque (lbs-in)	Rotation (rad)	Torque (lbs-in)	Rotation (rad)
0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000	0.0	0.0000
273595.9	0.0161	94205.1	0.0055	277378.4	0.0067	91701.5	0.0023	176399.1	0.0031	56535.9	0.0012	136358.0	0.0017	44670.3	0.0007
888900.0	0.0778	442623.2	0.0372	1077332.8	0.0382	513867.3	0.0179	839352.4	0.0213	388998.8	0.0101	765009.3	0.0129	350541.5	0.0063
1638443.9	0.1816	1000599.4	0.1099	2174410.3	0.0994	1287282.7	0.0590	1895509.1	0.0629	1093632.3	0.0368	1891449.7	0.0418	1069555.8	0.0243
2036398.3	0.2478	1341491.9	0.1637	2792163.4	0.1410	1791011.2	0.0915	2528964.8	0.0932	1581715.9	0.0598	2596698.2	0.0641	1602364.7	0.0409
3110772.6	0.4577	2328357.0	0.3539	4494440.5	0.2792	3329719.3	0.2144	4351643.8	0.2003	3185710.3	0.1529	4723460.5	0.1472	3424736.7	0.1120
3614239.0	0.5708	2815417.4	0.4633	5302222.5	0.3563	4104841.8	0.2884	5231581.7	0.2628	4022932.3	0.2123	5771936.2	0.1975	4413514.5	0.1595
4708583.4	0.8778	3900429.2	0.7663	7079804.2	0.5731	5848056.4	0.5015	7181143.2	0.4468	5914727.6	0.3925	8096987.4	0.3518	6658625.6	0.3103
4971645.0	1.0158	4167561.1	0.9047	7499037.1	0.6766	6274145.5	0.6051	7630396.8	0.5411	6370137.6	0.4868	8619699.5	0.4356	7184414.5	0.3940
5389549.7	1.2758	4587956.3	1.1649	8181544.0	0.8748	6962335.7	0.8035	8383702.6	0.7247	7131244.3	0.6705	9519699.4	0.6002	8094539.6	0.5586





Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section		Abutment / Scour Case		Depth below Bottom of Abutment (ft)																			
		1 / No Scour		--		--		--		--		--		--		--		--		0		1	
		1 / 100-yr Scour		4		5		6		7		8		9		10		11		12		--	
		1 / 500-yr Scour		5		6		7		8		9		10		11		12		13		--	
		2 / No Scour		--		--		--		--		--		--		--		--		--		0	
		2 / 100-yr Scour		4		5		6		7		7		9		10		11		12		--	
		2 / 500-yr Scour		5		6		7		8		8		10		11		12		13		--	
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P		
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0.033567	84.58927	0.034528	174.0213	0.02948	222.8695	0.019089	192.4178	0.007471	94.13471	0.006807	102.9146	0.032347	326.054	0.03699	426.1233	0.046109	580.9714	0.034972	528.7835
		0.022576	0	0.053091	96.65999	0.053965	200.0618	0.049376	265.7115	0.039929	262.9403	0.029368	202.5409	0.028764	244.1057	0.051982	435.0619	0.056203	549.5337	0.078281	697.0647	0.068157	687.9526
		0.045152	0	0.072616	105.881	0.073402	220.2328	0.069272	298.2212	0.06077	314.0733	0.051264	276.6566	0.05072	342.9305	0.071617	528.6437	0.075416	657.1108	0.110453	784.7589	0.101341	804.449
		0.067727	0	0.09214	113.477	0.092839	236.9958	0.089167	325.0274	0.08161	355.8063	0.073161	337.5995	0.072677	425.4258	0.091252	612.5494	0.094629	754.334	0.142625	856.9336	0.134525	899.5245
		0.090303	0	0.111664	120.0031	0.112275	251.4899	0.109063	348.1291	0.102451	391.7461	0.095057	390.8851	0.094634	498.3463	0.110887	689.6068	0.113842	844.0593	0.174797	919.0772	0.16771	981.2397
		0.112879	0	0.131188	125.7633	0.131712	264.3467	0.128959	368.5952	0.123291	423.6724	0.116954	438.9778	0.116591	564.7245	0.130522	761.4651	0.133055	928.0088	0.206968	974.1041	0.200894	1053.651
		0.135455	0	0.150712	130.9438	0.151149	275.9569	0.148855	387.0726	0.144131	452.6149	0.13885	483.239	0.138548	626.2443	0.150158	829.1903	0.152268	1007.319	0.23914	1023.771	0.234078	1119.13
		0.15803	0	0.170237	135.6681	0.170586	286.5809	0.16875	403.9859	0.164972	479.2311	0.160747	524.5168	0.160505	683.9601	0.169793	893.52	0.171481	1082.791	0.271312	1069.227	0.267263	1179.199
		0.180606	0	0.189761	140.0223	0.190023	296.402	0.188646	419.6309	0.185812	503.9703	0.182644	563.3831	0.182462	738.5859	0.189428	954.9912	0.190694	1155.011	0.303484	1111.271	0.300447	1234.902
		0.203182	0	0.209285	144.0694	0.20946	305.5544	0.208542	434.2229	0.206653	527.1555	0.20454	600.2454	0.204419	790.6328	0.209063	1014.01	0.209907	1224.429	0.335656	1150.486	0.333631	1286.991
		0.225758	0	0.228809	147.857	0.228896	314.1399	0.228438	447.9238	0.227493	549.0275	0.226437	635.4069	0.226376	840.482	0.228698	1070.891	0.22912	1291.396	0.367828	1187.306	0.366816	1336.03
		0.248333	0	0.248333	151.4219	0.248333	322.2376	0.248333	460.8591	0.248333	569.7717	0.248333	669.1	0.248333	888.4274	0.248333	1125.887	0.248333	1356.195	0.4	1222.07	0.4	1382.449
		0.403542	0	0.403542	178.9574	0.403542	385.1285	0.403542	559.0548	0.403542	720.4459	0.403542	903.179	0.403542	1221.189	0.403542	1553.724	0.403542	1871.55	0.65	1484.958	0.65	1723.193
		0.55875	0	0.55875	206.4928	0.55875	448.0195	0.55875	657.2505	0.55875	871.1201	0.55875	1137.258	0.55875	1553.951	0.55875	1981.561	0.55875	2386.904	0.9	1747.845	0.9	2063.937
		0.6705	0	0.6705	206.4928	0.6705	448.0195	0.6705	657.2505	0.6705	871.1201	0.6705	1137.258	0.6705	1553.951	0.6705	1981.561	0.6705	2386.904	1.08	1747.845	1.08	2063.937
		5	0	5	206.4928	5	448.0195	5	657.2505	5	871.1201	5	1137.258	5	1553.951	5	1981.561	5	2386.904	5	1747.845	5	2063.937
HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0.069124	70.50663	0.068632	140.0102	0.058411	178.7385	0.04071	166.0985	0.019725	100.599	0.019438	118.9618	0.06794	313.884	0.076871	405.8794	0.091432	466.3018	0.072338	442.7086
		0.022576	0	0.085416	74.98445	0.084969	149.6637	0.075677	195.2358	0.059585	195.1475	0.040508	150.4954	0.040247	184.0035	0.08434	357.9836	0.092459	454.0973	0.119483	511.2875	0.102125	507.2023
		0.045152	0	0.101708	78.89142	0.101305	158.1122	0.092943	209.4047	0.07846	219.2448	0.06129	189.7559	0.061055	236.2066	0.100739	398.8228	0.108046	499.2146	0.147535	549.7793	0.131913	561.069
		0.067727	0	0.117999	82.3766	0.117642	165.6689	0.110208	221.9289	0.097335	240.1824	0.082073	223.4475	0.081864	281.5931	0.117138	437.1243	0.123634	541.841	0.175587	583.7241	0.1617	607.9776
		0.090303	0	0.134291	85.53543	0.133978	172.5345	0.127474	233.218	0.11621	258.8869	0.102855	253.5397	0.102673	322.5287	0.133538	473.3725	0.139221	582.4056	0.203638	614.2741	0.191488	649.8991
		0.112879	0	0.150583	88.43306	0.150315	178.846	0.144739	243.5392	0.135084	275.9092	0.123638	281.0499	0.123481	360.2456	0.149937	507.9121	0.154808	621.224	0.23169	642.1745	0.221275	688.0324
		0.135455	0	0.166875	91.11617	0.166651	184.7018	0.162005	253.0776	0.153959	291.6079	0.144421	306.5868	0.14429	395.4859	0.166336	540.9987	0.170396	658.5372	0.259742	667.9385	0.251063	723.1687
		0.15803	0	0.183166	93.61945	0.182988	190.175	0.179271	261.9675	0.172834	306.2313	0.165203	330.5496	0.165099	428.7394	0.182736	572.8286	0.185983	694.5338	0.287793	691.9364	0.28085	755.8616
		0.180606	0	0.199458	95.96947	0.199324	195.3217	0.196536	270.3094	0.191709	319.9596	0.185986	353.2172	0.185907	460.35	0.199135	603.5564	0.201571	729.3655	0.315845	714.4453	0.310638	786.5157
		0.203182	0	0.21575	98.18706	0.21566	200.186	0.213802	278.1814	0.210584	332.9284	0.206768	374.794	0.206716	490.5707	0.215535	633.3068	0.217158	763.1558	0.343897	735.6784	0.340425	815.4369
		0.225758	0	0.232042	100.2889	0.231997	204.803	0.231068	285.6447	0.229459	345.2426	0.227551	395.4349	0.227525	519.5942	0.231934	662.182	0.232746	796.0077	0.371948	755.804	0.370213	842.8629
		0.248333	0	0.248333	102.2886	0.248333	209.2015	0.248333	292.7489	0.248333	356.9852	0.248333	415.2609	0.248333	547.5716	0.248333	690.267	0.248333	828.0076	0.4	774.9571	0.4	868.9827
		0.403542	0	0.403542	120.8893	0.403542	250.0313	0.403542	355.1252	0.403542	451.3887	0.403542	560.5364	0.403542	752.6654	0.403542	952.5685	0.403542	1142.651	0.65	941.663	0.65	1083.169
		0.55875	0	0.55875	139.4901	0.55875	290.861	0.55875	417.5015	0.55875	545.7923	0.55875	705.8119	0.55875	957.7591	0.55875	1214.87	0.55875	1457.293	0.9	1108.369	0.9	1297.355
		0.6705	0	0.6705	139.4901	0.6705	290.861	0.6705	417.5015	0.6705	545.7923	0.6705	705.8119	0.6705	957.7591	0.6705	1214.87	0.6705	1457.293	1.08	1108.369	1.08	1297.355
		5	0	5	139.4901	5	290.861	5	417.5015	5	545.7923	5	705.8119	5	957.7591	5	1214.87	5	1457.293	5	1108.369	5	1297.355

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section	Abutment / Scour Case	Depth below Bottom of Abutment (ft)																					
	1 / No Scour	2		3		4		5		6		7		8		9		10		11		12	
	1 / 100-yr Scour	--		--		13		14		15		16		17		18		19		20		21	
	1 / 500-yr Scour	--		--		14		15		16		17		18		19		20		21		22	
	2 / No Scour	2		3		4		5		6		7		8		9		10		11		12	
	2 / 100-yr Scour	--		--		29		14		15		16		17		18		19		20		21	
	2 / 500-yr Scour	--		--		33		15		16		17		18		19		20		21		22	
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P		
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.065273	657.9527	0.034312	395.2709	0.042215	547.1023	0.048015	691.4111	0.054392	861.572	0.061354	1060.204	0.068911	1290.016	0.077074	1553.809	0.085855	1854.467	0.095267	2194.959	0.105324	2578.334
		0.095703	785.946	0.067556	577.0518	0.060953	684.0103	0.066225	840.7061	0.072023	1021.948	0.078352	1230.164	0.085222	1467.883	0.092643	1737.72	0.100626	2042.381	0.109182	2384.653	0.118325	2767.405
		0.126133	893.489	0.1008	721.5711	0.079691	805.0872	0.084436	974.5197	0.089654	1167.477	0.095351	1386.142	0.101533	1632.801	0.108212	1909.842	0.115396	2219.744	0.123097	2565.074	0.131326	2948.486
		0.156562	987.8444	0.134045	846.0834	0.098429	915.3879	0.102647	1097.387	0.107285	1302.128	0.112349	1531.526	0.117844	1787.604	0.123781	2072.486	0.130167	2388.399	0.137013	2737.656	0.144327	3122.662
		0.186992	1072.801	0.167289	957.5243	0.117167	1017.701	0.120858	1211.948	0.124916	1428.334	0.129347	1668.501	0.134156	1934.2	0.13935	2227.282	0.144938	2549.697	0.150928	2903.487	0.157327	3290.784
		0.217422	1150.63	0.200534	1059.531	0.135905	1113.766	0.139069	1319.91	0.142547	1547.72	0.146345	1798.575	0.150467	2073.953	0.154919	2375.428	0.159709	2704.666	0.164843	3063.423	0.170328	3453.541
		0.247851	1222.817	0.233778	1154.299	0.154643	1204.757	0.157279	1422.452	0.160178	1661.439	0.163343	1922.844	0.166778	2207.879	0.170488	2517.84	0.17448	2854.108	0.178758	3218.146	0.183329	3611.495
		0.278281	1290.396	0.267022	1243.276	0.173381	1291.516	0.17549	1520.431	0.177809	1770.344	0.180341	2042.136	0.183089	2336.758	0.186057	2655.236	0.18925	2998.665	0.192673	3368.213	0.19633	3765.114
		0.308711	1354.122	0.300267	1327.48	0.192119	1374.668	0.193701	1614.497	0.19544	1875.09	0.197339	2157.092	0.1994	2461.207	0.201626	2788.192	0.204021	3138.861	0.206588	3514.086	0.209331	3914.793
		0.339141	1414.565	0.333511	1407.657	0.210857	1454.694	0.211912	1705.153	0.213071	1976.19	0.214337	2268.227	0.215711	2581.724	0.217195	2917.179	0.218792	3275.131	0.220503	3656.156	0.222332	4060.87
		0.36957	1472.168	0.366756	1484.375	0.229595	1531.977	0.230123	1792.802	0.230702	2074.059	0.231335	2375.955	0.232022	2698.716	0.232764	3042.589	0.233563	3407.838	0.234418	3794.751	0.235332	4203.634
		0.4	1527.283	0.4	1558.078	0.248333	1606.823	0.248333	1877.77	0.248333	2169.036	0.248333	2480.621	0.248333	2812.526	0.248333	3164.75	0.248333	3537.293	0.248333	3930.156	0.248333	4343.338
		0.65	1970.687	0.65	2101.935	0.403542	2217.416	0.403542	2591.322	0.403542	2993.27	0.403542	3423.257	0.403542	3881.286	0.403542	4367.355	0.403542	4881.465	0.403542	5423.615	0.403542	5993.806
		0.9	2414.09	0.9	2645.791	0.55875	2828.008	0.55875	3304.875	0.55875	3817.503	0.55875	4365.893	0.55875	4950.046	0.55875	5569.96	0.55875	6225.636	0.55875	6917.074	0.55875	7644.274
		1.08	2414.09	1.08	2645.791	0.6705	2828.008	0.6705	3304.875	0.6705	3817.503	0.6705	4365.893	0.6705	4950.046	0.6705	5569.96	0.6705	6225.636	0.6705	6917.074	0.6705	7644.274
		5	2414.09	5	2645.791	5	2828.008	5	3304.875	5	3817.503	5	4365.893	5	4950.046	5	5569.96	5	6225.636	5	6917.074	5	7644.274
HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.116229	536.9782	0.068216	360.1783	0.086978	516.6512	0.098229	648.3138	0.110616	803.0745	0.124145	983.2266	0.138828	1191.144	0.154684	1429.28	0.171733	1700.161	0.189999	2006.386	0.209503	2350.628
		0.142026	589.3791	0.098378	441.9009	0.101647	568.0008	0.111875	701.6696	0.123136	857.172	0.135435	1036.661	0.148783	1242.37	0.163198	1476.605	0.178697	1741.749	0.195302	2040.251	0.213033	2374.629
		0.167824	636.8906	0.12854	513.0841	0.116316	616.5147	0.125521	752.527	0.135656	909.1515	0.146725	1088.376	0.158738	1292.268	0.171711	1522.972	0.185661	1782.707	0.200605	2073.757	0.216563	2398.476
		0.193621	680.6298	0.158702	577.1854	0.130984	662.6813	0.139167	801.2577	0.148176	959.281	0.158014	1138.552	0.168693	1340.953	0.180225	1568.446	0.192624	1823.067	0.205908	2106.918	0.220093	2422.171
		0.219418	721.346	0.188864	636.0903	0.145653	706.8602	0.152813	848.1474	0.160695	1007.775	0.169304	1187.34	0.178648	1388.524	0.188738	1613.086	0.199588	1862.859	0.211211	2139.746	0.223623	2445.717
		0.245216	759.5708	0.219027	690.9646	0.160322	749.3256	0.166458	893.4217	0.173215	1054.809	0.180594	1234.869	0.188603	1435.067	0.197252	1656.942	0.206552	1902.11	0.216514	2172.252	0.227153	2469.117
		0.271013	795.697	0.249189	742.5897	0.17499	790.2924	0.180104	937.2622	0.185735	1100.527	0.191884	1281.247	0.198558	1480.656	0.205765	1700.063	0.213515	1940.845	0.221818	2204.447	0.230683	2492.376
		0.296811	830.0245	0.279351	791.5204	0.189659	829.9332	0.19375	979.8184	0.198254	1145.052	0.203174	1326.566	0.208513	1525.357	0.214279	1742.49	0.220479	1979.089	0.227121	2236.342	0.234213	2515.496
		0.322608	862.7885	0.309513	838.168	0.204327	868.3887	0.207396	1021.215	0.210774	1188.488	0.214464	1370.908	0.218468	1569.229	0.222793	1784.26	0.227442	2016.862	0.232424	2267.947	0.237743	2538.479
		0.348405	894.1773	0.339676	882.8474	0.218996	905.776	0.221042	1061.556	0.223294	1230.923	0.225754	1414.344	0.228423	1612.325	0.231306	1825.41	0.234406	2054.184	0.237727	2299.27	0.241273	2561.329
		0.374203	924.3446	0.369838	925.8063	0.233665	942.1936	0.234688	1100.932	0.235814	1272.435	0.237043	1456.936	0.238378	1654.689	0.23982	1865.97	0.24137	2091.074	0.24303	2330.32	0.244803	2584.048
		0.4	953.4174	0.4	967.2438	0.248333	977.7253	0.248333	1139.42	0.248333	1313.092	0.248333	1498.74	0.248333	1696.366	0.248333	1905.969	0.248333	2127.549	0.248333	2361.106	0.248333	2606.64
		0.65	1230.216	0.65	1304.866	0.403542	1349.261	0.403542	1572.4	0.403542	1812.067	0.403542	2068.262	0.403542	2340.985	0.403542	2630.237	0.403542	2936.017	0.403542	3258.326	0.403542	3597.163
		0.9	1507.014	0.9	1642.488	0.55875	1720.797	0.55875	2005.379	0.55875	2311.041	0.55875	2637.783	0.55875	2985.605	0.55875	3354.506	0.55875	3744.486	0.55875	4155.546	0.55875	4587.686
		1.08	1507.014	1.08	1642.488	0.6705	1720.797	0.6705	2005.379	0.6705	2311.041	0.6705	2637.783	0.6705	2985.605	0.6705	3354.506	0.6705	3744.486	0.6705	4155.546	0.6705	4587.686
		5	1507.014	5	1642.488	5	1720.797	5	2005.379	5	2311.041	5	2637.783	5	2985.605	5	3354.506	5	3744.486	5	4155.546	5	4587.686

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section	Abutment / Scour Case	Depth below Bottom of Abutment (ft)																					
	1 / No Scour	13	14	15	16	17	18	19	20	21	22	23											
	1 / 100-yr Scour	22	23	24	25	26	27	28	29	30	31	32											
	1 / 500-yr Scour	23	24	25	26	27	28	29	30	31	32	33											
	2 / No Scour	13	14	15	16	17	18	19	20	21	22	23											
	2 / 100-yr Scour	22	23	24	25	26	27	28	29	30	31	32											
	2 / 500-yr Scour	23	24	25	26	27	28	29	30	31	32	33											
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0.116039	3007.722	0.127424	3486.332	0.139495	4017.446	0.152263	4604.423	0.165742	5250.695	0.179945	5959.767	0.194885	6735.215	0.195686	7044.708	0.191798	7180.926	0.18824	7318.785	0.184973	7458.104
		0.128065	3193.581	0.138416	3666.204	0.149389	4188.368	0.160996	4763.241	0.17325	5394.059	0.186162	6084.127	0.199744	6836.82	0.200472	7148.969	0.196938	7297.313	0.193703	7447.201	0.190733	7598.46
		0.140092	3372.71	0.149408	3840.556	0.159283	4354.907	0.16973	4918.716	0.180758	5535.006	0.192379	6206.87	0.204603	6937.462	0.205259	7252.259	0.202077	7412.516	0.199166	7574.204	0.196493	7737.163
		0.152119	3545.903	0.1604	4009.947	0.169178	4517.436	0.178464	5071.084	0.188267	5673.677	0.198596	6328.066	0.209462	7037.17	0.210045	7354.609	0.207217	7526.576	0.204629	7699.848	0.202253	7874.281
		0.164146	3713.804	0.171391	4174.844	0.179072	4676.279	0.187197	5220.556	0.195775	5810.195	0.204813	6447.785	0.214321	7135.976	0.214831	7456.049	0.212356	7639.532	0.210092	7824.185	0.208013	8009.877
		0.176173	3876.947	0.182383	4335.644	0.188967	4831.716	0.195931	5367.318	0.203283	5944.677	0.21103	6566.087	0.21918	7233.908	0.219617	7556.607	0.217496	7751.421	0.215555	7947.26	0.213773	8144.009
		0.188199	4035.777	0.193375	4492.687	0.198861	4983.993	0.204665	5511.537	0.210792	6077.224	0.217248	6683.03	0.224038	7330.992	0.224403	7656.31	0.222636	7862.278	0.221018	8069.118	0.219533	8276.731
		0.200226	4190.675	0.204366	4646.267	0.208756	5133.328	0.213399	5653.362	0.2183	6207.933	0.223465	6798.668	0.228897	7427.254	0.229189	7755.182	0.227775	7972.137	0.226481	8189.802	0.225293	8408.095
		0.212253	4341.966	0.215358	4796.641	0.21865	5279.913	0.222132	5792.93	0.225808	6336.891	0.229682	6913.053	0.233756	7522.719	0.233975	7853.248	0.232915	8081.028	0.231944	8309.349	0.231053	8538.149
		0.22428	4489.931	0.22635	4944.035	0.228544	5423.92	0.230866	5930.362	0.233317	6464.179	0.235899	7026.229	0.238615	7617.409	0.238761	7950.531	0.238054	8188.981	0.237407	8427.798	0.236813	8666.938
		0.236307	4634.816	0.237342	5088.648	0.238439	5565.502	0.2396	6065.771	0.240825	6589.871	0.242116	7138.242	0.243474	7711.346	0.243547	8047.052	0.243194	8296.024	0.24287	8545.182	0.242573	8794.504
		0.248333	4776.839	0.248333	5230.659	0.248333	5704.799	0.248333	6199.258	0.248333	6714.036	0.248333	7249.133	0.248333	7804.55	0.248333	8142.833	0.248333	8402.185	0.248333	8661.537	0.248333	8920.889
		0.403542	6592.037	0.403542	7218.309	0.403542	7872.622	0.403542	8554.976	0.403542	9265.37	0.403542	10003.8	0.403542	10770.28	0.403542	11237.11	0.403542	11595.02	0.403542	11952.92	0.403542	12310.83
		0.55875	8407.236	0.55875	9205.96	0.55875	10040.45	0.55875	10910.69	0.55875	11816.7	0.55875	12758.48	0.55875	13736.01	0.55875	14331.39	0.55875	14787.85	0.55875	15244.31	0.55875	15700.76
		0.6705	8407.236	0.6705	9205.96	0.6705	10040.45	0.6705	10910.69	0.6705	11816.7	0.6705	12758.48	0.6705	13736.01	0.6705	14331.39	0.6705	14787.85	0.6705	15244.31	0.6705	15700.76
		5	8407.236	5	9205.96	5	10040.45	5	10910.69	5	11816.7	5	12758.48	5	13736.01	5	14331.39	5	14787.85	5	15244.31	5	15700.76

HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0.230271	2735.625	0.234985	2946.715	0.227509	3003.125	0.220872	3061.284	0.214941	3120.944	0.209611	3181.902	0.204797	3243.989	0.200428	3307.064	0.196446	3371.01	0.192802	3435.727	0.189455	3501.129
		0.231913	2747.469	0.236199	2955.957	0.229403	3018.293	0.223368	3082.275	0.217977	3147.669	0.213132	3214.285	0.208755	3281.962	0.204783	3350.569	0.201163	3419.996	0.19785	3490.146	0.194808	3560.941
		0.233555	2759.279	0.237412	2965.181	0.231296	3033.413	0.225865	3103.175	0.221012	3174.25	0.216652	3246.459	0.212713	3319.655	0.209138	3393.714	0.20588	3468.532	0.202898	3544.023	0.20016	3620.112
		0.235197	2771.058	0.238626	2974.387	0.233189	3048.484	0.228361	3123.984	0.224048	3200.687	0.220172	3278.429	0.216671	3357.073	0.213493	3436.507	0.210597	3516.635	0.207947	3597.378	0.205513	3678.666
		0.236839	2782.804	0.239839	2983.574	0.235082	3063.507	0.230858	3144.704	0.227084	3226.984	0.223692	3310.199	0.220629	3394.225	0.217848	3478.959	0.215314	3564.318	0.212995	3650.227	0.210865	3736.625
		0.238481	2794.518	0.241053	2992.743	0.236975	3078.482	0.233354	3165.337	0.230119	3253.144	0.227212	3341.773	0.224586	3431.116	0.222203	3521.081	0.220031	3611.592	0.218043	3702.587	0.216218	3794.01
		0.240123	2806.201	0.242266	3001.894	0.238868	3093.411	0.235851	3185.883	0.233155	3279.169	0.230732	3373.157	0.228544	3467.753	0.226558	3562.879	0.224748	3658.471	0.223092	3754.474	0.22157	3850.841
		0.241765	2817.852	0.243479	3011.026	0.240761	3108.294	0.238347	3206.344	0.236191	3305.062	0.234253	3404.353	0.232502	3504.142	0.230913	3604.364	0.229465	3704.966	0.22814	3805.903	0.226923	3907.136
		0.243407	2829.473	0.244693	3020.141	0.242654	3123.131	0.240844	3226.721	0.239226	3330.824	0.237773	3435.366	0.23646	3540.289	0.235268	3645.543	0.234182	3751.088	0.233188	3856.887	0.232276	3962.913
		0.245049	2841.062	0.245906	3029.239	0.244547	3137.922	0.24334	3247.016	0.242262	3356.458	0.241293	3466.2	0.240418	3576.2	0.239623	3686.425	0.238899	3796.847	0.238237	3907.441	0.237628	4018.189
		0.246691	2852.622	0.24712	3038.319	0.24644	3152.669	0.245837	3267.229	0.245298	3381.967	0.244813	3496.858	0.244376	3611.88	0.243978	3727.016	0.243616	3842.253	0.243285	3957.577	0.242981	4072.978
		0.248333	2864.151	0.248333	3047.381	0.248333	3167.371	0.248333	3287.362	0.248333	3407.353	0.248333	3527.343	0.248333	3647.334	0.248333	3767.325	0.248333	3887.315	0.248333	4007.306	0.248333	4127.296
		0.403542	3952.528	0.403542	4205.386	0.403542	4370.973	0.403542	4536.56	0.403542	4702.147	0.403542	4867.734	0.403542	5033.321	0.403542	5198.908	0.403542	5364.495	0.403542	5530.082	0.403542	5695.669
		0.55875	5040.905	0.55875	5363.39	0.55875	5574.574	0.55875	5785.757	0.55875	5996.941	0.55875	6208.124	0.55875	6419.308	0.55875	6630.491	0.55875	6841.675	0.55875	7052.858	0.55875	7264.042
		0.6705	5040.905	0.6705	5363.39	0.6705	5574.574	0.6705	5785.757	0.6705	5996.941	0.6705	6208.124	0.6705	6419.308	0.6705	6630.491	0.6705	6841.675	0.6705	7052.858	0.6705	7264.042
		5	5040.905	5	5363.39	5	5574.574	5	5785.757	5	5996.941	5	6208.124	5	6419.308	5	6630.491	5	6841.675	5	7052.858	5	7264.042

