GEI Consultants

Geotechnical Design Report

Mill Cove New Bridge (#6205) over Mill Cove WIN 026630.06

Robbinston, Maine

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Project No. 2502334

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Executive Summary

This report presents the results of our subsurface explorations and geotechnical recommendations for the proposed replacement of the existing Mill Cove Bridge (#6205), which carries South River Road (Route 1) over Mill Cove, in Robbinston, Washington County, Maine.

Our recommendations in this report are based on our review of the results of preliminary (Phase 1) and final design phase (Phase 2) subsurface exploration programs conducted by New England Boring Contractors (NEBC) of Hermon, Maine. The Phase 1 subsurface exploration program took place from March 25 to April 11, 2024, during which four borings (BB-RMC-101 through BB-RMC-104) were advanced at the location of the proposed bridge. The Phase 2 subsurface exploration program occurred between May 12 and May 13, 2025, and included two additional borings (BB-RMC-201 and BB-RMC-202) to evaluate the subsurface conditions in an area that has had recent shallow slope failures. Soil sampling was performed at 5-foot intervals using Standard Penetration Testing (SPT). At least 10 feet of bedrock was cored in three borings (BB-RMC-101 through BB-RMC-103), 3 feet of bedrock was cored in boring BB-RMC-104, and 5 feet of bedrock was cored in boring BB-RMC-201. Boring BB-RMC-202 was not advanced into bedrock. A GEI Consultants, Inc. engineer observed and documented the borings.

The Phase 1 borings (BB-RMC-101 through BB-RMC-104) encountered approximately 75 to 89 feet of fill and glacial till overlying conglomerate bedrock. Phase 2 borings (BB-RMC-201 and BB-RMC-202) encountered approximately 42 to more than 50 feet of fill and glacial till overlying conglomerate bedrock. Bedrock was encountered in the Phase 1 borings from approximately El. -38.7 to El. -52.2 (74.7 to 89.0 feet below ground surface), and at approximately El. 0.7 (41.6 feet below ground surface) in Phase 2 boring BB-RMC-201. Boring BB-RMC-202 encountered 37 feet of fill and was terminated 19 feet into glacial till. The borings were terminated between El. -4.8 to El. -55.8 (47.1 to 93.0 feet below ground surface).

Based on our pile design analyses, we recommend that HP14x117 piles approximately 65 to 76 feet in length at Abutments 1 and 2, respectively, be driven to top of bedrock or until a nominal geotechnical resistance of 553 kips is verified by Dynamic Load Testing (DLT) on at least one pile per abutment. Based on lateral stability analyses, a minimum pile embedment of 29 feet below the bottom of the pile cap is required for fixity; however, pile lengths will be controlled by axial resistance requirements. Predrilling may be required if refusal occurs due to the presence of boulders and cobbles which were encountered in the fill and glacial till during the subsurface exploration programs. All the H-piles should be equipped with driving shoes due to the potential for hard driving conditions. Piles can be spaced at 6 feet on-center in a single row and oriented with the weak axis bending (pile webs perpendicular to the centerline of the girder).

Our professional services for this project have been performed in accordance with generally accepted engineering practices; no warranty, express or implied, is made.

1. Introduction

1.1. Purpose

This report presents the results of the subsurface explorations, our evaluation of the existing subsurface conditions, and our geotechnical recommendations for design and construction of the proposed replacement of Mill Cove New Bridge (#6205), which carries South River Road (Route 1) over Mill Cove, in Robbinston, Washington County, Maine as shown in Sheet 1.

1.2. Scope

Our scope of work included:

- Reviewing available published geologic data for the project vicinity and the design drawings of the existing bridge.
- Preparing a Health and Safety Plan prior to conducting field activities.
- Preparing a Traffic Control Plan in accordance with Work Zone Traffic Control Guidebook, MaineDOT, March 2015, and the MUTCD (FHWA).
- Engaging a drilling subcontractor to complete preliminary (Phase 1) and final design (Phase 2) subsurface exploration programs.
- Providing full-time observation during the subsurface exploration programs and classification of the soil samples in general accordance with Maine Department of Transportation (MaineDOT) guidelines.
- Engaging a third-party laboratory to perform Atterberg limits, grain size analyses, and water contents of representative soil samples.
- Reviewed the results of the subsurface explorations, prepared a subsurface profile, and developed soil properties for geotechnical analysis.
- Developed geotechnical recommendations for the design and construction of a new integral abutment bridge supported on driven H-piles.
- Preparing this geotechnical design report presenting the results of the subsurface explorations and our geotechnical analyses and recommendations.

1.3. Authorization

We performed this work in accordance with our proposal revised April 16, 2025, and the email notice to proceed from MaineDOT on April 17, 2025.

1.4. Project Personnel

The following personnel at GEI were involved with the field exploration, evaluations, recommendations, and preparation of this report:

Michael Johnescu, P.E.	Project Manager
Laureen Beintum, P.E. (MA)	In-house Consultant
Nicolas Betancur, P.E.	Senior Geotechnical Engineer
Sebastian Carvajal	Staff Engineer
Madeleine Schoeff	Staff Engineer
Yonathan Sojo	Drafter

1.5. Elevation Datum

Elevations in this report are in feet and are referenced to the 1988 North American Vertical Datum (NAVD 1988).

2. Site and Project Description

2.1. Site and Project Description

We understand that MaineDOT is considering replacing Mill Cove New Bridge (#6205), which carries South River Road (Route 1) over Mill Cove in Robbinston, Maine. Sheet 1 shows the site location map. Mill Cove New Bridge is a 15-foot-diameter, 156-foot-long, aluminum alloy structural plate pipe culvert that was constructed in 1967. The existing site survey indicates the top of roadway is roughly El. 37, and the culvert inverts are El. 3.5 and El. 0.5 on the upstream and downstream sides, respectively. The grade downstream of the culvert is approximately El. -6.0.

Based on the Maine State Highway Commission as-built drawings dated 1967 for the culvert, the roadway final grade is about El. 36 (datum unknown) and about 18 feet of fill was used to raise grades from the existing to the final grade. Maine Highway Commission drawings from 1928 for the bridge located about 75 feet upstream of the culvert (Bridge #2559 built in 1929) indicate the bridge footings are founded at El. -3.0 (datum unknown) on “clay and rocks.”

According to the Highway Bridge Inspection Report dated September 7, 2021, the downstream 10 feet of culvert was “hanging” or unsupported based on culvert soundings. There were also missing and rusted bolts, a 2-inch drilled hole that was seeping water and gravel, and the concrete collar around the upstream end of the culvert was severely deteriorated.

2.2. Proposed Construction

The proposed replacement bridge will be a 120-foot-span, 35-foot-wide single span integral abutment bridge supported on six (6) HP 14x117 piles spaced 6’-0” on-center. Grade raises are expected to be minimal, with finished grade elevations of approximately El. 37.0 and El. 38 at Abutments 1 and 2, respectively. Channel and slope protection consisting of heavy riprap will be placed at approximate slopes of 1.75H:1V and 2H:1V, depending on the location.

2.3. Project Design Basis

Our recommendations are based on the Maine Department of Transportation (MaineDOT) Bridge Design Guide (BDG), dated August 2003 and revised June 2018. Our recommendations conform to the AASHTO 2020 LRFD Bridge Design Specifications, 9th Edition.

3. Subsurface Conditions

3.1. Site Geology

The Reconnaissance Surficial Geology of the Robbinston Quadrangle, Maine, prepared by the Maine Geological Survey in 1974, indicates the surficial material in the area of the bridge is Presumpscot Formation, which consists of glaciomarine silt, clay, and sand. In this location, the unit is described as mostly low permeability silt and clay. However, Presumpscot Formation was not encountered in the boring explorations, instead artificial fill generally consisting of mixtures of fine to coarse sand and gravel with boulders and cobbles were encountered. Areas of glacial till are mapped north and south of the bridge, and consist of a heterogeneous mixture of sand, silt, clay, and stones. The glacial till can either be basal till or ablation till. Basal till is described as fine grained and very compact, with low permeability and poor drainage. Ablation till is described as loose, sandy, and stony with moderate permeability and fair to good drainage. The surficial geology map is shown in Fig. A-1 in Appendix A.

The Bedrock Geology of the Devils Head, Robbinston, and Red Beach Quadrangles, Maine, prepared by the Maine Geological Survey in 1986, indicates bedrock at the site consists of the Perry Formation, described as red cobble and pebble alluvial conglomerate with interbedded arkosic sandstone with clasts from underlying granite, volcanic rocks, and sedimentary rocks. The bedrock geology map is shown in Fig. A-2, Appendix A.

3.2. 2024 Subsurface Exploration Program

New England Boring Contractors (NEBC) of Hermon, Maine drilled four borings (BB-RMC-101 through BB-RMC-104) between March 25 and April 11, 2024. The boring locations are shown in Sheet 2. The boring locations were chosen in the field based on access and clearance from existing utilities. A GEI field engineer coordinated the drilling and logged the borings. Boring logs are provided in Appendix B.1. The as-drilled boring locations were surveyed by MaineDOT. The boring locations and elevations are included on the boring logs and summarized in Table 1.

A Mobile B-53 track-mounted drill rig was used to advance the borings. The borings were drilled using solid stem augers (SSA) for the first several feet of fill material, and then 4-inch-inside-diameter (HW) (ID) and 3-inch-ID (NW) steel casing was advanced with drive and wash or spin and wash techniques. Open hole drilling with drilling mud was also utilized in borings BB-RMC-103 and -104 in the glacial till layer. NEBC advanced ahead of the casing with the rotary bit at various depths due to the dense nature of the overburden and the presence of boulders and cobbles. Bedrock was cored using a 2-inch, NQ-sized core barrel. Borings were advanced to depths of about 86 to 93 feet below existing grade.

Standard Penetration Tests (SPT) were obtained at approximate 5-foot depth intervals in all borings. The split spoons were advanced with an automatic hammer consisting of a hydraulically actuated 140-lb weight falling 30 inches in accordance with ASTM D 1586. At least 10 feet of bedrock was cored at borings BB-RMC-101 through and BB-RMC-103. In boring BB-RMC-104, only 3 feet of probable bedrock was cored because the core barrel could not advance through the casing due to a pinch at the casing shoe. NEBC provided the Standard Penetration Test Energy Measurement Calibration Report prepared by

GZA GeoEnvironmental, Inc. for the Mobile B-53 drill rig used at the site. The calibration results for the automatic hammer (NEBC D-28) indicate an average energy transfer ratio of 76.5%. Therefore, we used a hammer energy ratio correction factor of C_E =1.28 to correct SPT N Values for hammer energy.

Recovered split-spoon soil samples were placed in jars, and rock core samples were placed in wooden boxes. The soil and rock samples were sent to our Portland, Maine office for verification of field classification. Individual sample descriptions are provided in the boring logs in Appendix B.1. Rock core photographs are provided in Appendix B.2.

Borings BB-RMC-101 through BB-RMC-104 were backfilled with bentonite chips, soil cuttings, and gravel, and patched with asphalt upon completion.

3.3. 2025 Phase 2 Subsurface Exploration Program

GEI engaged NEBC of Hermon, Maine to drill two additional borings (BB-RMC-201 and BB-RMC-202) between May 12, 2025 and May 13, 2025. The borings were drilled south of the proposed bridge at approximately stations 19+03 and 21+05 as shown on Sheet 2. The purpose of the borings was to obtain subsurface information to support the slope stability analyses along the causeway within the observed slope failure areas. A GEI field engineer coordinated the drilling and logged the borings. The as-drilled boring locations are approximate and were measured in the field from the existing site features. The ground surface elevations are approximate and were estimated from a topographic survey provided by MaineDOT. The boring locations and elevations are included on the boring logs and summarized in Table 1. Boring logs are provided in Appendix B.1.

A Mobile B-53 track-mounted drill rig was used to advance the borings. The borings were drilled using a combination of solid stem augers (SSA) for the first 4 feet of fill material, then 4-inch-inside-diameter (HW) (ID) and 3-inch-ID (NW) steel casing was advanced with drive and wash or spin and wash drilling techniques. A tri-cone roller bit with water was used to clean the soil cuttings from inside the casing. NEBC advanced ahead of the casing with the rotary bit at various depths due to the dense nature of the overburden and the presence of boulders and cobbles. Bedrock was cored using a 2-inch, NQ-sized core barrel in boring BB-RMC-201. Borings BB-RMC-201 and BB-RMC-202 were advanced to depths of about 47.1 and 56 feet below existing grade, respectively.

SPT were obtained at approximate 5-foot depth intervals in all borings. The split-spoon samples were advanced with an automatic hammer consisting of a hydraulically actuated 140-lb weight falling 30 inches in accordance with ASTM D 1586. About 5 feet of bedrock was cored in boring BB-RMC-201. NEBC provided the Standard Penetration Test Energy Measurement Calibration Report prepared by GZA GeoEnvironmental, Inc. for the Mobile B-53 drill rig used at the site. The calibration results for the automatic hammer (NEBC D-23) indicate an average energy transfer ratio of 83.4%. Therefore, we used a hammer energy ratio correction factor of C_E =1.39 to correct SPT N Values for hammer energy.

Recovered split-spoon samples were placed in jars, and rock core samples were placed in wooden boxes. The soil and rock samples were sent to our Portland, Maine office for verification of field classification. Individual sample descriptions are provided in the boring logs in Appendix B.1. Rock core photographs are provided in Appendix B.2. Automatic hammer calibration summary tables are provided in Appendix B.3.

Borings BB-RMC-201 and BB-RMC-202 were backfilled with soil cuttings and gravel and patched with asphalt upon completion.

3.4. Sample Review

The soil samples from the borings were examined at the office by Michael Johnescu. The field engineer examined the rock core samples and calculated the Rock Quality Designations (RQDs) of the rock core samples in the field. Based on our review, it is our opinion that the descriptions in the boring logs in Appendix B.1 are a reasonable characterization of the conditions encountered.