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section	Abutment / Scour Case	Depth below Bottom of Abutment (ft)																					
	1 / No Scour	24	25	26	27	28	29	30	31	32	33	34											
	1 / 100-yr Scour	33	34	35	36	37	38	39	40	41	42	43											
	1 / 500-yr Scour	34	35	36	37	38	39	40	41	42	43	44											
	2 / No Scour	24	25	26	27	28	29	30	31	32	33	34											
	2 / 100-yr Scour	33	34	35	36	37	38	39	40	41	42	43											
	2 / 500-yr Scour	34	35	36	37	38	39	40	41	42	43	44											
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P		
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.181962	7598.727	0.179179	7740.518	0.176599	7883.362	0.1742	8027.157	0.171966	8171.813	0.169879	8317.253	0.167925	8463.408	0.166092	8610.215	0.16437	8757.622	0.162748	8905.579	0.161219	9054.043
		0.187996	7750.944	0.185465	7904.527	0.18312	8059.099	0.18094	8214.564	0.178908	8370.839	0.177011	8527.85	0.175235	8685.532	0.173569	8843.828	0.172003	9002.685	0.170529	9162.06	0.169138	9321.911
		0.194029	7901.258	0.191752	8066.371	0.189641	8232.399	0.187679	8399.255	0.185851	8566.86	0.184143	8735.146	0.182545	8904.052	0.181045	9073.527	0.179636	9243.521	0.178309	9413.993	0.177058	9584.905
		0.200063	8049.75	0.198039	8226.147	0.196163	8403.378	0.194419	8581.363	0.192793	8760.03	0.191275	8939.317	0.189854	9119.168	0.188522	9299.536	0.187269	9480.377	0.18609	9661.652	0.184977	9843.326
		0.206097	8196.497	0.204326	8383.947	0.202684	8572.143	0.201158	8761.012	0.199736	8950.492	0.198408	9140.524	0.197164	9331.061	0.195998	9522.058	0.194902	9713.477	0.19387	9905.283	0.192897	10097.45
		0.212131	8341.569	0.210613	8539.854	0.209205	8738.792	0.207897	8938.318	0.206678	9138.375	0.20554	9338.916	0.204474	9539.895	0.203474	9741.276	0.202535	9943.025	0.201651	10145.11	0.200816	10347.51
		0.218164	8485.032	0.216899	8693.948	0.215727	8903.417	0.214637	9113.384	0.213621	9323.801	0.212672	9534.626	0.211784	9745.823	0.210951	9957.359	0.210168	10169.21	0.209431	10381.34	0.208736	10593.73
		0.224198	8626.948	0.223186	8846.301	0.222248	9066.102	0.221376	9286.308	0.220563	9506.878	0.219804	9727.78	0.219094	9948.982	0.218427	10170.46	0.217801	10392.19	0.217211	10614.15	0.216655	10836.32
		0.230232	8767.374	0.229473	8996.98	0.228769	9226.926	0.228115	9457.18	0.227506	9687.71	0.226937	9918.492	0.226404	10149.5	0.225904	10380.72	0.225434	10612.13	0.224992	10843.71	0.224575	11075.45
		0.236266	8906.365	0.23576	9146.049	0.235291	9385.963	0.234855	9626.084	0.234448	9866.392	0.234069	10106.87	0.233714	10347.5	0.23338	10588.27	0.233067	10829.17	0.232772	11070.18	0.232494	11311.3
		0.2423	9043.972	0.242047	9293.568	0.241812	9543.282	0.241594	9793.099	0.241391	10043.01	0.241201	10293.01	0.241023	10543.08	0.240857	10793.23	0.2407	11043.44	0.240553	11293.7	0.240414	11544.03
		0.248333	9180.241	0.248333	9439.593	0.248333	9698.945	0.248333	9958.297	0.248333	10217.65	0.248333	10477	0.248333	10736.35	0.248333	10995.71	0.248333	11255.06	0.248333	11514.41	0.248333	11773.76
		0.403542	12668.73	0.403542	13026.64	0.403542	13384.54	0.403542	13742.45	0.403542	14100.36	0.403542	14458.26	0.403542	14816.17	0.403542	15174.07	0.403542	15531.98	0.403542	15889.89	0.403542	16247.79
		0.55875	16157.22	0.55875	16613.68	0.55875	17070.14	0.55875	17526.6	0.55875	17983.06	0.55875	18439.52	0.55875	18895.98	0.55875	19352.44	0.55875	19808.9	0.55875	20265.36	0.55875	20721.82
		0.6705	16157.22	0.6705	16613.68	0.6705	17070.14	0.6705	17526.6	0.6705	17983.06	0.6705	18439.52	0.6705	18895.98	0.6705	19352.44	0.6705	19808.9	0.6705	20265.36	0.6705	20721.82
		5	16157.22	5	16613.68	5	17070.14	5	17526.6	5	17983.06	5	18439.52	5	18895.98	5	19352.44	5	19808.9	5	20265.36	5	20721.82
HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.186371	3567.143	0.18352	3633.705	0.180878	3700.762	0.178422	3768.265	0.176133	3836.172	0.173995	3904.447	0.171994	3973.058	0.170117	4041.975	0.168353	4111.174	0.166692	4180.631	0.165125	4250.325
		0.192004	3632.311	0.189413	3704.197	0.18701	3776.547	0.184777	3849.316	0.182696	3922.466	0.180753	3995.961	0.178934	4069.771	0.177227	4143.87	0.175624	4218.232	0.174114	4292.838	0.17269	4367.666
		0.197637	3696.734	0.195305	3773.833	0.193143	3851.363	0.191133	3929.282	0.18926	4007.553	0.187511	4086.143	0.185874	4165.025	0.184338	4244.174	0.182895	4323.567	0.181536	4403.184	0.180254	4483.009
		0.20327	3760.441	0.201197	3842.651	0.199275	3925.255	0.197488	4008.212	0.195824	4091.49	0.194269	4175.06	0.192814	4258.895	0.191449	4342.972	0.190166	4427.272	0.188958	4511.776	0.187818	4596.468
		0.208903	3823.459	0.207089	3910.684	0.205407	3998.26	0.203844	4086.152	0.202388	4174.332	0.201027	4262.772	0.199754	4351.449	0.198559	4440.342	0.197437	4529.434	0.19638	4618.709	0.195383	4708.151
		0.214536	3885.815	0.212981	3977.962	0.211539	4070.415	0.2102	4163.146	0.208951	4256.127	0.207785	4349.335	0.206694	4442.75	0.20567	4536.355	0.204708	4630.132	0.203802	4724.068	0.202947	4818.15
		0.220169	3947.532	0.218873	4044.514	0.217672	4141.755	0.216555	4239.232	0.215515	4336.92	0.214543	4434.801	0.213634	4532.858	0.21278	4631.074	0.211979	4729.437	0.211224	4827.933	0.210512	4926.553
		0.225802	4008.634	0.224765	4110.367	0.223804	4212.312	0.222911	4314.447	0.222079	4416.755	0.221301	4519.219	0.220574	4621.825	0.219891	4724.561	0.219249	4827.415	0.218646	4930.378	0.218076	5033.44
		0.231435	4069.14	0.230657	4175.547	0.229936	4282.114	0.229267	4388.827	0.228642	4495.67	0.228059	4602.632	0.227513	4709.701	0.227002	4816.869	0.22652	4924.127	0.226067	5031.467	0.22564	5138.883
		0.237067	4129.072	0.236549	4240.077	0.236069	4351.191	0.235622	4462.402	0.235206	4573.702	0.234817	4685.081	0.234453	4796.533	0.234112	4908.051	0.233791	5019.63	0.233489	5131.264	0.233205	5242.949
		0.2427	4188.449	0.242441	4303.98	0.242201	4419.567	0.241978	4535.203	0.24177	4650.884	0.241575	4766.605	0.241393	4882.363	0.241223	4998.154	0.241062	5113.976	0.240911	5229.825	0.240769	5345.7
		0.248333	4247.287	0.248333	4367.278	0.248333	4487.268	0.248333	4607.259	0.248333	4727.25	0.248333	4847.24	0.248333	4967.231	0.248333	5087.221	0.248333	5207.212	0.248333	5327.203	0.248333	5447.193
		0.403542	5861.256	0.403542	6026.843	0.403542	6192.43	0.403542	6358.017	0.403542	6523.604	0.403542	6689.191	0.403542	6854.778	0.403542	7020.366	0.403542	7185.953	0.403542	7351.54	0.403542	7517.127
		0.55875	7475.225	0.55875	7686.409	0.55875	7897.592	0.55875	8108.776	0.55875	8319.959	0.55875	8531.143	0.55875	8742.326	0.55875	8953.51	0.55875	9164.693	0.55875	9375.877	0.55875	9587.06
		0.6705	7475.225	0.6705	7686.409	0.6705	7897.592	0.6705	8108.776	0.6705	8319.959	0.6705	8531.143	0.6705	8742.326	0.6705	8953.51	0.6705	9164.693	0.6705	9375.877	0.6705	9587.06
		5	7475.225	5	7686.409	5	7897.592	5	8108.776	5	8319.959	5	8531.143	5	8742.326	5	8953.51	5	9164.693	5	9375.877	5	9587.06

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section	Abutment / Scour Case	Depth below Bottom of Abutment (ft)																					
	1 / No Scour	35	36	37	38	39	40	41	42	43	44	45											
	1 / 100-yr Scour	44	45	46	47	48	49	50	51	52	53	54											
	1 / 500-yr Scour	45	46	47	48	49	50	51	52	53	54	55											
	2 / No Scour	35	36	37	38	39	40	41	42	43	44	45											
	2 / 100-yr Scour	44	45	46	47	48	49	50	51	52	53	54											
	2 / 500-yr Scour	45	46	47	48	49	50	51	52	53	54	55											
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P		
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.159774	9202.975	0.158407	9352.34	0.157112	9502.106	0.155883	9652.244	0.154715	9802.729	0.153604	9953.538	0.152546	10104.65	0.151537	10256.04	0.150574	10407.69	0.149654	10559.6	0.148774	10711.73
		0.167825	9482.201	0.166582	9642.897	0.165404	9803.971	0.164287	9965.393	0.163226	10127.14	0.162216	10289.19	0.161254	10451.53	0.160337	10614.13	0.159461	10776.97	0.158625	10940.05	0.157825	11103.34
		0.175876	9756.223	0.174757	9927.916	0.173697	10099.96	0.172692	10272.32	0.171736	10444.99	0.170827	10617.93	0.169962	10791.14	0.169137	10964.59	0.168349	11138.26	0.167596	11312.16	0.166876	11486.25
		0.183926	10025.37	0.182932	10207.75	0.18199	10390.45	0.181096	10573.45	0.180247	10756.71	0.179439	10940.23	0.17867	11123.99	0.177936	11307.97	0.177236	11492.15	0.176567	11676.53	0.175927	11861.09
		0.191977	10289.94	0.191107	10482.73	0.190283	10675.81	0.189501	10869.14	0.188758	11062.72	0.188051	11256.53	0.187378	11450.54	0.186736	11644.75	0.186123	11839.15	0.185537	12033.72	0.184977	12228.45
		0.200028	10550.19	0.199283	10753.13	0.198576	10956.32	0.197906	11159.74	0.197269	11363.37	0.196663	11567.19	0.196086	11771.2	0.195535	11975.37	0.19501	12179.71	0.194508	12384.19	0.194028	12588.82
		0.208079	10806.36	0.207458	11019.22	0.206869	11232.28	0.20631	11445.54	0.205779	11658.97	0.205275	11872.56	0.204794	12086.31	0.204335	12300.21	0.203897	12514.24	0.203479	12728.39	0.203079	12942.66
		0.21613	11058.68	0.215633	11281.23	0.215162	11503.94	0.214715	11726.8	0.21429	11949.81	0.213886	12172.96	0.213502	12396.22	0.213135	12619.6	0.212785	12843.09	0.21245	13066.69	0.21213	13290.37
		0.224181	11307.34	0.223808	11539.37	0.223455	11771.52	0.223119	12003.79	0.222801	12236.16	0.222498	12468.64	0.22221	12701.21	0.221934	12933.87	0.221672	13166.61	0.221421	13399.43	0.221181	13632.31
		0.232232	11552.53	0.231983	11793.84	0.231748	12035.24	0.231524	12276.71	0.231312	12518.26	0.23111	12759.87	0.230917	13001.55	0.230734	13243.29	0.230559	13485.08	0.230392	13726.92	0.230232	13968.81
		0.240282	11794.4	0.240158	12044.82	0.24004	12295.28	0.239929	12545.78	0.239823	12796.31	0.239722	13046.88	0.239625	13297.48	0.239534	13548.11	0.239446	13798.77	0.239363	14049.45	0.239282	14300.16
		0.248333	12033.11	0.248333	12292.47	0.248333	12551.82	0.248333	12811.17	0.248333	13070.52	0.248333	13329.87	0.248333	13589.23	0.248333	13848.58	0.248333	14107.93	0.248333	14367.28	0.248333	14626.64
		0.403542	16605.7	0.403542	16963.6	0.403542	17321.51	0.403542	17679.42	0.403542	18037.32	0.403542	18395.23	0.403542	18753.13	0.403542	19111.04	0.403542	19468.94	0.403542	19826.85	0.403542	20184.76
		0.55875	21178.28	0.55875	21634.74	0.55875	22091.2	0.55875	22547.66	0.55875	23004.12	0.55875	23460.58	0.55875	23917.04	0.55875	24373.5	0.55875	24829.96	0.55875	25286.42	0.55875	25742.88
		0.6705	21178.28	0.6705	21634.74	0.6705	22091.2	0.6705	22547.66	0.6705	23004.12	0.6705	23460.58	0.6705	23917.04	0.6705	24373.5	0.6705	24829.96	0.6705	25286.42	0.6705	25742.88
		5	21178.28	5	21634.74	5	22091.2	5	22547.66	5	23004.12	5	23460.58	5	23917.04	5	24373.5	5	24829.96	5	25286.42	5	25742.88
HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.163645	4320.24	0.162245	4390.358	0.160919	4460.664	0.15966	4531.145	0.158464	4601.788	0.157326	4672.584	0.156242	4743.521	0.155209	4814.59	0.154223	4885.782	0.153281	4957.091	0.152379	5028.509
		0.171344	4442.701	0.170071	4517.927	0.168865	4593.33	0.167721	4668.896	0.166634	4744.616	0.165599	4820.478	0.164614	4896.473	0.163675	4972.591	0.162778	5048.826	0.161922	5125.17	0.161102	5201.617
		0.179043	4563.024	0.177898	4643.215	0.176812	4723.569	0.175782	4804.076	0.174804	4884.723	0.173873	4965.502	0.172986	5046.404	0.172141	5127.42	0.171334	5208.544	0.170563	5289.768	0.169825	5371.086
		0.186742	4681.334	0.185724	4766.36	0.184759	4851.534	0.183843	4936.846	0.182974	5022.286	0.182146	5107.846	0.181358	5193.516	0.180607	5279.291	0.179889	5365.163	0.179204	5451.127	0.178548	5537.176
		0.194441	4797.747	0.19355	4887.486	0.192706	4977.358	0.191905	5067.353	0.191144	5157.461	0.19042	5247.676	0.18973	5337.99	0.189073	5428.396	0.188445	5518.889	0.187845	5609.463	0.187272	5700.113
		0.20214	4912.367	0.201376	5006.708	0.200653	5101.164	0.199966	5195.727	0.199314	5290.389	0.198693	5385.144	0.198102	5479.984	0.197538	5574.906	0.197	5669.902	0.196486	5764.969	0.195995	5860.102
		0.209839	5025.287	0.209202	5124.126	0.208599	5223.062	0.208027	5322.088	0.207484	5421.198	0.206966	5520.385	0.206474	5619.645	0.206004	5718.973	0.205556	5818.365	0.205128	5917.815	0.204718	6017.322
		0.217538	5136.595	0.217029	5239.834	0.216546	5343.153	0.216088	5446.544	0.215654	5550.002	0.21524	5653.524	0.214846	5757.104	0.21447	5860.738	0.214111	5964.424	0.213769	6068.158	0.213441	6171.936
		0.225237	5246.369	0.224855	5353.918	0.224493	5461.528	0.22415	5569.192	0.223823	5676.907	0.223513	5784.67	0.223218	5892.477	0.222936	6000.326	0.222667	6108.213	0.22241	6216.136	0.222164	6324.093
		0.232936	5354.681	0.232681	5466.456	0.23244	5578.271	0.232211	5690.123	0.231993	5802.009	0.231787	5913.927	0.23159	6025.875	0.231402	6137.85	0.231222	6249.851	0.231051	6361.877	0.230887	6473.925
		0.240634	5461.599	0.240507	5577.519	0.240387	5693.46	0.240272	5809.419	0.240163	5925.395	0.24006	6041.387	0.239961	6157.395	0.239868	6273.416	0.239778	6389.45	0.239692	6505.496	0.23961	6621.554
		0.248333	5567.184	0.248333	5687.174	0.248333	5807.165	0.248333	5927.156	0.248333	6047.146	0.248333	6167.137	0.248333	6287.128	0.248333	6407.118	0.248333	6527.109	0.248333	6647.099	0.248333	6767.09
		0.403542	7682.714	0.403542	7848.301	0.403542	8013.888	0.403542	8179.475	0.403542	8345.062	0.403542	8510.649	0.403542	8676.236	0.403542	8841.823	0.403542	9007.41	0.403542	9172.997	0.403542	9338.584
		0.55875	9798.244	0.55875	10009.43	0.55875	10220.61	0.55875	10431.79	0.55875	10642.98	0.55875	10854.16	0.55875	11065.34	0.55875	11276.53	0.55875	11487.71	0.55875	11698.9	0.55875	11910.08
		0.6705	9798.244	0.6705	10009.43	0.6705	10220.61	0.6705	10431.79	0.6705	10642.98	0.6705	10854.16	0.6705	11065.34	0.6705	11276.53	0.6705	11487.71	0.6705	11698.9	0.6705	11910.08
		5	9798.244	5	10009.43	5	10220.61	5	10431.79	5	10642.98	5	10854.16	5	11065.34	5	11276.53	5	11487.71	5	11698.9	5	11910.08

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section	Abutment / Scour Case	Depth below Bottom of Abutment (ft)																					
	1 / No Scour	46	47	48	49	50	51	52	53	54	55	56											
	1 / 100-yr Scour	55	56	57	58	59	60	61	62	63	64	65											
	1 / 500-yr Scour	56	57	58	59	60	61	62	63	64	65	66											
	2 / No Scour	46	47	48	49	50	51	52	53	54	55	56											
	2 / 100-yr Scour	55	56	57	58	59	60	61	62	63	64	65											
	2 / 500-yr Scour	56	57	58	59	60	61	62	63	64	65	66											
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P		
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.147931	10864.08	0.147124	11016.64	0.146349	11169.39	0.145606	11322.33	0.144892	11475.43	0.144205	11628.7	0.143544	11782.13	0.142908	11935.7	0.142295	12089.4	0.141704	12243.24	0.141134	12397.21
		0.157059	11266.85	0.156325	11430.54	0.155621	11594.41	0.154945	11758.46	0.154296	11922.67	0.153671	12087.03	0.153071	12251.53	0.152492	12416.17	0.151935	12580.94	0.151398	12745.84	0.150879	12910.85
		0.166186	11660.53	0.165526	11834.99	0.164892	12009.61	0.164284	12184.4	0.163699	12359.33	0.163138	12534.41	0.162597	12709.61	0.162076	12884.95	0.161575	13060.4	0.161091	13235.97	0.160625	13411.64
		0.175314	12045.82	0.174727	12230.72	0.174163	12415.76	0.173623	12600.95	0.173103	12786.27	0.172604	12971.72	0.172123	13157.29	0.171661	13342.97	0.171215	13528.76	0.170785	13714.66	0.17037	13900.65
		0.184441	12423.33	0.183927	12618.35	0.183435	12813.51	0.182961	13008.8	0.182507	13204.2	0.18207	13399.72	0.181649	13595.35	0.181245	13791.08	0.180855	13986.9	0.180478	14182.81	0.180116	14378.81
		0.193569	12793.58	0.193128	12998.46	0.192706	13203.46	0.1923	13408.57	0.191911	13613.78	0.191536	13819.09	0.191176	14024.49	0.190829	14229.98	0.190494	14435.56	0.190172	14641.21	0.189861	14846.94
		0.202696	13157.04	0.202329	13371.53	0.201977	13586.12	0.201639	13800.79	0.201314	14015.56	0.201002	14230.4	0.200702	14445.33	0.200413	14660.33	0.200134	14875.4	0.199866	15090.53	0.199606	15305.73
		0.211824	13514.15	0.21153	13738.01	0.211248	13961.95	0.210978	14185.96	0.210718	14410.04	0.210469	14634.19	0.210228	14858.41	0.209997	15082.68	0.209774	15307	0.209559	15531.38	0.209352	15755.82
		0.220951	13865.27	0.220731	14098.29	0.22052	14331.37	0.220317	14564.5	0.220122	14797.69	0.219935	15030.92	0.219755	15264.21	0.219581	15497.53	0.219414	15730.9	0.219253	15964.31	0.219097	16197.76
		0.230078	14210.75	0.229932	14452.73	0.229791	14694.74	0.229656	14936.8	0.229526	15178.89	0.229401	15421.01	0.229281	15663.17	0.229165	15905.35	0.229054	16147.56	0.228946	16389.8	0.228843	16632.07
		0.239206	14550.89	0.239132	14801.64	0.239062	15052.42	0.238994	15303.21	0.23893	15554.01	0.238867	15804.84	0.238807	16055.68	0.238749	16306.53	0.238694	16557.4	0.23864	16808.29	0.238588	17059.18
		0.248333	14885.99	0.248333	15145.34	0.248333	15404.69	0.248333	15664.04	0.248333	15923.4	0.248333	16182.75	0.248333	16442.1	0.248333	16701.45	0.248333	16960.8	0.248333	17220.16	0.248333	17479.51
		0.403542	20542.66	0.403542	20900.57	0.403542	21258.47	0.403542	21616.38	0.403542	21974.29	0.403542	22332.19	0.403542	22690.1	0.403542	23048	0.403542	23405.91	0.403542	23763.82	0.403542	24121.72
		0.55875	26199.34	0.55875	26655.8	0.55875	27112.26	0.55875	27568.72	0.55875	28025.18	0.55875	28481.64	0.55875	28938.1	0.55875	29394.56	0.55875	29851.02	0.55875	30307.47	0.55875	30763.93
		0.6705	26199.34	0.6705	26655.8	0.6705	27112.26	0.6705	27568.72	0.6705	28025.18	0.6705	28481.64	0.6705	28938.1	0.6705	29394.56	0.6705	29851.02	0.6705	30307.47	0.6705	30763.93
		5	26199.34	5	26655.8	5	27112.26	5	27568.72	5	28025.18	5	28481.64	5	28938.1	5	29394.56	5	29851.02	5	30307.47	5	30763.93
HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.151516	5100.03	0.150689	5171.646	0.149896	5243.354	0.149134	5315.147	0.148403	5387.022	0.147699	5458.972	0.147023	5530.995	0.146371	5603.087	0.145743	5675.244	0.145138	5747.462	0.144554	5819.74
		0.160318	5278.159	0.159566	5354.792	0.158845	5431.51	0.158152	5508.308	0.157487	5585.182	0.156848	5662.129	0.156233	5739.143	0.15564	5816.221	0.15507	5893.36	0.154519	5970.558	0.153988	6047.81
		0.169119	5452.493	0.168443	5533.984	0.167794	5615.553	0.167171	5697.196	0.166572	5778.91	0.165997	5860.689	0.165443	5942.532	0.16491	6024.433	0.164396	6106.391	0.163901	6188.402	0.163423	6270.464
		0.177921	5623.305	0.177319	5709.51	0.176742	5795.787	0.176189	5882.13	0.175657	5968.537	0.175145	6055.004	0.174653	6141.528	0.174179	6228.105	0.173722	6314.733	0.173282	6401.41	0.172857	6488.132
		0.186722	5790.835	0.186196	5881.624	0.185691	5972.476	0.185207	6063.388	0.184741	6154.357	0.184294	6245.378	0.183863	6336.45	0.183448	6427.57	0.183049	6518.734	0.182664	6609.942	0.182292	6701.191
		0.195524	5955.296	0.195073	6050.55	0.19464	6145.858	0.194225	6241.218	0.193826	6336.627	0.193442	6432.082	0.193073	6527.58	0.192718	6623.12	0.192375	6718.7	0.192045	6814.316	0.191726	6909.967
		0.204325	6116.88	0.20395	6216.488	0.203589	6316.141	0.203243	6415.839	0.20291	6515.577	0.202591	6615.354	0.202283	6715.168	0.201987	6815.017	0.201702	6914.899	0.201426	7014.811	0.201161	7114.754
		0.213127	6275.757	0.212826	6379.617	0.212538	6483.515	0.212261	6587.447	0.211995	6691.413	0.211739	6795.41	0.211493	6899.437	0.211256	7003.491	0.211028	7107.572	0.210808	7211.678	0.210595	7315.808
		0.221929	6432.082	0.221703	6540.101	0.221487	6648.147	0.221279	6756.221	0.22108	6864.319	0.220888	6972.441	0.220703	7080.585	0.220525	7188.75	0.220354	7296.935	0.220189	7405.139	0.22003	7513.361
		0.23073	6585.995	0.23058	6698.084	0.230436	6810.192	0.230297	6922.318	0.230164	7034.461	0.230036	7146.619	0.229913	7258.793	0.229795	7370.98	0.229681	7483.181	0.229571	7595.395	0.229464	7707.62
		0.239532	6737.622	0.239457	6853.7	0.239384	6969.788	0.239315	7085.885	0.239249	7201.99	0.239185	7318.103	0.239123	7434.223	0.239064	7550.351	0.239007	7666.485	0.238952	7782.626	0.238899	7898.772
		0.248333	6887.081	0.248333	7007.071	0.248333	7127.062	0.248333	7247.053	0.248333	7367.043	0.248333	7487.034	0.248333	7607.024	0.248333	7727.015	0.248333	7847.006	0.248333	7966.996	0.248333	8086.987
		0.403542	9504.171	0.403542	9669.758	0.403542	9835.345	0.403542	10000.93	0.403542	10166.52	0.403542	10332.11	0.403542	10497.69	0.403542	10663.28	0.403542	10828.87	0.403542	10994.46	0.403542	11160.04
		0.55875	12121.26	0.55875	12332.45	0.55875	12543.63	0.55875	12754.81	0.55875	12966	0.55875	13177.18	0.55875	13388.36	0.55875	13599.55	0.55875	13810.73	0.55875	14021.91	0.55875	14233.1
		0.6705	12121.26	0.6705	12332.45	0.6705	12543.63	0.6705	12754.81	0.6705	12966	0.6705	13177.18	0.6705	13388.36	0.6705	13599.55	0.6705	13810.73	0.6705	14021.91	0.6705	14233.1
		5	12121.26	5	12332.45	5	12543.63	5	12754.81	5	12966	5	13177.18	5	13388.36	5	13599.55	5	13810.73	5	14021.91	5	14233.1

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section	Abutment / Scour Case	Depth below Bottom of Abutment (ft)																					
	1 / No Scour	57	58	59	60	61	62	63	64	65	66	67											
	1 / 100-yr Scour	66	67	68	69	70	71	72	73	74	75	76											
	1 / 500-yr Scour	67	68	69	70	71	72	73	74	75	76	77											
	2 / No Scour	57	58	59	60	61	62	63	64	65	66	67											
	2 / 100-yr Scour	66	67	68	69	70	71	72	73	74	75	76											
	2 / 500-yr Scour	67	68	69	70	71	72	73	74	75	76	77											
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P		
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.140583	12551.29	0.140052	12705.49	0.139538	12859.79	0.139041	13014.2	0.13856	13168.71	0.138094	13323.3	0.137643	13477.99	0.137206	13632.76	0.136782	13787.62	0.136371	13942.55	0.135972	14097.56
		0.150379	13075.98	0.149895	13241.21	0.149428	13406.54	0.148976	13571.96	0.148539	13737.48	0.148116	13903.09	0.147706	14068.78	0.147308	14234.55	0.146923	14400.39	0.146549	14566.31	0.146186	14732.3
		0.160174	13587.42	0.159739	13763.29	0.159319	13939.26	0.158912	14115.32	0.158518	14291.46	0.158137	14467.68	0.157768	14643.98	0.157411	14820.35	0.157064	14996.79	0.156728	15173.3	0.156401	15349.88
		0.16997	14086.74	0.169583	14272.91	0.169209	14459.17	0.168848	14645.51	0.168498	14831.92	0.168159	15018.41	0.167831	15204.97	0.167513	15391.59	0.167205	15578.28	0.166906	15765.02	0.166616	15951.83
		0.179765	14574.9	0.179427	14771.06	0.1791	14967.29	0.178783	15163.6	0.178477	15359.97	0.178181	15556.41	0.177894	15752.91	0.177616	15949.47	0.177346	16146.09	0.177084	16342.76	0.176831	16539.48
		0.189561	15052.73	0.189271	15258.6	0.18899	15464.53	0.188719	15670.52	0.188457	15876.57	0.188203	16082.68	0.187957	16288.84	0.187718	16495.05	0.187487	16701.31	0.187263	16907.61	0.187045	17113.96
		0.199356	15520.98	0.199114	15736.3	0.198881	15951.66	0.198655	16167.08	0.198436	16382.55	0.198225	16598.06	0.198019	16813.62	0.197821	17029.23	0.197628	17244.87	0.197441	17460.55	0.19726	17676.27
		0.209152	15980.29	0.208958	16204.82	0.208771	16429.39	0.208591	16654	0.208416	16878.65	0.208246	17103.33	0.208082	17328.05	0.207923	17552.81	0.207769	17777.6	0.20762	18002.42	0.207475	18227.27
		0.218947	16431.25	0.218802	16664.77	0.218662	16898.32	0.218526	17131.9	0.218395	17365.51	0.218268	17599.15	0.218145	17832.82	0.218026	18066.51	0.21791	18300.23	0.217798	18533.97	0.217689	18767.74
		0.228742	16874.36	0.228646	17116.67	0.228552	17359	0.228462	17601.36	0.228374	17843.73	0.22829	18086.13	0.228208	18328.54	0.228128	18570.97	0.228051	18813.41	0.227977	19055.87	0.227904	19298.35
		0.238538	17310.09	0.23849	17561.01	0.238443	17811.94	0.238398	18062.88	0.238354	18313.83	0.238312	18564.79	0.238271	18815.76	0.238231	19066.73	0.238192	19317.72	0.238155	19568.71	0.238119	19819.71
		0.248333	17738.86	0.248333	17998.21	0.248333	18257.56	0.248333	18516.92	0.248333	18776.27	0.248333	19035.62	0.248333	19294.97	0.248333	19554.33	0.248333	19813.68	0.248333	20073.03	0.248333	20332.38
		0.403542	24479.63	0.403542	24837.53	0.403542	25195.44	0.403542	25553.34	0.403542	25911.25	0.403542	26269.16	0.403542	26627.06	0.403542	26984.97	0.403542	27342.87	0.403542	27700.78	0.403542	28058.69
		0.55875	31220.39	0.55875	31676.85	0.55875	32133.31	0.55875	32589.77	0.55875	33046.23	0.55875	33502.69	0.55875	33959.15	0.55875	34415.61	0.55875	34872.07	0.55875	35328.53	0.55875	35784.99
		0.6705	31220.39	0.6705	31676.85	0.6705	32133.31	0.6705	32589.77	0.6705	33046.23	0.6705	33502.69	0.6705	33959.15	0.6705	34415.61	0.6705	34872.07	0.6705	35328.53	0.6705	35784.99
		5	31220.39	5	31676.85	5	32133.31	5	32589.77	5	33046.23	5	33502.69	5	33959.15	5	34415.61	5	34872.07	5	35328.53	5	35784.99
HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.14399	5892.073	0.143445	5964.459	0.142919	6036.895	0.14241	6109.38	0.141917	6181.91	0.14144	6254.485	0.140978	6327.101	0.14053	6399.758	0.140096	6472.452	0.139675	6545.184	0.139267	6617.95
		0.153476	6125.114	0.152981	6202.469	0.152502	6279.871	0.152039	6357.317	0.151591	6434.807	0.151158	6512.338	0.150738	6589.909	0.150331	6667.517	0.149936	6745.161	0.149553	6822.839	0.149182	6900.55
		0.162962	6352.574	0.162516	6434.73	0.162085	6516.929	0.161669	6599.17	0.161266	6681.451	0.160875	6763.77	0.160497	6846.125	0.160131	6928.514	0.159776	7010.937	0.159431	7093.391	0.159097	7175.875
		0.172447	6574.898	0.172051	6661.706	0.171668	6748.553	0.171298	6835.438	0.17094	6922.359	0.170593	7009.313	0.170257	7096.301	0.169931	7183.32	0.169616	7270.369	0.169309	7357.446	0.169012	7444.551
		0.181933	6792.478	0.181586	6883.802	0.181251	6975.16	0.180927	7066.553	0.180614	7157.977	0.18031	7249.431	0.180016	7340.915	0.179732	7432.426	0.179455	7523.964	0.179187	7615.527	0.178927	7707.114
		0.191419	7005.653	0.191122	7101.37	0.190835	7197.117	0.190557	7292.893	0.190288	7388.697	0.190028	7484.527	0.189776	7580.382	0.189532	7676.261	0.189295	7772.163	0.189065	7868.087	0.188842	7964.032
		0.200905	7214.725	0.200657	7314.722	0.200418	7414.745	0.200186	7514.792	0.199962	7614.862	0.199746	7714.954	0.199536	7815.067	0.199332	7915.201	0.199135	8015.354	0.198943	8115.525	0.198758	8215.713
		0.21039	7419.961	0.210192	7524.135	0.210001	7628.329	0.209816	7732.544	0.209637	7836.776	0.209463	7941.027	0.209295	8045.294	0.209132	8149.578	0.208974	8253.876	0.208821	8358.19	0.208673	8462.518
		0.219876	7621.6	0.219728	7729.855	0.219584	7838.126	0.219445	7946.411	0.219311	8054.711	0.219181	8163.023	0.219055	8271.349	0.218933	8379.686	0.218814	8488.035	0.218699	8596.396	0.218588	8704.766
		0.229362	7819.857	0.229263	7932.105	0.229167	8044.363	0.229075	8156.63	0.228985	8268.907	0.228898	8381.193	0.228814	8493.488	0.228733	8605.791	0.228654	8718.101	0.228577	8830.419	0.228503	8942.744
		0.238848	8014.924	0.238798	8131.082	0.23875	8247.245	0.238704	8363.412	0.238659	8479.585	0.238616	8595.762	0.238574	8711.943	0.238533	8828.128	0.238494	8944.317	0.238455	9060.51	0.238418	9176.706
		0.248333	8206.978	0.248333	8326.968	0.248333	8446.959	0.248333	8566.949	0.248333	8686.94	0.248333	8806.931	0.248333	8926.921	0.248333	9046.912	0.248333	9166.902	0.248333	9286.893	0.248333	9406.884
		0.403542	11325.63	0.403542	11491.22	0.403542	11656.8	0.403542	11822.39	0.403542	11987.98	0.403542	12153.56	0.403542	12319.15	0.403542	12484.74	0.403542	12650.33	0.403542	12815.91	0.403542	12981.5
		0.55875	14444.28	0.55875	14655.46	0.55875	14866.65	0.55875	15077.83	0.55875	15289.01	0.55875	15500.2	0.55875	15711.38	0.55875	15922.57	0.55875	16133.75	0.55875	16344.93	0.55875	16556.12
		0.6705	14444.28	0.6705	14655.46	0.6705	14866.65	0.6705	15077.83	0.6705	15289.01	0.6705	15500.2	0.6705	15711.38	0.6705	15922.57	0.6705	16133.75	0.6705	16344.93	0.6705	16556.12
		5	14444.28	5	14655.46	5	14866.65	5	15077.83	5	15289.01	5	15500.2	5	15711.38	5	15922.57	5	16133.75	5	16344.93	5	16556.12

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section	Abutment / Scour Case	Depth below Bottom of Abutment (ft)																					
	1 / No Scour	68	69	70	71	72	73	74	75	76	77	78											
	1 / 100-yr Scour	77	78	79	80	81	82	83	84	85	86	87											
	1 / 500-yr Scour	78	79	80	81	82	83	84	85	86	87	88											
	2 / No Scour	68	69	70	71	72	73	74	75	76	77	78											
	2 / 100-yr Scour	77	78	79	80	81	82	83	84	85	86	87											
	2 / 500-yr Scour	78	79	80	81	82	83	84	85	86	87	88											
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P		
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.135584	14252.64	0.135208	14407.78	0.134843	14563	0.134487	14718.27	0.134142	14873.61	0.133805	15029.01	0.133478	15184.46	0.133159	15339.97	0.132849	15495.52	0.132547	15651.13	0.132252	15806.79
		0.145834	14898.36	0.145492	15064.48	0.14516	15230.66	0.144837	15396.9	0.144523	15563.2	0.144217	15729.55	0.143919	15895.96	0.14363	16062.42	0.143348	16228.92	0.143073	16395.48	0.142805	16562.07
		0.156084	15526.51	0.155776	15703.21	0.155477	15879.96	0.155186	16056.77	0.154904	16233.62	0.154629	16410.53	0.154361	16587.49	0.1541	16764.5	0.153846	16941.54	0.153599	17118.64	0.153358	17295.77
		0.166334	16138.69	0.16606	16325.61	0.165795	16512.57	0.165536	16699.59	0.165285	16886.65	0.16504	17073.76	0.164802	17260.91	0.16457	17448.1	0.164345	17635.34	0.164125	17822.61	0.163911	18009.92
		0.176584	16736.25	0.176345	16933.07	0.176112	17129.93	0.175886	17326.83	0.175666	17523.78	0.175452	17720.77	0.175244	17917.8	0.175041	18114.86	0.174843	18311.96	0.174651	18509.1	0.174464	18706.26
		0.186834	17320.35	0.186629	17526.79	0.186429	17733.26	0.186235	17939.77	0.186047	18146.31	0.185863	18352.89	0.185685	18559.51	0.185511	18766.16	0.185342	18972.83	0.185177	19179.54	0.185016	19386.27
		0.197084	17892.02	0.196913	18107.81	0.196747	18323.63	0.196585	18539.49	0.196428	18755.37	0.196275	18971.28	0.196126	19187.22	0.195982	19403.19	0.195841	19619.18	0.195703	19835.2	0.195569	20051.24
		0.207334	18452.15	0.207197	18677.06	0.207064	18901.99	0.206935	19126.95	0.206809	19351.93	0.206687	19576.93	0.206568	19801.96	0.206452	20027.01	0.206339	20252.08	0.206229	20477.17	0.206122	20702.28
		0.217584	19001.52	0.217481	19235.33	0.217381	19469.15	0.217284	19703	0.21719	19936.86	0.217098	20170.74	0.217009	20404.64	0.216922	20638.55	0.216838	20872.48	0.216755	21106.42	0.216675	21340.38
		0.227834	19540.84	0.227765	19783.34	0.227699	20025.86	0.227634	20268.39	0.227571	20510.93	0.22751	20753.48	0.227451	20996.05	0.227393	21238.62	0.227336	21481.21	0.227281	21723.8	0.227228	21966.41
		0.238083	20070.72	0.238049	20321.73	0.238016	20572.76	0.237984	20823.78	0.237952	21074.82	0.237922	21325.86	0.237892	21576.9	0.237863	21827.95	0.237835	22079.01	0.237807	22330.07	0.237781	22581.13
		0.248333	20591.73	0.248333	20851.09	0.248333	21110.44	0.248333	21369.79	0.248333	21629.14	0.248333	21888.49	0.248333	22147.85	0.248333	22407.2	0.248333	22666.55	0.248333	22925.9	0.248333	23185.25
		0.403542	28416.59	0.403542	28774.5	0.403542	29132.4	0.403542	29490.31	0.403542	29848.22	0.403542	30206.12	0.403542	30564.03	0.403542	30921.93	0.403542	31279.84	0.403542	31637.75	0.403542	31995.65
		0.55875	36241.45	0.55875	36697.91	0.55875	37154.37	0.55875	37610.83	0.55875	38067.29	0.55875	38523.75	0.55875	38980.21	0.55875	39436.67	0.55875	39893.13	0.55875	40349.59	0.55875	40806.05
		0.6705	36241.45	0.6705	36697.91	0.6705	37154.37	0.6705	37610.83	0.6705	38067.29	0.6705	38523.75	0.6705	38980.21	0.6705	39436.67	0.6705	39893.13	0.6705	40349.59	0.6705	40806.05
		5	36241.45	5	36697.91	5	37154.37	5	37610.83	5	38067.29	5	38523.75	5	38980.21	5	39436.67	5	39893.13	5	40349.59	5	40806.05
HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.13887	6690.75	0.138484	6763.583	0.13811	6836.446	0.137746	6909.339	0.137392	6982.261	0.137048	7055.209	0.136712	7128.185	0.136386	7201.185	0.136068	7274.211	0.135759	7347.259	0.135457	7420.33
		0.148821	6978.292	0.148471	7056.065	0.14813	7133.867	0.147799	7211.697	0.147478	7289.553	0.147164	7367.435	0.14686	7445.342	0.146563	7523.272	0.146274	7601.226	0.145993	7679.201	0.145718	7757.198
		0.158772	7258.389	0.158457	7340.93	0.158151	7423.498	0.157853	7506.091	0.157563	7588.71	0.157281	7671.351	0.157007	7754.016	0.15674	7836.702	0.15648	7919.41	0.156227	8002.138	0.15598	8084.885
		0.168724	7531.682	0.168443	7618.838	0.168171	7706.018	0.167906	7793.222	0.167649	7880.447	0.167398	7967.694	0.167154	8054.962	0.166917	8142.249	0.166686	8229.555	0.166461	8316.88	0.166241	8404.222
		0.178675	7798.725	0.17843	7890.357	0.178191	7982.012	0.17796	8073.686	0.177734	8165.381	0.177515	8257.094	0.177302	8348.825	0.177094	8440.574	0.176892	8532.34	0.176695	8624.122	0.176503	8715.92
		0.188626	8059.997	0.188416	8155.981	0.188212	8251.984	0.188013	8348.004	0.18782	8444.042	0.187632	8540.096	0.187449	8636.165	0.187271	8732.25	0.187098	8828.349	0.186929	8924.462	0.186764	9020.589
		0.198577	8315.919	0.198402	8416.14	0.198232	8516.377	0.198066	8616.629	0.197905	8716.895	0.197749	8817.175	0.197597	8917.468	0.197448	9017.774	0.197304	9118.092	0.197163	9218.422	0.197026	9318.763
		0.208528	8566.859	0.208388	8671.214	0.208252	8775.581	0.20812	8879.959	0.207991	8984.349	0.207866	9088.751	0.207744	9193.162	0.207625	9297.584	0.20751	9402.016	0.207397	9506.457	0.207287	9610.907
		0.21848	8813.148	0.218375	8921.538	0.218272	9029.939	0.218173	9138.348	0.218077	9246.765	0.217983	9355.191	0.217891	9463.625	0.217802	9572.067	0.217716	9680.516	0.217631	9788.972	0.217549	9897.435
		0.228431	9055.076	0.228361	9167.414	0.228293	9279.758	0.228227	9392.109	0.228162	9504.465	0.2281	9616.827	0.228039	9729.194	0.227979	9841.566	0.227922	9953.943	0.227865	10066.32	0.22781	10178.71
		0.238382	9292.906	0.238347	9409.109	0.238313	9525.315	0.23828	9641.524	0.238248	9757.736	0.238216	9873.95	0.238186	9990.168	0.238156	10106.39	0.238127	10222.61	0.238099	10338.83	0.238072	10455.06
		0.248333	9526.874	0.248333	9646.865	0.248333	9766.856	0.248333	9886.846	0.248333	10006.84	0.248333	10126.83	0.248333	10246.82	0.248333	10366.81	0.248333	10486.8	0.248333	10606.79	0.248333	10726.78
		0.403542	13147.09	0.403542	13312.67	0.403542	13478.26	0.403542	13643.85	0.403542	13809.44	0.403542	13975.02	0.403542	14140.61	0.403542	14306.2	0.403542	14471.78	0.403542	14637.37	0.403542	14802.96
		0.55875	16767.3	0.55875	16978.48	0.55875	17189.67	0.55875	17400.85	0.55875	17612.03	0.55875	17823.22	0.55875	18034.4	0.55875	18245.58	0.55875	18456.77	0.55875	18667.95	0.55875	18879.13
		0.6705	16767.3	0.6705	16978.48	0.6705	17189.67	0.6705	17400.85	0.6705	17612.03	0.6705	17823.22	0.6705	18034.4	0.6705	18245.58	0.6705	18456.77	0.6705	18667.95	0.6705	18879.13
		5	16767.3	5	16978.48	5	17189.67	5	17400.85	5	17612.03	5	17823.22	5	18034.4	5	18245.58	5	18456.77	5	18667.95	5	18879.13

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section	Abutment / Scour Case	Depth below Bottom of Abutment (ft)																					
	1 / No Scour	79	80	81	82	83	84	85	86	87	88	89											
	1 / 100-yr Scour	88	89	90	91	92	93	94	95	96	97	98											
	1 / 500-yr Scour	89	90	91	92	93	94	95	96	97	98	99											
	2 / No Scour	79	80	81	82	83	84	85	86	87	88	89											
	2 / 100-yr Scour	88	89	90	91	92	93	94	95	96	97	98											
	2 / 500-yr Scour	89	90	91	92	93	94	95	96	97	98	99											
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		0.131965	15962.49	0.131685	16118.24	0.131412	16274.03	0.131145	16429.86	0.130885	16585.73	0.130631	16741.65	0.130383	16897.6	0.13014	17053.58	0.129903	17209.6	0.129672	17365.66	0.129446	17521.75
		0.142544	16728.71	0.142289	16895.4	0.142041	17062.12	0.141799	17228.88	0.141562	17395.68	0.141331	17562.52	0.141105	17729.39	0.140885	17896.3	0.14067	18063.24	0.140459	18230.21	0.140254	18397.21
		0.153123	17472.94	0.152894	17650.16	0.15267	17827.41	0.152452	18004.69	0.152239	18182.01	0.152031	18359.36	0.151828	18536.75	0.15163	18714.17	0.151436	18891.61	0.151247	19069.09	0.151061	19246.6
		0.163702	18197.27	0.163498	18384.65	0.163299	18572.07	0.163106	18759.51	0.162916	18946.99	0.162732	19134.5	0.162551	19322.04	0.162375	19509.61	0.162202	19697.2	0.162034	19884.82	0.161869	20072.47
		0.174281	18903.46	0.174103	19100.69	0.173929	19297.95	0.173759	19495.24	0.173593	19692.56	0.173432	19889.9	0.173274	20087.27	0.17312	20284.66	0.172969	20482.08	0.172821	20679.52	0.172677	20876.98
		0.18486	19593.04	0.184707	19799.83	0.184558	20006.64	0.184412	20213.48	0.184271	20420.35	0.184132	20627.23	0.183997	20834.14	0.183864	21041.07	0.183735	21248.02	0.183609	21454.99	0.183485	21661.98
		0.195439	20267.31	0.195311	20483.39	0.195187	20699.5	0.195066	20915.63	0.194948	21131.78	0.194832	21347.95	0.194719	21564.13	0.194609	21780.34	0.194502	21996.56	0.194396	22212.8	0.194293	22429.05
		0.206018	20927.41	0.205916	21152.56	0.205816	21377.72	0.205719	21602.9	0.205625	21828.09	0.205532	22053.3	0.205442	22278.53	0.205354	22503.77	0.205268	22729.02	0.205184	22954.29	0.205101	23179.57
		0.216597	21574.35	0.21652	21808.34	0.216446	22042.34	0.216373	22276.35	0.216302	22510.37	0.216233	22744.4	0.216165	22978.45	0.216099	23212.5	0.216034	23446.57	0.215971	23680.65	0.215909	23914.73
		0.227175	22209.02	0.227125	22451.64	0.227075	22694.28	0.227026	22936.92	0.226979	23179.56	0.226933	23422.22	0.226888	23664.88	0.226844	23907.55	0.226801	24150.23	0.226759	24392.91	0.226717	24635.6
		0.237754	22832.2	0.237729	23083.28	0.237704	23334.36	0.23768	23585.44	0.237656	23836.53	0.237633	24087.62	0.237611	24338.71	0.237589	24589.81	0.237567	24840.91	0.237546	25092.01	0.237525	25343.12
		0.248333	23444.61	0.248333	23703.96	0.248333	23963.31	0.248333	24222.66	0.248333	24482.02	0.248333	24741.37	0.248333	25000.72	0.248333	25260.07	0.248333	25519.42	0.248333	25778.78	0.248333	26038.13
		0.403542	32353.56	0.403542	32711.46	0.403542	33069.37	0.403542	33427.27	0.403542	33785.18	0.403542	34143.09	0.403542	34500.99	0.403542	34858.9	0.403542	35216.8	0.403542	35574.71	0.403542	35932.62
		0.55875	41262.51	0.55875	41718.97	0.55875	42175.43	0.55875	42631.89	0.55875	43088.35	0.55875	43544.81	0.55875	44001.27	0.55875	44457.73	0.55875	44914.18	0.55875	45370.64	0.55875	45827.1
		0.6705	41262.51	0.6705	41718.97	0.6705	42175.43	0.6705	42631.89	0.6705	43088.35	0.6705	43544.81	0.6705	44001.27	0.6705	44457.73	0.6705	44914.18	0.6705	45370.64	0.6705	45827.1
		5	41262.51	5	41718.97	5	42175.43	5	42631.89	5	43088.35	5	43544.81	5	44001.27	5	44457.73	5	44914.18	5	45370.64	5	45827.1
HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		0.135163	7493.423	0.134876	7566.537	0.134596	7639.672	0.134323	7712.826	0.134056	7785.999	0.133796	7859.19	0.133542	7932.399	0.133294	8005.625	0.133051	8078.867	0.132814	8152.125	0.132582	8225.399
		0.145451	7835.215	0.14519	7913.252	0.144936	7991.308	0.144688	8069.382	0.144445	8147.474	0.144209	8225.583	0.143978	8303.709	0.143752	8381.851	0.143531	8460.008	0.143316	8538.18	0.143105	8616.366
		0.155739	8167.651	0.155505	8250.435	0.155276	8333.237	0.155052	8416.056	0.154834	8498.891	0.154621	8581.741	0.154413	8664.607	0.15421	8747.488	0.154012	8830.383	0.153818	8913.291	0.153628	8996.213
		0.166027	8491.581	0.165819	8578.957	0.165615	8666.348	0.165417	8753.755	0.165223	8841.177	0.165034	8928.612	0.164849	9016.061	0.164668	9103.524	0.164492	9190.999	0.164319	9278.487	0.164151	9365.987
		0.176316	8807.732	0.176133	8899.559	0.175955	8991.4	0.175781	9083.255	0.175612	9175.122	0.175446	9267.002	0.175284	9358.895	0.175126	9450.799	0.174972	9542.714	0.174821	9634.64	0.174674	9726.577
		0.186604	9116.729	0.186447	9212.881	0.186295	9309.045	0.186146	9405.221	0.186	9501.408	0.185859	9597.606	0.18572	9693.814	0.185584	9790.033	0.185452	9886.261	0.185323	9982.499	0.185196	10078.75
		0.196892	9419.114	0.196762	9519.477	0.196635	9619.849	0.19651	9720.231	0.196389	9820.623	0.196271	9921.023	0.196155	10021.43	0.196043	10121.85	0.195932	10222.28	0.195825	10322.71	0.195719	10423.15
		0.20718	9715.366	0.207076	9819.833	0.206974	9924.309	0.206875	10028.79	0.206778	10133.28	0.206683	10237.78	0.206591	10342.29	0.206501	10446.8	0.206413	10551.32	0.206326	10655.84	0.206242	10760.37
		0.217469	10005.9	0.21739	10114.38	0.217314	10222.86	0.21724	10331.35	0.217167	10439.84	0.217096	10548.34	0.217027	10656.85	0.216959	10765.35	0.216893	10873.87	0.216828	10982.39	0.216765	11090.91
		0.227757	10291.1	0.227705	10403.5	0.227654	10515.9	0.227604	10628.3	0.227556	10740.7	0.227508	10853.11	0.227462	10965.53	0.227417	11077.95	0.227373	11190.37	0.22733	11302.79	0.227288	11415.22
		0.238045	10571.29	0.238019	10687.52	0.237994	10803.76	0.237969	10919.99	0.237945	11036.23	0.237921	11152.47	0.237898	11268.71	0.237875	11384.95	0.237853	11501.19	0.237832	11617.44	0.237811	11733.69
		0.248333	10846.77	0.248333	10966.76	0.248333	11086.75	0.248333	11206.74	0.248333	11326.73	0.248333	11446.72	0.248333	11566.72	0.248333	11686.71	0.248333	11806.7	0.248333	11926.69	0.248333	12046.68
		0.403542	14968.54	0.403542	15134.13	0.403542	15299.72	0.403542	15465.31	0.403542	15630.89	0.403542	15796.48	0.403542	15962.07	0.403542	16127.65	0.403542	16293.24	0.403542	16458.83	0.403542	16624.42
		0.55875	19090.32	0.55875	19301.5	0.55875	19512.68	0.55875	19723.87	0.55875	19935.05	0.55875	20146.24	0.55875	20357.42	0.55875	20568.6	0.55875	20779.79	0.55875	20990.97	0.55875	21202.15
		0.6705	19090.32	0.6705	19301.5	0.6705	19512.68	0.6705	19723.87	0.6705	19935.05	0.6705	20146.24	0.6705	20357.42	0.6705	20568.6	0.6705	20779.79	0.6705	20990.97	0.6705	21202.15
		5	19090.32	5	19301.5	5	19512.68	5	19723.87	5	19935.05	5	20146.24	5	20357.42	5	20568.6	5	20779.79	5	20990.97	5	21202.15

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section	Abutment / Scour Case	Depth below Bottom of Abutment (ft)																					
	1 / No Scour	90		91		92		93		94		95		96		97		98		99		100	
	1 / 100-yr Scour	99		100		101		102		--		--		--		--		--		--		--	
	1 / 500-yr Scour	100		101		102		--		--		--		--		--		--		--		--	
	2 / No Scour	90		91		92		93		94		95		96		97		98		99		100	
	2 / 100-yr Scour	99		100		101		102		--		--		--		--		--		--		--	
	2 / 500-yr Scour	100		101		102		--		--		--		--		--		--		--		--	
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0.129224	17677.86	0.129008	17834.02	0.128796	17990.2	0.128588	18146.41	0.128386	18302.64	0.128187	18458.91	0.127992	18615.2	0.127802	18771.52	0.03531	11347.16	0.035324	11461.79	0.035337	11576.42
		0.140052	18564.24	0.139855	18731.3	0.139663	18898.39	0.139474	19065.51	0.13929	19232.65	0.139109	19399.82	0.138932	19567.01	0.138759	19734.23	0.054676	14802.85	0.054688	14950.93	0.0547	15099.01
		0.15088	19424.13	0.150703	19601.69	0.15053	19779.27	0.15036	19956.88	0.150194	20134.52	0.150032	20312.17	0.149872	20489.85	0.149717	20667.55	0.074041	17799.48	0.074053	17976.69	0.074064	18153.91
		0.161708	20260.14	0.161551	20447.83	0.161397	20635.55	0.161246	20823.29	0.161099	21011.05	0.160954	21198.83	0.160813	21386.64	0.160674	21574.46	0.093407	20500.19	0.093417	20703.73	0.093427	20907.27
		0.172537	21074.47	0.172399	21271.97	0.172264	21469.5	0.172132	21667.05	0.172003	21864.61	0.171876	22062.2	0.171753	22259.8	0.171631	22457.42	0.112773	22988.33	0.112782	23216.15	0.11279	23443.98
		0.183365	21868.99	0.183247	22076.02	0.183131	22283.07	0.183018	22490.13	0.182907	22697.21	0.182799	22904.3	0.182693	23111.41	0.182589	23318.54	0.132139	25313.55	0.132146	25564.1	0.132154	25814.65
		0.194193	22645.33	0.194094	22861.61	0.193998	23077.91	0.193904	23294.23	0.193812	23510.56	0.193721	23726.9	0.193633	23943.25	0.193546	24159.62	0.151504	27508.41	0.151511	27780.42	0.151517	28052.43
		0.205021	23404.86	0.204942	23630.17	0.204865	23855.49	0.20479	24080.81	0.204716	24306.15	0.204644	24531.5	0.204573	24756.86	0.204504	24982.24	0.17087	29595.66	0.170875	29888.09	0.17088	30180.52
		0.215849	24148.83	0.21579	24382.93	0.215732	24617.05	0.215676	24851.17	0.21562	25085.3	0.215566	25319.44	0.215513	25553.59	0.215461	25787.74	0.190236	31591.98	0.19024	31903.95	0.190243	32215.92
		0.226677	24878.3	0.226638	25121	0.226599	25363.71	0.226562	25606.43	0.226525	25849.15	0.226489	26091.87	0.226453	26334.6	0.226418	26577.34	0.209602	33510.04	0.209604	33840.8	0.209607	34171.55
		0.237505	25594.23	0.237486	25845.35	0.237466	26096.46	0.237447	26347.58	0.237429	26598.71	0.237411	26849.83	0.237393	27100.96	0.237376	27352.09	0.228968	35359.77	0.228969	35708.64	0.22897	36057.51
		0.248333	26297.48	0.248333	26556.83	0.248333	26816.18	0.248333	27075.54	0.248333	27334.89	0.248333	27594.24	0.248333	27853.59	0.248333	28112.94	0.248333	37149.08	0.248333	37515.48	0.248333	37881.88
		0.403542	36290.52	0.403542	36648.43	0.403542	37006.33	0.403542	37364.24	0.403542	37722.15	0.403542	38080.05	0.403542	38437.96	0.403542	38795.86	0.403542	51265.74	0.403542	51771.37	0.403542	52277
		0.55875	46283.56	0.55875	46740.02	0.55875	47196.48	0.55875	47652.94	0.55875	48109.4	0.55875	48565.86	0.55875	49022.32	0.55875	49478.78	0.55875	65382.39	0.55875	66027.25	0.55875	66672.11
		0.6705	46283.56	0.6705	46740.02	0.6705	47196.48	0.6705	47652.94	0.6705	48109.4	0.6705	48565.86	0.6705	49022.32	0.6705	49478.78	0.6705	65382.39	0.6705	66027.25	0.6705	66672.11
	5	46283.56	5	46740.02	5	47196.48	5	47652.94	5	48109.4	5	48565.86	5	49022.32	5	49478.78	5	65382.39	5	66027.25	5	66672.11	
HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0.132355	8298.688	0.132134	8371.991	0.131917	8445.308	0.131704	8518.639	0.131497	8591.983	0.131293	8665.34	0.131094	8738.709	0.130899	8812.091	0.03531	11347.16	0.035324	11461.79	0.035337	11576.42
		0.142899	8694.567	0.142697	8772.781	0.1425	8851.008	0.142307	8929.248	0.142118	9007.5	0.141933	9085.765	0.141752	9164.041	0.141574	9242.328	0.054676	14802.85	0.054688	14950.93	0.0547	15099.01
		0.153442	9079.148	0.153261	9162.095	0.153083	9245.054	0.15291	9328.025	0.15274	9411.007	0.152573	9494.001	0.15241	9577.005	0.15225	9660.019	0.074041	17799.48	0.074053	17976.69	0.074064	18153.91
		0.163986	9453.498	0.163825	9541.021	0.163667	9628.555	0.163512	9716.099	0.163361	9803.653	0.163213	9891.217	0.163068	9978.791	0.162926	10066.38	0.093407	20500.19	0.093417	20703.73	0.093427	20907.27
		0.174529	9818.524	0.174388	9910.482	0.17425	10002.45	0.174115	10094.42	0.173983	10186.41	0.173853	10278.4	0.173726	10370.41	0.173602	10462.42	0.112773	22988.33	0.112782	23216.15	0.11279	23443.98
		0.185073	10175	0.184952	10271.27	0.184833	10367.54	0.184718	10463.82	0.184604	10560.11	0.184493	10656.4	0.184384	10752.71	0.184278	10849.02	0.132139	25313.55	0.132146	25564.1	0.132154	25814.65
		0.195616	10523.6	0.195515	10624.06	0.195417	10724.52	0.19532	10824.99	0.195226	10925.47	0.195133	11025.95	0.195043	11126.44	0.194954	11226.93	0.151504	27508.41	0.151511	27780.42	0.151517	28052.43
		0.20616	10864.91	0.206079	10969.45	0.206	11074	0.205923	11178.55	0.205847	11283.11	0.205773	11387.68	0.205701	11492.25	0.20563	11596.82	0.17087	29595.66	0.170875	29888.09	0.17088	30180.52
		0.216703	11199.44	0.216643	11307.97	0.216583	11416.51	0.216525	11525.05	0.216469	11633.59	0.216413	11742.14	0.216359	11850.69	0.216306	11959.25	0.190236	31591.98	0.19024	31903.95	0.190243	32215.92
		0.227246	11527.65	0.227206	11640.08	0.227167	11752.51	0.227128	11864.95	0.22709	11977.39	0.227053	12089.84	0.227017	12202.28	0.226982	12314.73	0.209602	33510.04	0.209604	33840.8	0.209607	34171.55
		0.23779	11849.93	0.23777	11966.18	0.23775	12082.44	0.237731	12198.69	0.237712	12314.94	0.237693	12431.2	0.237675	12547.45	0.237657	12663.71	0.228968	35359.77	0.228969	35708.64	0.22897	36057.51
		0.248333	12166.67	0.248333	12286.66	0.248333	12406.65	0.248333	12526.64	0.248333	12646.63	0.248333	12766.62	0.248333	12886.61	0.248333	13006.6	0.248333	37149.08	0.248333	37515.48	0.248333	37881.88
		0.403542	16790	0.403542	16955.59	0.403542	17121.18	0.403542	17286.76	0.403542	17452.35	0.403542	17617.94	0.403542	17783.52	0.403542	17949.11	0.403542	51265.74	0.403542	51771.37	0.403542	52277
		0.55875	21413.34	0.55875	21624.52	0.55875	21835.7	0.55875	22046.89	0.55875	22258.07	0.55875	22469.25	0.55875	22680.44	0.55875	22891.62	0.55875	65382.39	0.55875	66027.25	0.55875	66672.11
		0.6705	21413.34	0.6705	21624.52	0.6705	21835.7	0.6705	22046.89	0.6705	22258.07	0.6705	22469.25	0.6705	22680.44	0.6705	22891.62	0.6705	65382.39	0.6705	66027.25	0.6705	66672.11
	5	21413.34	5	21624.52	5	21835.7	5	22046.89	5	22258.07	5	22469.25	5	22680.44	5	22891.62	5	65382.39	5	66027.25	5	66672.11	