3.5. Laboratory Testing

We engaged Soil Metrics, LLC of Cape Elizabeth, Maine to perform grain size analyses (ASTM D 6913) on 16 soil samples and Atterberg limits (ASTM D 4318) on 8 soil samples. Moisture content tests (ASTM D 2216) were also obtained on grain size and Atterberg limit tests samples to confirm the sample descriptions and to provide data for engineering analyses. The gradation results and Atterberg limit results are provided in Tables 2 and 3, respectively, and the compiled lab results are provided in Appendix C.

3.6. Subsurface Conditions

The materials encountered in the borings are described below in order of increasing depth. Conditions are only known at the boring locations, and conditions between borings may differ from those indicated below and shown in the interpretive subsurface profile in Sheet 3.

The soil descriptions below refer to N_{60}, which is the measured N-value corrected to an equivalent hammer energy of 60 percent efficiency (i.e., the standard energy assumed in many SPT correlations). Field-measured N-values as well as corrected, N_{60} values are reported on the boring logs in Appendix B.1.

- Existing Fill – Granular fill was encountered in all six borings and ranged in thickness between 26.2 and 41.2 feet. An approximately 8- to 11-inch-thick layer of asphalt was encountered above the fill in each boring.

  The granular fill observed in the borings was generally variable from black to red, medium dense to very dense, gravel, trace sand to sandy, trace silt, to grey to reddish brown, medium dense to very dense, fine to coarse sand, trace gravel to gravelly, trace silt to silty. One sample in BB-RMC-201 and one sample in BB-RMC-202 were described as stiff to very stiff, silty clay. This layer contains probable boulders and cobbles based on the drill rig behavior, SPT results, and split-spoon sample recoveries. In Boring BB-RMC-101, approximately 9.5 feet of coring was performed in the fill to advance the borehole through boulders. Grain size analyses performed on eight of the samples indicate the percent fines ranged from 5.7 to 33.1 percent, and an Atterberg limit test was performed on two of the samples indicated moderately plastic fines. USCS classifications were GW, SM, SW, and CL and the AASHTO classifications were A-1-a, A-1-b, A-2(0), and A-6.

Corrected N-values (N_{60}) in the fill ranged from 13 to 110 blows per foot (bpf), with an average of 57 bpf, indicating a mostly very dense soil. N60 values in the two silty clay fill samples ranged from 13 to 17 bpf, with an average of 15 bpf, indicating a stiff soil.

- Glacial Till – Glacial till was encountered below the fill in all the borings. The thickness of the till ranged between 36.4 feet at boring BB-RMC-101 to 57.0 feet at boring BB-RMC-104. The thickness of the till was about 14.6 feet at boring BB-RMC-201. BB-RMC-202 terminated at 56 feet below ground surface, or 19 feet in the glacial till layer. The material was variable from grey, gravel, little silt, little sand, to grey, hard, silt to silty clay, trace to some gravel, and trace to some sand. The glacial till in boring BB-RMC-104 had increasing amounts of granular material with depth, ranging from hard silty clay, little to some gravel, little to some sand, to; very dense clayey gravel, little sand. Boulders and cobbles were also encountered in the glacial till. Grain size analyses performed on eight of the samples indicate the percent fines ranged from 0.3 to 67.3 percent, and Atterberg limit tests performed on six of the samples indicated low to moderately plastic fines. USCS classifications were CL, ML, SM and SP, and the AASHTO classifications were A-1-a, A-2(0), A-4, and A-4(0).

  The N_{60} value ranged from 40 to 132 bpf, with an average of 72 bpf, indicating a mostly hard to very dense soil.

- Bedrock – Bedrock was encountered in five borings (BB-RMC-101 to BB-RMC-104, and BB-RMC-201). The borings for the proposed bridge, BB-RMC-101 through BB-RMC-104, encountered bedrock between 74.7 to 89.0 feet below ground surface (bgs) (approximately El. -38.7 to El. -52.2). Bedrock was deepest (89.0 feet bgs) in the boring performed at the proposed Abutment 2 (BB-RMC-104), and shallowest (74.7 feet bgs) in the boring performed adjacent to the northside of the existing culvert (BB-RMC-103). Boring BB-RMC-201 which was performed for the slope stability analyses encountered bedrock at 41.6 feet bgs (approximately El. 0.7).

  The bedrock was generally classified as greyish-red, fine to coarse grained cobble and pebble alluvial conglomerate, hard to moderately hard, and ranged from very slight to moderately weathered. The bedrock had horizontal to moderate dipping joints, as shown in the rock core photos in Appendix B.2. The RQD in the conglomerate ranged from 0 to 100 percent, with an average of 36 percent, indicating very poor to good rock quality.

3.7. Groundwater and Surface Water Levels

Groundwater levels were measured in borings BB-RMC-102 through -104 at the beginning of a new shift before any drilling activity. Groundwater levels ranged from 12.3 to 26.1 feet bgs (approximately El. 23.7 to El. 10.7). Groundwater levels were measured in borings BB-RMC-201 and BB-RMC-202 at the end of drilling activity and were encountered between 7.1 and 18.2 feet bgs, (approximately El. 30.1 to El. 24.1). These measurements may not accurately reflect the true groundwater level. The bridge is constructed on a manmade causeway along the coast, and groundwater levels are likely influenced by tides and precipitation. Significantly different groundwater levels may occur at other times and locations

4. Design Recommendations

4.1. General

We understand that the preferred configuration of the replacement bridge is a simple span concrete superstructure on integral abutments. The new abutments will be approximately 60 feet from the existing culvert centerline (i.e, approximately a 120-foot span), and the new bridge is expected to match the approach roadway width. The preferred substructure for the replacement bridge is integral abutments supported on driven H-piles.

The borings encountered bedrock approximately 65 and 76 feet below the proposed bottom of pile cap at abutments 1 and 2, respectively. At both abutments, bedrock was directly overlain by a very dense or hard glacial till layer.

Significant re-grading of the roadway surrounding the bridge is not anticipated. The design preference will be to keep final grades as close as possible to existing grades.

Shallow slope failures have been observed along the existing causeway slope face. Slope stability analyses were performed to evaluate global stability of the causeway in the areas of the observed failures. The existing slope in the areas of the observed failures is poorly vegetated and not protected with riprap. We understand that the preferred solution for slope stability is to install a heavy riprap apron that extends from the toe of the slope to the top of the slope.

Recommendations for foundation design for the abutments and slope stability of the causeway are presented below. Calculations supporting these recommendations are presented in Appendix D.

4.2. Soil Properties and Lateral Earth Pressures

Recommended soil properties and earth pressure coefficients for design are presented in Table 4. We selected these values based on published correlations to SPT N-values, our review of the soil descriptions, and our engineering judgment.

For the integral abutments, the lateral earth pressures developed against the abutments by the backfill will be a function of the movement of the abutment and can range from at-rest pressure to full passive pressure. The abutment reinforcement should be designed for the passive earth pressure (P_p), which results on the back face of the abutment when the bridge expands. This earth pressure should be calculated using the formula provided in Section 5.4.2.11 of the MaineDOT BDG. The Passive Lateral Earth Pressure Coefficient (Kp) needed for this equation is provided in Table 4 of this report and was evaluated using FHWA NHI-06-089, Figure 10-4. This Kp value was obtained assuming a magnitude of wall rotation equal of 0.02 expressed in terms of the ratio of wall movement to wall height (Y/H). However, the designer should calculate Kp based on estimated superstructure thermal movement using both FHWA NHI-06-089 and MassDOT Bridge Design Manual Figure 3.10.8-1 and use the more stringent value. It should also be noted that the design passive pressure coefficient should be no less than Kp calculated using Rankine, regardless of estimated wall rotation.

4.3. Integral Abutment Pile Design

We understand that the proposed replacement bridge substructure will consist of integral bridge abutments supported on steel H-piles. Within the footprint of the proposed abutments, the depth to bedrock from the bottom of the pile caps is approximately 65.4 feet at Abutment 1 and 76.2 feet at Abutment 2. Based on the results of our subsurface explorations, the depth of overburden below the bottom of the proposed pile caps is sufficient to provide adequate lateral support for driven H-piles installed in the glacial till stratum. The piles may reach the required nominal geotechnical resistance in the glacial till or may need to be driven to bedrock depending on pile plugging conditions develop during driving. Our recommendations are based on design analyses performed using the computer program LPile Version 2022-12.010 by Ensoft Inc., a program for the analysis of individual piles subjected to lateral loading using the p-y method, APile Version 2025.11.1 by Ensoft Inc., a program for the analysis of individual piles subjected to axial loading, and GRLWEAP14 by Pile Dynamics Inc., a program that performs wave equation analysis for pile driving.

4.3.1. Lateral Pile Analyses

We performed LPile analyses for HP 14x89 and HP 14x117 steel piles using the loading provided by Thornton Tomasetti. The loading included Strength I Limit State factored axial load of 359 kips and the larger thermal movement between thermal contraction and thermal expansion as estimated by Thornton Tomasetti. The thermal movement was input as unfactored and factored thermal contraction of 0.475 and 0.570 inches, respectively. A load factor γ_{TU} of 1.2 was applied to the thermal movement in accordance with AASHTO LRFD Table 3.4.1-1. It is our understanding that the structural pile design was based on the larger of the bending moment obtained using the factored thermal movement loading and that was obtained by applying the load factor γ_{TU} of 1.2 to the resulting bending moment using the unfactored thermal movement loading.

The analyses used the intact H-pile section without corrosion loss consideration to maximize the bending moment demand. We recommend that the structural pile design considers a corrosion allowance of 1/16-inch. We assumed a pile spacing of 6 feet and p-multiplier of 1.0, consistent with a 5B pile spacing (with B equal to a pile depth of 14.2 inches) in accordance with AASHTO LRFD Section 10.7.2.4.
A P-multiplier of 1.0 is also conservative as it results in a stiffer soil response and a higher flexural demand on the piles.

The Mill Cove New Bridge Preliminary Hydraulic Report prepared by GEI, dated June 2024, and revised August 2024, estimated scour depths of approximately 9.0 feet at the abutments based on a Q_{100} with average tides. Scour was not considered in our pile design analyses for several reasons. The flood events considered for the scour analyses are tidal in nature and peak velocities occur for discrete amounts of time during the tidal cycle. The peak velocities may not last long enough for scour to reach the estimated depths. We also considered scour of the estimated magnitude to be unlikely given the proposed heavy riprap protection in front and around the abutments and the significant distance between the proposed abutment piles (approximately 53 to 55 feet) and the toe of the riprap at the Mill Cove Stream channel.

Based on the results of our laterally loaded pile analyses and coordination with Thornton Tomasetti, we recommend that the pile foundations consist of HP14x117 steel piles. The estimated depth to fixity for the piles is 23.5 feet below the bottom of pile cap for Abutments 1 and 2 based AASHTO Fig. C6.15.2.1. We recommend a minimum embedment of 29 feet to satisfy lateral stability requirements. The recommended pile layout consists of a single row of six (6) HP 14x117 piles oriented with the weak axis bending (pile webs perpendicular to the centerline girders). The piles can be spaced 6 feet on-center along the bridge transverse direction.

Supporting calculations for these recommendations are provided in Appendix D.5.

4.3.2. Axial Pile Analyses

We performed APile analyses for HP 14x117 steel piles using the FHWA method. The fill and glacial till layers were modeled as sand, and each layer was modeled as a uniform material. APile does not include bedrock models, so we analyzed the rock bearing layer as a clay with an effective unit weight of 107.6 pcf and an undrained shear strength equal to half the typical unconfined compressive strength of conglomerate bedrock based on AASHTO Highway Bridges 2002, Table 4.4.8.1.2B. This allowed us to model the piles bearing on bedrock.

The integral abutments are planned to be supported on a single row of six (6) HP 14x117, Grade 50, steel piles. The estimated pile lengths are 65.4 and 76.2 feet for Abutments 1 and 2, respectively. A Strength I Limit State factored axial load of 359 kips was provided by Thornton Tomasetti. A geotechnical nominal pile resistance of 553 kips is required, based on a geotechnical resistance factor of 0.65 per AASHTO Table 10.5.5.2.3-1 assuming PDA testing. See Section 5.1 for PDA testing requirements.

The glacial till at the site is hard or very dense and contains gravel, boulders, and cobbles based on the subsurface explorations. There is the potential for the tip of the H-piles to become partially or fully plugged when being driven through the glacial till stratum, although it is difficult to predict. As a result, the pile tip resistance was evaluated using three scenarios, unplugged, half plugged, and fully plugged. The unplugged condition uses the steel area at the tip of the pile, while the fully plugged uses the area of the pile taken as the depth times the flange width, and the half plug as half the fully plugged area. The unplugged model estimated a nominal end bearing resistance of 817.5 kips on bedrock. We assumed this nominal end bearing resistance for all plugging conditions where piles are driven to rock. We estimate that the piles can achieve the required nominal geotechnical resistance in the overburden materials as verified by dynamic load testing. The piles could be installed with pile tip elevations above bedrock so long as the pile fixity requirements are met. We recommend that estimated pile lengths be evaluated assuming that the piles are driven to rock. Combined pile resistance plots are provided in Appendix D.6.

4.3.3. Drivability Analyses

We performed preliminary drivability analyses to identify potential pile driving hammers that can be used for the installation of the proposed HP14x117 steel piles, and to estimate the driving criteria. The driving criteria for a given hammer is evaluated based on the required nominal geotechnical capacity and the allowable pile stresses. Allowable pile stresses are in accordance with MaineDOT BDG Section 5.7.7.

The maximum allowable compressive and tensile driving stresses for the steel H piles are defined by 0.9 times the steel yield stress (F_y). Using Fy equal to 50 ksi for the steel H piles, the maximum allowable driving stress is 45 ksi.

The long-term static resistance of the piles was estimated using the computer program APile which generates specific input files that can imported into GRLWEAP to generate the soil resistance profile for the drivability analyses. We evaluated unplugged and fully plugged conditions to consider relatively easy and hard driving conditions, respectively. The soil resistance profiles were developed using a pile length of 76.2 feet, corresponding to the deepest anticipated depth to bedrock at Abutment 2, which is considered a more conservative pile driving scenario. We modeled 85-foot-long piles in GRLWEAP with approximately 75 feet of penetration.