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section	Abutment / Scour Case	Depth below Bottom of Abutment (ft)																					
	1 / No Scour	101		102		103		104		105		106		107		108		109		110		111	
	1 / 100-yr Scour	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	1 / 500-yr Scour	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	2 / No Scour	101		102		103		104		105		106		107		108		109		110		111	
	2 / 100-yr Scour	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	2 / 500-yr Scour	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		0.03535	11691.06	0.035363	11805.69	0.035376	11920.33	0.035389	12034.96	0.035401	12149.6	0.035413	12264.23	0.035425	12378.87	0.035437	12493.51	0.035448	12608.15	0.035459	12722.79	0.03547	12837.43
		0.054712	15247.09	0.054724	15395.17	0.054736	15543.25	0.054747	15691.33	0.054758	15839.42	0.054769	15987.5	0.05478	16135.58	0.054791	16283.67	0.054801	16431.76	0.054811	16579.84	0.054822	16727.93
		0.074075	18331.13	0.074085	18508.35	0.074096	18685.57	0.074106	18862.79	0.074116	19040.01	0.074126	19217.23	0.074136	19394.45	0.074145	19571.68	0.074154	19748.9	0.074164	19926.12	0.074173	20103.35
		0.093437	21110.81	0.093446	21314.36	0.093455	21517.9	0.093464	21721.44	0.093473	21924.99	0.093482	22128.53	0.093491	22332.08	0.093499	22535.62	0.093508	22739.17	0.093516	22942.71	0.093524	23146.26
		0.112799	23671.81	0.112807	23899.64	0.112815	24127.47	0.112823	24355.3	0.112831	24583.13	0.112839	24810.97	0.112846	25038.8	0.112854	25266.63	0.112861	25494.46	0.112868	25722.3	0.112875	25950.13
		0.132161	26065.2	0.132168	26315.75	0.132175	26566.3	0.132182	26816.85	0.132188	27067.4	0.132195	27317.95	0.132201	27568.5	0.132208	27819.05	0.132214	28069.61	0.13222	28320.16	0.132226	28570.71
		0.151523	28324.44	0.151529	28596.46	0.151535	28868.47	0.15154	29140.48	0.151546	29412.49	0.151551	29684.51	0.151557	29956.52	0.151562	30228.53	0.151567	30500.55	0.151572	30772.56	0.151577	31044.58
		0.170885	30472.96	0.17089	30765.39	0.170894	31057.82	0.170899	31350.26	0.170903	31642.69	0.170908	31935.12	0.170912	32227.56	0.170916	32519.99	0.17092	32812.43	0.170925	33104.86	0.170929	33397.3
		0.190247	32527.89	0.190251	32839.87	0.190254	33151.84	0.190258	33463.81	0.190261	33775.79	0.190264	34087.76	0.190267	34399.73	0.190271	34711.71	0.190274	35023.68	0.190277	35335.66	0.19028	35647.63
		0.209609	34502.3	0.209612	34833.05	0.209614	35163.81	0.209616	35494.56	0.209618	35825.32	0.209621	36156.07	0.209623	36486.82	0.209625	36817.58	0.209627	37148.33	0.209629	37479.08	0.209631	37809.84
		0.228971	36406.38	0.228972	36755.25	0.228974	37104.12	0.228975	37452.99	0.228976	37801.86	0.228977	38150.73	0.228978	38499.6	0.228979	38848.47	0.22898	39197.34	0.228981	39546.21	0.228982	39895.08
		0.248333	38248.28	0.248333	38614.68	0.248333	38981.08	0.248333	39347.48	0.248333	39713.88	0.248333	40080.28	0.248333	40446.68	0.248333	40813.07	0.248333	41179.47	0.248333	41545.87	0.248333	41912.27
		0.403542	52782.63	0.403542	53288.26	0.403542	53793.89	0.403542	54299.52	0.403542	54805.15	0.403542	55310.78	0.403542	55816.41	0.403542	56322.04	0.403542	56827.67	0.403542	57333.3	0.403542	57838.93
		0.55875	67316.98	0.55875	67961.84	0.55875	68606.7	0.55875	69251.56	0.55875	69896.42	0.55875	70541.29	0.55875	71186.15	0.55875	71831.01	0.55875	72475.87	0.55875	73120.74	0.55875	73765.6
		0.6705	67316.98	0.6705	67961.84	0.6705	68606.7	0.6705	69251.56	0.6705	69896.42	0.6705	70541.29	0.6705	71186.15	0.6705	71831.01	0.6705	72475.87	0.6705	73120.74	0.6705	73765.6
		5	67316.98	5	67961.84	5	68606.7	5	69251.56	5	69896.42	5	70541.29	5	71186.15	5	71831.01	5	72475.87	5	73120.74	5	73765.6
HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		0.03535	11691.06	0.035363	11805.69	0.035376	11920.33	0.035389	12034.96	0.035401	12149.6	0.035413	12264.23	0.035425	12378.87	0.035437	12493.51	0.035448	12608.15	0.035459	12722.79	0.03547	12837.43
		0.054712	15247.09	0.054724	15395.17	0.054736	15543.25	0.054747	15691.33	0.054758	15839.42	0.054769	15987.5	0.05478	16135.58	0.054791	16283.67	0.054801	16431.76	0.054811	16579.84	0.054822	16727.93
		0.074075	18331.13	0.074085	18508.35	0.074096	18685.57	0.074106	18862.79	0.074116	19040.01	0.074126	19217.23	0.074136	19394.45	0.074145	19571.68	0.074154	19748.9	0.074164	19926.12	0.074173	20103.35
		0.093437	21110.81	0.093446	21314.36	0.093455	21517.9	0.093464	21721.44	0.093473	21924.99	0.093482	22128.53	0.093491	22332.08	0.093499	22535.62	0.093508	22739.17	0.093516	22942.71	0.093524	23146.26
		0.112799	23671.81	0.112807	23899.64	0.112815	24127.47	0.112823	24355.3	0.112831	24583.13	0.112839	24810.97	0.112846	25038.8	0.112854	25266.63	0.112861	25494.46	0.112868	25722.3	0.112875	25950.13
		0.132161	26065.2	0.132168	26315.75	0.132175	26566.3	0.132182	26816.85	0.132188	27067.4	0.132195	27317.95	0.132201	27568.5	0.132208	27819.05	0.132214	28069.61	0.13222	28320.16	0.132226	28570.71
		0.151523	28324.44	0.151529	28596.46	0.151535	28868.47	0.15154	29140.48	0.151546	29412.49	0.151551	29684.51	0.151557	29956.52	0.151562	30228.53	0.151567	30500.55	0.151572	30772.56	0.151577	31044.58
		0.170885	30472.96	0.17089	30765.39	0.170894	31057.82	0.170899	31350.26	0.170903	31642.69	0.170908	31935.12	0.170912	32227.56	0.170916	32519.99	0.17092	32812.43	0.170925	33104.86	0.170929	33397.3
		0.190247	32527.89	0.190251	32839.87	0.190254	33151.84	0.190258	33463.81	0.190261	33775.79	0.190264	34087.76	0.190267	34399.73	0.190271	34711.71	0.190274	35023.68	0.190277	35335.66	0.19028	35647.63
		0.209609	34502.3	0.209612	34833.05	0.209614	35163.81	0.209616	35494.56	0.209618	35825.32	0.209621	36156.07	0.209623	36486.82	0.209625	36817.58	0.209627	37148.33	0.209629	37479.08	0.209631	37809.84
		0.228971	36406.38	0.228972	36755.25	0.228974	37104.12	0.228975	37452.99	0.228976	37801.86	0.228977	38150.73	0.228978	38499.6	0.228979	38848.47	0.22898	39197.34	0.228981	39546.21	0.228982	39895.08
		0.248333	38248.28	0.248333	38614.68	0.248333	38981.08	0.248333	39347.48	0.248333	39713.88	0.248333	40080.28	0.248333	40446.68	0.248333	40813.07	0.248333	41179.47	0.248333	41545.87	0.248333	41912.27
		0.403542	52782.63	0.403542	53288.26	0.403542	53793.89	0.403542	54299.52	0.403542	54805.15	0.403542	55310.78	0.403542	55816.41	0.403542	56322.04	0.403542	56827.67	0.403542	57333.3	0.403542	57838.93
		0.55875	67316.98	0.55875	67961.84	0.55875	68606.7	0.55875	69251.56	0.55875	69896.42	0.55875	70541.29	0.55875	71186.15	0.55875	71831.01	0.55875	72475.87	0.55875	73120.74	0.55875	73765.6
		0.6705	67316.98	0.6705	67961.84	0.6705	68606.7	0.6705	69251.56	0.6705	69896.42	0.6705	70541.29	0.6705	71186.15	0.6705	71831.01	0.6705	72475.87	0.6705	73120.74	0.6705	73765.6
		5	67316.98	5	67961.84	5	68606.7	5	69251.56	5	69896.42	5	70541.29	5	71186.15	5	71831.01	5	72475.87	5	73120.74	5	73765.6

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section	Abutment / Scour Case	Depth below Bottom of Abutment (ft)																					
	1 / No Scour	112		113		114		115		116		117		118		119		120		121		122	
	1 / 100-yr Scour	--		--		--		--		--		--		--		--		--		--		--	
	1 / 500-yr Scour	--		--		--		--		--		--		--		--		--		--		--	
	2 / No Scour	112		113		114		115		116		117		118		119		120		121		122	
	2 / 100-yr Scour	--		--		--		--		--		--		--		--		--		--		--	
	2 / 500-yr Scour	--		--		--		--		--		--		--		--		--		--		--	
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0.035481	12952.08	0.035492	13066.72	0.035502	13181.36	0.035513	13296.01	0.035523	13410.65	0.035533	13525.3	0.035543	13639.94	0.035553	13754.59	0.035562	13869.24	0.035572	13983.89	0.035581	14098.53
		0.054831	16876.02	0.054841	17024.11	0.054851	17172.2	0.05486	17320.29	0.054869	17468.38	0.054879	17616.47	0.054887	17764.57	0.054896	17912.66	0.054905	18060.75	0.054914	18208.85	0.054922	18356.94
		0.074182	20280.57	0.07419	20457.8	0.074199	20635.03	0.074207	20812.25	0.074216	20989.48	0.074224	21166.71	0.074232	21343.94	0.07424	21521.16	0.074248	21698.39	0.074256	21875.62	0.074263	22052.85
		0.093532	23349.81	0.09354	23553.36	0.093547	23756.91	0.093555	23960.45	0.093562	24164	0.093569	24367.55	0.093577	24571.1	0.093584	24774.65	0.093591	24978.21	0.093597	25181.76	0.093604	25385.31
		0.112882	26177.96	0.112889	26405.8	0.112896	26633.63	0.112902	26861.47	0.112909	27089.3	0.112915	27317.14	0.112921	27544.98	0.112927	27772.81	0.112933	28000.65	0.112939	28228.49	0.112945	28456.33
		0.132232	28821.27	0.132238	29071.82	0.132244	29322.37	0.132249	29572.93	0.132255	29823.48	0.13226	30074.04	0.132266	30324.59	0.132271	30575.15	0.132276	30825.71	0.132281	31076.26	0.132286	31326.82
		0.151582	31316.59	0.151587	31588.61	0.151592	31860.62	0.151597	32132.64	0.151601	32404.65	0.151606	32676.67	0.15161	32948.68	0.151615	33220.7	0.151619	33492.72	0.151623	33764.73	0.151628	34036.75
		0.170933	33689.73	0.170936	33982.17	0.17094	34274.6	0.170944	34567.04	0.170948	34859.47	0.170951	35151.91	0.170955	35444.35	0.170959	35736.78	0.170962	36029.22	0.170965	36321.65	0.170969	36614.09
		0.190283	35959.6	0.190286	36271.58	0.190289	36583.55	0.190291	36895.53	0.190294	37207.5	0.190297	37519.48	0.1903	37831.45	0.190302	38143.43	0.190305	38455.4	0.190307	38767.38	0.19031	39079.36
		0.209633	38140.59	0.209635	38471.35	0.209637	38802.1	0.209639	39132.86	0.209641	39463.61	0.209642	39794.37	0.209644	40125.12	0.209646	40455.88	0.209648	40786.63	0.209649	41117.39	0.209651	41448.14
		0.228983	40243.95	0.228984	40592.82	0.228985	40941.69	0.228986	41290.56	0.228987	41639.43	0.228988	41988.3	0.228989	42337.17	0.22899	42686.04	0.228991	43034.91	0.228991	43383.78	0.228992	43732.65
		0.248333	42278.67	0.248333	42645.07	0.248333	43011.47	0.248333	43377.87	0.248333	43744.27	0.248333	44110.67	0.248333	44477.06	0.248333	44843.46	0.248333	45209.86	0.248333	45576.26	0.248333	45942.66
		0.403542	58344.57	0.403542	58850.2	0.403542	59355.83	0.403542	59861.46	0.403542	60367.09	0.403542	60872.72	0.403542	61378.35	0.403542	61883.98	0.403542	62389.61	0.403542	62895.24	0.403542	63400.87
		0.55875	74410.46	0.55875	75055.32	0.55875	75700.18	0.55875	76345.05	0.55875	76989.91	0.55875	77634.77	0.55875	78279.63	0.55875	78924.5	0.55875	79569.36	0.55875	80214.22	0.55875	80859.08
		0.6705	74410.46	0.6705	75055.32	0.6705	75700.18	0.6705	76345.05	0.6705	76989.91	0.6705	77634.77	0.6705	78279.63	0.6705	78924.5	0.6705	79569.36	0.6705	80214.22	0.6705	80859.08
		5	74410.46	5	75055.32	5	75700.18	5	76345.05	5	76989.91	5	77634.77	5	78279.63	5	78924.5	5	79569.36	5	80214.22	5	80859.08
HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0.035481	12952.08	0.035492	13066.72	0.035502	13181.36	0.035513	13296.01	0.035523	13410.65	0.035533	13525.3	0.035543	13639.94	0.035553	13754.59	0.035562	13869.24	0.035572	13983.89	0.035581	14098.53
		0.054831	16876.02	0.054841	17024.11	0.054851	17172.2	0.05486	17320.29	0.054869	17468.38	0.054879	17616.47	0.054887	17764.57	0.054896	17912.66	0.054905	18060.75	0.054914	18208.85	0.054922	18356.94
		0.074182	20280.57	0.07419	20457.8	0.074199	20635.03	0.074207	20812.25	0.074216	20989.48	0.074224	21166.71	0.074232	21343.94	0.07424	21521.16	0.074248	21698.39	0.074256	21875.62	0.074263	22052.85
		0.093532	23349.81	0.09354	23553.36	0.093547	23756.91	0.093555	23960.45	0.093562	24164	0.093569	24367.55	0.093577	24571.1	0.093584	24774.65	0.093591	24978.21	0.093597	25181.76	0.093604	25385.31
		0.112882	26177.96	0.112889	26405.8	0.112896	26633.63	0.112902	26861.47	0.112909	27089.3	0.112915	27317.14	0.112921	27544.98	0.112927	27772.81	0.112933	28000.65	0.112939	28228.49	0.112945	28456.33
		0.132232	28821.27	0.132238	29071.82	0.132244	29322.37	0.132249	29572.93	0.132255	29823.48	0.13226	30074.04	0.132266	30324.59	0.132271	30575.15	0.132276	30825.71	0.132281	31076.26	0.132286	31326.82
		0.151582	31316.59	0.151587	31588.61	0.151592	31860.62	0.151597	32132.64	0.151601	32404.65	0.151606	32676.67	0.15161	32948.68	0.151615	33220.7	0.151619	33492.72	0.151623	33764.73	0.151628	34036.75
		0.170933	33689.73	0.170936	33982.17	0.17094	34274.6	0.170944	34567.04	0.170948	34859.47	0.170951	35151.91	0.170955	35444.35	0.170959	35736.78	0.170962	36029.22	0.170965	36321.65	0.170969	36614.09
		0.190283	35959.6	0.190286	36271.58	0.190289	36583.55	0.190291	36895.53	0.190294	37207.5	0.190297	37519.48	0.1903	37831.45	0.190302	38143.43	0.190305	38455.4	0.190307	38767.38	0.19031	39079.36
		0.209633	38140.59	0.209635	38471.35	0.209637	38802.1	0.209639	39132.86	0.209641	39463.61	0.209642	39794.37	0.209644	40125.12	0.209646	40455.88	0.209648	40786.63	0.209649	41117.39	0.209651	41448.14
		0.228983	40243.95	0.228984	40592.82	0.228985	40941.69	0.228986	41290.56	0.228987	41639.43	0.228988	41988.3	0.228989	42337.17	0.22899	42686.04	0.228991	43034.91	0.228991	43383.78	0.228992	43732.65
		0.248333	42278.67	0.248333	42645.07	0.248333	43011.47	0.248333	43377.87	0.248333	43744.27	0.248333	44110.67	0.248333	44477.06	0.248333	44843.46	0.248333	45209.86	0.248333	45576.26	0.248333	45942.66
		0.403542	58344.57	0.403542	58850.2	0.403542	59355.83	0.403542	59861.46	0.403542	60367.09	0.403542	60872.72	0.403542	61378.35	0.403542	61883.98	0.403542	62389.61	0.403542	62895.24	0.403542	63400.87
		0.55875	74410.46	0.55875	75055.32	0.55875	75700.18	0.55875	76345.05	0.55875	76989.91	0.55875	77634.77	0.55875	78279.63	0.55875	78924.5	0.55875	79569.36	0.55875	80214.22	0.55875	80859.08
		0.6705	74410.46	0.6705	75055.32	0.6705	75700.18	0.6705	76345.05	0.6705	76989.91	0.6705	77634.77	0.6705	78279.63	0.6705	78924.5	0.6705	79569.36	0.6705	80214.22	0.6705	80859.08
		5	74410.46	5	75055.32	5	75700.18	5	76345.05	5	76989.91	5	77634.77	5	78279.63	5	78924.5	5	79569.36	5	80214.22	5	80859.08

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section	Abutment / Scour Case	Depth below Bottom of Abutment (ft)																					
	1 / No Scour	123		124		125		126		127		128		129		130		--		--		--	
	1 / 100-yr Scour	--		--		--		--		--		--		--		--		103		104		105	
	1 / 500-yr Scour	--		--		--		--		--		--		--		--		103		104		105	
	2 / No Scour	123		124		124		124		124		124		124		124		--		--		--	
	2 / 100-yr Scour	--		--		--		--		--		--		--		--		103		104		105	
	2 / 500-yr Scour	--		--		--		--		--		--		--		--		103		104		105	
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0.03559	14213.18	0.035599	14327.83	0.035608	14442.48	0.035608	14557.13	0.035608	14671.78	0.035608	14786.43	0.035608	14901.08	0.035608	15015.73	0.030284	8787.189	0.030349	8900.706	0.030412	9014.248
		0.05493	18505.04	0.054938	18653.13	0.054946	18801.23	0.054946	18949.33	0.054946	19097.43	0.054946	19245.53	0.054946	19393.63	0.054946	19541.73	0.050107	11934.63	0.050166	12081.73	0.050223	12228.84
		0.074271	22230.08	0.074278	22407.32	0.074285	22584.55	0.074285	22761.78	0.074285	22939.01	0.074285	23116.24	0.074285	23293.47	0.074285	23470.7	0.069929	14615.9	0.069982	14792.29	0.070034	14968.69
		0.093611	25588.86	0.093617	25792.41	0.093624	25995.97	0.093624	26199.53	0.093624	26403.09	0.093624	26606.65	0.093624	26810.21	0.093624	27013.77	0.089752	17010.75	0.089799	17213.6	0.089845	17416.46
		0.112951	28684.16	0.112957	28912	0.112962	29139.84	0.112962	29367.68	0.112962	29595.52	0.112962	29823.36	0.112962	30051.2	0.112962	30279.04	0.109575	19205.1	0.109616	19432.35	0.109656	19659.61
		0.132291	31577.37	0.132296	31827.93	0.132301	32078.49	0.132301	32329.05	0.132301	32579.61	0.132301	32830.17	0.132301	33080.73	0.132301	33331.29	0.129397	21248.26	0.129433	21498.34	0.129467	21748.43
		0.151632	34308.77	0.151636	34580.79	0.15164	34852.8	0.15164	35124.81	0.15164	35396.82	0.15164	35668.83	0.15164	35940.84	0.15164	36212.85	0.14922	23171.79	0.149249	23443.43	0.149278	23715.07
		0.170972	36906.53	0.170975	37198.97	0.170979	37491.4	0.170979	37783.83	0.170979	38076.26	0.170979	38368.69	0.170979	38661.12	0.170979	38953.55	0.169043	24997.38	0.169066	25289.53	0.169089	25581.68
		0.190312	39391.33	0.190315	39703.31	0.190317	40015.28	0.190317	40327.25	0.190317	40639.22	0.190317	40951.19	0.190317	41263.16	0.190317	41575.13	0.188865	26740.74	0.188883	27052.5	0.1889	27364.27
		0.209653	41778.9	0.209654	42109.65	0.209656	42440.41	0.209656	42771.17	0.209656	43101.93	0.209656	43432.69	0.209656	43763.45	0.209656	44094.21	0.208688	28413.67	0.2087	28744.29	0.208711	29074.91
		0.228993	44081.52	0.228994	44430.39	0.228995	44779.27	0.228995	45128.15	0.228995	45477.03	0.228995	45825.91	0.228995	46174.79	0.228995	46523.67	0.228511	30025.34	0.228517	30374.15	0.228522	30722.95
		0.248333	46309.06	0.248333	46675.46	0.248333	47041.86	0.248333	47408.26	0.248333	47774.66	0.248333	48141.06	0.248333	48507.46	0.248333	48873.86	0.248333	31583.05	0.248333	31949.45	0.248333	32315.85
		0.403542	63906.5	0.403542	64412.13	0.403542	64917.76	0.403542	65423.39	0.403542	65929.02	0.403542	66434.65	0.403542	66940.28	0.403542	67445.91	0.403542	43584.61	0.403542	44090.24	0.403542	44595.87
		0.55875	81503.94	0.55875	82148.81	0.55875	82793.67	0.55875	83438.53	0.55875	84083.39	0.55875	84728.25	0.55875	85373.11	0.55875	86017.97	0.55875	55586.17	0.55875	56231.04	0.55875	56875.9
		0.6705	81503.94	0.6705	82148.81	0.6705	82793.67	0.6705	83438.53	0.6705	84083.39	0.6705	84728.25	0.6705	85373.11	0.6705	86017.97	0.6705	55586.17	0.6705	56231.04	0.6705	56875.9
		5	81503.94	5	82148.81	5	82793.67	5	83438.53	5	84083.39	5	84728.25	5	85373.11	5	86017.97	5	55586.17	5	56231.04	5	56875.9
HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0.03559	14213.18	0.035599	14327.83	0.035608	14442.48	0.035608	14557.13	0.035608	14671.78	0.035608	14786.43	0.035608	14901.08	0.035608	15015.73	0.030284	8787.189	0.030349	8900.706	0.030412	9014.248
		0.05493	18505.04	0.054938	18653.13	0.054946	18801.23	0.054946	18949.33	0.054946	19097.43	0.054946	19245.53	0.054946	19393.63	0.054946	19541.73	0.050107	11934.63	0.050166	12081.73	0.050223	12228.84
		0.074271	22230.08	0.074278	22407.32	0.074285	22584.55	0.074285	22761.78	0.074285	22939.01	0.074285	23116.24	0.074285	23293.47	0.074285	23470.7	0.069929	14615.9	0.069982	14792.29	0.070034	14968.69
		0.093611	25588.86	0.093617	25792.41	0.093624	25995.97	0.093624	26199.53	0.093624	26403.09	0.093624	26606.65	0.093624	26810.21	0.093624	27013.77	0.089752	17010.75	0.089799	17213.6	0.089845	17416.46
		0.112951	28684.16	0.112957	28912	0.112962	29139.84	0.112962	29367.68	0.112962	29595.52	0.112962	29823.36	0.112962	30051.2	0.112962	30279.04	0.109575	19205.1	0.109616	19432.35	0.109656	19659.61
		0.132291	31577.37	0.132296	31827.93	0.132301	32078.49	0.132301	32329.05	0.132301	32579.61	0.132301	32830.17	0.132301	33080.73	0.132301	33331.29	0.129397	21248.26	0.129433	21498.34	0.129467	21748.43
		0.151632	34308.77	0.151636	34580.79	0.15164	34852.8	0.15164	35124.81	0.15164	35396.82	0.15164	35668.83	0.15164	35940.84	0.15164	36212.85	0.14922	23171.79	0.149249	23443.43	0.149278	23715.07
		0.170972	36906.53	0.170975	37198.97	0.170979	37491.4	0.170979	37783.83	0.170979	38076.26	0.170979	38368.69	0.170979	38661.12	0.170979	38953.55	0.169043	24997.38	0.169066	25289.53	0.169089	25581.68
		0.190312	39391.33	0.190315	39703.31	0.190317	40015.28	0.190317	40327.25	0.190317	40639.22	0.190317	40951.19	0.190317	41263.16	0.190317	41575.13	0.188865	26740.74	0.188883	27052.5	0.1889	27364.27
		0.209653	41778.9	0.209654	42109.65	0.209656	42440.41	0.209656	42771.17	0.209656	43101.93	0.209656	43432.69	0.209656	43763.45	0.209656	44094.21	0.208688	28413.67	0.2087	28744.29	0.208711	29074.91
		0.228993	44081.52	0.228994	44430.39	0.228995	44779.27	0.228995	45128.15	0.228995	45477.03	0.228995	45825.91	0.228995	46174.79	0.228995	46523.67	0.228511	30025.34	0.228517	30374.15	0.228522	30722.95
		0.248333	46309.06	0.248333	46675.46	0.248333	47041.86	0.248333	47408.26	0.248333	47774.66	0.248333	48141.06	0.248333	48507.46	0.248333	48873.86	0.248333	31583.05	0.248333	31949.45	0.248333	32315.85
		0.403542	63906.5	0.403542	64412.13	0.403542	64917.76	0.403542	65423.39	0.403542	65929.02	0.403542	66434.65	0.403542	66940.28	0.403542	67445.91	0.403542	43584.61	0.403542	44090.24	0.403542	44595.87
		0.55875	81503.94	0.55875	82148.81	0.55875	82793.67	0.55875	83438.53	0.55875	84083.39	0.55875	84728.25	0.55875	85373.11	0.55875	86017.97	0.55875	55586.17	0.55875	56231.04	0.55875	56875.9
		0.6705	81503.94	0.6705	82148.81	0.6705	82793.67	0.6705	83438.53	0.6705	84083.39	0.6705	84728.25	0.6705	85373.11	0.6705	86017.97	0.6705	55586.17	0.6705	56231.04	0.6705	56875.9
		5	81503.94	5	82148.81	5	82793.67	5	83438.53	5	84083.39	5	84728.25	5	85373.11	5	86017.97	5	55586.17	5	56231.04	5	56875.9

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section		Abutment / Scour Case		Depth below Bottom of Abutment (ft)																				
		1 / No Scour		--		--		--		--		--		--		--		--		--		--		
		1 / 100-yr Scour		106	107	108	109	110	111	112	113	114	115	116										
		1 / 500-yr Scour		106	107	108	109	110	111	112	113	114	115	116										
		2 / No Scour		--	--	--	--	--	--	--	--	--	--	--										
		2 / 100-yr Scour		106	107	108	109	110	111	112	113	114	115	116										
		2 / 500-yr Scour		106	107	108	109	110	111	112	113	114	115	116										
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		0.030475	9127.813	0.030536	9241.4	0.030596	9355.01	0.030655	9468.641	0.030712	9582.293	0.030769	9695.966	0.030825	9809.657	0.030879	9923.368	0.030933	10037.1	0.030985	10150.85	0.031037	10264.61	
		0.05028	12375.98	0.050336	12523.14	0.05039	12670.32	0.050444	12817.51	0.050496	12964.72	0.050548	13111.96	0.050598	13259.2	0.050648	13406.47	0.050697	13553.75	0.050744	13701.05	0.050791	13848.36	
		0.070085	15145.11	0.070135	15321.55	0.070185	15498	0.070233	15674.47	0.07028	15850.95	0.070326	16027.45	0.070372	16203.97	0.070416	16380.5	0.07046	16557.04	0.070503	16733.59	0.070546	16910.16	
		0.089891	17619.33	0.089935	17822.22	0.089979	18025.12	0.090022	18228.04	0.090064	18430.96	0.090105	18633.91	0.090145	18836.86	0.090185	19039.82	0.090224	19242.8	0.090262	19445.78	0.0903	19648.78	
		0.109696	19886.89	0.109735	20114.18	0.109773	20341.48	0.109811	20568.79	0.109847	20796.11	0.109883	21023.44	0.109919	21250.78	0.109953	21478.13	0.109988	21705.49	0.110021	21932.86	0.110054	22160.24	
		0.129501	21998.52	0.129535	22248.63	0.129567	22498.75	0.1296	22748.87	0.129631	22999.01	0.129662	23249.15	0.129692	23499.3	0.129722	23749.46	0.129751	23999.63	0.12978	24249.8	0.129808	24499.98	
		0.149307	23986.72	0.149335	24258.38	0.149362	24530.05	0.149389	24801.72	0.149415	25073.4	0.149441	25345.09	0.149466	25616.78	0.149491	25888.48	0.149515	26160.19	0.149539	26431.9	0.149562	26703.62	
		0.169112	25873.83	0.169134	26166	0.169156	26458.16	0.169177	26750.34	0.169198	27042.51	0.169219	27334.7	0.169239	27626.89	0.169259	27919.08	0.169279	28211.28	0.169298	28503.48	0.169317	28795.69	
		0.188917	27676.04	0.188934	27987.82	0.18895	28299.6	0.188966	28611.38	0.188982	28923.17	0.188998	29234.96	0.189013	29546.76	0.189028	29858.56	0.189042	30170.36	0.189057	30482.17	0.189071	30793.98	
		0.208723	29405.53	0.208734	29736.16	0.208745	30066.79	0.208755	30397.42	0.208766	30728.05	0.208776	31058.69	0.208786	31389.33	0.208796	31719.97	0.208806	32050.61	0.208816	32381.26	0.208825	32711.91	
		0.228528	31071.76	0.228534	31420.57	0.228539	31769.38	0.228544	32118.19	0.22855	32467	0.228555	32815.81	0.22856	33164.63	0.228565	33513.44	0.22857	33862.26	0.228574	34211.08	0.228579	34559.9	
		0.248333	32682.25	0.248333	33048.65	0.248333	33415.05	0.248333	33781.45	0.248333	34147.85	0.248333	34514.25	0.248333	34880.64	0.248333	35247.04	0.248333	35613.44	0.248333	35979.84	0.248333	36346.24	
		0.403542	45101.51	0.403542	45607.14	0.403542	46112.77	0.403542	46618.4	0.403542	47124.03	0.403542	47629.66	0.403542	48135.29	0.403542	48640.92	0.403542	49146.55	0.403542	49652.18	0.403542	50157.81	
		0.55875	57520.76	0.55875	58165.62	0.55875	58810.48	0.55875	59455.35	0.55875	60100.21	0.55875	60745.07	0.55875	61389.93	0.55875	62034.8	0.55875	62679.66	0.55875	63324.52	0.55875	63969.38	
		0.6705	57520.76	0.6705	58165.62	0.6705	58810.48	0.6705	59455.35	0.6705	60100.21	0.6705	60745.07	0.6705	61389.93	0.6705	62034.8	0.6705	62679.66	0.6705	63324.52	0.6705	63969.38	
		5	57520.76	5	58165.62	5	58810.48	5	59455.35	5	60100.21	5	60745.07	5	61389.93	5	62034.8	5	62679.66	5	63324.52	5	63969.38	
HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.030475	9127.813	0.030536	9241.4	0.030596	9355.01	0.030655	9468.641	0.030712	9582.293	0.030769	9695.966	0.030825	9809.657	0.030879	9923.368	0.030933	10037.1	0.030985	10150.85	0.031037	10264.61	
		0.05028	12375.98	0.050336	12523.14	0.05039	12670.32	0.050444	12817.51	0.050496	12964.72	0.050548	13111.96	0.050598	13259.2	0.050648	13406.47	0.050697	13553.75	0.050744	13701.05	0.050791	13848.36	
		0.070085	15145.11	0.070135	15321.55	0.070185	15498	0.070233	15674.47	0.07028	15850.95	0.070326	16027.45	0.070372	16203.97	0.070416	16380.5	0.07046	16557.04	0.070503	16733.59	0.070546	16910.16	
		0.089891	17619.33	0.089935	17822.22	0.089979	18025.12	0.090022	18228.04	0.090064	18430.96	0.090105	18633.91	0.090145	18836.86	0.090185	19039.82	0.090224	19242.8	0.090262	19445.78	0.0903	19648.78	
		0.109696	19886.89	0.109735	20114.18	0.109773	20341.48	0.109811	20568.79	0.109847	20796.11	0.109883	21023.44	0.109919	21250.78	0.109953	21478.13	0.109988	21705.49	0.110021	21932.86	0.110054	22160.24	
		0.129501	21998.52	0.129535	22248.63	0.129567	22498.75	0.1296	22748.87	0.129631	22999.01	0.129662	23249.15	0.129692	23499.3	0.129722	23749.46	0.129751	23999.63	0.12978	24249.8	0.129808	24499.98	
		0.149307	23986.72	0.149335	24258.38	0.149362	24530.05	0.149389	24801.72	0.149415	25073.4	0.149441	25345.09	0.149466	25616.78	0.149491	25888.48	0.149515	26160.19	0.149539	26431.9	0.149562	26703.62	
		0.169112	25873.83	0.169134	26166	0.169156	26458.16	0.169177	26750.34	0.169198	27042.51	0.169219	27334.7	0.169239	27626.89	0.169259	27919.08	0.169279	28211.28	0.169298	28503.48	0.169317	28795.69	
		0.188917	27676.04	0.188934	27987.82	0.18895	28299.6	0.188966	28611.38	0.188982	28923.17	0.188998	29234.96	0.189013	29546.76	0.189028	29858.56	0.189042	30170.36	0.189057	30482.17	0.189071	30793.98	
		0.208723	29405.53	0.208734	29736.16	0.208745	30066.79	0.208755	30397.42	0.208766	30728.05	0.208776	31058.69	0.208786	31389.33	0.208796	31719.97	0.208806	32050.61	0.208816	32381.26	0.208825	32711.91	
		0.228528	31071.76	0.228534	31420.57	0.228539	31769.38	0.228544	32118.19	0.22855	32467	0.228555	32815.81	0.22856	33164.63	0.228565	33513.44	0.22857	33862.26	0.228574	34211.08	0.228579	34559.9	
		0.248333	32682.25	0.248333	33048.65	0.248333	33415.05	0.248333	33781.45	0.248333	34147.85	0.248333	34514.25	0.248333	34880.64	0.248333	35247.04	0.248333	35613.44	0.248333	35979.84	0.248333	36346.24	
		0.403542	45101.51	0.403542	45607.14	0.403542	46112.77	0.403542	46618.4	0.403542	47124.03	0.403542	47629.66	0.403542	48135.29	0.403542	48640.92	0.403542	49146.55	0.403542	49652.18	0.403542	50157.81	
		0.55875	57520.76	0.55875	58165.62	0.55875	58810.48	0.55875	59455.35	0.55875	60100.21	0.55875	60745.07	0.55875	61389.93	0.55875	62034.8	0.55875	62679.66	0.55875	63324.52	0.55875	63969.38	
		0.6705	57520.76	0.6705	58165.62	0.6705	58810.48	0.6705	59455.35	0.6705	60100.21	0.6705	60745.07	0.6705	61389.93	0.6705	62034.8	0.6705	62679.66	0.6705	63324.52	0.6705	63969.38	
		5	57520.76	5	58165.62	5	58810.48	5	59455.35	5	60100.21	5	60745.07	5	61389.93	5	62034.8	5	62679.66	5	63324.52	5	63969.38	

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section		Abutment / Scour Case		Depth below Bottom of Abutment (ft)																			
		1 / No Scour		--		--		--		--		--		--		--		--		--			
		1 / 100-yr Scour		117	118	119	120	121	122	123	124	125	126										
		1 / 500-yr Scour		117	118	119	120	121	122	123	124	125	126										
		2 / No Scour		--	--	--	--	--	--	--	--	--	--										
		2 / 100-yr Scour		117	118	119	120	121	122	123	124	125	126										
		2 / 500-yr Scour		117	118	119	120	121	122	123	124	125	126										
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P		
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.031088	10378.39	0.031138	10492.19	0.031187	10606	0.031235	10719.83	0.031282	10833.68	0.031329	10947.54	0.031375	11061.41	0.03142	11175.3	0.031464	11289.21	0.031507	11403.12		
		0.050838	13995.69	0.050883	14143.03	0.050927	14290.39	0.050971	14437.76	0.051014	14585.14	0.051056	14732.54	0.051098	14879.95	0.051139	15027.37	0.051179	15174.81	0.051219	15322.25		
		0.070587	17086.74	0.070628	17263.34	0.070668	17439.94	0.070707	17616.56	0.070746	17793.19	0.070784	17969.83	0.070822	18146.47	0.070858	18323.14	0.070895	18499.81	0.07093	18676.49		
		0.090337	19851.79	0.090373	20054.81	0.090409	20257.84	0.090444	20460.88	0.090478	20663.92	0.090512	20866.98	0.090545	21070.04	0.090578	21273.12	0.09061	21476.2	0.090642	21679.29		
		0.110086	22387.63	0.110118	22615.02	0.110149	22842.42	0.11018	23069.84	0.11021	23297.26	0.11024	23524.68	0.110269	23752.12	0.110297	23979.56	0.110325	24207.01	0.110353	24434.46		
		0.129836	24750.17	0.129863	25000.37	0.12989	25250.57	0.129916	25500.78	0.129942	25750.99	0.129967	26001.21	0.129992	26251.44	0.130017	26501.67	0.130041	26751.91	0.130065	27002.16		
		0.149585	26975.34	0.149608	27247.07	0.14963	27518.81	0.149652	27790.55	0.149674	28062.29	0.149695	28334.04	0.149716	28605.8	0.149736	28877.55	0.149756	29149.32	0.149776	29421.09		
		0.169335	29087.9	0.169353	29380.11	0.169371	29672.33	0.169388	29964.56	0.169406	30256.78	0.169423	30549.01	0.169439	30841.25	0.169456	31133.49	0.169472	31425.73	0.169488	31717.98		
		0.189085	31105.79	0.189098	31417.61	0.189112	31729.42	0.189125	32041.25	0.189138	32353.07	0.18915	32664.9	0.189163	32976.73	0.189175	33288.56	0.189187	33600.39	0.189199	33912.23		
		0.208834	33042.56	0.208843	33373.21	0.208852	33703.86	0.208861	34034.52	0.20887	34365.18	0.208878	34695.84	0.208886	35026.5	0.208894	35357.16	0.208903	35687.82	0.20891	36018.49		
		0.228584	34908.72	0.228588	35257.54	0.228593	35606.36	0.228597	35955.18	0.228601	36304.01	0.228606	36652.83	0.22861	37001.65	0.228614	37350.48	0.228618	37699.31	0.228622	38048.13		
		0.248333	36712.64	0.248333	37079.04	0.248333	37445.44	0.248333	37811.84	0.248333	38178.24	0.248333	38544.63	0.248333	38911.03	0.248333	39277.43	0.248333	39643.83	0.248333	40010.23		
		0.403542	50663.44	0.403542	51169.07	0.403542	51674.7	0.403542	52180.33	0.403542	52685.96	0.403542	53191.59	0.403542	53697.23	0.403542	54202.86	0.403542	54708.49	0.403542	55214.12		
		0.55875	64614.24	0.55875	65259.11	0.55875	65903.97	0.55875	66548.83	0.55875	67193.69	0.55875	67838.56	0.55875	68483.42	0.55875	69128.28	0.55875	69773.14	0.55875	70418		
		0.6705	64614.24	0.6705	65259.11	0.6705	65903.97	0.6705	66548.83	0.6705	67193.69	0.6705	67838.56	0.6705	68483.42	0.6705	69128.28	0.6705	69773.14	0.6705	70418		
	5	64614.24	5	65259.11	5	65903.97	5	66548.83	5	67193.69	5	67838.56	5	68483.42	5	69128.28	5	69773.14	5	70418			
HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.031088	10378.39	0.031138	10492.19	0.031187	10606	0.031235	10719.83	0.031282	10833.68	0.031329	10947.54	0.031375	11061.41	0.03142	11175.3	0.031464	11289.21	0.031507	11403.12		
		0.050838	13995.69	0.050883	14143.03	0.050927	14290.39	0.050971	14437.76	0.051014	14585.14	0.051056	14732.54	0.051098	14879.95	0.051139	15027.37	0.051179	15174.81	0.051219	15322.25		
		0.070587	17086.74	0.070628	17263.34	0.070668	17439.94	0.070707	17616.56	0.070746	17793.19	0.070784	17969.83	0.070822	18146.47	0.070858	18323.14	0.070895	18499.81	0.07093	18676.49		
		0.090337	19851.79	0.090373	20054.81	0.090409	20257.84	0.090444	20460.88	0.090478	20663.92	0.090512	20866.98	0.090545	21070.04	0.090578	21273.12	0.09061	21476.2	0.090642	21679.29		
		0.110086	22387.63	0.110118	22615.02	0.110149	22842.42	0.11018	23069.84	0.11021	23297.26	0.11024	23524.68	0.110269	23752.12	0.110297	23979.56	0.110325	24207.01	0.110353	24434.46		
		0.129836	24750.17	0.129863	25000.37	0.12989	25250.57	0.129916	25500.78	0.129942	25750.99	0.129967	26001.21	0.129992	26251.44	0.130017	26501.67	0.130041	26751.91	0.130065	27002.16		
		0.149585	26975.34	0.149608	27247.07	0.14963	27518.81	0.149652	27790.55	0.149674	28062.29	0.149695	28334.04	0.149716	28605.8	0.149736	28877.55	0.149756	29149.32	0.149776	29421.09		
		0.169335	29087.9	0.169353	29380.11	0.169371	29672.33	0.169388	29964.56	0.169406	30256.78	0.169423	30549.01	0.169439	30841.25	0.169456	31133.49	0.169472	31425.73	0.169488	31717.98		
		0.189085	31105.79	0.189098	31417.61	0.189112	31729.42	0.189125	32041.25	0.189138	32353.07	0.18915	32664.9	0.189163	32976.73	0.189175	33288.56	0.189187	33600.39	0.189199	33912.23		
		0.208834	33042.56	0.208843	33373.21	0.208852	33703.86	0.208861	34034.52	0.20887	34365.18	0.208878	34695.84	0.208886	35026.5	0.208894	35357.16	0.208903	35687.82	0.20891	36018.49		
		0.228584	34908.72	0.228588	35257.54	0.228593	35606.36	0.228597	35955.18	0.228601	36304.01	0.228606	36652.83	0.22861	37001.65	0.228614	37350.48	0.228618	37699.31	0.228622	38048.13		
		0.248333	36712.64	0.248333	37079.04	0.248333	37445.44	0.248333	37811.84	0.248333	38178.24	0.248333	38544.63	0.248333	38911.03	0.248333	39277.43	0.248333	39643.83	0.248333	40010.23		
		0.403542	50663.44	0.403542	51169.07	0.403542	51674.7	0.403542	52180.33	0.403542	52685.96	0.403542	53191.59	0.403542	53697.23	0.403542	54202.86	0.403542	54708.49	0.403542	55214.12		
		0.55875	64614.24	0.55875	65259.11	0.55875	65903.97	0.55875	66548.83	0.55875	67193.69	0.55875	67838.56	0.55875	68483.42	0.55875	69128.28	0.55875	69773.14	0.55875	70418		
		0.6705	64614.24	0.6705	65259.11	0.6705	65903.97	0.6705	66548.83	0.6705	67193.69	0.6705	67838.56	0.6705	68483.42	0.6705	69128.28	0.6705	69773.14	0.6705	70418		
	5	64614.24	5	65259.11	5	65903.97	5	66548.83	5	67193.69	5	67838.56	5	68483.42	5	69128.28	5	69773.14	5	70418			

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y)
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO. 09.0025972.01
CALCULATED BY BMC 4/24/2020
CHECKED BY ARB 4/24/2020

Pile Section	Abutment / Scour Case	Depth below Bottom of Abutment (ft)							
	1 / No Scour	--	--	--	--	--	--	--	--
	1 / 100-yr Scour	127	128	129	130	127	128	129	130
	1 / 500-yr Scour	127	128	129	130	127	128	129	130
	2 / No Scour	--	--	--	--	--	--	--	--
	2 / 100-yr Scour	127	128	129	130	127	128	129	130
	2 / 500-yr Scour	127	128	129	130	127	128	129	130
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P
HP 14 x 117 (Upper Bound)		0	0	0	0	0	0	0	0
		0.03155	11517.05	0.031592	11630.99	0.031634	11744.95	0.031674	11858.91
		0.051258	15469.71	0.051296	15617.18	0.051334	15764.66	0.051371	15912.15
		0.070965	18853.18	0.071	19029.88	0.071034	19206.58	0.071067	19383.3
		0.090673	21882.39	0.090703	22085.5	0.090734	22288.61	0.090763	22491.74
		0.11038	24661.93	0.110407	24889.4	0.110434	25116.87	0.110459	25344.35
		0.130088	27252.41	0.130111	27502.66	0.130134	27752.92	0.130156	28003.19
		0.149796	29692.86	0.149815	29964.64	0.149833	30236.42	0.149852	30508.2
		0.169503	32010.22	0.169518	32302.48	0.169533	32594.73	0.169548	32886.99
		0.189211	34224.07	0.189222	34535.91	0.189233	34847.76	0.189245	35159.6
		0.208918	36349.16	0.208926	36679.83	0.208933	37010.5	0.208941	37341.17
		0.228626	38396.96	0.22863	38745.79	0.228633	39094.62	0.228637	39443.45
		0.248333	40376.63	0.248333	40743.03	0.248333	41109.43	0.248333	41475.83
		0.403542	55719.75	0.403542	56225.38	0.403542	56731.01	0.403542	57236.64
		0.55875	71062.87	0.55875	71707.73	0.55875	72352.59	0.55875	72997.45
		0.6705	71062.87	0.6705	71707.73	0.6705	72352.59	0.6705	72997.45
		5	71062.87	5	71707.73	5	72352.59	5	72997.45
HP 14 x 117 (Lower Bound)		0	0	0	0	0	0	0	0
		0.03155	11517.05	0.031592	11630.99	0.031634	11744.95	0.031674	11858.91
		0.051258	15469.71	0.051296	15617.18	0.051334	15764.66	0.051371	15912.15
		0.070965	18853.18	0.071	19029.88	0.071034	19206.58	0.071067	19383.3
		0.090673	21882.39	0.090703	22085.5	0.090734	22288.61	0.090763	22491.74
		0.11038	24661.93	0.110407	24889.4	0.110434	25116.87	0.110459	25344.35
		0.130088	27252.41	0.130111	27502.66	0.130134	27752.92	0.130156	28003.19
		0.149796	29692.86	0.149815	29964.64	0.149833	30236.42	0.149852	30508.2
		0.169503	32010.22	0.169518	32302.48	0.169533	32594.73	0.169548	32886.99
		0.189211	34224.07	0.189222	34535.91	0.189233	34847.76	0.189245	35159.6
		0.208918	36349.16	0.208926	36679.83	0.208933	37010.5	0.208941	37341.17
		0.228626	38396.96	0.22863	38745.79	0.228633	39094.62	0.228637	39443.45
		0.248333	40376.63	0.248333	40743.03	0.248333	41109.43	0.248333	41475.83
		0.403542	55719.75	0.403542	56225.38	0.403542	56731.01	0.403542	57236.64
		0.55875	71062.87	0.55875	71707.73	0.55875	72352.59	0.55875	72997.45
		0.6705	71062.87	0.6705	71707.73	0.6705	72352.59	0.6705	72997.45
		5	71062.87	5	71707.73	5	72352.59	5	72997.45

Notes: 1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.



Unit Lateral Resistance vs. Lateral Displacement (P-y) - *CUSHION SAND*
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO.	09.0025972.01
CALCULATED BY	BMC 4/23/2020
CHECKED BY	ARB 4/23/2020

Pile Section		Abutment / Scour Case		Depth below Bottom of Abutment (ft)																			
		1 and 2 / No Scour, 3' concrete jacket <i>(Note 3)</i>		3		4		5		6		7		8		9		10		11		12	
		1 and 2 / No Scour, no jacket <i>(Note 4)</i>		0		1		2		3		4		5		6		7		8		9	
		1 and 2 / 4' Scour		4		5		6		7		8		9		10		11		12		13	
		1 and 2 / 5' Scour		5		6		7		8		9		10		11		12		13		14	
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P		
HP 14 x 117		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0	0	0.067105	32.21044	0.066567	63.90385	0.056578	81.47207	0.039254	75.3673	0.018806	45.13358	0.018445	53.12121	0.023257	78.14245	0.030787	118.2205	0.039637	171.231		
		0.022575758	0	0.08358	34.33513	0.083091	68.48537	0.07401	89.2842	0.058261	89.0729	0.039672	68.54344	0.039344	83.64355	0.043718	114.6961	0.050564	159.8462	0.058609	217.2009		
		0.045151515	0	0.100056	36.18037	0.099615	72.47631	0.091442	95.9599	0.077268	100.3758	0.060538	86.83704	0.060243	107.9734	0.06418	144.8518	0.070341	195.3755	0.077582	257.5798		
		0.067727273	0	0.116531	37.82109	0.116139	76.03443	0.108875	101.8413	0.096275	110.1648	0.081404	102.4941	0.081142	129.0707	0.084641	171.3941	0.090118	227.1396	0.096554	294.2245		
		0.09030303	0	0.133006	39.30463	0.132664	79.25943	0.126307	107.1305	0.115283	118.8915	0.10227	116.4585	0.102041	148.0722	0.105103	195.5093	0.109894	256.2609	0.115526	328.1321		
		0.11287879	0	0.149482	40.66301	0.149188	82.21879	0.143739	111.9579	0.13429	126.822	0.123136	129.2134	0.12294	165.5643	0.125564	217.8395	0.129671	283.386	0.134499	359.9145		
		0.13545455	0	0.165957	41.91901	0.165712	84.96052	0.161172	116.4133	0.153297	134.1281	0.144003	141.0462	0.143839	181.8979	0.146026	238.7807	0.149448	308.9297	0.153471	389.9805		
		0.1580303	0	0.182432	43.08946	0.182236	87.52013	0.178604	120.5614	0.172304	140.9282	0.164869	152.1446	0.164738	197.304	0.166487	258.5983	0.169225	333.1778	0.172444	418.62		
		0.18060606	0	0.198907	44.18718	0.198761	89.92473	0.196036	124.4505	0.191312	147.3081	0.185735	162.6396	0.185636	211.944	0.186949	277.4811	0.189002	356.3371	0.191416	446.0477		
		0.20318182	0	0.215383	45.22219	0.215285	92.19549	0.213469	128.1178	0.210319	153.3317	0.206601	172.6269	0.206535	225.9366	0.20741	295.569	0.208779	378.5637	0.210389	472.4282		
		0.22575758	0	0.231858	46.20248	0.231809	94.34935	0.230901	131.5927	0.229326	159.0489	0.227467	182.1789	0.227434	239.3721	0.227872	312.9694	0.228556	399.9787	0.229361	497.8909		
		0.24833333	0	0.248333	47.13456	0.248333	96.40005	0.248333	134.8987	0.248333	164.4988	0.248333	191.3522	0.248333	252.321	0.248333	329.7671	0.248333	420.6784	0.248333	522.5402		
		0.40354167	0	0.403542	55.70579	0.403542	115.2144	0.403542	163.6417	0.403542	207.9999	0.403542	258.2952	0.403542	346.8282	0.403542	455.0786	0.403542	580.5362	0.403542	721.1055		
		0.55875	0	0.55875	64.27701	0.55875	134.0288	0.55875	192.3847	0.55875	251.5011	0.55875	325.2381	0.55875	441.3354	0.55875	580.39	0.55875	740.394	0.55875	919.6707		
		0.6705	0	0.6705	64.27701	0.6705	134.0288	0.6705	192.3847	0.6705	251.5011	0.6705	325.2381	0.6705	441.3354	0.6705	580.39	0.6705	740.394	0.6705	919.6707		
		5	0	5	64.27701	5	134.0288	5	192.3847	5	251.5011	5	325.2381	5	441.3354	5	580.39	5	740.394	5	919.6707		

- Notes:
1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
 2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.
 3. The first row of depths assumes a 3' long concrete jacket is used, not surrounded by cushion sand, and cushion sand is installed around the pile from 3 to 23' below bottom of abutment.
 4. The second row of depths assumes no concrete jacket is used, and cushion sand extends from 0 to 20' below bottom of abutment.
 5. Parameters assume cushion sand is loosely dumped after the piles are driven.
 6. Standard p-y curves at 13' below abutment should be used below this section



Unit Lateral Resistance vs. Lateral Displacement (P-y) - *CUSHION SAND*
HNTB - Pleasant Street Bridge No. 3244 over Pleasant River
Milo, Maine

GZA FILE NO.	09.0025972.01
CALCULATED BY	BMC 4/23/2020
CHECKED BY	ARB 4/23/2020

Pile Section		Abutment / Scour Case		Depth below Bottom of Abutment (ft)																					
		1 and 2 / No Scour, 3' concrete jacket (<i>Note 3</i>)		13		14		15		16		17		18		19		20		--		--		--	
		1 and 2 / No Scour, no jacket (<i>Note 4</i>)		10		11		12		13		14		15		16		17		18		19		20	
		1 and 2 / 4' Scour		14		15		16		17		18		19		20		--		--		--		--	
		1 and 2 / 5' Scour		15		16		17		18		19		20		--		--		--		--		--	
See Notes 1 and 2 for definition of P and y		y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P	y	P		
HP 14 x 117		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		0.049881	239.431	0.061592	325.2036	0.074836	431.0526	0.089679	559.5982	0.106186	713.5725	0.124419	895.8165	0.144437	1109.276	0.166299	1357	0.190062	1642.135	0.200946	1832.623	0.08918	1177.17		
		0.067923	288.867	0.078568	377.0823	0.090608	484.206	0.104102	612.7109	0.119109	765.1775	0.135684	944.2897	0.153882	1152.831	0.173757	1393.681	0.195359	1669.813	0.205254	1856.411	0.103648	1289.85		
		0.085964	333.3471	0.095545	424.7093	0.106381	533.8326	0.118525	663.0054	0.132031	814.6289	0.146949	991.2086	0.163327	1195.349	0.181214	1429.75	0.200657	1697.198	0.209561	1880.005	0.118117	1396.507		
		0.104005	374.2843	0.112521	469.1122	0.122153	580.645	0.132949	710.9504	0.144954	862.2153	0.158214	1036.737	0.172772	1236.914	0.188672	1465.241	0.205954	1724.301	0.213869	1903.409	0.132585	1498.148		
		0.122046	412.5145	0.129498	510.9538	0.137926	625.1395	0.147372	756.8945	0.157876	908.165	0.169479	1081.011	0.182217	1277.597	0.19613	1500.186	0.211252	1751.133	0.218177	1926.628	0.147054	1595.524		
		0.140087	448.5832	0.146474	550.6924	0.153698	667.6784	0.161795	801.1061	0.170799	952.6619	0.180744	1124.145	0.191663	1317.461	0.203587	1534.615	0.216549	1777.701	0.222485	1949.669	0.161522	1689.208		
		0.158128	482.8704	0.163451	588.6614	0.169471	708.5366	0.176218	843.7971	0.183721	995.8569	0.192009	1166.238	0.201108	1356.563	0.211045	1568.552	0.221846	1804.016	0.226793	1972.536	0.175991	1779.655		
		0.176169	515.6542	0.180427	625.1123	0.185243	747.9285	0.190641	885.1383	0.196644	1037.876	0.203274	1207.372	0.210553	1394.95	0.218503	1602.022	0.227144	1830.086	0.231101	1995.233	0.190459	1867.229		
		0.19421	547.1453	0.197404	660.2409	0.201016	786.0255	0.205064	925.2701	0.209566	1078.826	0.214539	1247.623	0.219998	1432.669	0.22596	1635.048	0.232441	1855.919	0.235409	2017.764	0.204928	1952.231		
		0.212251	577.5083	0.21438	694.2034	0.216788	822.9672	0.219487	964.3095	0.222488	1118.797	0.225803	1287.052	0.229443	1469.757	0.233418	1667.649	0.237739	1881.522	0.239717	2040.135	0.219396	2034.911		
		0.230292	606.875	0.231357	727.1265	0.232561	858.8691	0.23391	1002.355	0.235411	1157.867	0.237068	1325.718	0.238888	1506.252	0.240876	1699.844	0.243036	1906.902	0.244025	2062.348	0.233865	2115.478		
		0.248333	635.3524	0.248333	759.1151	0.248333	893.8282	0.248333	1039.492	0.248333	1196.106	0.248333	1363.67	0.248333	1542.185	0.248333	1731.65	0.248333	1932.066	0.248333	2084.409	0.248333	2194.114		
		0.403542	876.7863	0.403542	1047.579	0.403542	1233.483	0.403542	1434.499	0.403542	1650.626	0.403542	1881.865	0.403542	2128.215	0.403542	2389.677	0.403542	2666.251	0.403542	2876.484	0.403542	3027.878		
		0.55875	1118.22	0.55875	1336.043	0.55875	1573.138	0.55875	1829.505	0.55875	2105.146	0.55875	2400.059	0.55875	2714.246	0.55875	3047.704	0.55875	3400.436	0.55875	3668.559	0.55875	3861.641		
		0.6705	1118.22	0.6705	1336.043	0.6705	1573.138	0.6705	1829.505	0.6705	2105.146	0.6705	2400.059	0.6705	2714.246	0.6705	3047.704	0.6705	3400.436	0.6705	3668.559	0.6705	3861.641		
		5	1118.22	5	1336.043	5	1573.138	5	1829.505	5	2105.146	5	2400.059	5	2714.246	5	3047.704	5	3400.436	5	3668.559	5	3861.641		

- Notes:
1. "P" is the unit lateral resistance, in lb/in, at the specified depth below bottom of abutment.
 2. "y" is the lateral movement of the pile, in inches, at the corresponding P value.
 3. The first row of depths assumes a 3' long concrete jacket is used, not surrounded by cushion sand, and cushion sand is installed around the pile from 3 to 23' below bottom of abutment.
 4. The second row of depths assumes no concrete jacket is used, and and cushion sand extends from 0 to 20' below bottom of abutment.
 5. Parameters assume cushion san is loosely dumped after the piles are driven.
 6. Standard p-y curves at 13' below abutment should be used below this section



08/07/2020

GEOTECHNICAL DESIGN REPORT
PLEASANT RIVER BRIDGE NO. 3244 - MILO
HNTB Corporation
09.0025972.01

APPENDIX E – CALCULATIONS

Seismic Calculation



Seismic Site Class Calculation Summary

Project: Milo Bridge over Pleasant River **Project No.:** 09.0025972.01
Location: Milo, ME
Evaluated By/Date: E. Tome **Date:** 6/19/2020
Checked By/Date: B. Cardali **Date:** 6/24/2020

Objective:

Determine seismic site class by performing calculations in accordance with the MassDOT LRFD Bridge Manual 2013 Edition, which references the AASHTO LRFD Seismic Bridge Design Specifications, 2nd Edition (2011) and Interim.

Subsurface Data: Borings BB-MPR-101, -102 and -103 were drilled by NEBC of Hermon, Maine between April 22 and May 25, 2018. Borings BB-MPR-201 and -202 were drilled by NEBC of Hermon, Maine between October 8 and October 24, 2019.

Assumptions: Soil borings extended to depths between 127 and 178 feet below the roadway level and bedrock was encountered encountered in the soil borings.

- Approach:**
- 1) Evaluate if the procedure in AASHTO LRFD Seismic Section 3.4.2.1 for classifying a site is appropriate for the site. Sites with highly variable subsurface conditions or very large sites may require multiple site class determinations or a site-specific seismic response analysis. Furthermore, classifying a site based on the 100 feet of soil and rock beneath the ground surface may be inappropriate if deep deposits of weak soils are present below 100 feet, or if foundation structures are supported on firm soil or rock below soft soils which can be justified as having little effect on the structure's seismic response.
 - 2) Evaluate if soil properties are known in sufficient detail to determine site class. If data is not known in sufficient detail, AASHTO permits the use of Site Class D, unless conditions for Site Class E or Site Class F are likely to be present.
 - 3) Check for the four categories of Site Class F requiring site-specific evaluation:
 - Soils vulnerable to potential failure (liquefiable soils, sensitive clays, weakly cemented soils)
 - Peats or highly organic clays greater than 10 feet in thickness
 - Thick layers (greater than 25 feet) of highly plastic clay ($PI > 75$)
 - Very thick soft/medium stiff clays (greater than 125 feet)
 - 4) Check for existence of greater than 10 feet of soft clay (where $s_u < 500$ psf, $w > 40\%$, and $PI > 20$). If these conditions are met, classify as Site Class E.
 - 5) Categorize the site using one of the following three methods in AASHTO 3.4.2.2:
 - $\bar{V}_s$ (Method A)
 - $\bar{N}$ (Method B)
 - $\bar{N}_{ch}$ and $\bar{s}_u$ (Method C)If shear wave velocity data are available, they should be used to classify the site. The N and s_u methods should only be used if shear wave velocity data is not available, as the correlation between site amplification and these geotechnical parameters is more uncertain (and therefore more conservative) than the correlation with $\bar{V}_s$.

Results: Calculations of the Seismic Site Class based on Method B as described in section 3.4.2.2 of the LRFD Seismic Bridge Design Specifications are attached. Calculations results are summarized in the table below.

Boring ID	BB-MPR-101	BB-MPR-102	BB-MPR-103	BB-MPR-201	BB-MPR-202	Average
N-Value	21	31	18	20	34	25

Conclusions: Based on the procedure outlined in section 3.4.2.2 and table 3.4.2.1-1 of the LRFD Seismic Bridge Design Specifications, we recommend that Site Class "D" be used for preliminary design.