The results of the drivability analyses are summarized in the table below. Gain/Loss factors are used in the analyses in conjunction with the soil setup factors to simulate the driving resistance during initial pile driving and restrike. The initial drive analyses considered the full reduction in driving resistance associated with the soil setup factors assumed and the restrike condition assumes full setup has occurred given at least 24-hours after the initial drive.

Pile Analysis	Pile Size	Hammer Maker, Model, and Fuel Setting	Blows per inch(EOD) / Blows per inch (RS)[1]	Maximum Compressive Stress (ksi)	Maximum Tensile Stress (ksi)	Average Energy Transfer (ft-kip)
Unplugged	HP 14x117	Delmag D25-32 (Fuel Setting 1)	3 bpi (EOD)	27	5	30
			6 bpi (RS)	29	4	32
Fully Plugged		Delmag D25-32 (Fuel Setting 1)	4 bpi (EOD)	28	5	34
			10 bpi (RS)	31	8	36

Notes:
1. EOD = End of initial drive. RS = Re strike

Supporting calculations for these recommendations are provided in Appendix D.7.

4.4. Slope Stability Analyses

MaineDOT had observed and documented shallow slope failures along the southeastern slope of the alignment between approximately stations 18+50 and 23+50 in April 2025. Two additional borings, BB-RMC-201 and BB-RMC-202, were drilled along the alignment within the failure areas to gain a better understanding of the subsurface conditions. We performed slope stability analyses using the soil properties provided in Table 4. We used the Spencer analysis method in the software SLOPE/W developed by GEO-SLOPE International. Our analyses considered:

- One cross section at approximately station 19+50 (i.e., across the roadway profile).
- A 2H:1V slope over a 1.75H:1V slope with riprap armor extending from the toe of the slope to the top of the slope.
- Variable subsurface conditions in the existing fill:
    - Existing granular fill with a 34-degree friction angle
    - Existing granular fill with a 36-degree friction angle

  - Existing granular fill with a 36-degree friction angle and a lower phreatic surface.
  - Existing granular fill with a 38-degree friction angle
- Loading conditions:
  - Long-term loading (static, drained)
  - Pseudostatic loading (undrained)
- The analyses included a traffic surcharge load of 250 psf, which is equivalent to 2 feet of earth with an average unit weight of 125 pcf, in accordance with AASHTO LRFD 9th Edition, section 11.10.10.2.
- Optimization of each critical circular slip surface using the optimization tool in SLOPE/W software. This process results in initial circular slip surfaces optimized to multi-linear slip surfaces typically with lower factors of safety.

The results of our slope stability analyses are presented in Appendix D.8 and summarized in the table provided below:

Slope Stability Results for Approximately STA 19+50

Condition	Static Loading		Seismic Loading	
	Calculated FS	Min Reqd. FS[1]	Calculated FS	Min Reqd. FS[2]
34 deg fill; 2H:1V over 1.75H:1V Riprap slope	1.3	1.3	1.4	1.1
36 deg fill; 2H:1V over 1.75H:1V Riprap slope	1.4	1.3	1.4	1.1
36 deg fill; 2H:1V over 1.75H:1V Riprap slope w/ lower phreatic surface	1.4	1.3	1.4	1.1
38 deg fill; 2H:1V over 1.75H:1V Riprap slope	1.4	1.3	1.4	1.1

Notes:
1. MaineDOT BDG requires a minimum factor of safety (FS) of 1.5 for slopes containing a structural element (i.e., an abutment or wall) and a FS of 1.3 for slopes without a structural element. A FS of 1.5 equates to a resistance factor of 0.65. A FS of 1.3 equates to a resistance factor of 0.75. On a project-by-project basis, MaineDOT may allow a lower FS of 1.3 for slopes containing a structural element if geotechnical parameters are well defined per AASHTO Section 11.6.3.7. USACE EM-1110-2-1902 requires a minimum FS of 1.3 for end of construction, which is a temporary loading condition.
2. Per our discussions with MaineDOT, we understand MaineDOT's preferred minimum FS is 1.1 for pseudo-static condition.

We performed pseudo-static analyses using an undrained shear strength in existing fill (Silty Clay) of 2,000 psf and a horizontal seismic coefficient equal to half of the site's spectral response acceleration (i.e., 0.5As = 0.048g) which resulted in the calculated factors of safety of greater than 1.1 for all runs.

Based on the static loading and seismic loading analyses performed, and the installation of riprap armor on MaineDOT slopes of 2H:1V and 1.75H:1V, we expect that the slopes will be stable. Based on review of photographs available of the slope failures, we attribute these conditions to surficial sloughing likely related to tidal and wave action on the unprotected slope. Based on our slope stability analyses, we do not consider the existing failures to be associated with deep seated global instability.

4.5. Seismic Design Parameters

Based on the borings and our seismic design calculations (Appendix D), we conclude that the site should be classified as Site Class C.

Based on the 2020 AASHTO LRFD seismic hazard maps for the 1,000-year return period, we recommend the following parameters for seismic design:

- Horizontal Peak Ground Coefficient (PGA) = 0.080
- Horizontal Response Spectral Coefficient (period = 0.2 sec) (S_s) = 0.160
- Horizontal Response Spectral Coefficient (period = 1.0 sec) (S_1) = 0.041

The applicable site coefficients for peak ground acceleration ([F_{PGA}], short-period range [F_A], and long-period range [F_v]) at this site are 1.2, 1.2, and 1.7, respectively. Application of these site coefficients results in the following recommended coefficients for development of design response spectra:

- Response Spectral Acceleration, A_s = 0.096
- Design Spectral Acceleration Coefficient at 0.2 second period, S_{DS} = 0.192
- Design Spectral Acceleration Coefficient at 1.0 second period, S_{D1} = 0.068

This site falls into Seismic Zone 1, based on the 1-second-period design spectral acceleration. For single span bridges in Seismic Zone 1, there is no detailed seismic analysis required other than connection design and seat bearing length.

4.6. Settlement

The proposed bridge design calls for minimal grade raises at the approaches, and the existing fill and glacial till encountered in the explorations are generally dense to very dense sand with lesser amounts of silt and gravel, and hard silt or silty clay with lesser amounts of sand and gravel. Based on the material encountered and our past experience, we do not anticipate settlement related issues.

4.7. Frost Protection

Existing or imported granular backfill and glacial till, are anticipated to be present at the abutments and are frost susceptible. Based on MaineDOT BDG Section 5.2.1, the Freezing Index for the site is approximately 1300. Test soils had an average moisture content of 12.0 percent and were a mix of coarse- and fine-grained soils. For a mix of coarse- and fine-grained soils with a water content of 10 percent and a Freeze Index of 1300 the estimated depth of frost penetration is approximately 5.4 feet.

5. Construction Recommendations

5.1. Pile Driving and Testing

The piles should be installed in accordance with the requirements in the Bridge Manual and appropriate MaineDOT Standard Specifications. The piles should consist of HP14x117 ASTM 572, Grade 50 steel (50 ksi yield stress) H-piles. We recommend that tip reinforcement be provided for the steel H-piles due to the potential of cobbles and boulders in the fill and glacial till layers overlying bedrock. We recommend that a driving shoe be welded to the tip of each driven pile in accordance with MaineDOT Standard Specification, Section 501.048 to prevent walking on the bedrock.

The piles should be driven to bedrock or to a geotechnical nominal resistance of 553 kips, calculated by dividing the Strength I Limit State factored axial load of 359 kips by a resistance factor of 0.65. Dynamic load testing (DLT) with a 24-hour restrike should be performed on the first pile driven during each construction phase at each abutment. Dynamic load testing should be anticipated during all phases of construction due to the length of time in between stages, and the possibility of different pile driving systems being utilized during each stage.

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 66,300 ft-lbs. The piles should be driven without exceeding the allowable driving stress of 45 ksi. The final driving criteria should be selected based on the results of the DLTs and CAPWAP analyses and the calculated nominal geotechnical resistance of the piles.

5.2. Obstructions

The borings indicate the presence of boulders and cobbles in the fill and glacial till. Pre-augering, or removal and relocation, may be necessary for piles that encounter refusal before being driven deep enough to reach required axial resistance and fixity. Where the obstructions are relatively shallow, the contractor may be able to remove them using an excavator.

5.3. Backfilling

MaineDOT granular borrow for underwater backfill should be used behind the abutments in accordance with MaineDOT BDG, Section 5.4.2.13. Drainage behind the integral abutment should be designed in accordance with MaineDOT BDG, Section 5.4.1.9, to minimize hydrostatic pressure and control erosion of the underside of the abutment embankment riprap. It is our understanding that MaineDOT prefers the use of French drains on the uphill side of integral abutments to prevent buildup of hydrostatic pressure. The French drains should be sloped to drain by gravity and should outlet through a series of 4-inch diameter weep holes, spaced at a maximum distance of 10 feet on center.

Fill for the roadway and behind the abutments, backfill of excavations for utilities, and crushed stone for scour protection, if any, should be placed and compacted in accordance with MaineDOT Standard Specifications Section 206 (2020 version). However, we recommend that compaction in areas too small for a smooth wheel vibratory compactor, within 5 feet of walls less than 15 feet high, or within 10 feet of walls greater than 15 feet high, should be performed using a vibratory walk-behind roller or plate compactor (weighing at least 200 lbs imparting an impact load of at least 2.5 tons), with soil placed in maximum 6-inch-loose lifts.

5.4. Re-Use of Existing Materials

Based on the soil descriptions on the boring logs, some of the existing on-site granular soils may meet the requirements for common borrow. Suitability for reuse can be confirmed by testing samples to evaluate if the soil in question meets the MaineDOT requirements for common borrow. The on-site soils may have oversized cobbles and boulders that would need to be removed prior to re-use as common borrow. The Contractor should be aware that materials that are not free draining may be difficult to compact in wet weather.

5.5. Freezing Conditions

If construction is performed during freezing weather, special precautions will be required to prevent the soil subgrades from freezing. Freezing of the soil beneath foundations and pavements during construction may result in heave and subsequent settlement of the structure.

All soil subgrades should be free of frost before foundation construction. Frost-susceptible soils that have frozen should be removed and replaced with compacted gravel borrow. The foundation and the soil adjacent to the foundation should be insulated until they are backfilled.

Soil placed as fill should be free of frost, as should the ground on which it is placed.

6. Limitations

Our recommendations are based on the project information provided to us at the time of this report and may require modification if there are any changes in the nature, design, or location of the proposed construction. We recommend that GEI be engaged to perform a final design geotechnical exploration and prepare final design geotechnical foundation and construction recommendations. We recommend that GEI be engaged to review the final plans and specifications to evaluate whether changes in the project affect the validity of our recommendations and whether our recommendations have been properly implemented in the design.

The recommendations in this report are based in part on the data obtained from the borings. The nature and extent of variations between borings may not become evident until construction. If variations from the anticipated conditions are encountered, it may be necessary to revise the recommendations in this report. Therefore, we recommend that GEI be engaged to make site visits during construction to:
a) check that the subsurface conditions exposed during construction are in general conformance with our design assumptions, and b) ascertain that, in general, the geotechnical aspects of the work are being performed in compliance with the contract documents.

Our professional services for this project have been performed in accordance with generally accepted engineering practices; no warranty, express or implied, is made.

Tables

Table 1. Subsurface Explorations

Table 2. Grain Size Analysis Results

Table 3. Atterberg Limits Test Results

Table 4. Recommended Soil Properties

Table 1. Subsurface Explorations
Geotechnical Design Report
Mill Cove New Bridge #6205
WIN 026630.06
Robbinston, Maine

Exploration Number	STA	Offset	Northing (ft)	Easting (ft)	Surface Elevation[1,2] (ft)	Depth of Exploration (ft)	Depth to Groundwater (ft)	Depth to Fill (Asphalt Thickness) (ft)	Depth to Glacial Till (ft)	Depth to Top of Bedrock (ft)
BB-RMC-101	23+06	13.6 RT	447399.3	2492113.1	35.8	89.1	NM	0.8	42.0	78.4
BB-RMC-102	23+60	15.2 LT	447460.2	2492104.2	37.2	93.0	18.5	0.8	37.0	80.4
BB-RMC-103	23+88	14.2 RT	447476.3	2492141.9	36.0	86.0	12.3	0.7	34.4	74.7
BB-RMC-104	24+46	13.9 RT	447529.6	2492163.4	36.8	92.0	26.1	0.9	32.0	89.0
BB-RMC-201	19+03	12.0 RT	447010.7	2492023.4	42.3	47.1	18.2	0.8	27.0	41.6
BB-RMC-202	21+05	12.2 RT	447208.5	2492057.5	37.2	56.0	7.1	0.8	37.0	NE

1. The boring coordinates and elevations for BB-RMC-101 through BB-RMC-104 were surveyed by MaineDOT. Elevations are referenced to NAVD88.
2. The boring coordinates and elevations for BB-RMC-201 and -202 were estimated using tape ties and a topographic survey provided by MaineDOT, and should be considered accurate to the degree implied.
3. NM = Not Measured
4. NE = Not Encountered

Table 2. Grain Size Analysis Results
Geotechnical Design Report
Mill Cove New Bridge #6205
WIN 026630.06
Robbinston, Maine