Milo Bridge over Pleasant River
Milo, ME

Calculated By: E. Tome Date: 6/19/2020
Checked By: B.Cardali Date: 6/24/2020

INPUT

Exploration ID: BB-MPR-101

Ground Surface Elevation: 288.6 ft

Depth of Boring: 147.0 ft

Depth to Bedrock: 136.0 ft

EQUATIONS

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

where: m = number of layers

d_i = the thickness of all layers between 0 and 100 feet.

d_c = the thickness of any clay layers between 0 and 100 feet.

N_i = the Standard Penetration Resistance (ASTM D 1586) of cohesionless soil layers not to exceed 100 blows/ft, corrected for hammer energy for calibrated auto hammers (i.e., N_{60}).

Note: d_i calculated assuming breaks between sub-layers occur at the midpoint between SPT sample intervals (unless noted otherwise)

CALCULATION

$$\bar{N} = 21.0$$

Soil Strata	SPT Interval Depth		SPT Elevation (mid-interval)	SPT N-value	d_i	d_i / N_i	Comment
	Top, ft	Bottom, ft					
Fill	1.0	3.0	286.6	34	4.0	0.12	
	5.0	7.0	282.6	11	4.5	0.41	
	10.0	12.0	277.6	10	5.0	0.50	
	15.0	17.0	272.6	20	5.0	0.25	
Alluvium	20.0	21.8	267.7	14	4.9	0.35	
	25.0	27.0	262.6	19	5.1	0.27	
	30.0	32.0	257.6	23	5.0	0.22	
	35.0	37.0	252.6	17	5.0	0.29	
	40.0	42.0	247.6	23	5.0	0.22	
	45.0	47.0	242.6	20	5.0	0.25	
	50.0	52.0	237.6	22	5.0	0.23	
	55.0	57.0	232.6	15	5.0	0.33	
	60.0	62.0	227.6	24	5.0	0.21	
	65.0	67.0	222.6	41	5.0	0.12	
	70.0	72.0	217.6	24	5.0	0.21	
	75.0	77.0	212.6	28	5.0	0.18	
	80.0	82.0	207.6	23	5.0	0.22	
	85.0	87.0	202.6	27	5.0	0.19	
	90.0	92.0	197.6	51	5.0	0.10	
	95.0	97.0	192.6	57	5.0	0.09	
	100.0	102.0	187.6	61	1.5	0.02	

Top of Rock 136.0

Milo Bridge over Pleasant River
Milo, ME

Calculated By: E. Tome Date: 6/19/2020
Checked By: B. Cardali Date: 6/24/2020

INPUT

Exploration ID: BB-MPR-102

Ground Surface Elevation: 269.7 ft

Depth of Boring: 129.0 ft

Depth to Bedrock: 118.0 ft

EQUATIONS

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

where: m = number of layers

d_i = the thickness of all layers between 0 and 100 feet.

d_c = the thickness of any clay layers between 0 and 100 feet.

N_i = the Standard Penetration Resistance (ASTM D 1586) of cohesionless soil layers not to exceed 100 blows/ft, corrected for hammer energy for calibrated auto hammers (i.e., N_{60}).

Note: d_i calculated assuming breaks between sub-layers occur at the midpoint between SPT sample intervals (unless noted otherwise)

CALCULATION

$$\bar{N} = 30.5$$

Soil Strata	SPT Interval Depth		SPT Elevation (mid-interval)	SPT N-value	d_i	d_i / N_i	Comment
	Top, ft	Bottom, ft					
Alluvium	0.0	2.0	268.7	51	3.5	0.07	
	5.0	7.0	263.7	18	5.0	0.28	
	10.0	12.0	258.7	49	5.0	0.10	
	15.0	17.0	253.7	23	5.0	0.22	
	20.0	22.0	248.7	42	5.0	0.12	
	25.0	27.0	243.7	15	5.0	0.33	
	30.0	32.0	238.7	38	5.0	0.13	
	35.0	37.0	233.7	34	7.5	0.22	
	45.0	47.0	223.7	50	10.0	0.20	
	55.0	57.0	213.7	20	10.0	0.50	
	65.0	67.0	203.7	46	10.0	0.22	
	75.0	77.0	193.7	24	7.5	0.31	
	80.0	82.0	188.7	19	5.0	0.26	
	85.0	87.0	183.7	61	5.0	0.08	
Glacial Till	90.0	92.0	178.7	50	5.0	0.10	
	95.0	97.0	173.7	50	5.0	0.10	
	100.0	102.0	168.7	50	1.5	0.03	

Top of Rock 118.0

Milo Bridge over Pleasant River
Milo, ME

Calculated By: E. Tome Date: 6/19/2020
Checked By: B. Cardali Date: 6/24/2020

INPUT

Exploration ID: BB-MPR-103

Ground Surface Elevation: 288.8 ft

Depth of Boring: 178.0 ft

Depth to Bedrock: 164.0 ft

EQUATIONS

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

where: m = number of layers

d_i = the thickness of all layers between 0 and 100 feet.

d_c = the thickness of any clay layers between 0 and 100 feet.

N_i = the Standard Penetration Resistance (ASTM D 1586) of cohesionless soil layers not to exceed 100 blows/ft, corrected for hammer energy for calibrated auto hammers (i.e., N_{60}).

Note: d_i calculated assuming breaks between sub-layers occur at the midpoint between SPT sample intervals (unless noted otherwise)

CALCULATION

$$\bar{N} = 18.4$$

Soil Strata	SPT Interval Depth		SPT Elevation (mid-interval)	SPT N-value	d_i	d_i / N_i	Comment
	Top, ft	Bottom, ft					
Fill	1.0	3.0	286.8	32	4.0	0.13	
	5.0	7.0	282.8	5	4.5	0.90	
	10.0	12.0	277.8	15	5.0	0.33	
	15.0	17.0	272.8	21	5.0	0.24	
	20.0	22.0	267.8	9	5.0	0.56	
Alluvium	25.0	27.0	262.8	14	5.0	0.36	
	30.0	32.0	257.8	25	5.0	0.20	
	35.0	37.0	252.8	47	5.0	0.11	
	40.0	42.0	247.8	26	5.0	0.19	
	45.0	47.0	242.8	16	5.0	0.31	
	50.0	52.0	237.8	14	5.0	0.36	
	55.0	57.0	232.8	18	5.0	0.28	
	60.0	62.0	227.8	24	5.0	0.21	
	65.0	67.0	222.8	19	5.0	0.26	
	70.0	72.0	217.8	28	5.0	0.18	
	75.0	77.0	212.8	32	5.0	0.16	
	80.0	82.0	207.8	94	5.0	0.05	
	85.0	87.0	202.8	21	5.0	0.24	
	90.0	92.0	197.8	27	5.0	0.19	
	95.0	97.0	192.8	32	5.0	0.16	
	100.0	102.0	187.8	46	1.5	0.03	

Top of Rock 164.0

Milo Bridge over Pleasant River
Milo, ME

Calculated By: E. Tome Date: 6/19/2020
Checked By: B. Cardali Date: 6/24/2020

INPUT

Exploration ID: BB-MPR-201

Ground Surface Elevation: 277.8 ft

Depth of Boring: 155.0 ft

Depth to Bedrock: 125.6 ft

EQUATIONS

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

where: m = number of layers

d_i = the thickness of all layers between 0 and 100 feet.

d_c = the thickness of any clay layers between 0 and 100 feet.

N_i = the Standard Penetration Resistance (ASTM D 1586) of cohesionless soil layers not to exceed 100 blows/ft, corrected for hammer energy for calibrated auto hammers (i.e., N_{60}).

Note: d_i calculated assuming breaks between sub-layers occur at the midpoint between SPT sample intervals (unless noted otherwise)

CALCULATION

$$\bar{N} = 20.0$$

Soil Strata	SPT Interval Depth		SPT Elevation (mid-interval)	SPT N-value	d_i	d_i / N_i	Comment
	Top, ft	Bottom, ft					
Alluvium	0.0	2.0	276.8	2	3.5	1.75	
	5.0	7.0	271.8	20	5.0	0.25	
	10.0	12.0	266.8	34	5.0	0.15	
	15.0	17.0	261.8	31	5.0	0.16	
	20.0	22.0	256.8	29	5.0	0.17	
	25.0	27.0	251.8	22	5.0	0.23	
	30.0	32.0	246.8	33	5.0	0.15	
	35.0	37.0	241.8	25	5.0	0.20	
	40.0	42.0	236.8	42	5.0	0.12	
	45.0	47.0	231.8	28	5.0	0.18	
	50.0	52.0	226.8	62	5.0	0.08	
	55.0	57.0	221.8	22	5.0	0.23	
	60.0	62.0	216.8	40	5.0	0.13	
	65.0	67.0	211.8	17	5.3	0.31	
	70.5	72.5	206.3	33	5.0	0.15	
	75.0	77.0	201.8	28	4.8	0.17	
	80.0	82.0	196.8	34	5.0	0.15	
	85.0	87.0	191.8	25	5.0	0.20	
	90.0	92.0	186.8	51	5.0	0.10	
	95.0	96.0	182.3	50	5.3	0.11	
	101.6	104.5	174.8	50	1.2	0.02	

Top of Rock 125.6

Milo Bridge over Pleasant River
Milo, ME

Calculated By: E. Tome Date: 6/19/2020
Checked By: B. Cardali Date: 6/24/2020

INPUT

Exploration ID: BB-MPR-202

Ground Surface Elevation: 280.1 ft

Depth of Boring: 143.2 ft

Depth to Bedrock: 125.1 ft

EQUATIONS

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

where: m = number of layers

d_i = the thickness of all layers between 0 and 100 feet.

d_c = the thickness of any clay layers between 0 and 100 feet.

N_i = the Standard Penetration Resistance (ASTM D 1586) of cohesionless soil layers not to exceed 100 blows/ft, corrected for hammer energy for calibrated auto hammers (i.e., N_{60}).

Note: d_i calculated assuming breaks between sub-layers occur at the midpoint between SPT sample intervals (unless noted otherwise)

CALCULATION

$$\bar{N} = 33.6$$

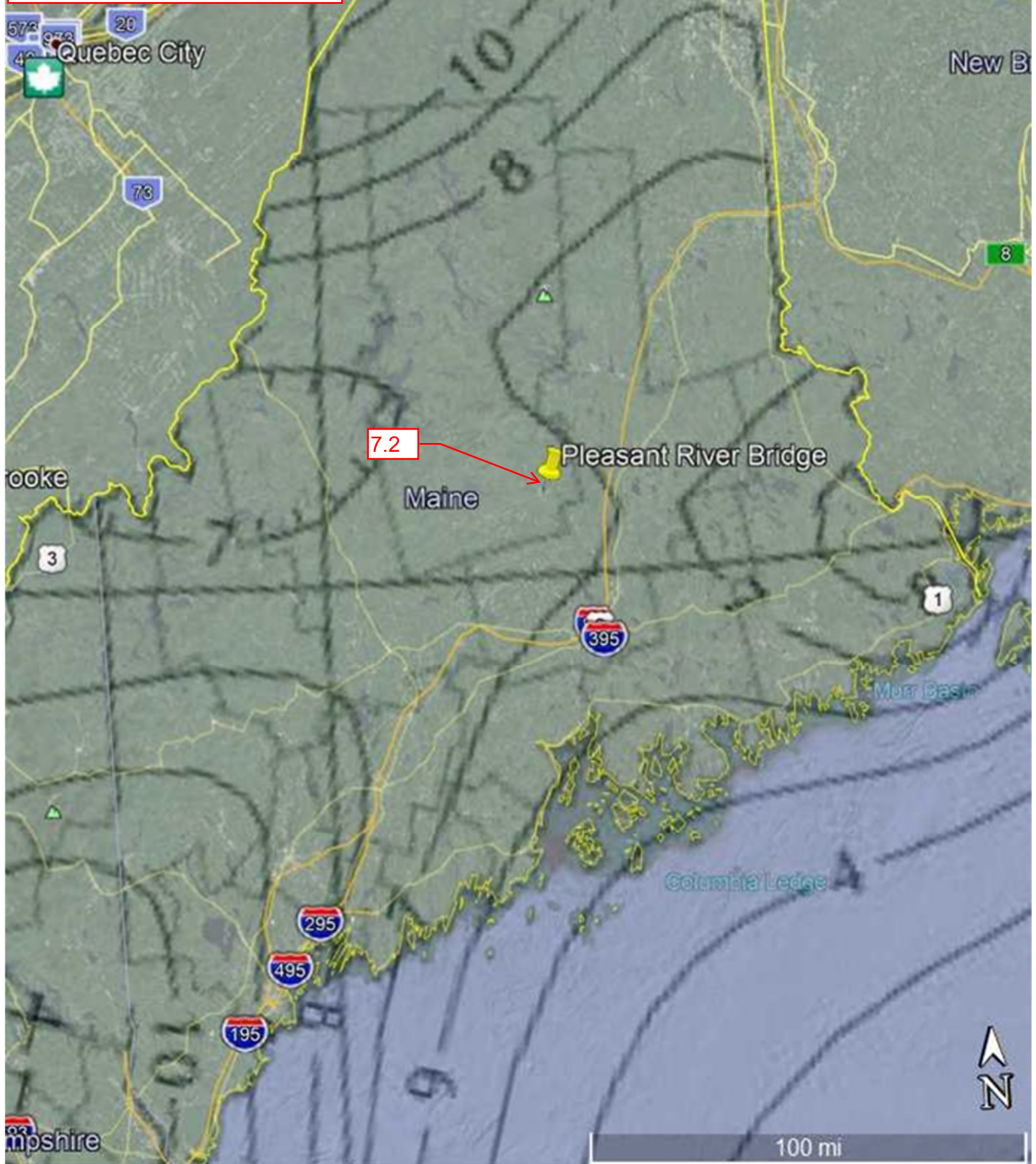
Soil Strata	SPT Interval Depth		SPT Elevation (mid-interval)	SPT N-value	d_i	d_i / N_i	Comment
	Top, ft	Bottom, ft					
Alluvium	0.0	2.0	279.1	6	3.5	0.58	
	5.0	7.0	274.1	57	5.0	0.09	
	10.0	12.0	269.1	47	5.0	0.11	
	15.0	17.0	264.1	36	5.0	0.14	
	20.0	22.0	259.1	22	5.0	0.23	
	25.0	27.0	254.1	64	5.0	0.08	
	30.0	32.0	249.1	50	5.0	0.10	
	35.0	37.0	244.1	36	5.0	0.14	
	40.0	42.0	239.1	28	5.0	0.18	
	45.0	47.0	234.1	54	5.0	0.09	
	50.0	52.0	229.1	42	5.0	0.12	
	55.0	57.0	224.1	74	5.0	0.07	
	60.0	62.0	219.1	40	5.0	0.13	
	65.0	67.0	214.1	25	5.0	0.20	
	70.0	72.0	209.1	20	5.0	0.25	
	75.0	77.0	204.1	61	5.0	0.08	
	80.0	82.0	199.1	34	5.0	0.15	
	85.0	87.0	194.1	78	5.0	0.06	
	90.0	92.0	189.1	59	5.0	0.08	
	95.0	96.0	184.6	64	5.3	0.08	
	101.6	104.5	177.1	50	1.2	0.02	

Top of Rock 125.1

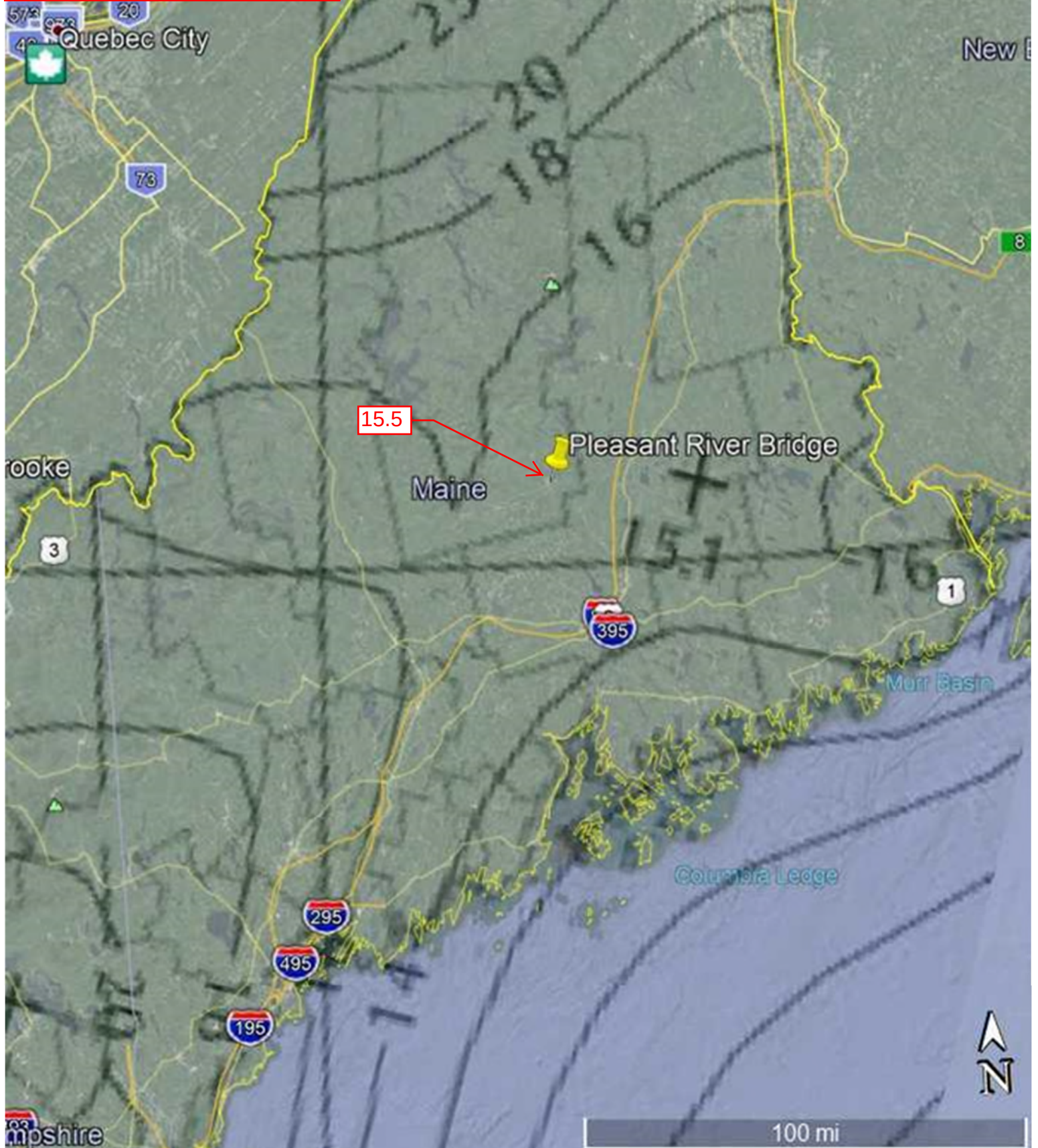
Seismic Design Parameters



Horizontal Peak Ground
Acceleration Coefficient (PGA)

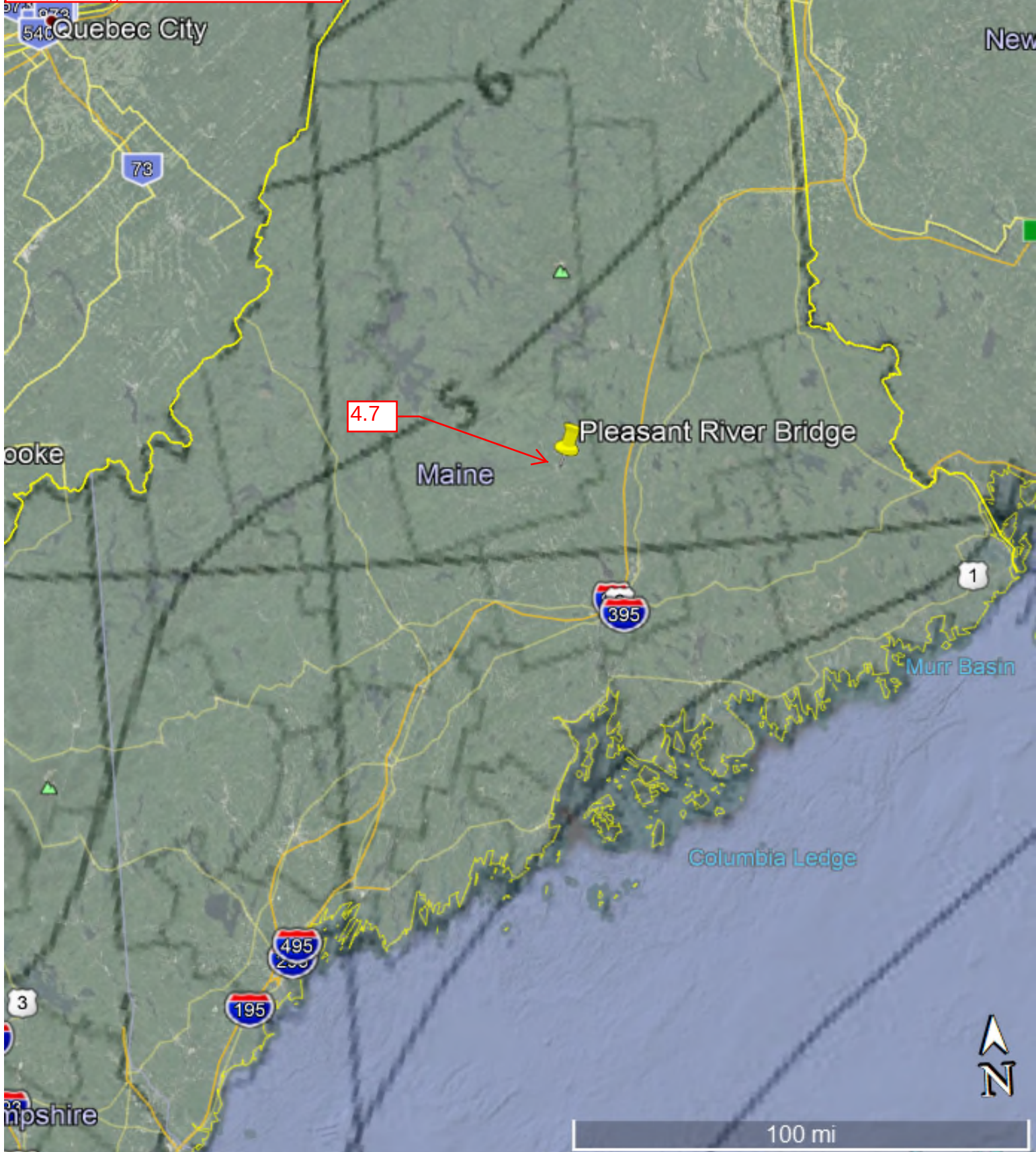


Horizontal Response Spectral
Acceleration Coefficient for period
of 0.2 s (S_s)





Horizontal Response Spectral
Acceleration Coefficient for period
of 1.0 s (S_a)





Milo Seismic Interpolation for Coefficients		
Seismic Parameter	Interpolated Value from Maps ¹	Design Parameter
Horizontal Peak ground Acceleration Coefficient	7.2	$PGA = .072$
Horizontal Response Spectral Acceleration Coefficient for Period of 0.2s	15.5	$S_s = 0.155$
Horizontal Response Spectral Acceleration Coefficient for Period of 1.0s	4.7	$S_1 = .047$

Notes: 1. AASHTO Figures 3.10.2.1-1,-2, and -3 were overlaid within the Google Earth software. Coefficients were interpolated between lines on these figures as presented in pages 1 through 3 of this calculation.

For Class D, values of F_{PGA} and $F_a = 1.6$, and $F_v = 2.4$

Therefore:

$$A_s = F_{PGA} \times PGA = 1.6 \times 0.072 = 0.115 \text{ g}$$

$$S_{DS} = F_a \times S_s = 1.6 \times 0.155 = 0.248 \text{ g}$$

$$S_{D1} = F_v \times S_1 = 2.4 \times 0.047 = 0.113 \text{ g}$$

Summary:

SITE CLASS D SEISMIC DESIGN PARAMETERS	
Parameter	Design Value
F_{pga}	1.6
F_a	1.6
F_v	2.4
A_s (Period = 0.0 sec)	0.115 g
S_{Ds} (Period = 0.2 sec)	0.248 g
S_{D1} (Period = 1.0 sec)	0.113 g

Frost Calculation

Figure 5-1 Maine Design Freezing Index Map

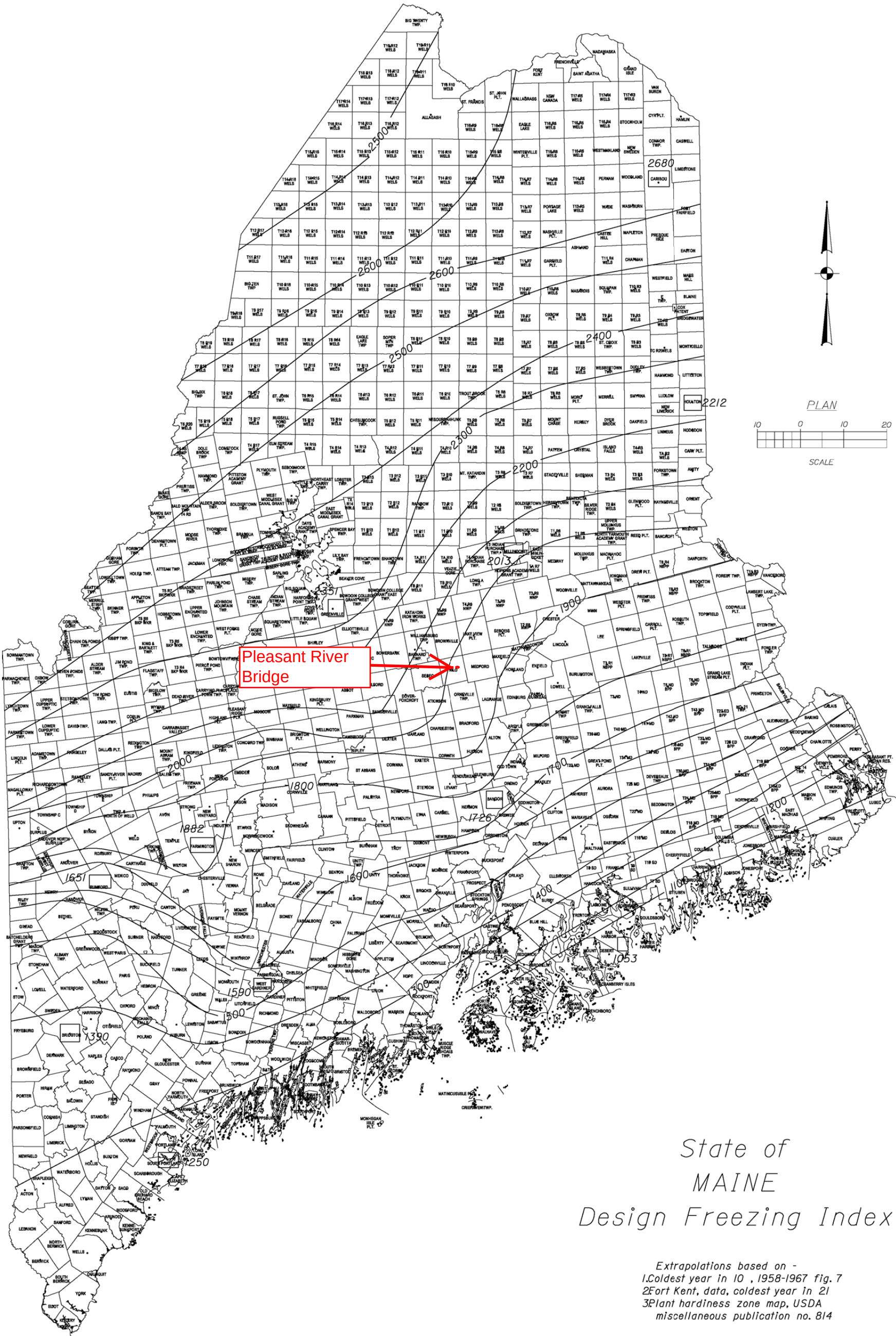


Table 5-1 Depth of Frost Penetration

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

- Notes: 1. w = water content
2. Where the Freezing Index and/or water content is between the presented values, linear interpretation may be used to determine the frost penetration.

Alluvial soil is anticipated to be present at the abutments near the elevation of the pile caps. The material is coarse-grained with water contents less than 10%. Based on the MaineDOT BDG, Section 5.2.1 and a Freezing Index of 1,980 the estimated depth of frost penetration is 95 inches.

Pile Drivability Analyses



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*Engineers and
 Scientists*

JOB: 09.0025975.01 Pleasant River Bridge
 SUBJECT: Axial Pile Resistance
 SHEET: 1 OF 18
 CALCULATED BY M. Johnescu, 7/15/20
 REVIEWED BY A. Blaisdell, 7/15/20

Objective

Evaluate the axial geotechnical resistance of the abutment and pier piles for the Pleasant River Bridge Replacement in Milo, ME. Evaluations were conducted to assess a suitable driving system to install piles to the required geotechnical nominal resistance of 362 and 669 kips for the abutment and pier piles, respectively.

Methodology

Evaluate proposed pile section for governing factored axial compression resistance as follows.

1. Nominal Compressive Resistance
2. Factored Structural Compressive Resistance - Strength Limit State
3. Factored Structural Compressive Resistance - Extreme/Service Limit State
4. Geotechnical Resistance (Static Analysis)
5. Geotechnical Resistance (Drivability Analysis)
6. Factored Geotechnical Resistance - Strength Limit State
7. Factored Geotechnical Resistance - Extreme/Service Limit State

References

1. American Association of State Highway and Transportation Officials, AASHTO LRFD Bridge Design Specifications: Customary U.S. Units, 8th edition. (AASHTO LRFD)

Soil Properties

Consider Pleasant River Bridge Interpretive Subsurface Profile (see Figure 3), subsurface layering and properties relative to pile design are presented in the Apile outputs on pages 8 through 12 for abutment piles and 15 through 19 for pier piles.