Exploration Number	Surface Elevation (ft)	Sample Number	Sample Depth (ft)			Sample Elevation (ft)			Material	Description	MC (%)	% Fines	AASHTO	USCS
BB-RMC-101	35.8	2D	4.0	-	6.0	31.8	-	29.8	Fill	Grey and brown fine to medium SAND, some silt, trace gravel	13.9	33.1	A-2(0)	SM
BB-RMC-101	35.8	4D	24.0	-	26.0	11.8	-	9.8	Fill	Grey and reddish brown Sandy GRAVEL, trace silt	6.9	6.1	A-1-b	GW
BB-RMC-101	35.8	10D	54.0	-	56.0	-18.2	-	-20.2	Glacial Till	Grey Silty CLAY, some sand, trace gravel	11.2	60.8	A-4	CL
BB-RMC-102	37.2	3D	9.0	-	11.0	28.2	-	26.2	Fill	Brown Gravelly fine to coarse SAND, trace silt	10.3	5.7	A-1-a	SW
BB-RMC-102	37.2	14D	64.0	-	66.0	-26.8	-	-28.8	Glacial Till	Grey Silty CLAY, some sand, some gravel	12.3	46.3	A-4(0)	SM
BB-RMC-103	36.0	4D	14.0	-	16.0	22.0	-	20.0	Fill	Brown and grey fine to coarse SAND, some gravel, little silt	9.3	14.6	A-1-b	SM
BB-RMC-103	36.0	8D (5-11")	34.0	-	35.9	2.0	-	0.1	Glacial Till	Grey coarse SAND, some gravel, trace silt	9.3	0.3	A-1-a	SP
BB-RMC-103	36.0	16D	74.0	-	74.7	-38.0	-	-38.7	Glacial Till	Purple fine to coarse SAND, some silt, little gravel	14.3	30.2	A-2(0)	SM
BB-RMC-104	36.8	3D	14.0	-	16.0	22.8	-	20.8	Fill	Brown fine to coarse SAND, little silt, little gravel	10.4	23.8	A-1-b	SM
BB-RMC-104	36.8	5D	29.0	-	31.0	7.8	-	5.8	Fill	Grey and reddish brown fine to medium SAND, little silt, trace gravel	15.3	14.7	A-2(0)	SM
BB-RMC-104	36.8	9D	49.0	-	51.0	-12.2	-	-14.2	Glacial Till	Grey SILT, some sand, little gravel	10.8	47.3	A-4(0)	ML
BB-RMC-104	36.8	11D	59.0	-	60.4	-22.2	-	-23.6	Glacial Till	Grey fine to coarse SAND, some silt, some gravel	11.3	27.6	A-2(0)	SM
BB-RMC-201	42.3	5D	19.0	-	21.0	23.3	-	21.3	Fill	Brown to red fine to coarse SAND, some silt, little gravel	8.5	29.6	A-2(0)	SM
BB-RMC-201	42.3	7D	29.0	-	31.0	13.3	-	11.3	Glacial Till	Grey fine to coarse SAND, some gravel, some silt	8.2	33	A-2(0)	SM
BB-RMC-202	37.2	2D	4.0	-	6.0	33.2	-	31.2	Fill	Light brown fine to coarse SAND, some silt, little gravel	6.8	32.2	A-2(0)	SM
BB-RMC-202	37.2	12D	54.0	-	56.0	-16.8	-	-18.8	Glacial Till	Grey SILT & CLAY, some sand, trace gravel	10.4	67.3	A-4	CL

Table 3. Atterberg Limits Test Results
Geotechnical Design Report
Mill Cove New Bridge #6205
WIN 026630.06
Robbinston, Maine

Exploration Number	Surface Elevation (ft)	Sample Number	Sample Depth (ft)			Sample Elevation (ft)			Material	Description	LL	PL	PI	MC (%)	AASHTO	USCS
BB-RMC-101	35.8	8D	44.0	-	46.0	-8.2	-	-10.2	Glacial Till	Grey Silty CLAY, little gravel	24.7	15.9	8.8	10.4	A-4	CL
BB-RMC-101	35.8	10D	54.0	-	56.0	-18.2	-	-20.2	Glacial Till	Grey Silty CLAY, some sand, trace gravel	23.8	15.5	8.3	11.2	A-4	CL
BB-RMC-102	37.2	9D	39.0	-	41.0	-1.8	-	-3.8	Glacial Till	Grey Silty CLAY, little sand, trace gravel	24.8	15.9	8.9	10.0	A-4	CL
BB-RMC-103	36.0	9D	39.0	-	41.0	-3.0	-	-5.0	Glacial Till	Grey Silty CLAY, trace gravel	25.4	16.0	9.4	10.7	A-4	CL
BB-RMC-104	36.8	10D	54.0	-	54.9	-17.2	-	-18.1	Glacial Till	Grey Silty CLAY, some sand, little gravel	23.0	14.7	8.3	8.7	A-4	CL
BB-RMC-201	42.3	3D	9	-	11	33.3	-	31.3	Fill	Grey Silty CLAY	37.6	21.9	15.7	26.8	A-6	CL
BB-RMC-202	37.2	4D	14	-	16	23.2	-	21.2	Fill	Brown to grey Silty CLAY, little gravel	33.6	20.1	13.5	28.1	A-6	CL
BB-RMC-202	37.2	12D	54	-	56	-16.8	-	-18.8	Glacial Till	Grey SILT & CLAY, some sand, trace gravel	23.8	16.1	7.7	10.4	A-4	CL

Table 4. Recommended Soil Properties
Geotechnical Design Report
Mill Cove New Bridge #6205
WIN 026630.06
Robbinston, Maine

Layer/Soil Type	Unit Weight, γ (pcf)	Friction Angle, ϕ (deg)	Earth Pressure Coefficients[1,2]			
			Active, $K_{a\_Rankine}$[3]	Active, $K_{a\_Coulomb}$[3]	At Rest, K_0	Passive, K_p
Existing Fill	125	34	0.28	0.25	0.44	5.8
Existing Fill (Silty Clay)[5]	120	30	0.33	0.30	0.50	5.8
Glacial Till	130	36	0.26	0.23	0.41	5.8
Granular Borrow	125	32	0.31	0.27	0.47	5.8
Gravel Borrow	135	36	0.26	0.24	0.41	5.8

Notes:

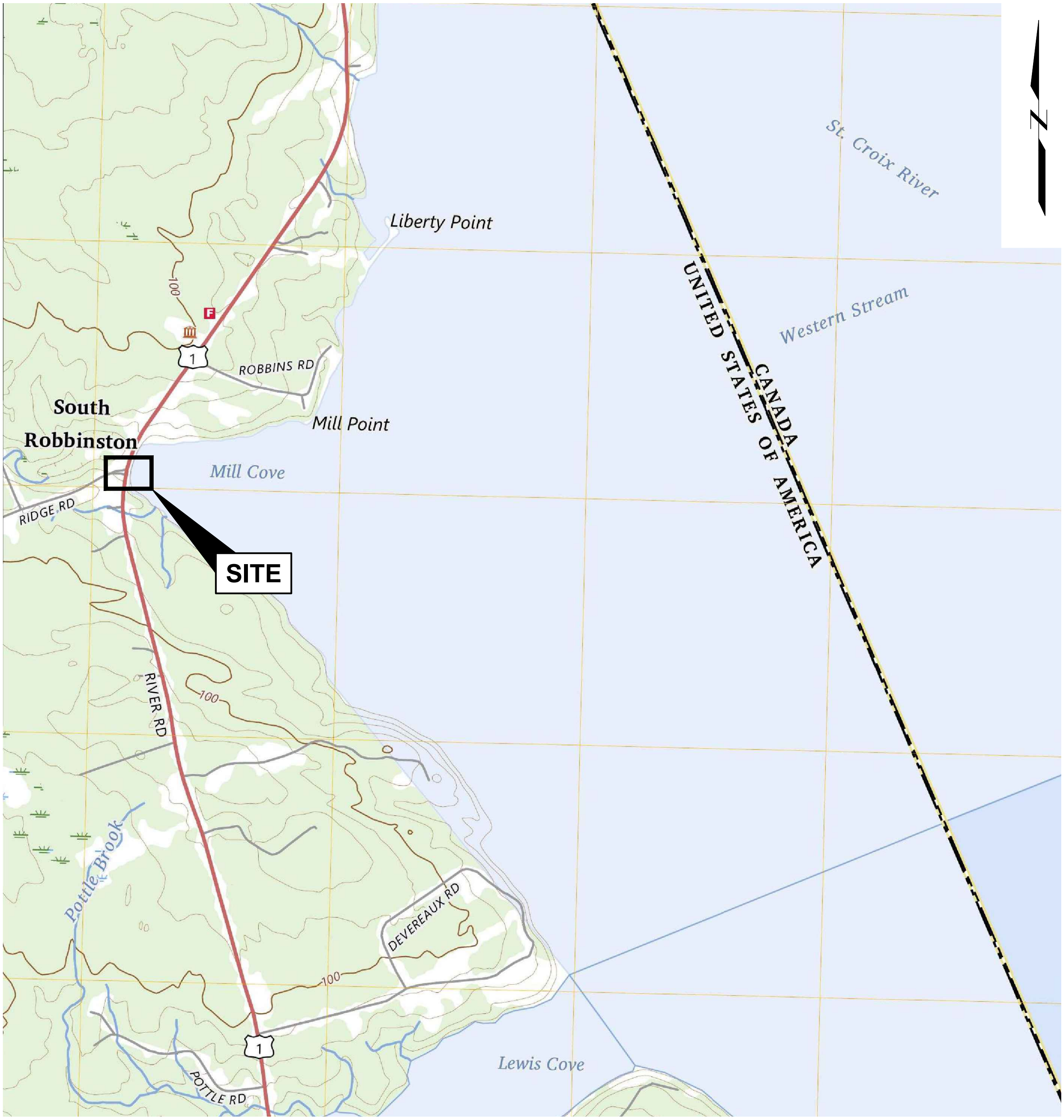
1. Recommended earth pressure coefficients are associated with vertical wall face and horizontal ground both in front and behind the wall, and are in accordance with the recommendations of Section 3.6 of the MaineDOT BDG, AASHTO LRFD 3.11.5.3 and 3.11.5.4. Supporting calculations are included in Appendix D. For sloping wall face, calculate using log spiral method and actual wall slope angle, with the interface angle assumed to be half the angle of internal friction of the soil.
2. Seismic earth pressure coefficients are not included because the bridge is classified under Seismic Zone 1. Seismic coefficients should be evaluated if necessary during final design based on the final bridge type.
3. Active earth pressure using Coulomb's Theory should be used for gravity and short-heel cantilever walls. Use Rankine's Theory for long-heel cantilever walls.
4. Passive earth pressure for walls should be neglected for cases outlined in MaineDOT BDG 3.6.9. MaineDOT BDG 5.4.2.11 recommends abutment and wingwall reinforcement be sized assuming passive earth pressure on the backface of the wall. Design passive pressure coefficient should be calculated using MassDOT BDM Figure 3.10.8-1 and NHI-06-089 Figure 10-4, and the more stringent value should apply. However, passive earth pressure should be no less than Rankine passive earth pressure, regardless of wall rotation. (FHWA NHI-06-089 Figure 10-4 Assuming a wall rotation of 0.02 for dense granular soil, the bridge designer should use MassDOT BDM Figure 3.10.8-1)
5. The exisitng fill (Silty Clay) has an undrained shear strength of 2000 psf.

Sheets

Sheet 1. Site Location Map

Sheet 2. Boring Location Plan

Sheet 3. Interpretive Subsurface Profile



0 2000 4000

SCALE, FEET

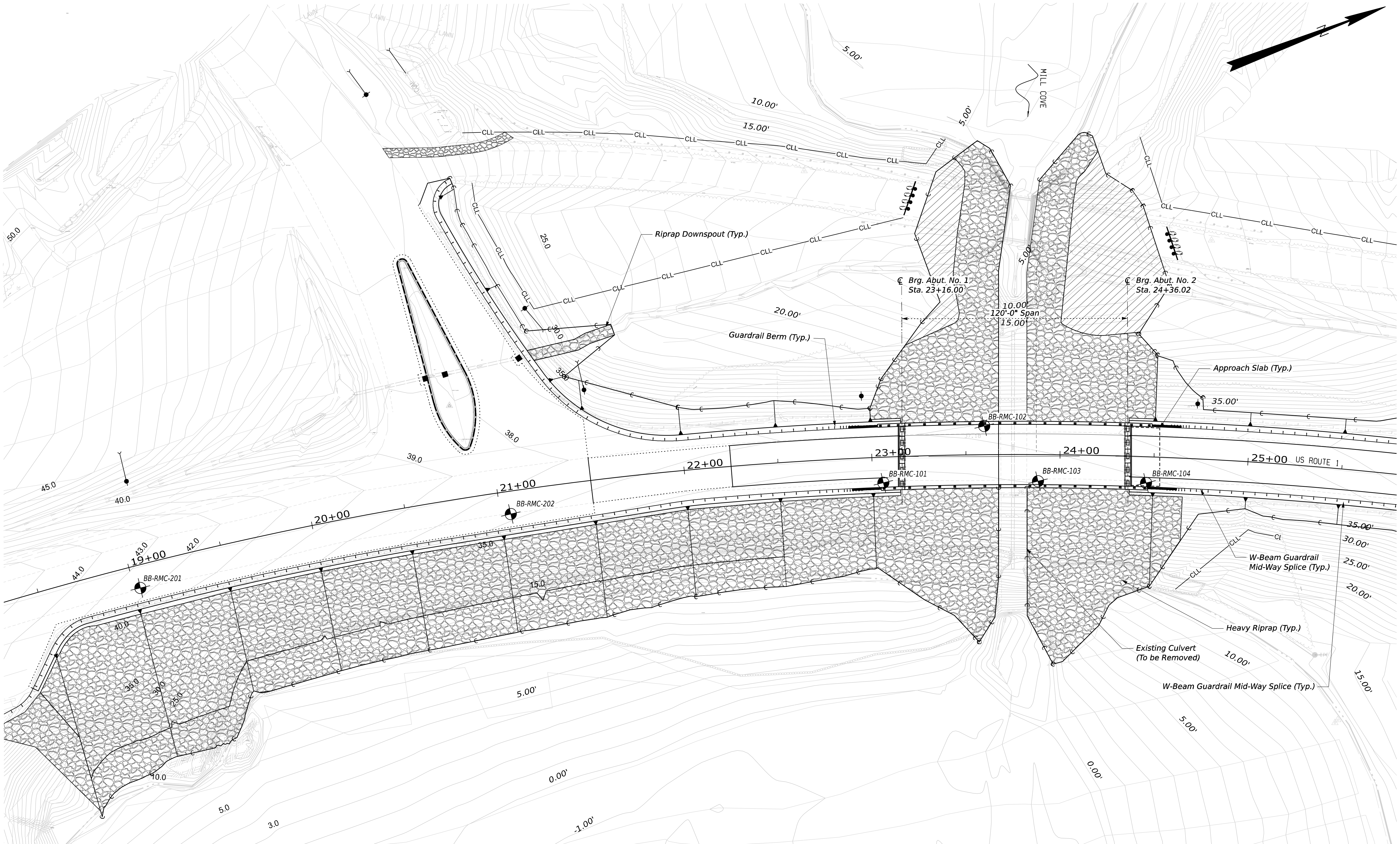
SOURCE:

USGS TOPOGRAPHIC QUADRANGLE, 7.5 MINUTE SERIES: ROBBINSTON QUADRANGLE, MAINE-WASHINGTON COUNTY, 2024.
NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88)
20-FOOT CONTOUR INTERVAL

QUADRANGLE LOCATION

Mill Cove New Bridge (#6205) over Mill Cove WIN 026630.06 Robbinston, Maine	GEI Consultants	SITE LOCATION MAP
Thornton Tomasetti Portland, Maine	Project 2502334	Aug. 2025 Sheet 1

CARVAJAL, SEBASTIAN B:\Working\THORNTON TOMASETTI\2502334 MaineDOT Downeast Bridges Phase II\00_CAD\Figures\Site Location Map\Sheet 1.Site Location Map - Robbinston Ph2.dwg - 4/30/2025



LEGEND

CASED WASHED BORINGS

SOURCE

Base plan is developed from electronic files (Ground.dgn, Topo.dgn, z_abutment.dgn) provided to GEI by Thornton Tomasetti on August 12, 2024, electronic files (Alignment_Rt1.dgn) provided to GEI by Thornton Tomasetti on May 22, 2025 and electronic files (Corridor_Route 1_Linework.dgn) provided to GEI by Thornton Tomasetti on June 31, 2025

NOTES

1. Borings BB-RMC-101 through BB-RMC-104 were drilled by New England Boring Contractors of Hermon, Maine between March 25 and April 11, 2024 and were observed by GEI personnel.
2. Borings BB-RMC-201 and BB-RMC-202 were drilled by New England Boring Contractors of Hermon, Maine between May 12 and May 13, 2025 and were observed by GEI personnel.
3. As-drilled boring locations for borings BB-RMC-101 through BB-RMC-104 were surveyed by MaineDOT and provided to GEI.
4. As-drilled boring locations for borings BB-RMC-201 and BB-RMC-202 were estimated using tape ties and should be considered accurate to the degree implied.

PLAN

25 0 25 50

Scale of Feet

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

APPROVED | DATE
COMMISSIONER:
CHIEF ENGINEER:

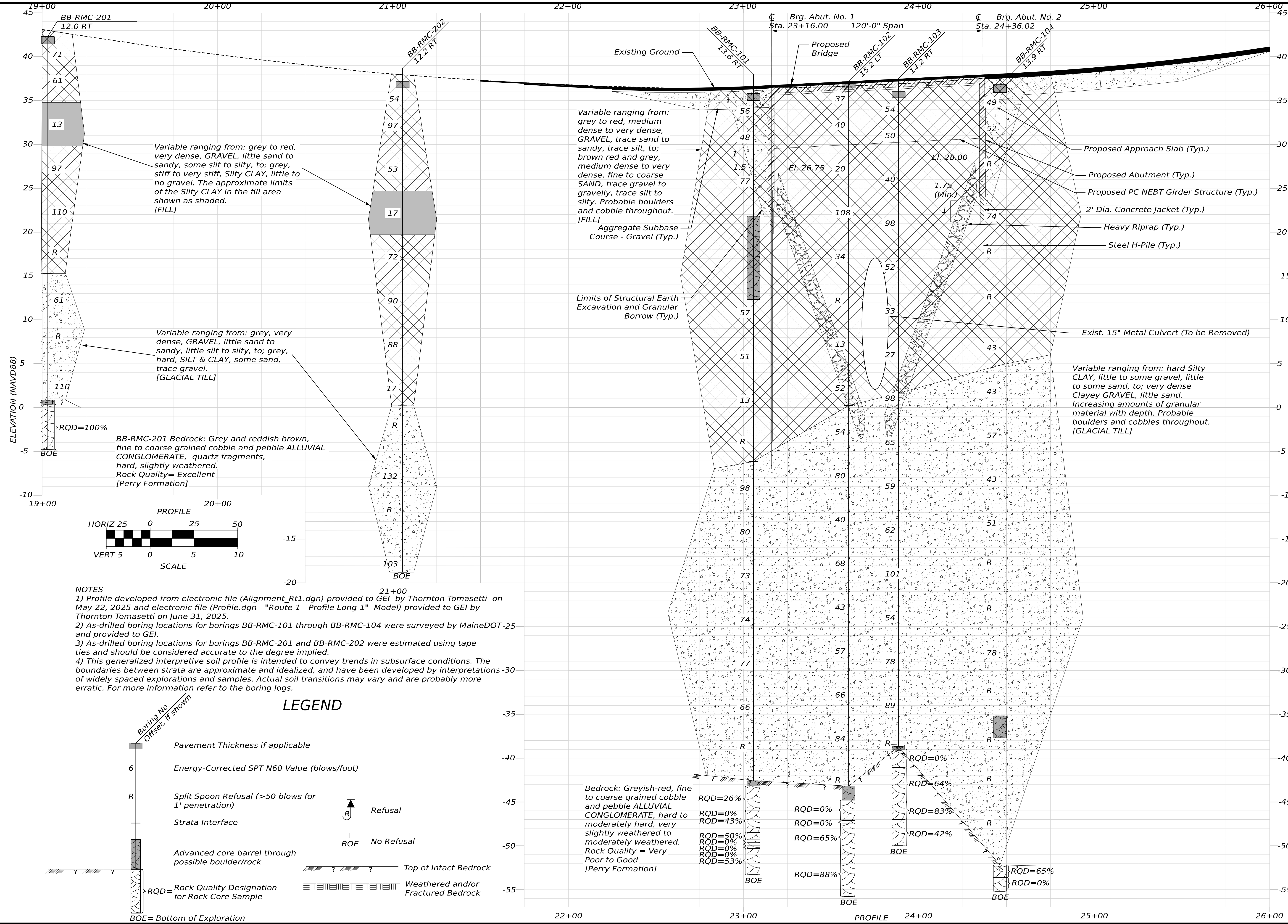
	BY	DATE
PROJ. MANAGER	M. JOHNESCU	
DESIGN-DETAILED	M. JOHNESCU / Y. SOJO	7/17/2025
CHECKED-REVIEWED	M. JOHNESCU / N. BETANCUR	8/5/2025
DESIGN2-DETAILED2		
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

SIGNATURE
P.E. NUMBER
DATE

U.S. ROUTE 1 BRIDGE NO. 6205
CROSSING MILL COVE
ROBBINSTON

BORING LOCATION PLAN

SHEET NUMBER
2
OF 3



NOTES
1) Profile developed from electronic file (Alignment_Rt1.dgn) provided to GEI by Thornton Tomasetti on May 22, 2025 and electronic file (Profile.dgn - "Route 1 - Profile Long-1" Model) provided to GEI by Thornton Tomasetti on June 31, 2025.
2) As-drilled boring locations for borings BB-RMC-101 through BB-RMC-104 were surveyed by MaineDOT and provided to GEI.
3) As-drilled boring locations for borings BB-RMC-201 and BB-RMC-202 were estimated using tape ties and should be considered accurate to the degree implied.
4) 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 transitions may vary and are probably more erratic. For more information refer to the boring logs.

LEGEND

Boring No. Offset, if shown
Pavement Thickness if applicable
6 — Energy-Corrected SPT N60 Value (blows/foot)
R — Split Spoon Refusal (>50 blows for 1' penetration)
Strata Interface
Advanced core barrel through possible boulder/rock
RQD= Rock Quality Designation for Rock Core Sample
BOE= Bottom of Exploration
R — Refusal
BOE — No Refusal
Top of Intact Bedrock
Weathered and/or Fractured Bedrock

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION
APPROVED
DATE
COMMISSIONER:
CHIEF ENGINEER:

SIGNATURE
P.E. NUMBER
DATE

	BY	DATE
PROJ. MANAGER	M. JOHNESCU	
DESIGN-DETAILED	M. JOHNESCU	7/17/2025
CHECKED-REVIEWED	Y. SOJO	8/1/2025
DESIGN2-DETAILED2	N. BETANCUR	8/5/2025
DESIGN3-DETAILED3		
REVISIONS 1		
REVISIONS 2		
REVISIONS 3		
REVISIONS 4		
FIELD CHANGES		

U.S. ROUTE 1 BRIDGE NO. 6205
CROSSING MILL COVE
ROBBINSTON

INTERPRETIVE SUBSURFACE PROFILE

SHEET NUMBER
3
OF 3

USERNAME:SOJO YONATHAN DATE:8/5/2025
FILENAME:...\003_GEOPROFILE-ROBBINSTON.DGN DIVISION:

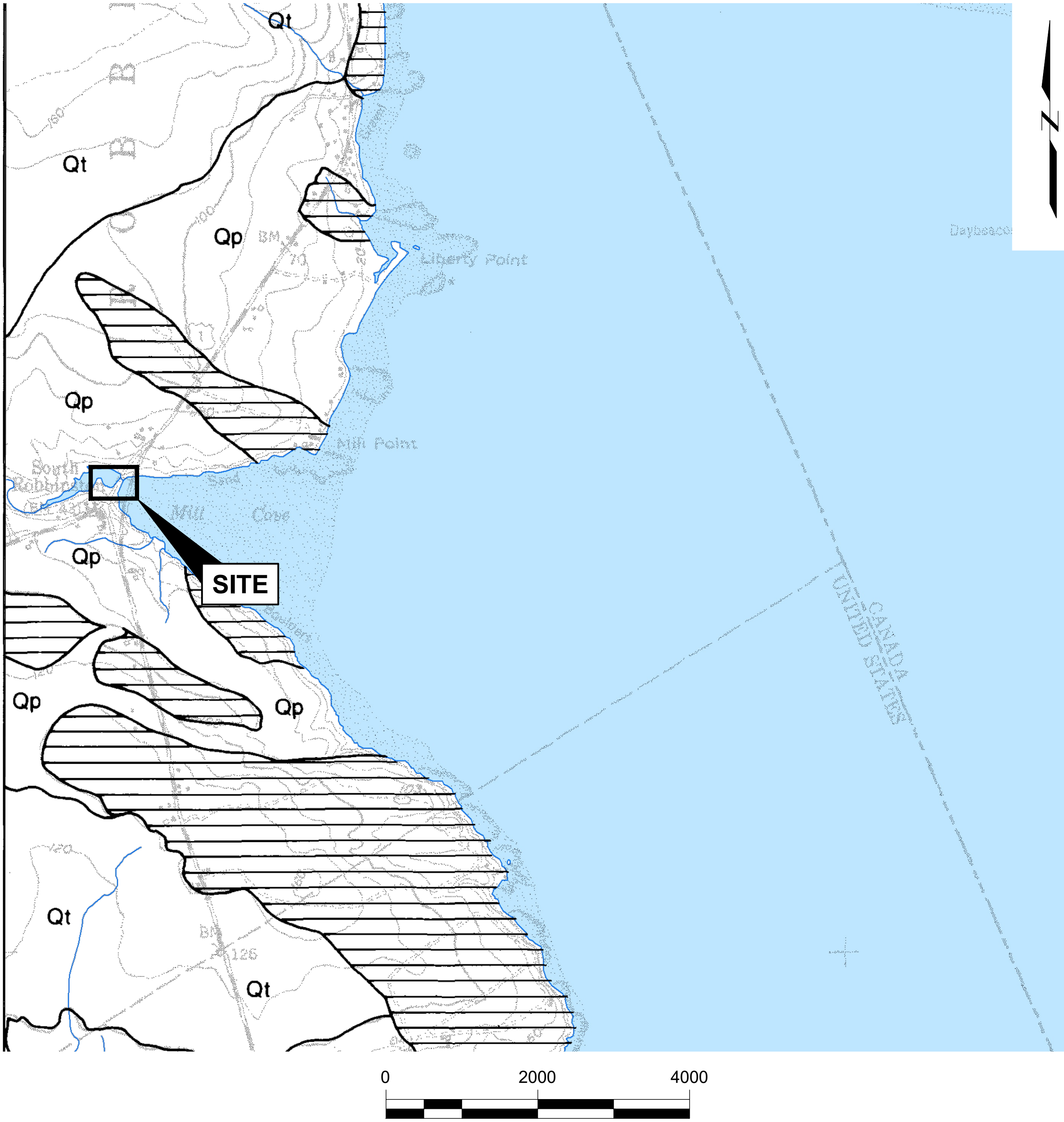
Filename: B:\Working\THORNTON TOMASETTI\2502334 MaineDOT Downeast Bridges Phase II\00_CAD\DGN\03_Robbinston\SHT\003_GeoProfile-Robbinston.dgn

Appendix A Geology

A.1. Surficial Geology Map

A.2. Bedrock Geology

A.1. Surficial Geology Map



LEGEND:

Qp - Glacial-marine deposits (Presumpscot Formation): Silt, clay and sand. Commonly a clayey silt, but sand is very abundant at the surface in some places. Low permeability silt and clay.
Qt - Till: Heterogeneous mixture of sand, silt, clay, and stones.
Ruled pattern Indicates areas of many outcrops and/or surficial deposits (generally less than 10 ft. thick).