Structural Properties

HP14x117, ASTM A572, Gr. 50

Yield Strength of Steel

$$F_y := 50 \text{ ksi}$$

Area of section

$$A_s := 34.4 \text{ in}^2$$

Young's Modulus of Steel

$$E_s := 30000 \cdot \text{ksi}$$

Radius of gyration (weak axis)

$$r_x := 5.96 \text{ in}$$



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Engineers and
 Scientists

JOB: 09.0025975.01 Pleasant River Bridge
 SUBJECT: Axial Pile Resistance
 SHEET: 2 OF 18
 CALCULATED BY M. Johnescu, 7/15/20
 REVIEWED BY A. Blaisdell, 7/15/20

1. Nominal Structural Compressive Resistance P_n

Nominal Compressive Resistance: $P_n := 0.66 \cdot F_y \cdot A_s$ AASHTO Eq. 6.9.5.1-1

Determine normalized column slenderness factor λ

$$\lambda := \left(\frac{K \cdot l}{r_s \cdot \pi} \right)^2 \cdot \frac{F_y}{E} \quad \text{AASHTO Eq. 6.9.4.1-3} \quad \text{pg. 6-74}$$

$\lambda := 0$ Where the pile is fully embedded, AASHTO 10.7.3.13.1.

Given: $P_n := 0.66 \cdot F_y \cdot A_s$ $P_n = 1720 \cdot \text{kip}$

2. Factored Structural Compressive Resistance - Strength Limit State:

Factor for piles in compression under hard driving conditions:

From Article 6.5.4.2 $\phi_c := 0.5$

Factored Compressive Resistance for Strength Limit State:

$$P_r := \phi_c \cdot P_n \quad \text{AASHTO Eq. 6.9.2.1-1} \quad \text{pg. 6-71}$$

$$P_r = 860 \cdot \text{kip}$$

Note: This is the maximum structural resistance assuming no unbraced length, actual structural resistance should be checked by the structural engineer.

3. Factored Structural Compressive Resistance - Service/Extreme Limit State:

Resistance Factors for Extreme Limit States:

From Article 10.5.5.1 and 10.5.5.3 $\phi := 1$

Factored Compressive Resistance for Service/Extreme Limit State:

$$P_{r, \text{max}} := \phi \cdot P_n \quad \text{AASHTO Eq. 6.9.2.1-1} \quad \text{pg. 6-71}$$

$$P_r = 1720 \cdot \text{kip}$$

4. Geotechnical Axial Resistance - Static Analysis

AASHTO Article 10.7.3.2.3 states that the nominal resistance of piles driven to point bearing on hard rock is controlled by the structural limit state or potential for driving damage to occur during hard driving.

Required nominal resistance of 362 and 669 kips for the pile configurations based on a maximum factored pile loads of 235 and 435 kips and a 0.65 resistance factor for the Abutments and Piers.



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*Engineers and
 Scientists*

JOB: 09.0025975.01 Pleasant River Bridge
 SUBJECT: Axial Pile Resistance
 SHEET: 3 OF 18
 CALCULATED BY M. Johnescu, 7/15/20
 REVIEWED BY A. Blaisdell, 7/15/20

Based on geotechnical resistance calculation results, which are presented in the Axial Resistance Chart on Page 5 of this calculation, the required nominal resistance is achieved with 115-foot and 103-foot piles of penetration for the Abutments and Pier, respectively. The result indicate pier piles will be driven to or near bedrock and abutment piles will be driven into glacial till to achieve the geotechnical resistance.

The estimated % skin friction resistance is about 40% to 70% for the piles at the required nominal pile resistance, based on the estimated friction resistance. A-pile is higher, but we anticipate driving resistance in the upper sand may be lower than the calculated static resistance.

5. Geotechnical Axial Resistance - Drivability Analysis

$$\sigma_{dr} := 0.9 \cdot \phi_{da} \cdot f_y \quad \text{AASHTO Eq. 10.7.8.1}$$

$$f_y := 50 \text{ ksi} \quad \text{yield Strength of steel}$$

$$\phi_{da} := 1.0 \quad \text{AASHTO Table 10.5.5.2.3-1 Refers to Article 6.5.4.2, Pg. 6-28}$$

$$\sigma_{dr} := 0.9 \cdot \phi_{da} \cdot f_y \quad \sigma_{dr} = 45 \cdot \text{ksi} \quad \text{Driving Stress in pile cannot exceed 45 ksi}$$

Abutments - Drive pile through 115 feet of soil to rock with toe quake representative of tip resistance in soil (0.143 in) and a half plug in the bottom 5 feet. Model pile length as 132 feet (2 foot stickup at end of drive and 15 feet of isolation casing).

Pier - Drive pile plumb or at batter of 12:3 through 103 feet of soil to rock with toe quake representative of tip resistance in soil (0.143 in) and no plug. Model pile length as 105 feet (2 foot stickup at end of drive).

Drive piles with a Delmag D36-32 open-ended diesel hammer with a rated energy of 90,561 ft-lbs (fuel setting 4, 3 below maximum and fuel setting 1, maximum for the Abutments and Piers, respectively). **The proposed hammer is sized to achieve the required nominal pile resistance for each of the potential driving scenarios; not the maximum driveability resistance for the pile section and profile.**

GRLWEAP Output is attached on Sheets 5 through 6 for abutment piles and sheets 12 through 13 for pier piles.

Abutments: $R_{ndr1} := 362 \text{ kip}$ Required nominal geotechnical resistance, pile driving stress=24.4 ksi, final penetration resistance=4 bpi.

Piers: $R_{ndr2} := 669 \text{ kip}$ Required nominal geotechnical resistance, pile driving stress=36.1 ksi, final penetration resistance=11 bpi.

6. Factored Drivability Resistance - Strength Limit State:

Strength Limit State Factored Drivability Resistance:

PDA, WEAP and CAPWAP used to establishing driving criteria

$$\phi_{dyn} := 0.65 \quad \text{AASHTO Table 10.5.5.2.3-1}$$

Abutments: $R_{ndr1_factored} := R_{ndr1} \cdot \phi_{dyn}$

$$R_{ndr1_factored} = 235 \cdot \text{kip}$$



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 207-879-9190
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<http://www.gza.com>

*Engineers and
 Scientists*

JOB: 09.0025975.01 Pleasant River Bridge
 SUBJECT: Axial Pile Resistance
 SHEET: 4 OF 18
 CALCULATED BY M. Johnescu, 7/15/20
 REVIEWED BY A. Blaisdell, 7/15/20

Pier: $R_{\text{ndr2_factored}} := R_{\text{ndr2}} \cdot \phi_{\text{dyn}}$

$$R_{\text{ndr2_factored}} = 435 \cdot \text{kip}$$

7. Factored Drivability Resistance - Service/Extreme Limit States:

Service and Extreme Limit State Factored Drivability Resistance:

Resistance Factors for Extreme Limit States: $\phi_{\text{serv_ext}} := 1$

From Article 10.5.5.1 and 10.5.5.3

Abutments: $R_{\text{ndr1_serv_ext}} := R_{\text{ndr1}} \cdot \phi_{\text{serv_ext}}$

$$R_{\text{ndr1_serv_ext}} = 362 \cdot \text{kip}$$

Pier: $R_{\text{ndr2_serv_ext}} := R_{\text{ndr2}} \cdot \phi_{\text{serv_ext}}$

$$R_{\text{ndr2_serv_ext}} = 669 \cdot \text{kip}$$

Summary of Results - Axial Loading:

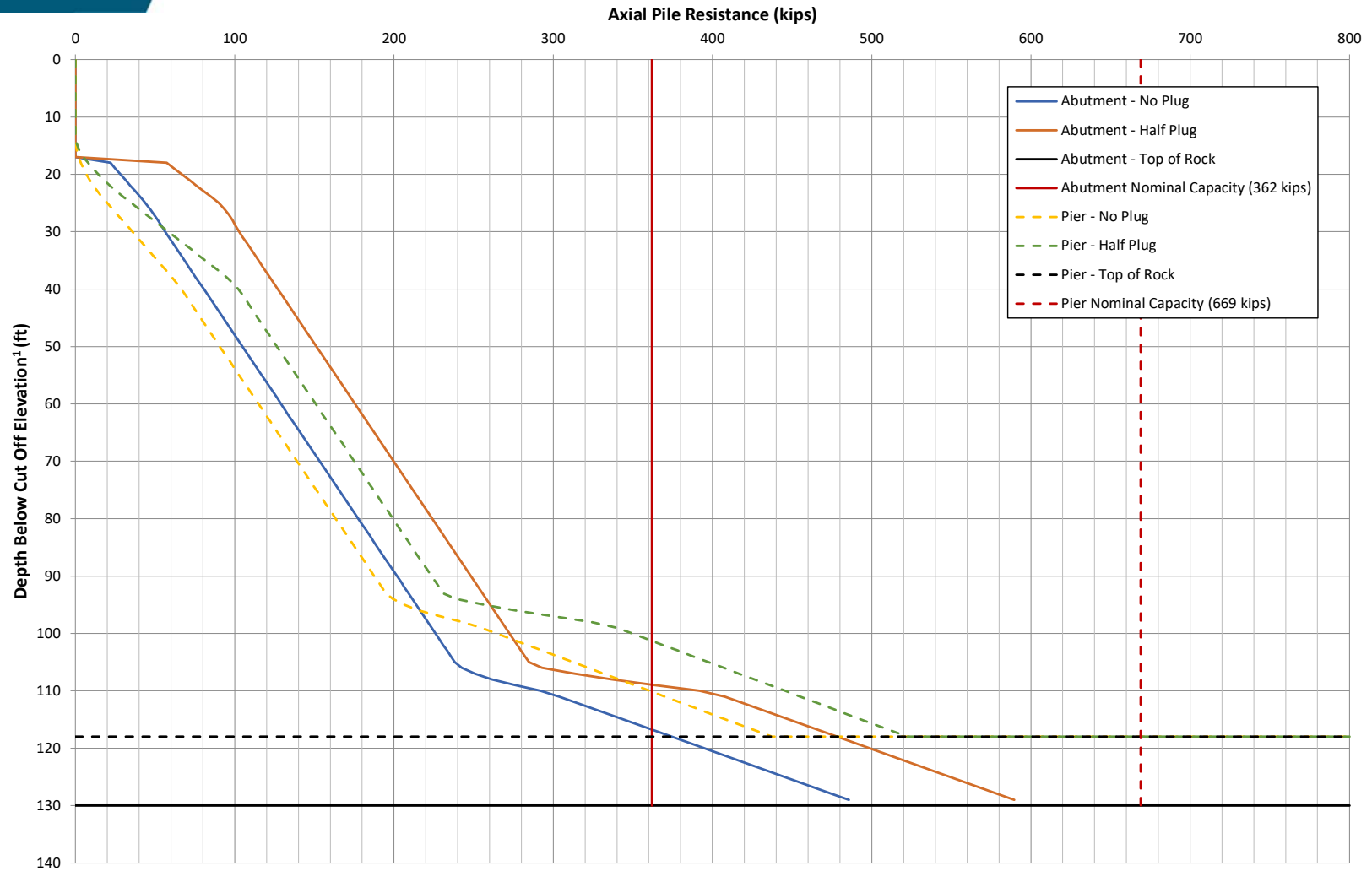
ASTM A572, HP 14x117	Structural Resistance (kips)	Geotechnical Static Resistance (kips)	Required Geotechnical Resistance (kips)	Governing Resistance (kips)
Abutments: Strength Limit State, Design	860	n/a	235	235
Abutments: Service/Extreme Limit State, Design	1720	n/a	362	362
Piers: Strength Limit State, Design	860	n/a	435	435
Piers: Service/Extreme Limit State, Design	1720	n/a	669	669

Since the driving stresses do not exceed the limiting driving stress of 45 ksi for ASTM A572 steel (50 ksi yield stress), and the calculated penetration resistance for the pier is within the MaineDOT preferred range of 3 to 15 blows per inch, the analyzed hammer system is judged acceptable to install the piles to the required nominal resistance. The selected hammer system is large enough for the pier piles and is larger than required for the abutment piles due to the smaller required nominal capacity. As smaller hammer would be capable of installing the abutment piles. Our analyses utilize a single pile system capable of installing piles at all substructures for the project.



Milo Pleasant River Bridge
Milo, Maine
HP 14x117 Pile Resistance Chart

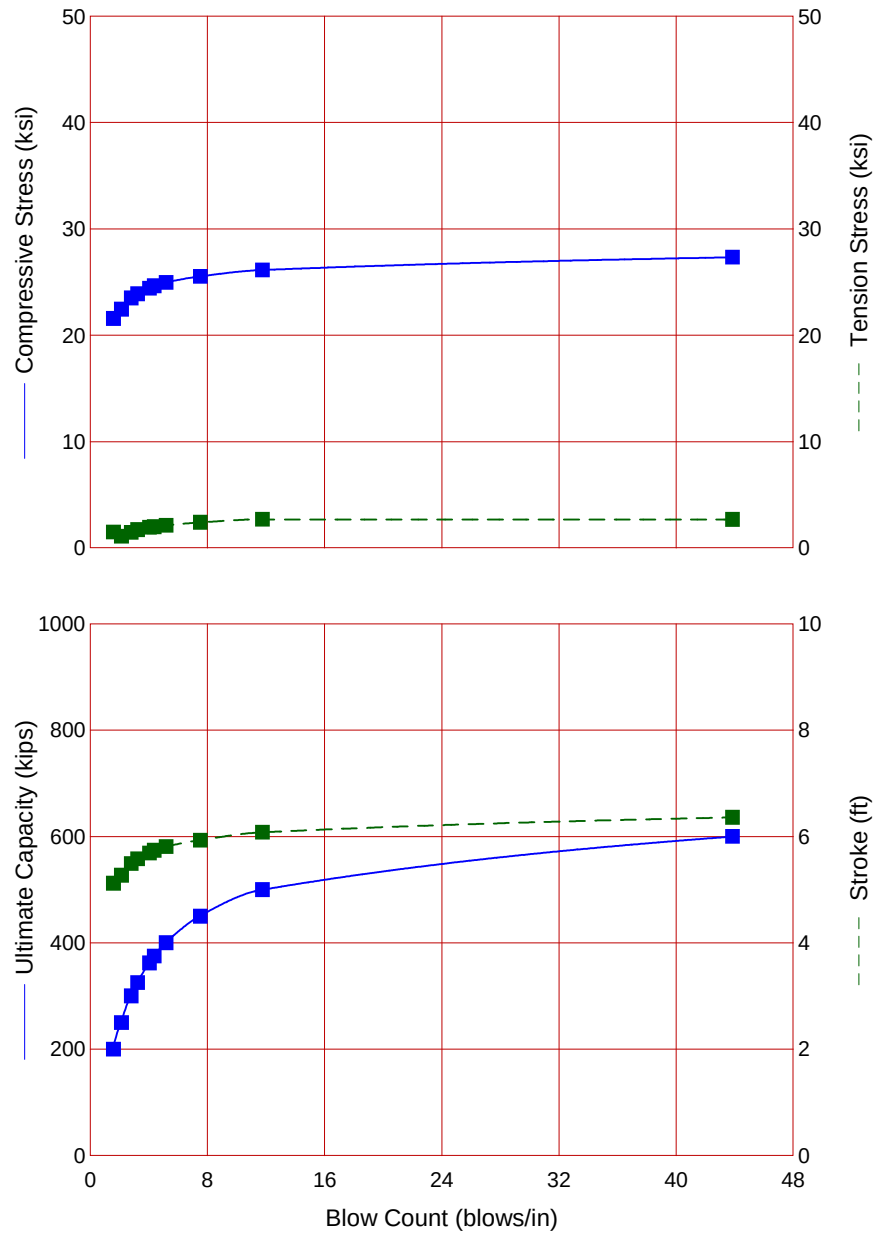
GZA File No. 09.0025972.01
Date: 7/3/2020
By: B.Cardali
Checked By: A.Blaissdell



- Notes:
1. Cut off elevations are approximately EL. 282.5 and 267.0 feet at the abutments and pier, respectively.
 2. The abutment piles are modeled to be driven through an unfilled casing extending 15 feet below the bottom of the abutment (EL. 264.5 at Abutment 1 & 2)
 3. Pier piles are modelled to be driven when the cofferdam is excavated to or near the bottom of seal elevation (EL. 254)

GZA Geo Environmental, Inc.
Pleasant River Bridge - Milo

15-Jul-2020
GRLWEAP Version 2010



DELMAG D 36-32

Ram Weight	7.93 kips
Efficiency	0.800
Pressure	1057 (72%) psi
Helmet Weight	1.90 kips
Hammer Cushion	60155 kips/in
COR of H.C.	0.800
Skin Quake	0.140 in
Toe Quake	0.143 in
Skin Damping	0.200 sec/ft
Toe Damping	0.157 sec/ft
Pile Length	132.00 ft
Pile Penetration	115.00 ft
Pile Top Area	34.40 in ²

Pile Model

Skin Friction
Distribution

Res. Shaft = 70 %
(Proportional)

GZA Geo Environmental, Inc.
Pleasant River Bridge - Milo

15-Jul-2020
GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count blows/in	Stroke ft	Energy kips-ft
200.0	21.57	1.49	1.6	5.12	22.59
250.0	22.44	1.10	2.1	5.27	21.74
300.0	23.50	1.45	2.8	5.49	22.49
325.0	23.89	1.72	3.2	5.58	22.72
362.0	24.41	1.94	4.0	5.69	23.08
375.0	24.65	1.99	4.4	5.74	23.28
400.0	24.96	2.12	5.2	5.81	23.48
450.0	25.53	2.40	7.5	5.93	23.88
500.0	26.14	2.69	11.8	6.08	24.38
600.0	27.33	2.67	43.9	6.36	25.45

HP14x117 (half plug).ap8o

APILE for Windows, Version 2018.8.5

Serial Number : 653550831

A Program for Analyzing the Axial Capacity
and Short-term Settlement of Driven Piles
under Axial Loading.
(c) Copyright ENSOFT, Inc., 1987-2015
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This program is licensed to :

GZA GeoEnvironmental, Inc.
Portland, OR

Path to file locations : P:\09 Jobs\0025900s\09.0025972.00 - Pleasant River Bridge, Milo\09.0025972.01 - Final
Design\Work\Calcs\APile\Final APILE for WEAP\Abutments\
Name of input data file : HP14x117 (half plug).ap8d
Name of output file : HP14x117 (half plug).ap8o
Name of plot output file : HP14x117 (half plug).ap8p

Time and Date of Analysis

Date: July 01, 2020 Time: 09:25:15

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* INPUT INFORMATION *

DESIGNER : B.Cardali

JOB NUMBER : 09.0025972.00

Page 1

HP14x117 (half plug).ap8o

METHOD FOR UNIT LOAD TRANSFERS :

- USACE (U.S. Army Corps of Engineers)
Unfactored Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- USACE (U.S. Army Corps of Engineers)
Critical Depth Method for Sand:
10 to 20 Pile Diameter based on the Density
Use Long Pile Option

TYPE OF LOADING :
- COMPRESSION

PILE TYPE :

H-Pile/Steel Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 105.80 IN2

NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL = 132.00 FT.
- BATTER ANGLE = 0.00 DEG
- PILE STICKUP LENGTH, PSL = 2.00 FT.
- ZERO FRICTION LENGTH, ZFL = 15.00 FT.
- PERIMETER OF PILE = 58.20 IN.
- TIP AREA OF PILE = 105.80 IN2
- INCREMENT OF PILE LENGTH
USED IN COMPUTATION = 1.00 FT.

SOIL INFORMATIONS :

Page 2

HP14x117 (half plug).ap8o

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	1.25	125.00	35.00	30.00
6.50	SAND	1.25	125.00	35.00	30.00
6.50	SAND	1.25	63.00	35.00	50.00
106.00	SAND	1.25	63.00	35.00	50.00
106.00	SAND	1.25	67.60	40.00	50.00
140.00	SAND	1.25	67.60	40.00	50.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.50E+00	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.50E+00	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.50E+00	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.50E+00	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
6.50	1.000	1.000
6.50	1.000	1.000
106.00	1.000	1.000
106.00	1.000	1.000
140.00	1.000	1.000

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HP14x117 (half plug).ap8o

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* COMPUTATION RESULT *

* ARMY CORPS METHOD *

PILE PENETRATION FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	2.6	2.6
1.00	0.0	4.9	4.9
2.00	0.0	8.7	8.7
3.00	0.0	13.6	13.6
4.00	0.0	18.2	18.2
5.00	0.0	22.7	22.7
6.00	0.0	26.9	26.9
7.00	0.0	30.5	30.5
8.00	0.0	33.7	33.7
9.00	0.0	36.4	36.4
10.00	0.0	38.7	38.7
11.00	0.0	41.0	41.0
12.00	0.0	43.3	43.3
13.00	0.0	45.6	45.6
14.00	0.0	47.9	47.9
15.00	2.4	50.2	52.6
16.00	4.8	52.4	57.3
17.00	7.3	54.7	62.0
18.00	9.7	57.0	66.7
19.00	12.1	59.3	71.4
20.00	14.5	61.6	76.2
21.00	17.0	63.9	80.9
22.00	19.4	66.2	85.6
23.00	21.8	68.2	90.0
24.00	24.2	69.1	93.4
25.00	26.7	69.6	96.3
26.00	29.1	69.6	98.7
27.00	31.5	69.1	100.6
28.00	33.9	68.8	102.8
29.00	36.4	68.8	105.2
30.00	38.8	68.8	107.6
31.00	41.2	68.8	110.1

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HP14x117 (half plug).ap8o			
32.00	43.6	68.8	112.5
33.00	46.1	68.8	114.9
34.00	48.5	68.8	117.3
35.00	50.9	68.8	119.8
36.00	53.3	68.8	122.2
37.00	55.8	68.8	124.6
38.00	58.2	68.8	127.0
39.00	60.6	68.8	129.5
40.00	63.0	68.8	131.9
41.00	65.5	68.8	134.3
42.00	67.9	68.8	136.7
43.00	70.3	68.8	139.2
44.00	72.7	68.8	141.6
45.00	75.2	68.8	144.0
46.00	77.6	68.8	146.4
47.00	80.0	68.8	148.9
48.00	82.4	68.8	151.3
49.00	84.9	68.8	153.7
50.00	87.3	68.8	156.1
51.00	89.7	68.8	158.6
52.00	92.1	68.8	161.0
53.00	94.6	68.8	163.4
54.00	97.0	68.8	165.8
55.00	99.4	68.8	168.3
56.00	101.8	68.8	170.7
57.00	104.3	68.8	173.1
58.00	106.7	68.8	175.5
59.00	109.1	68.8	178.0
60.00	111.5	68.8	180.4
61.00	114.0	68.8	182.8
62.00	116.4	68.8	185.2
63.00	118.8	68.8	187.7
64.00	121.2	68.8	190.1
65.00	123.7	68.8	192.5
66.00	126.1	68.8	194.9
67.00	128.5	68.8	197.4
68.00	130.9	68.8	199.8
69.00	133.4	68.8	202.2
70.00	135.8	68.8	204.6
71.00	138.2	68.8	207.1
72.00	140.6	68.8	209.5
73.00	143.1	68.8	211.9
74.00	145.5	68.8	214.3
75.00	147.9	68.8	216.8
76.00	150.3	68.8	219.2
77.00	152.8	68.8	221.6

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HP14x117 (half plug).ap8o			
78.00	155.2	68.8	224.0
79.00	157.6	68.8	226.5
80.00	160.0	68.8	228.9
81.00	162.5	68.8	231.3
82.00	164.9	68.8	233.7
83.00	167.3	68.8	236.2
84.00	169.7	68.8	238.6
85.00	172.2	68.8	241.0
86.00	174.6	68.8	243.4
87.00	177.0	68.8	245.9
88.00	179.4	68.8	248.3
89.00	181.9	68.8	250.7
90.00	184.3	68.8	253.1
91.00	186.7	68.8	255.6
92.00	189.1	68.8	258.0
93.00	191.6	68.8	260.4
94.00	194.0	68.8	262.8
95.00	196.4	68.8	265.3
96.00	198.8	68.8	267.7
97.00	201.3	68.8	270.1
98.00	203.7	68.8	272.5
99.00	206.1	68.8	275.0
100.00	208.5	68.8	277.4
101.00	211.0	68.8	279.8
102.00	213.4	68.8	282.2
103.00	215.8	68.8	284.7
104.00	218.2	74.6	292.9
105.00	220.7	93.0	313.7
106.00	225.3	111.3	336.6
107.00	233.7	129.7	363.4
108.00	243.8	148.0	391.9
109.00	253.9	153.8	407.8
110.00	264.0	153.8	417.9
111.00	274.1	153.8	428.0
112.00	284.2	153.8	438.1
113.00	294.3	153.8	448.2
114.00	304.4	153.8	458.3
115.00	314.5	153.8	468.4
116.00	324.6	153.8	478.5
117.00	334.7	153.8	488.6
118.00	344.8	153.8	498.7
119.00	354.9	153.8	508.8
120.00	365.0	153.8	518.9
121.00	375.1	153.8	529.0
122.00	385.2	153.8	539.1
123.00	395.3	153.8	549.2

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			HP14x117 (half plug).ap8o
124.00	405.4	153.8	559.3
125.00	415.5	153.8	569.4
126.00	425.6	153.8	579.5
127.00	435.7	153.8	589.6
128.00	445.8	153.8	599.7
129.00	455.9	153.8	609.7
130.00	466.0	153.8	619.8

NOTES:

- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00	0.0000E+00	0.0000E+00
			0.0000E+00	0.1000E-01
			0.0000E+00	0.2000E-01
			0.0000E+00	0.4000E-01
			0.0000E+00	0.6000E-01
			0.0000E+00	0.8000E-01
			0.0000E+00	0.1200E+00
			0.0000E+00	0.1600E+00
			0.0000E+00	0.5000E+00
			0.0000E+00	0.1000E+02
2	10	0.3275E+01	0.0000E+00	0.0000E+00
			0.0000E+00	0.1000E-01
			0.0000E+00	0.2000E-01
			0.0000E+00	0.4000E-01
			0.0000E+00	0.6000E-01
			0.0000E+00	0.8000E-01
			0.0000E+00	0.1200E+00
			0.0000E+00	0.1600E+00
			0.0000E+00	0.5000E+00

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			HP14x117 (half plug).ap8o	
3	10	0.6458E+01	0.0000E+00	0.1000E+02
			0.0000E+00	0.0000E+00
			0.0000E+00	0.1000E-01
			0.0000E+00	0.2000E-01
			0.0000E+00	0.4000E-01
			0.0000E+00	0.6000E-01
			0.0000E+00	0.8000E-01
			0.0000E+00	0.1200E+00
			0.0000E+00	0.1600E+00
			0.0000E+00	0.5000E+00
			0.0000E+00	0.1000E+02
4	10	0.6500E+01	0.0000E+00	0.0000E+00
			0.0000E+00	0.1000E-01
			0.0000E+00	0.2000E-01
			0.0000E+00	0.4000E-01
			0.0000E+00	0.6000E-01
			0.0000E+00	0.8000E-01
			0.0000E+00	0.1200E+00
			0.0000E+00	0.1600E+00
			0.0000E+00	0.5000E+00
			0.0000E+00	0.1000E+02
5	10	0.5628E+02	0.0000E+00	0.0000E+00
			0.7595E+00	0.1000E-01
			0.1246E+01	0.2000E-01
			0.1834E+01	0.4000E-01
			0.2177E+01	0.6000E-01
			0.2401E+01	0.8000E-01
			0.2676E+01	0.1200E+00
			0.2839E+01	0.1600E+00
			0.3241E+01	0.5000E+00
			0.3460E+01	0.1000E+02
6	10	0.1060E+03	0.0000E+00	0.0000E+00
			0.8817E+00	0.1000E-01
			0.1613E+01	0.2000E-01
			0.2757E+01	0.4000E-01
			0.3609E+01	0.6000E-01
			0.4270E+01	0.8000E-01
			0.5226E+01	0.1200E+00
			0.5885E+01	0.1600E+00
			0.7924E+01	0.5000E+00
			0.9375E+01	0.1000E+02
7	10	0.1060E+03		

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HP14x117 (half plug).ap8o			
		0.0000E+00	0.0000E+00
		0.1108E+01	0.1000E-01
		0.1989E+01	0.2000E-01
		0.3302E+01	0.4000E-01
		0.4235E+01	0.6000E-01
		0.4931E+01	0.8000E-01
		0.5901E+01	0.1200E+00
		0.6544E+01	0.1600E+00
		0.8417E+01	0.5000E+00
		0.9652E+01	0.1000E+02
8	10	0.1230E+03	
		0.0000E+00	0.0000E+00
		0.1151E+01	0.1000E-01
		0.2132E+01	0.2000E-01
		0.3715E+01	0.4000E-01
		0.4939E+01	0.6000E-01
		0.5912E+01	0.8000E-01
		0.7363E+01	0.1200E+00
		0.8393E+01	0.1600E+00
		0.1174E+02	0.5000E+00
		0.1430E+02	0.1000E+02
9	10	0.1400E+03	
		0.0000E+00	0.0000E+00
		0.1151E+01	0.1000E-01
		0.2132E+01	0.2000E-01
		0.3715E+01	0.4000E-01
		0.4939E+01	0.6000E-01
		0.5912E+01	0.8000E-01
		0.7363E+01	0.1200E+00
		0.8393E+01	0.1600E+00
		0.1174E+02	0.5000E+00
		0.1430E+02	0.1000E+02

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.1598E+01	0.1000E-03
0.1130E+02	0.5000E-02
0.1598E+02	0.1000E-01
0.3574E+02	0.5000E-01
0.5054E+02	0.1000E+00
0.7148E+02	0.2000E+00
0.1130E+03	0.5000E+00

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HP14x117 (half plug).ap8o		
0.1598E+03	0.1000E+01	
0.2260E+03	0.2000E+01	