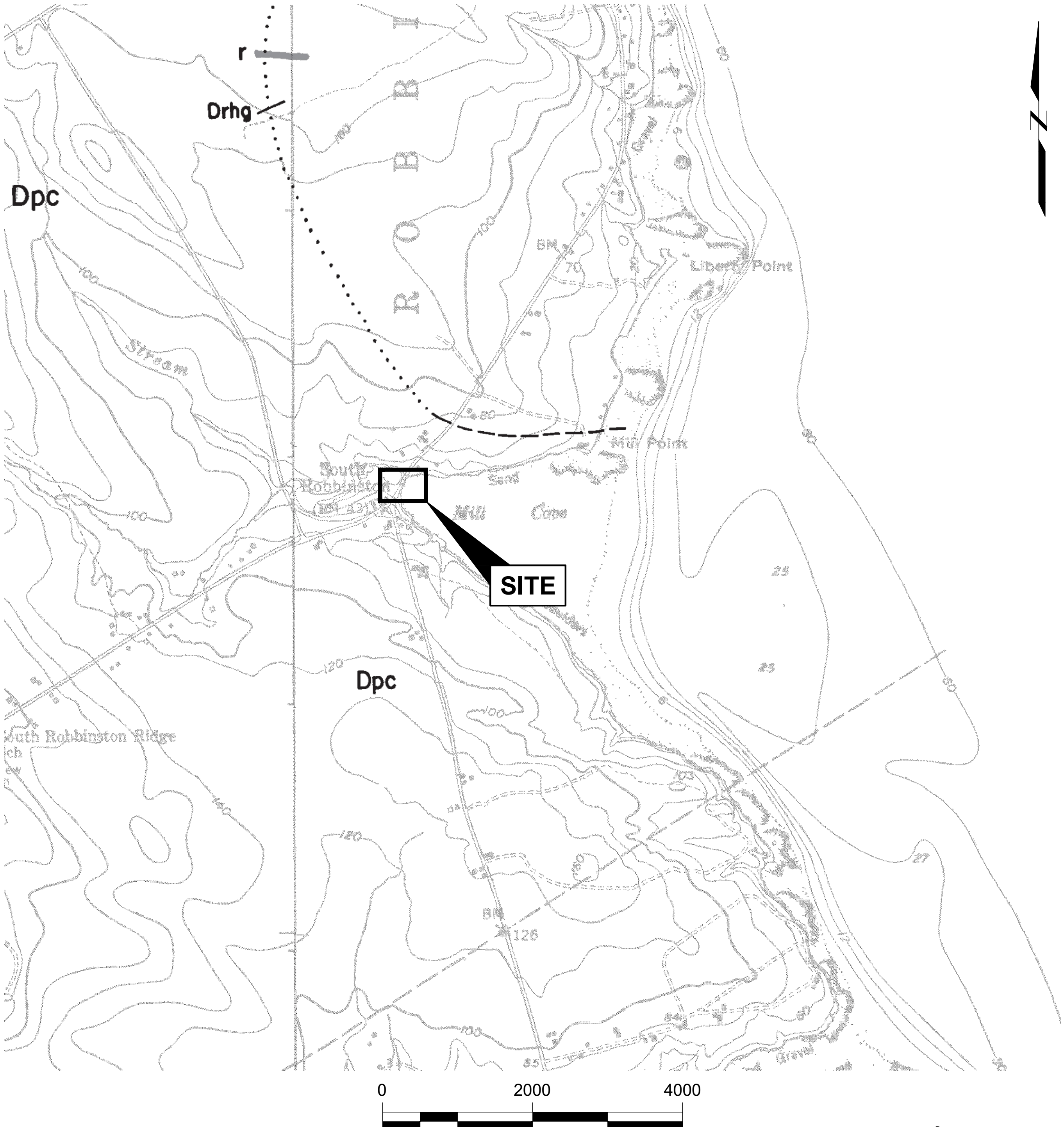
SOURCE:

Map created with Maine Surficial Geology 1:24,000 Maps from Maine Geological Survey. The project site is located on the Robbinston Quadrangle, Maine, prepared by the Maine Geological Survey in 1974.

Mill Cove New Bridge (#6205) over Mill Cove WIN 026630.06 Robbinston, Maine	GEI Consultants	SURFICIAL GEOLOGY MAP
Thornton Tomasetti Portland, Maine	Project 2502334	Aug. 2025 Fig. A-1

CARVAJAL, SEBASTIAN B:\Working\THORNTON TOMASETTI\2502334 MaineDOT Downeast Bridges Phase II\00_CAD\Figures\Geology Ph2\Mill Cove New Bridge at Robbinston\A-1 Surficial Geology - Mill Cove New Bridge.dwg - 5/5/2025

A.2. Bedrock Geology Map

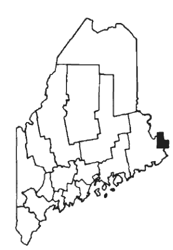


LEGEND:

Dpc - Perry Formation: Red Cobble and pebble alluvial conglomerate with interbedded arkosic sanstone. Clasts from underlying granite, volcanic rocks and sedimentary rocks.

SOURCE:

Map created with Maine Bedrock Geology 1:24,000 Maps from Maine Geological Survey. The project site is located on Devils Head, Robbinston, and Red Beach Quadrangles, Maine, prepared by the Maine Geological Survey in 1986.



Mill Cove New Bridge (#6205) over Mill Cove WIN 026630.06 Robbinston, Maine	GEI Consultants	BEDROCK GEOLOGY MAP
Thornton Tomasetti Portland, Maine	Project 2502334	Aug. 2025 Fig. A-2

CARVAJAL, SEBASTIAN B:\Working\THORNTON TOMASETTI\2502334 MaineDOT Downeast Bridges Phase II\00_CAD\Figures\Geology Ph2\Mill Cove New Bridge at Robbinston\A-2 Bedrock Geology - Mill Cove New Bridge.dwg - 5/5/2025

Appendix B Boring Logs and Core Photographs

B.1. Boring Logs

B.2. Rock Core Photographs

B.3. Automatic Hammer Calibration Report Summary Tables

B.1. Boring Logs

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS (more than half of material is larger than No. 200 sieve size)	GRAVELS (more than half of coarse fraction is larger than No. 4 sieve size)	CLEAN GRAVELS (little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel sand mixtures, little or no fines.
		GRAVEL WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SANDS (more than half of coarse fraction is smaller than No. 4 sieve size)	CLEAN SANDS (little or no fines)	SW	Well-graded sands, Gravelly sands, little or no fines
			SP	Poorly-graded sands, Gravelly sand, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures.
FINE-GRAINED SOILS (more than half of material is smaller than No. 200 sieve size)	SILTS AND CLAYS (liquid limit less than 50)		ML	Inorganic silts and very fine sands, rock flour, Silty or Clayey fine sands, or Clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, Gravelly clays, Sandy clays, Silty clays, lean clays.
			OL	Organic silts and organic Silty clays of low plasticity.
	SILTS AND CLAYS (liquid limit greater than 50)		MH	Inorganic silts, micaceous or diatomaceous fine Sandy or Silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
	HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils.

Desired Soil Observations (in this order, if applicable):
Color (Munsell color chart)
Moisture (dry, damp, moist, wet)
Density/Consistency (from above right hand side)
Texture (fine, medium, coarse, etc.)
Name (Sand, Silty Sand, Clay, etc., including portions - trace, little, etc.)
Gradation (well-graded, poorly-graded, uniform, etc.)
Plasticity (non-plastic, slightly plastic, moderately plastic, highly plastic)
Structure (layering, fractures, cracks, etc.)
Bonding (well, moderately, loosely, etc.,)
Cementation (weak, moderate, or strong)
Geologic Origin (till, marine clay, alluvium, etc.)
Groundwater level

Maine Department of Transportation
Geotechnical Section
Key to Soil and Rock Descriptions and Terms
Field Identification Information

MODIFIED BURMISTER SYSTEM

Descriptive Term	Portion of Total (%)
trace	0 - 10
little	11 - 20
some	21 - 35
adjective (e.g. Sandy, Clayey)	36 - 50

TERMS DESCRIBING DENSITY/CONSISTENCY

Coarse-grained soils (more than half of material is larger than No. 200 sieve): Includes (1) clean gravels; (2) Silty or Clayey gravels; and (3) Silty, Clayey or Gravelly sands. Density is rated according to standard penetration resistance (N-value).

Density of Cohesionless Soils	Standard Penetration Resistance N_{60}-Value (blows per foot)
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	> 50

Fine-grained soils (more than half of material is smaller than No. 200 sieve): Includes (1) inorganic and organic silts and clays; (2) Gravelly, Sandy or Silty clays; and (3) Clayey silts. Consistency is rated according to undrained shear strength as indicated.

Consistency of Cohesive soils	SPT N_{60}-Value (blows per foot)	Approximate Undrained Shear Strength (psf)	Field Guidelines
Very Soft	WOH, WOR, WOP, <2	0 - 250	Fist easily penetrates
Soft	2 - 4	250 - 500	Thumb easily penetrates
Medium Stiff	5 - 8	500 - 1000	Thumb penetrates with moderate effort
Stiff	9 - 15	1000 - 2000	Indented by thumb with great effort
Very Stiff	16 - 30	2000 - 4000	Indented by thumbnail
Hard	>30	over 4000	Indented by thumbnail with difficulty

Rock Quality Designation (RQD):

$$RQD\ (\%) = \frac{\text{sum of the lengths of intact pieces of core* > 4 inches}}{\text{length of core advance}}$$

*Minimum NQ rock core (1.88 in. OD of core)

Rock Quality Based on RQD

Rock Quality	RQD (%)
Very Poor	≤25
Poor	26 - 50
Fair	51 - 75
Good	76 - 90
Excellent	91 - 100

Desired Rock Observations (in this order, if applicable):
Color (Munsell color chart)
Texture (aphanitic, fine-grained, etc.)
Rock Type (granite, schist, sandstone, etc.)
Hardness (very hard, hard, mod. hard, etc.)
Weathering (fresh, very slight, slight, moderate, mod. severe, severe, etc.)
Geologic discontinuities/jointing:
- -dip (horiz - 0-5 deg., low angle - 5-35 deg., mod. dipping - 35-55 deg., steep - 55-85 deg., vertical - 85-90 deg.)
- -spacing (very close - <2 inch, close - 2-12 inch, mod. close - 1-3 feet, wide - 3-10 feet, very wide >10 feet)
- -tightness (tight, open, or healed)
- -infilling (grain size, color, etc.)

Formation (Waterville, Ellsworth, Cape Elizabeth, etc.)
RQD and correlation to rock quality (very poor, poor, etc.)
ref: ASTM D6032 and FHWA NHI-16-072 GEC 5 - Geotechnical Site Characterization, Table 4-12
Recovery (inch/inch and percentage)
Rock Core Rate (X.X ft - Y.Y ft (min:sec))

Sample Container Labeling Requirements:

WIN	Blow Counts
Bridge Name / Town	Sample Recovery
Boring Number	Date
Sample Number	Personnel Initials
Sample Depth	

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	**Project:** Mill Cove New Bridge #6205 carries Route 1 over Mill Cove **Location:** Robbinston, Maine	**Boring No.:** BB-RMC-101 **WIN:** 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	35.8	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	3/28/24-4/2/24	**Drilling Method:**	Drive/Spin & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447399.3, E 2492113.1	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	Not Measured
Hammer Efficiency Factor: 0.765		**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
$S_{u/r}$ = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60}=(Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA			10" ASPHALT	
								35.0		0.8	
	1D	24/10	1.0 - 3.0	20/27/17/11	44	56				Brown and grey, damp, very dense, fine to coarse SAND, some gravel, little silt, (Fill) Top 1" black/asphalt.	
	2D	24/13	4.0 - 6.0	11/19/19/30	38	48	84			Grey and brown, damp, dense, fine to medium SAND, some silt, trace gravel, (Fill)	A-2(0), SM WC=13.9%
5							152				
							132				
							117				
							145				
	3D	24/3	9.0 - 11.0	35/23/37/40	60	77	63			Red and grey, wet, very dense, GRAVEL, (Fill). Rock fragment in tip of spoon.	
10							177				
							96				
							63[1]			[1]63 blows for 0.4 ft.	
	R1	54/32	14.0 - 18.5	--			NQ			R1: Cobble/Boulder: Red, fine to coarse grained, cobble and pebble, alluvial conglomerate. 59% Recovery R1: Core Times (min:sec) 14.0-15.0 ft (2:39) 15.0-16.0 ft (2:29) 16.0-17.0 ft (2:32) 17.0-18.0 ft (1:12) 18.0-18.5 ft (3:09) Rotation pressure variations 14.5-16 ft.	
15											
	R2	60/3	18.5 - 23.5	--						R2: Cobble/Boulder: Red, fine to coarse grained, cobble and pebble, alluvial conglomerate. 5% Recovery R2: Core Times (min:sec) 18.5-19.5 ft (1:19) 19.5-20.5 ft (1:31) 20.5-21.5 ft (2:09) 21.5-22.5 ft (1:50) 22.5-23.5 ft (2:15)	
20											
	4D	24/8	24.0 - 26.0	7/21/24/27	45	57	SPIN			Grey to reddish brown, wet, very dense, Sandy GRAVEL, trace silt, (Fill).	A-1-b, GW WC=6.9%
25											

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Borehole backfilled with bentonite chips, soil cuttings, gravel, and patched with cold patch asphalt.

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

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

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	**Project:** Mill Cove New Bridge #6205 carries Route 1 over Mill Cove **Location:** Robbinston, Maine	**Boring No.:** BB-RMC-101 **WIN:** 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	35.8	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	3/28/24-4/2/24	**Drilling Method:**	Drive/Spin & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447399.3, E 2492113.1	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	Not Measured
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SSA = Solid Stem Auger
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WOH = weight of 140lb. hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
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$S_{u(lab)}$ = Lab Vane 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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WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25											
	5D	24/4	29.0 - 31.0	12/19/21/7	40	51				Grey to reddish brown, wet, very dense, GRAVEL, some sand, trace silt, (Fill).	
30											
							208			Rolled ahead of casing 31 ft to 49 ft.	
							107				
							70				
	6D	24/1	34.0 - 36.0	15/6/4/10	10	13	19			Grey to reddish brown, wet, medium dense, GRAVEL, trace sand, (Fill). Rock fragment tip of spoon, 1.25-in piece of gravel.	
35							29				
							54				
							68				
							76				
	7D	16/6	39.0 - 40.3	38/35/50(4")	--	--	26			Black to reddish brown, wet, very dense, GRAVEL, little sand, (Fill).	
40							114				
							190	-6.2		42.0	
							178				
							109				
	8D	24/24	44.0 - 46.0	24/42/35/44	77	98	61			Grey, wet, hard, Silty CLAY, little gravel, (Glacial Till).	A-4, CL WC=10.4% LL=24.7 PL=15.9 PI=8.8
45							108				
							80				
							78				
							86				
50	9D	24/24	49.0 - 51.0	21/29/34/47	63	80	125			Grey, wet, hard, Silty CLAY, trace gravel, (Glacial Till).	

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Borehole backfilled with bentonite chips, soil cuttings, gravel, and patched with cold patch asphalt.

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

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Location: Robbinston, Maine

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WIN: 026630.06

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Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N60	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
50							88²			² 88 blows for 0.8 ft.	
							92				
							94			Casing refusal at 51.8 ft, rolled ahead of casing to 79 ft.	
							96				
	10D	24/24	54.0 - 56.0	24/26/31/39	57	73	91			Grey, wet, hard, Silty CLAY, some sand, trace gravel, (Glacial Till).	A-4, CL WC=11.2% LL=23.8 PL=15.5 PI=8.3
55							72				
							73				
							63				
							76				
	11D	24/23	59.0 - 61.0	36/29/29/38	58	74	79			Grey, wet, hard, Silty CLAY, some sand, trace gravel, (Glacial Till).	
60							77				
							92				
							97				
							101				
	12D	24/22	64.0 - 66.0	18/27/33/42	60	77	60			Grey, wet, hard, Silty CLAY, some sand, trace gravel, (Glacial Till).	
65							93				
							104				
							108				
							117				
	13D	24/24	69.0 - 71.0	15/22/30/42	52	66	76			Grey, wet, hard, Silty CLAY, trace gravel, (Glacial Till).	
70							71				
							78				
							115				
							123				
75	14D	11/10	74.0 - 74.9	18/50(5")	--	--	92			Grey, wet, hard, Silty CLAY, little gravel, (Glacial Till). Fractured rock at 7".	

Remarks:

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Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	3/28/24-4/2/24	**Drilling Method:**	Drive/Spin & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447399.3, E 2492113.1	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	Not Measured
Hammer Efficiency Factor: 0.765		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N60	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
75							94				
							93				
							87				
							70	-42.6		78.4	
	MD	0/0	79.0 - 79.0	50(0")	--	--				Approximate Top of Bedrock at Elev. -42.6 ft. Red rock cuttings in return, roller cone slowed, increased pressure, rolled to 79 ft.	
80	R3	34/30	79.0 - 81.8	RQD = 26%						R3: Bedrock: Grey and reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, quartz fragments, hard, very slight to slightly weathered, horizontal to low angle, close, tight to open joints with clay infilling. [Perry Formation] Rock Quality: Poor 88% Recovery R3: Core Times (min:sec) 78.5-79.5 ft (2:50) 79.5-80.5 ft (3:09) 80.5-81.3 ft (2:20)	
	R4	6/6	81.3 - 81.8	RQD = 0%						R4: Bedrock: Grey and reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, hard, slightly weathered, very close, open joints. [Perry Formation] Rock Quality: Very Poor 100% Recovery R4: Core Times (min:sec) 81.3-81.8 ft (4:21)	
	R5	30/30	81.8 - 84.3	RQD = 43%						R5: Bedrock: Grey and reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE with clay infilling at bottom 1.5", hard, very slightly weathered, low angle, very close to close, tight to open joints. [Perry Formation] Rock Quality: Poor 100% Recovery R5: Core Times (min:sec) 81.8-82.8 ft (7:04) 82.8-83.8 ft (3:24) 83.8-84.3 ft (1:40)	
	R6	9/9	84.3 - 85.1	RQD = 50%						R6: Bedrock: Grey and reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, hard, very slightly weathered, low angle, very close to close, tight to open joints with clay infilling 6.0- 6.5". [Perry Formation] Rock Quality: Poor 100% Recovery R6: Core Times (min:sec) 84.3-85.0 ft (3:19)	
85	R7	5/4.5	85.0 - 85.4	RQD = 0%						R7: Bedrock: Grey and reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, quartz intrusion at 4", hard, slightly to mod. weathered, low angle, very close open joints with clay infilling 1.0-2.0". [Perry Formation]	
	R8	5/5	85.4 - 85.8	RQD = 0%							
	R9	4/4	85.8 - 86.1	RQD = 0%							
	R10	36/31	86.1 - 89.1	RQD = 53%				-53.3			
90											
95											
100											

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Borehole backfilled with bentonite chips, soil cuttings, gravel, and patched with cold patch asphalt.

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

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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	Project: Mill Cove New Bridge #6205 carries Route 1 over Mill Cove Location: Robbinston, Maine	Boring No.: BB-RMC-101 WIN: 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	35.8	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	3/28/24-4/2/24	**Drilling Method:**	Drive/Spin & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447399.3, E 2492113.1	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	Not Measured
Hammer Efficiency Factor:	0.765	**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
$S_{u/r}$ = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60}=(Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
100										Rock Quality: Very Poor 90% Recovery R7: Core Times (min:sec) 85.0-85.4 ft (2:12) R8: Bedrock: Grey and reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, hard to mod. hard, moderate weathered, very close, open joints. [Perry Formation] Rock Quality: Very Poor 100% Recovery R8: Core Times (min:sec) 85.4-85.8 ft (2:33)	
105										R9: Bedrock: Grey and reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, mod. hard, moderate weathered, very close open joints. [Perry Formation] Rock Quality: Very Poor 100% Recovery R9: Core Times (min:sec) 85.8-86.1 ft (2:45)	
110										R10: Bedrock: Grey and reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, hard, very slightly weathered, low angle to mod dipping, very close to close, tight to open joints. [Perry Formation] Rock Quality: Fair 86% Recovery R10: Core Times (min:sec) 86.1-87.1 ft (6:01) 87.1-88.1 ft (4:55) 88.1-89.1 ft (2:40) 89.1 **Bottom of Exploration at 89.1 feet below ground surface.**	
115											
120											
125											

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Borehole backfilled with bentonite chips, soil cuttings, gravel, and patched with cold patch asphalt.

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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	**Project:** Mill Cove New Bridge #6205 carries Route 1 over Mill Cove **Location:** Robbinston, Maine	**Boring No.:** BB-RMC-102 **WIN:** 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	37.2	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	3/25/24-3/27/24	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447460.2, E 2492104.2	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	18.5 ft bgs.
Hammer Efficiency Factor:	0.765	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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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
$S_{u/r}$ = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60}=(Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA	36.4		10" ASPHALT (0.8)	
	1D	24/7	1.0 - 3.0	14/15/14/14	29	37				Brown, damp, dense, fine to coarse SAND, some gravel, some silt, (Fill).	
	2D	24/16	4.0 - 6.0	13/13/18/25	31	40	88[1]			Brown, damp, dense, Silty fine to medium SAND, trace gravel, (Fill). [1] 88 blows for 0.8 ft.	
5							181				
							232				
							180				
							105				
	3D	24/5	9.0 - 11.0	8/8/8/7	16	20	41			Brown and reddish brown, wet, medium dense, Gravelly fine to coarse SAND, trace silt, (Fill).	A-1-a, SW WC=10.3%
10							54				
							82				
							81				
							263				
	4D	24/11	14.0 - 16.0	35/48/37/34	85	108	215			Brown and reddish brown, wet, very dense, GRAVEL, some silt, little sand, medium plasticity, (Fill).	
15							153				
							149				
							244				
							153				
	5D	24/7	19.0 - 21.0	21/13/14/17	27	34	49			Rolled ahead of casing 19 ft to 29 ft. Brown, wet, medium dense, fine to coarse SAND, some silt, little gravel, medium plasticity, (Fill).	
20							38				
							43				
							86				
							117				
	6D	24/5	24.0 - 26.0	20/23/50(3")	--	--	50			Brown, wet, very dense, Sandy GRAVEL, little silt, (Fill). Probable boulder/cobbles 25.3 to 26 ft.	
25											

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Water level measured on beginning of shift on 3/26/24 8:20.
3. Borehole backfilled with bentonite chips, soil cuttings, and gravel. Top patched with cold patch asphalt.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Mill Cove New Bridge #6205 carries Route 1 over Mill Cove
Location: Robbinston, Maine

Boring No.: BB-RMC-102
WIN: 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	37.2	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	3/25/24-3/27/24	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447460.2, E 2492104.2	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	18.5 ft bgs.
Hammer Efficiency Factor: 0.765		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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SSA = Solid Stem Auger
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WOH = weight of 140lb. hammer
WOR/C = Weight of Rods or Casing
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q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60}=(Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25							66				
							100				
							85				
							84				
	7D	24/1	29.0 - 31.0	8/7/3/5	10	13	60			Grey and reddish brown, wet, medium dense, GRAVEL, trace sand, (Fill).	
30							55				
							55				
							62				
							76				
	8D	24/1	34.0 - 36.0	13/16/25/24	41	52	90			Grey and reddish brown, wet, medium dense, GRAVEL, trace sand, (Fill). 1.8-in piece of gravel at tip.	
35							134				
							146				
							188	0.2		37.0	
							198				
	9D	24/16	39.0 - 41.0	17/20/22/29	42	54	160			Grey, wet, hard, Silty CLAY, little sand, trace gravel, (Glacial Till).	A-4, CL WC=10.0% LL=24.8 PL=15.9 PI=8.9
40							130				
							328				
							178				
							189			Rolled ahead of casing 43 to 47 ft.	
	10D	24/2	44.0 - 46.0	6/28/35/42	63	80	149			Grey, wet, hard, SILT, some gravel, some sand, (Glacial Till). Rock in tip.	
45							120				
							145				
							PUSH				
50	11D	24/24	49.0 - 51.0	13/17/14/55	31	40	149			Grey, wet, hard, Silty CLAY, trace gravel, (Glacial Till).	

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Water level measured on beginning of shift on 3/26/24 8:20.
3. Borehole backfilled with bentonite chips, soil cuttings, and gravel. Top patched with cold patch asphalt.

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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	**Project:** Mill Cove New Bridge #6205 carries Route 1 over Mill Cove **Location:** Robbinston, Maine	**Boring No.:** BB-RMC-102 **WIN:** 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	37.2	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	3/25/24-3/27/24	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447460.2, E 2492104.2	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	18.5 ft bgs.
Hammer Efficiency Factor:	0.765	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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SSA = Solid Stem Auger
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$S_{u/r}$ = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
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N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
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C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
50							144				
							144				
							314			Possible gravel layer based on drill rig behavior.	
							330			Rolled ahead of casing 54 to 82 ft.	
	12D	24/6	54.0 - 56.0	19/23/30/35	53	68	61			Grey, wet, hard, Silty CLAY, little gravel, (Glacial Till).	
55							90				
							162				
							165				
							199				
	13D	24/2	59.0 - 61.0	15/15/19/27	34	43	153			Grey, wet, hard, Silty CLAY, some gravel, (Glacial Till).	
60							173				
							184				
							157				
							192				
	14D	24/6	64.0 - 66.0	13/18/27/26	45	57	151			Grey, wet, hard, Silty CLAY, some gravel, some sand, (Glacial Till).	A-4(0), SM WC=12.3%
65							205				
							153				
							124				
							203				
	15D	24/22	69.0 - 71.0	26/15/37/50	52	66	222			Grey, wet, hard, Silty CLAY, little gravel, little sand, (Glacial Till).	
70							277				
							134				
							164				
							128				
75	16D	24/22	74.0 - 76.0	30/35/31/37	66	84	92			Grey, wet, hard, Silty CLAY, little sand, trace gravel, (Glacial Till).	

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Water level measured on beginning of shift on 3/26/24 8:20.
3. Borehole backfilled with bentonite chips, soil cuttings, and gravel. Top patched with cold patch asphalt.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Mill Cove New Bridge #6205 carries Route 1 over Mill Cove
Location: Robbinston, Maine

Boring No.: BB-RMC-102
WIN: 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	37.2	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	3/25/24-3/27/24	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447460.2, E 2492104.2	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	18.5 ft bgs.
Hammer Efficiency Factor: 0.765		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N60	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
75							114				
							109				
							139				
							152				
	17D	17/17	79.0 - 80.4	32/24/50(5")	--	--				Grey, wet, hard, Silty CLAY, little gravel, trace sand, (Glacial Till). 0.75-in red rock fragment at tip.	
80							RC	-43.2		80.4 Approximate Top of Bedrock at Elev. -43.2 ft. Roller Coned ahead to 82 ft bgs.	
	R1	28/28	82.0 - 84.3	RQD = 0%			NQ			R1: Bedrock: Grey to reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, quartz intrusion at 27.5", hard, slightly weathered, 1-9" fragments, 22-30" fragments. Horizontal to low angle, very close to close, tight joints with sand and silt infilling. [Perry Formation] Rock Quality: Very Poor 100% Recovery R1: Core Times (min:sec) 82.0-83.0 ft (6:08) 83.0-84.0 ft (3:24) 84.0-84.3 ft (1:53)	
	R2	5/5	84.3 - 84.7	RQD = 0%						R2: Bedrock: Grey to reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, hard, slightly weathered. One horizontal, tight joint with sand infilling. [Perry Formation] Rock Quality: Very Poor 100% Recovery R2: Core Times (min:sec) 84.3-84.7 ft (6:46)	
85	R3	40/40	84.7 - 88.0	RQD = 65%						R3: Bedrock: Grey to reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, 24-25" soft rock, hard, slightly weathered, horizontal to low angle, very close to close, tight to open joints with sand and silt infilling. [Perry Formation] Rock Quality: Fair 100% Recovery R3: Core Times (min:sec) 84.7-85.7 ft (9:30) 85.7-86.7 ft (7:23) 86.7-87.7 ft (6:51) 87.7-88.0 ft (1:51)	
	R4	60/60	88.0 - 93.0	RQD = 88%						R4: Bedrock: Grey to reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, quartz intrusion, hard, slightly weathered, horizontal to mod. dipping, very close to mod. close, tight to open joints with sand infilling. One vertical joint from 50"- 57" probable driller break. [Perry Formation] Rock Quality: Good	
90											
								-55.8			
95											
100											

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Water level measured on beginning of shift on 3/26/24 8:20.
3. Borehole backfilled with bentonite chips, soil cuttings, and gravel. Top patched with cold patch asphalt.