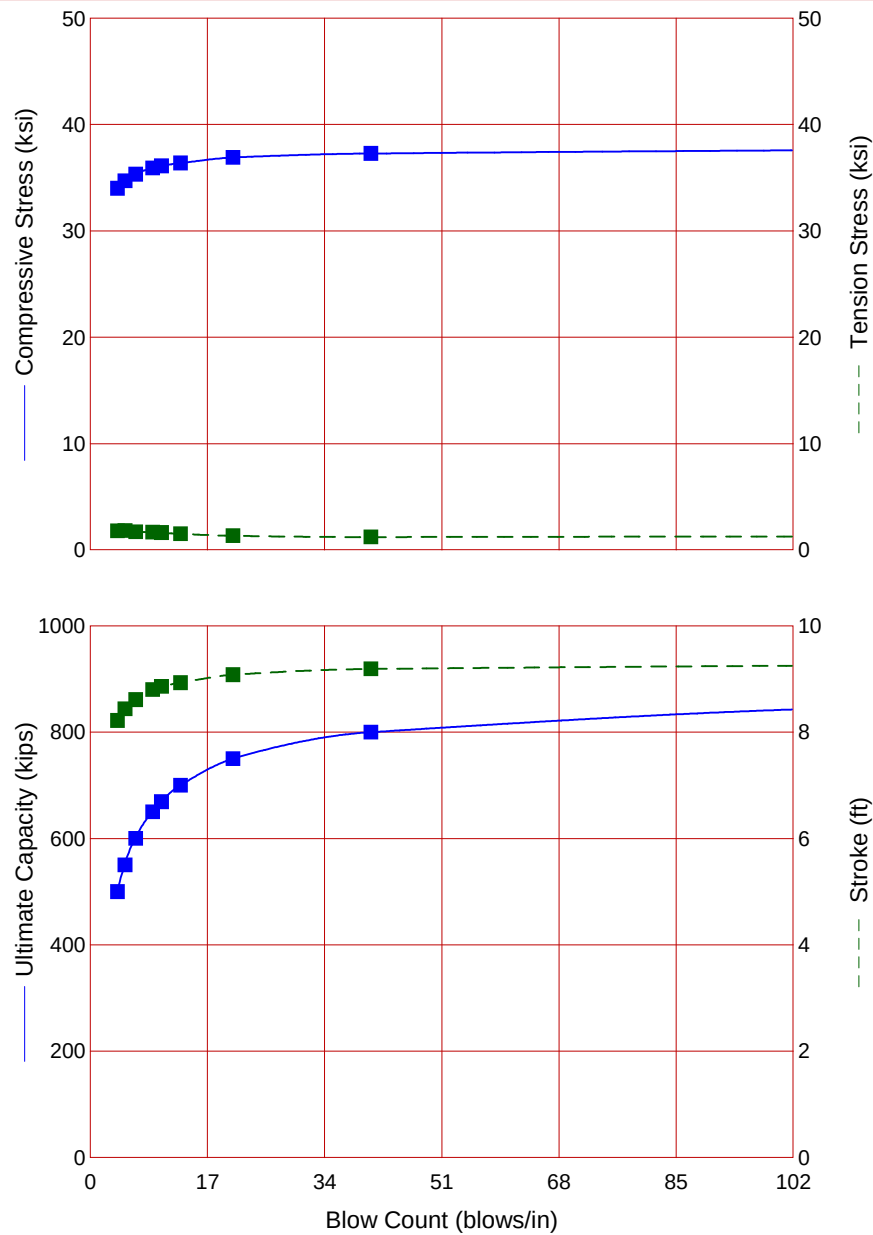
LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.3269E+01	0.1306E-02	0.1598E+01	0.1000E-03
0.1014E+02	0.4434E-02	0.3381E+01	0.1000E-02
0.4006E+02	0.1826E-01	0.1130E+02	0.5000E-02
0.6444E+02	0.3119E-01	0.1598E+02	0.1000E-01
0.1731E+03	0.1085E+00	0.3574E+02	0.5000E-01
0.2448E+03	0.1856E+00	0.5054E+02	0.1000E+00
0.4486E+03	0.6726E+00	0.1130E+03	0.5000E+00
0.5017E+03	0.1199E+01	0.1598E+03	0.1000E+01
0.5807E+03	0.2239E+01	0.2260E+03	0.2000E+01

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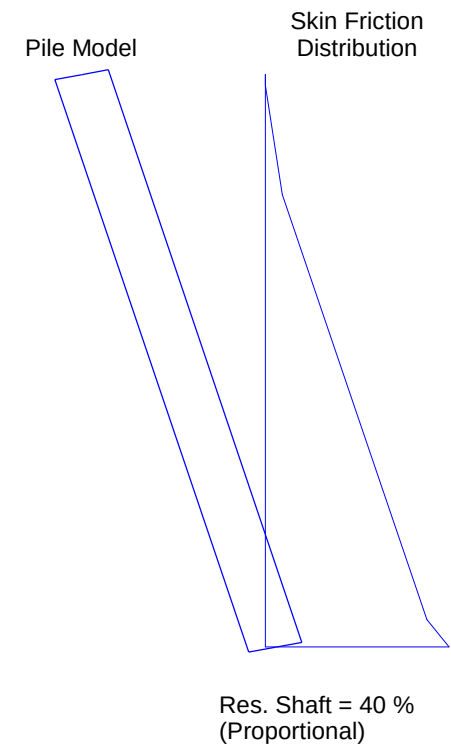
GZA Geo Environmental, Inc.
Pleasant River Bridge - Milo

15-Jul-2020
GRLWEAP Version 2010



DELMAG D 36-32

Ram Weight	7.93 kips
Efficiency	0.800
Pressure	1450 (100%) psi
Helmet Weight	1.90 kips
Hammer Cushion	60155 kips/in
COR of H.C.	0.800
Skin Quake	0.140 in
Toe Quake	0.143 in
Skin Damping	0.200 sec/ft
Toe Damping	0.157 sec/ft
Pile Length	105.00 ft
Pile Penetration	103.00 ft
Pile Top Area	34.40 in ²



GZA Geo Environmental, Inc.
Pleasant River Bridge - Milo

15-Jul-2020
GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count blows/in	Stroke ft	Energy kips-ft
500.0	34.00	1.79	4.0	8.22	40.17
550.0	34.70	1.81	5.1	8.44	40.83
600.0	35.33	1.71	6.6	8.61	41.42
650.0	35.91	1.66	9.1	8.80	41.84
669.0	36.11	1.62	10.4	8.86	42.06
700.0	36.37	1.51	13.1	8.93	42.39
750.0	36.90	1.33	20.7	9.08	42.80
800.0	37.28	1.21	40.8	9.19	43.12
850.0	37.62	1.28	131.7	9.26	43.23
900.0	37.93	1.31	9999.0	9.34	43.43

HP14x117 (no plug).ap8o

APILE for Windows, Version 2018.8.5

Serial Number : 653550831

A Program for Analyzing the Axial Capacity
and Short-term Settlement of Driven Piles
under Axial Loading.
(c) Copyright ENSOFT, Inc., 1987-2015
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This program is licensed to :

GZA GeoEnvironmental, Inc.
Portland, OR

Path to file locations : P:\09 Jobs\0025900s\09.0025972.00 - Pleasant River Bridge, Milo\09.0025972.01 - Final
Design\Work\Calcs\APile\Final APile for WEAP\Pier\
Name of input data file : HP14x117 (no plug).ap8d
Name of output file : HP14x117 (no plug).ap8o
Name of plot output file : HP14x117 (no plug).ap8p

Time and Date of Analysis

Date: July 01, 2020 Time: 09:29:17

1

* INPUT INFORMATION *

DESIGNER : B.Cardali

JOB NUMBER : 09.0025972.00

Page 1

HP14x117 (no plug).ap8o

METHOD FOR UNIT LOAD TRANSFERS :

- USACE (U.S. Army Corps of Engineers)
Unfactored Unit Side Friction and Unit Side Resistance are used.

COMPUTATION METHOD(S) FOR PILE CAPACITY :

- USACE (U.S. Army Corps of Engineers)
Critical Depth Method for Sand:
10 to 20 Pile Diameter based on the Density
Use Long Pile Option

TYPE OF LOADING :
- COMPRESSION

PILE TYPE :

H-Pile/Steel Pile

DATA FOR AXIAL STIFFNESS :

- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 34.40 IN2

NONCIRCULAR PILE PROPERTIES :

- TOTAL PILE LENGTH, TL = 103.00 FT.
- BATTER ANGLE = 14.00 DEG
- PILE STICKUP LENGTH, PSL = 0.00 FT.
- ZERO FRICTION LENGTH, ZFL = 0.00 FT.
- PERIMETER OF PILE = 58.20 IN.
- TIP AREA OF PILE = 34.40 IN2
- INCREMENT OF PILE LENGTH
USED IN COMPUTATION = 1.00 FT.

SOIL INFORMATIONS :

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HP14x117 (no plug).ap8o

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/CF	FRICTION ANGLE DEGREES	BEARING CAPACITY FACTOR
0.00	SAND	1.25	63.00	35.00	50.00
78.00	SAND	1.25	63.00	35.00	50.00
78.00	SAND	1.25	67.60	40.00	50.00
140.00	SAND	1.25	67.60	40.00	50.00

MAXIMUM UNIT FRICTION KSF	MAXIMUM UNIT BEARING KSF	UNDISTURB SHEAR STRENGTH KSF	REMOLDED SHEAR STRENGTH KSF	BLOW COUNT	UNIT SKIN FRICTION KSF	UNIT END BEARING KSF
0.50E+00	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.50E+00	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	0.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
WERE SET TO BE 0.10E+08 BECAUSE THE USER DOES NOT
PLAN TO LIMIT THE COMPUTED DATA.

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
78.00	1.000	1.000
78.00	1.000	1.000
140.00	1.000	1.000

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* COMPUTATION RESULT *

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HP14x117 (no plug).ap8o

* ARMY CORPS METHOD *

PILE LENGTH BELOW GND. FT.	DEPTH BELOW GND. FT.	TOTAL SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.00	0.0	0.4	0.4
1.00	0.97	0.1	0.8	0.9
2.00	1.94	0.5	1.4	1.9
3.00	2.91	1.1	2.2	3.3
4.00	3.88	2.0	2.9	4.9
5.00	4.85	3.2	3.6	6.8
6.00	5.82	4.6	4.3	8.9
7.00	6.79	6.3	5.1	11.3
8.00	7.76	8.2	5.8	14.0
9.00	8.73	10.3	6.5	16.8
10.00	9.70	12.8	7.2	20.0
11.00	10.67	15.2	8.0	23.1
12.00	11.64	17.6	8.7	26.3
13.00	12.61	20.0	9.4	29.4
14.00	13.58	22.5	10.1	32.6
15.00	14.55	24.9	10.8	35.7
16.00	15.52	27.3	11.6	38.9
17.00	16.50	29.7	12.3	42.0
18.00	17.47	32.2	13.0	45.2
19.00	18.44	34.6	13.7	48.3
20.00	19.41	37.0	14.5	51.5
21.00	20.38	39.4	15.2	54.6
22.00	21.35	41.9	15.9	57.8
23.00	22.32	44.3	16.5	60.8
24.00	23.29	46.7	17.0	63.7
25.00	24.26	49.1	17.2	66.4
26.00	25.23	51.6	17.3	68.9
27.00	26.20	54.0	17.3	71.3
28.00	27.17	56.4	17.3	73.7
29.00	28.14	58.8	17.3	76.1
30.00	29.11	61.3	17.3	78.5
31.00	30.08	63.7	17.3	80.9
32.00	31.05	66.1	17.3	83.4
33.00	32.02	68.5	17.3	85.8
34.00	32.99	71.0	17.3	88.2
35.00	33.96	73.4	17.3	90.6
36.00	34.93	75.8	17.3	93.1
37.00	35.90	78.2	17.3	95.5

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HP14x117 (no plug).ap8o				
38.00	36.87	80.7	17.3	97.9
39.00	37.84	83.1	17.3	100.3
40.00	38.81	85.5	17.3	102.8
41.00	39.78	87.9	17.3	105.2
42.00	40.75	90.4	17.3	107.6
43.00	41.72	92.8	17.3	110.0
44.00	42.69	95.2	17.3	112.5
45.00	43.66	97.6	17.3	114.9
46.00	44.63	100.1	17.3	117.3
47.00	45.60	102.5	17.3	119.7
48.00	46.57	104.9	17.3	122.2
49.00	47.54	107.3	17.3	124.6
50.00	48.51	109.8	17.3	127.0
51.00	49.49	112.2	17.3	129.4
52.00	50.46	114.6	17.3	131.9
53.00	51.43	117.0	17.3	134.3
54.00	52.40	119.5	17.3	136.7
55.00	53.37	121.9	17.3	139.1
56.00	54.34	124.3	17.3	141.6
57.00	55.31	126.7	17.3	144.0
58.00	56.28	129.2	17.3	146.4
59.00	57.25	131.6	17.3	148.8
60.00	58.22	134.0	17.3	151.3
61.00	59.19	136.4	17.3	153.7
62.00	60.16	138.9	17.3	156.1
63.00	61.13	141.3	17.3	158.5
64.00	62.10	143.7	17.3	161.0
65.00	63.07	146.1	17.3	163.4
66.00	64.04	148.6	17.3	165.8
67.00	65.01	151.0	17.3	168.2
68.00	65.98	153.4	17.3	170.7
69.00	66.95	155.8	17.3	173.1
70.00	67.92	158.3	17.3	175.5
71.00	68.89	160.7	17.3	177.9
72.00	69.86	163.1	17.3	180.4
73.00	70.83	165.5	17.3	182.8
74.00	71.80	168.0	17.3	185.2
75.00	72.77	170.4	17.3	187.6
76.00	73.74	172.8	17.3	190.1
77.00	74.71	175.2	17.3	192.5
78.00	75.68	177.7	17.3	194.9
79.00	76.65	180.1	19.2	199.3
80.00	77.62	182.5	24.1	206.6
81.00	78.59	186.8	29.1	215.8
82.00	79.56	194.6	34.0	228.7
83.00	80.53	204.2	39.0	243.2

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HP14x117 (no plug).ap8o				
84.00	81.50	213.8	40.9	254.7
85.00	82.48	223.5	40.9	264.3
86.00	83.45	233.1	40.9	274.0
87.00	84.42	242.7	40.9	283.6
88.00	85.39	252.3	40.9	293.2
89.00	86.36	261.9	40.9	302.8
90.00	87.33	271.5	40.9	312.4
91.00	88.30	281.1	40.9	322.0
92.00	89.27	290.7	40.9	331.6
93.00	90.24	300.3	40.9	341.2
94.00	91.21	309.9	40.9	350.8
95.00	92.18	319.6	40.9	360.5
96.00	93.15	329.2	40.9	370.1
97.00	94.12	338.8	40.9	379.7
98.00	95.09	348.4	40.9	389.3
99.00	96.06	358.0	40.9	398.9
100.00	97.03	367.6	40.9	408.5
101.00	98.00	377.2	40.9	418.1
102.00	98.97	386.8	40.9	427.7
103.00	99.94	396.4	40.9	437.3

NOTES:

- AN ASTERISK IS PLACED IN THE END-BEARING COLUMN
IF THE TIP RESISTANCE IS CONTROLLED BY THE FRICTION
OF SOIL PLUG INSIDE AN OPEN-ENDED PIPE PILE.

* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING *

T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.0000E+00	0.0000E+00	0.0000E+00
			0.0000E+00	0.1000E-01
			0.0000E+00	0.2000E-01
			0.0000E+00	0.4000E-01
			0.0000E+00	0.6000E-01
			0.0000E+00	0.8000E-01
			0.0000E+00	0.1200E+00

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HP14x117 (no plug).ap8o			
2	10	0.3903E+02	0.0000E+00
			0.1600E+00
			0.0000E+00
			0.5000E+00
			0.0000E+00
			0.1000E+02
			0.0000E+00
			0.0000E+00
			0.7595E+00
			0.1000E-01
3	10	0.7796E+02	0.1246E+01
			0.2000E-01
			0.1834E+01
			0.4000E-01
			0.2177E+01
			0.6000E-01
			0.2401E+01
			0.8000E-01
			0.2676E+01
			0.1200E+00
4	10	0.7800E+02	0.2839E+01
			0.1600E+00
			0.3241E+01
			0.5000E+00
			0.3460E+01
			0.1000E+02
			0.0000E+00
			0.0000E+00
			0.7595E+00
			0.1000E-01
5	10	0.1090E+03	0.1246E+01
			0.2000E-01
			0.1834E+01
			0.4000E-01
			0.2177E+01
			0.6000E-01
			0.2401E+01
			0.8000E-01
			0.2676E+01
			0.1200E+00
			0.2839E+01
			0.1600E+00
			0.3241E+01
			0.5000E+00
			0.3463E+01
			0.1000E+02
			0.0000E+00
			0.0000E+00
			0.9191E+00
			0.1000E-01
			0.1453E+01
			0.2000E-01
			0.2049E+01
			0.4000E-01
			0.2373E+01
			0.6000E-01
			0.2577E+01
			0.8000E-01
			0.2820E+01
			0.1200E+00
			0.2959E+01
			0.1600E+00
			0.3289E+01
			0.5000E+00
			0.3463E+01
			0.1000E+02
			0.0000E+00
			0.0000E+00
			0.1146E+01
			0.1000E-01
			0.2116E+01
			0.2000E-01
			0.3667E+01
			0.4000E-01
			0.4854E+01
			0.6000E-01
			0.5791E+01
			0.8000E-01
			0.7177E+01
			0.1200E+00
			0.8152E+01
			0.1600E+00
			0.1128E+02
			0.5000E+00
			0.1361E+02
			0.1000E+02
			0.0000E+00
			0.0000E+00
			0.1146E+01
			0.1000E-01
			0.2116E+01
			0.2000E-01
			0.3667E+01
			0.4000E-01
			0.4854E+01
			0.6000E-01
			0.5791E+01
			0.8000E-01
			0.7177E+01
			0.1200E+00
			0.8152E+01
			0.1600E+00
			0.1128E+02
			0.5000E+00
			0.1361E+02
			0.1000E+02
			0.0000E+00
			0.0000E+00
			0.1146E+01
			0.1000E-01

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HP14x117 (no plug).ap8o			
6	10	0.1400E+03	0.1361E+02
			0.1000E+02
			0.0000E+00
			0.0000E+00
			0.1146E+01
			0.1000E-01
			0.2116E+01
			0.2000E-01
			0.3667E+01
			0.4000E-01
			0.4854E+01
			0.6000E-01
			0.5791E+01
			0.8000E-01
			0.7177E+01
			0.1200E+00
			0.8152E+01
			0.1600E+00
			0.1128E+02
			0.5000E+00
			0.1361E+02
			0.1000E+02
			0.0000E+00
			0.0000E+00
			0.1146E+01
			0.1000E-01
			0.2116E+01
			0.2000E-01
			0.3667E+01
			0.4000E-01
			0.4854E+01
			0.6000E-01
			0.5791E+01
			0.8000E-01
			0.7177E+01
			0.1200E+00
			0.8152E+01
			0.1600E+00
			0.1128E+02
			0.5000E+00

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.4249E+00	0.1000E-03
0.3004E+01	0.5000E-02
0.4249E+01	0.1000E-01
0.9501E+01	0.5000E-01
0.1344E+02	0.1000E+00
0.1900E+02	0.2000E+00
0.3004E+02	0.5000E+00
0.4249E+02	0.1000E+01
0.6009E+02	0.2000E+01

LOAD VERSUS SETTLEMENT CURVE

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.1924E+01	0.1253E-02	0.4249E+00	0.1000E-03
0.8312E+01	0.5585E-02	0.8987E+00	0.1000E-02
0.3367E+02	0.2448E-01	0.3004E+01	0.5000E-02
0.5493E+02	0.4334E-01	0.4249E+01	0.1000E-01
0.1429E+03	0.1491E+00	0.9501E+01	0.5000E-01
0.1936E+03	0.2435E+00	0.1344E+02	0.1000E+00
0.3183E+03	0.7636E+00	0.3004E+02	0.5000E+00
0.3352E+03	0.1283E+01	0.4249E+02	0.1000E+01

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0.3617E+03	0.2313E+01	0.6009E+02	HP14x117 (no plug).ap8o 0.2000E+01
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0.3617E+03	0.2313E+01	0.6009E+02	HP14x117 (no plug).ap8o 0.2000E+01
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Soil Filter Compatibility Calculation



Soil Filter Compatibility Calculation

Project: Pleasant Street Bridge #3244 **Project No.:** 09.0025972.01
Location: Milo, ME
Calculated By: B. Cardali **Date:** 7/16/2020
Checked By: A. Blaisdell/C. Snow **Date:** 7/21/2020

Objective: Evaluate Cushion Sand compatibility with natural soils 15 feet below the bottom of abutment elevation and determine the required particle size distribution.

Reference: Naval Facilities Engineering Command (NAVFAC) DM 7.1-273 Chapter 6 Section 4 Section

Subsurface Data: Borings BB-MPR-201 and -202 were drilled by NEBC of Hermon, Maine between October 8 and October 24, 2019. Laboratory testing results for sieves conducted in the upper portions of the boreholes in the range of the 15 feet below the bottom of the abutment.

Approach: Evaluate filter compatibility of the proposed Cushion Sand with the native Alluvial deposit using the methodology presented in NAVFAC DM 7.1 Chapter 6 Section 4. The three criteria provided for General Requirement 2, shown below, are used to assess likelihood of movement of particles with ground water flow:

Criteria 1:
$$\frac{D_{15}(\text{Filter})}{D_{85}(\text{Base})} < 5$$

Criteria 2:
$$\frac{D_{50}(\text{Filter})}{D_{50}(\text{Base})} < 25$$

Criteria 3:
$$\frac{D_{15}(\text{Filter})}{D_{15}(\text{Base})} < 20$$

Summary: As presented in the grain size distribution chart, the Cushion Sand Material can be coarser or finer than the natural soils, therefore, we evaluated the cushion sand as either the filter or the base against each available sieve to evaluate the range of conditions. The results indicate that Cushion Sand with the particle size distribution shown below meets all three filter criteria for the range of sieve analyses and is judged to be acceptable to control the movement of particles between the layers.

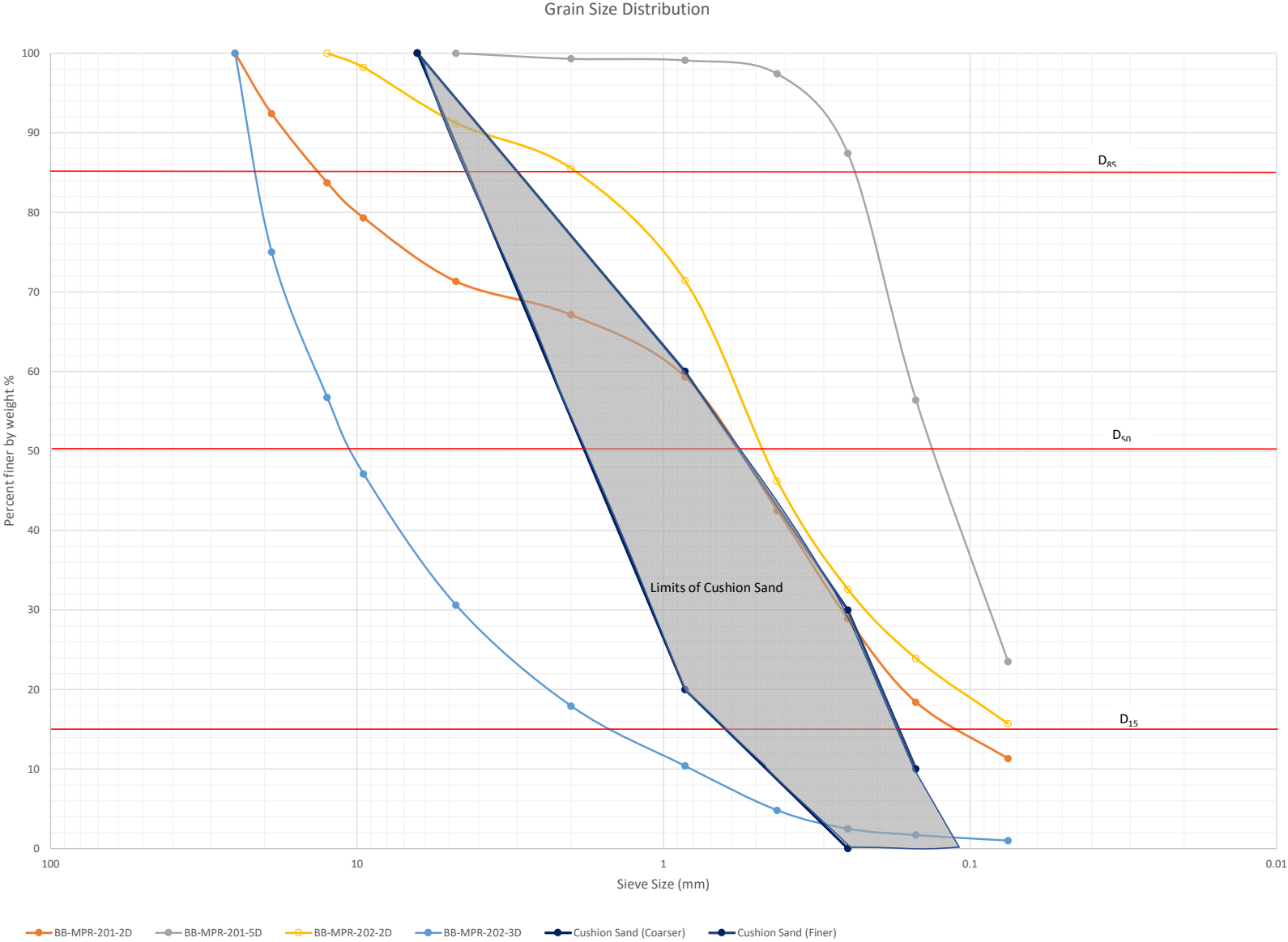
Recommended Cushion Sand Gradation:

Sieve Designation	Percentage by Weight Passing Square Mesh
	Cushion Sand
1/4-inch	100
No. 20	20 - 60
No. 60	0 - 30
No. 100	0 - 10



Particle Size Distribution of Materials							
Sieve	Sieve (mm)	Cushion Sand (Coarser)	Cushion Sand (Finer)	Alluvial Deposit			
				BB-MPR-201-2D	BB-MPR-201-5D	BB-MPR-202-2D	BB-MPR-202-3D
				Percent Passing by Weight			
3"	75						
2"	50						
1.5"	37.5						
1"	25			100			100
3/4"	19			92.4			75
1/2"	12.5			83.7		100	56.7
3/8"	9.525			79.3		98.2	47.1
1/4"	6.35	100	100				
# 4	4.75			71.3	100	91.2	30.6
#10	2			67.1	99.3	85.5	17.9
#20	0.85	20	60	59.3	99.1	71.4	10.4
#40	0.425			42.5	97.4	46.2	4.8
#50	0.297						
#60	0.25	0	30	28.9	87.4	32.6	2.5
#100	0.15	0	10	18.4	56.4	23.9	1.7
#200	0.075			11.3	23.5	15.7	1
D85		4.5	3	13.6	0.237	1.88	21.6
D50		2.3	0.55	0.563	0.134	0.474	10.4
D15		0.62	0.16	0.115	0.05	0.04	1.5
Cushion Sand (Fine) as the Coarser Material							
Criteria 1	D15F/D85B			0.01	0.68	0.09	0.01
Criteria 2	D50F/D50B			0.98	4.10	1.16	0.05
Criteria 3	D15F/D15B			1.39	3.20	4.00	0.11
Cushion Sand (Coarse) as the Coarser Material							
Criteria 1	D15F/D85B			0.05	2.62	0.33	0.03
Criteria 2	D50F/D50B			4.09	17.16	4.85	0.22
Criteria 3	D15F/D15B			5.39	12.40	15.50	0.41
Cushion Sand (Fine) as the Finer Material							
Criteria 1	D15F/D85B			0.04	0.02	0.01	0.50
Criteria 2	D50F/D50B			1.02	0.24	0.86	18.91
Criteria 3	D15F/D15B			0.72	0.31	0.25	9.38
Cushion Sand (Coarse) as the Finer Material							
Criteria 1	D15F/D85B			0.03	0.01	0.01	0.33
Criteria 2	D50F/D50B			0.24	0.06	0.21	4.52
Criteria 3	D15F/D15B			0.19	0.08	0.06	2.42

*Bold values indicate criteria has been met



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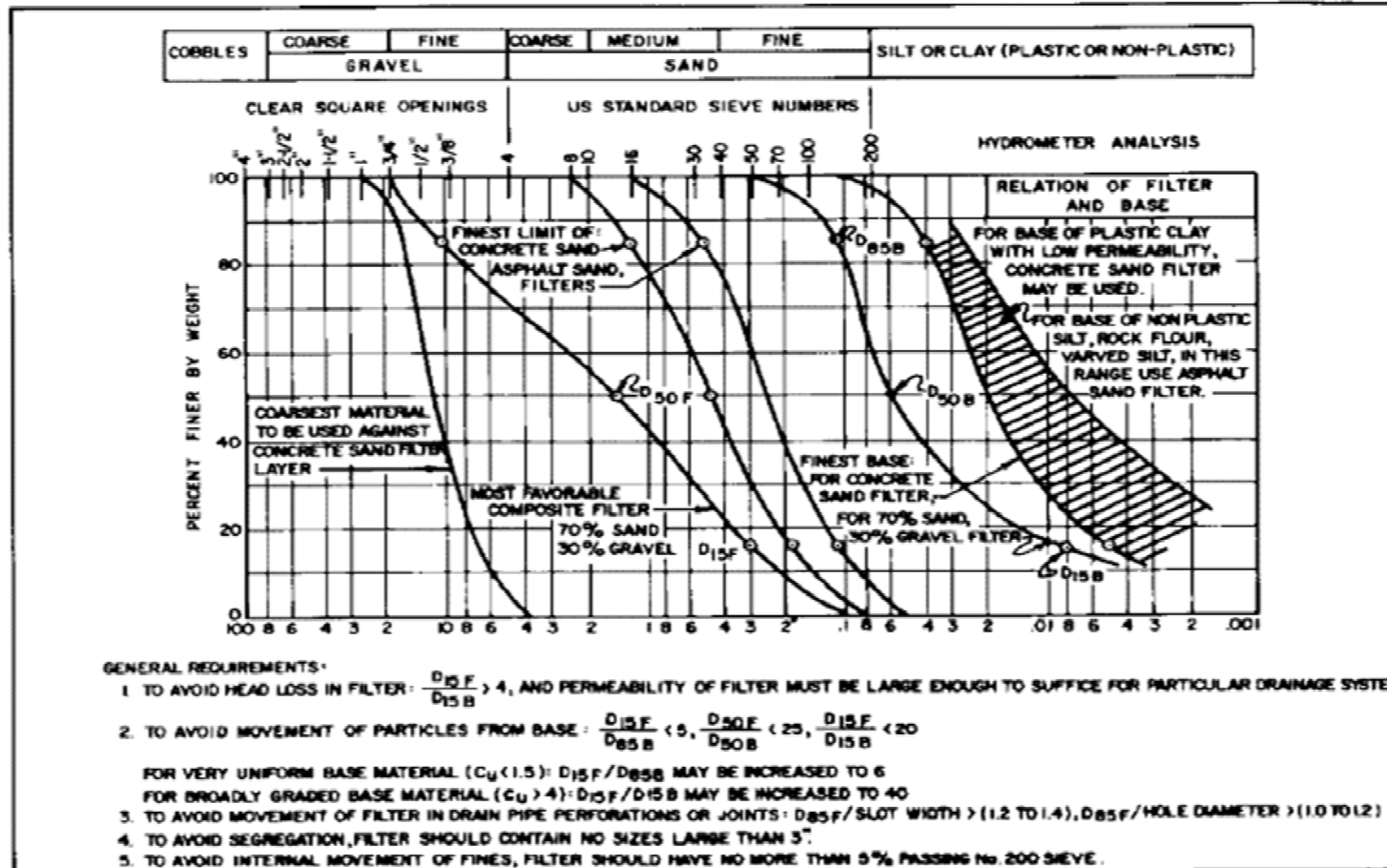


FIGURE 4 (continued)
Design Criteria for Protective Filters