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Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	Project: Mill Cove New Bridge #6205 carries Route 1 over Mill Cove Location: Robbinston, Maine	Boring No.: BB-RMC-102 WIN: 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	37.2	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	3/25/24-3/27/24	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447460.2, E 2492104.2	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	18.5 ft bgs.
Hammer Efficiency Factor:	0.765	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
$S_{u/r}$ = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60}=(Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
100										100% Recovery R4: Core Times (min:sec) 88.0-89.0 ft (5:05) 89.0-90.0 ft (3:19) 90.0-91.0 ft (1:57) 91.0-92.0 ft (2:09) 92.0-93.0 ft (2:35) 93.0 **Bottom of Exploration at 93.0 feet below ground surface.**	
105											
110											
115											
120											
125											

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Water level measured on beginning of shift on 3/26/24 8:20.
3. Borehole backfilled with bentonite chips, soil cuttings, and gravel. Top patched with cold patch asphalt.

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

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Maine Department of Transportation

Soil/Rock Exploration Log

US CUSTOMARY UNITS

Project: Mill Cove New Bridge #6205 carries Route 1 over Mill Cove
Location: Robbinston, Maine

Boring No.: BB-RMC-103

WIN: 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	36.0	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	4/2/24-4/8/24	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447476.3, E 2492141.9	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	12.3 ft bgs.
Hammer Efficiency Factor: 0.765		**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
$S_{u/r}$ = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60}=(Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N60	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA	35.3		8" ASPHALT — 0.7	
	1D	24/12	1.0 - 3.0	15/25/17/11	42	54				Brown and grey, damp, very dense, fine to coarse SAND, little gravel, little silt, (Fill).	
	2D	24/15	4.0 - 6.0	10/16/23/27	39	50	127			Brown, damp, dense, fine to medium SAND, little silt, (Fill).	
5							138				
							132				
							139				
							171				
	3D	24/11	9.0 - 11.0	15/14/17/18	31	40	60			Brown and reddish brown, wet, dense, Sandy GRAVEL, little silt, (Fill). Red rock fragments.	
10							98				
							95				
							188				
							166				
	4D	24/14	14.0 - 16.0	43/42/35/26	77	98	53			Rolled ahead of casing 14 ft to 39 ft. Brown and grey, wet, very dense, fine to coarse SAND, some gravel, little silt, (Fill). Red and grey rock fragments.	A-1-b, SM WC=9.3%
15							109				
							101				
							177				
							235				
	5D	24/7	19.0 - 21.0	33/20/21/19	41	52	112			(0-3"): Grey to reddish brown, wet, very dense GRAVEL, some sand, (Fill). (3"-7"): Brown and grey, wet, very dense, fine to coarse SAND, some gravel, little silt, (Fill).	
20							31				
							34				
							79				
							139				
	6D	24/7	24.0 - 26.0	16/16/10/8	26	33	44			Brown, wet, dense, fine to coarse SAND, some gravel, little silt, (Fill).	
25											

Remarks:
1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Water level measured three times between 4/3/2024 and 4/8/2024, average of 12.3 ft bgs.
3. Borehole backfilled with bentonite chips, soil cuttings, and gravel. Top patched with cold patch asphalt.

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Mill Cove New Bridge #6205 carries Route 1 over Mill Cove
Location: Robbinston, Maine

Boring No.: BB-RMC-103
WIN: 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	36.0	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	4/2/24-4/8/24	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447476.3, E 2492141.9	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	12.3 ft bgs.
Hammer Efficiency Factor: 0.765		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25							58				
							35[1] SPIN			[1]35 blows for 0.8 ft. Spin casing to 27 ft to tighen new piece of casing.	
							42				
							47				
	7D	24/10	29.0 - 31.0	21/14/7/7	21	27	53			Grey and reddish brown, wet, medium dense, Gravelly medium to coarse SAND, trace silt, (Fill).	
30							74				
							161				
							174				
							207				
	8D	23/11	34.0 - 35.9	18/41/36/50(5")	77	98	92	1.6		(0-5"): Light grey and reddish brown, wet, very dense GRAVEL, (Fill). — 34.4 — (5"-11"): Grey, wet, very dense, fine to coarse SAND, some gravel, trace silt, rock fragments, (Glacial Till).	A-1-a, SP WC=0.3%
35							127				
							168				
							163				
							189				
	9D	24/22	39.0 - 41.0	20/24/27/49	51	65	OPEN			Grey, wet, hard, Silty CLAY, trace gravel, (Glacial Till).	A-4, CL WC=10.0% LL=25.4 PL=16.0 PI=9.4
40											
	10D	24/24	44.0 - 46.0	14/21/25/34	46	59				Grey, wet, hard, Silty CLAY, trace gravel, trace sand, (Glacial Till).	
45											
	11D	24/20	49.0 - 51.0	21/22/27/29	49	62				Grey, wet, hard, Silty CLAY, little gravel, trace sand, (Glacial Till).	
50											

Remarks:
1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Water level measured three times between 4/3/2024 and 4/8/2024, average of 12.3 ft bgs.
3. Borehole backfilled with bentonite chips, soil cuttings, and gravel. Top patched with cold patch asphalt.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Mill Cove New Bridge #6205 carries Route 1 over Mill Cove				**Boring No.:**	BB-RMC-103
Location: Robbinston, Maine				**WIN:**	026630.06
Driller:	New England Boring Contractors	**Elevation (ft.)**	36.0	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	4/2/24-4/8/24	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447476.3, E 2492141.9	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	12.3 ft bgs.
Hammer Efficiency Factor:	0.765	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
50											
	12D	24/9	54.0 - 56.0	25/38/41/33	79	101				Grey, wet, hard, Silty CLAY, some gravel, little sand, (Glacial Till).	
55											
	13D	24/24	59.0 - 61.0	10/19/23/34	42	54				Grey, wet, hard, Silty CLAY, trace gravel, trace coarse sand, (Glacial Till).	
60											
	14D	24/21	64.0 - 66.0	21/30/31/38	61	78				Grey, wet, hard, Silty CLAY, trace gravel, little sand, (Glacial Till).	
65											
	15D	24/24	69.0 - 71.0	16/32/38/50	70	89				Grey, wet, hard, Silty CLAY, trace gravel, trace sand, (Glacial Till).	
70											
75	16D	8/6	74.0 - 74.7	35/50(2")	--	--		-38.7		Purple, wet, very dense, fine to coarse SAND, some silt, little gravel, rock fragments in top 1", (Glacial Till).	A-2(0), SM WC=14.3%

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Water level measured three times between 4/3/2024 and 4/8/2024, average of 12.3 ft bgs.
3. Borehole backfilled with bentonite chips, soil cuttings, and gravel. Top patched with cold patch asphalt.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Mill Cove New Bridge #6205 carries Route 1 over Mill Cove
Location: Robbinston, Maine

Boring No.: BB-RMC-103
WIN: 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	36.0	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	4/2/24-4/8/24	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447476.3, E 2492141.9	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	12.3 ft bgs.
Hammer Efficiency Factor: 0.765		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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WOH = weight of 140lb. hammer
WOR/C = Weight of Rods or Casing
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q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
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N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60}=(Hammer Efficiency Factor/60%)*N-uncorrected
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WC = Water Content, percent
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C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
75	R1	25/16	75.0 - 77.1	RQD = 0%			NQ			74.7 Approximate Top of Bedrock at Elev. -38.7 ft. R1: Bedrock: Grey and reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, hard, slightly to moderately weathered, highly weathered from 8" to 13", horizontal to steep, very close to close, tight to open joints with sand infilling. [Perry Formation] Rock Quality: Very Poor 64% Recovery R1: Core Times (min:sec) 75.0-76.0 ft (6:11) 76.0-77.0 ft (10:35) 77.0-77.1 ft (1:33) Low drilling head pressure.	
	R2	47/47	77.1 - 81.0	RQD = 64%						R2: Bedrock: Grey and reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, hard, slightly weathered, horizontal to low angle, very close to close, tight to open joints with clay and sand infilling. Red and brown clay from 2-3.5". [Perry Formation] Rock Quality: Fair 100% Recovery R2: Core Times (min:sec) 77.1-78.1 ft (5:50) 78.1-79.1 ft (6:57) 79.1-80.1 ft (4:41) 80.1-81.0 ft (6:38)	
80											
	R3	24/24	81.0 - 83.0	RQD = 83%						R3: Bedrock: Grey and reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, hard, slightly weathered, low angle, very close to close, tight to open joints with silt infilling. [Perry Formation] Rock Quality: Good 100% Recovery R3: Core Times (min:sec) 81.0-82.0 ft (7:14) 82.0-83.0 ft (7:50)	
	R4	36/36	83.0 - 86.0	RQD = 42%						R4: Bedrock: Grey and reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, hard, slightly weathered, horizontal to low angle, very close to close, open joints with sand infilling. [Perry Formation] Rock Quality: Poor 100% Recovery R4: Core Times (min:sec) 83.0-84.0 ft (7:15) 84.0-85.0 ft (8:44) 85.0-86.0 ft (7:46)	
85											
								-50.0		86.0 **Bottom of Exploration at 86.0 feet below ground surface.**	
90											
95											
100											

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Water level measured three times between 4/3/2024 and 4/8/2024, average of 12.3 ft bgs.
3. Borehole backfilled with bentonite chips, soil cuttings, and gravel. Top patched with cold patch asphalt.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Mill Cove New Bridge #6205 carries Route 1 over Mill Cove
Location: Robbinston, Maine

Boring No.: BB-RMC-104
WIN: 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	36.8	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	4/9/2024 - 4/11/2024	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447529.6, E 2492163.4	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	26.1 ft bgs.
Hammer Efficiency Factor:	0.765	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N60	Casing Blows	Elevation (ft.)	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA		11" ASPHALT	
	1D	24/12	1.0 - 3.0	22/25/13/20	38	49		35.9	0.9 Brown and grey, damp, dense, fine to coarse SAND, little gravel, trace silt, (Fill).	
	2D	24/20	4.0 - 6.0	16/19/22/20	41	52	92		Brown, damp, very dense, fine to medium SAND, some silt, (Fill).	
5							133			
							144			
							179			
							168[1] 150[2]		[1]168 blows for 0.5 ft. Probable boulder/cobble at 8.5 ft. Rolled ahead of casing 8.5 to 35 ft.	
	MD	1/0	9.0 - 9.1	50(1")	--	--	172		[2]150 blows for 0.5 ft. No recovery.	
10							92		Probable boulder/cobbles 9.1 to 9.8 ft.	
							122			
							155		Probable boulder/cobbles 11.5 to 13.5 ft.	
							175			
	3D	24/12	14.0 - 16.0	21/32/26/38	58	74	59		Brown, wet, very dense, fine to coarse SAND, little gravel, little silt, (Fill).	A-1-b, SM WC=10.4%
15							61			
							68			
							137			
							205			
	MD	0/0	19.0 - 19.0	50(0")	--	--	187		Split Spoon Refusal/No penetration. Probable boulder/cobbles.	
20							137			
							122			
							129			
							162			
	4D	4/4	24.0 - 24.3	50(4")	--	--	171		Brown and reddish brown, wet, GRAVEL, some sand, trace silt, (Fill).	
25										

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Samples R2 and R3 were cored outside casing. After R3, 3-in was driven to 92 ft, but core barrel was pinched at 86.2 ft.
3. Water level measured before drilling activities on 4/10 and 4/11 and had an average of 26.1 ft bgs.
4. Borehole backfilled with bentonite chips, soil cuttings, and gravel. Top patched with cold patch asphalt.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Mill Cove New Bridge #6205 carries Route 1 over Mill Cove	**Location:** Robbinston, Maine	**Boring No.:** BB-RMC-104	**WIN:** 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	36.8	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	4/9/2024 - 4/11/2024	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447529.6, E 2492163.4	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	26.1 ft bgs.
Hammer Efficiency Factor:	0.765	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25							143			Probable boulder/cobbles 24.7 to 26.5.	
							118				
							147				
							190				
	5D	24/9	29.0 - 31.0	28/21/13/12	34	43	109			Grey and reddish brown, wet, dense, fine to medium SAND, little silt, trace gravel, (Fill).	A-2(0), SM WC=15.3%
30							103				
							104				
							112	4.8		32.0	
							106				
	6D	24/10	34.0 - 36.0	9/11/23/40	34	43	126			Grey, wet, hard, Silty CLAY, some gravel, little sand, (Glacial Till).	
35							OPEN				
	7D	24/18	39.0 - 41.0	13/20/25/18	45	57				Grey, wet, very dense, Clayey fine to coarse SAND, some silt, trace gravel, (Glacial Till).	
40											
	8D	24/17	44.0 - 46.0	10/14/20/25	34	43				Grey, wet, hard, Silty CLAY, some gravel, trace sand, (Glacial Till).	
45											
50	9D	24/15	49.0 - 51.0	17/18/22/25	40	51				Grey, wet, hard, Silty CLAY, some sand, little gravel, (Glacial Till).	A-4(0), ML WC=10.8%

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Samples R2 and R3 were cored outside casing. After R3, 3-in was driven to 92 ft, but core barrel was pinched at 86.2 ft.
3. Water level measured before drilling activities on 4/10 and 4/11 and had an average of 26.1 ft bgs.
4. Borehole backfilled with bentonite chips, soil cuttings, and gravel. Top patched with cold patch asphalt.

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

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Mill Cove New Bridge #6205 carries Route 1 over Mill Cove
Location: Robbinston, Maine

Boring No.: BB-RMC-104
WIN: 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	36.8	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	4/9/2024 - 4/11/2024	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447529.6, E 2492163.4	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	26.1 ft bgs.
Hammer Efficiency Factor: 0.765		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
50											
	10D	11/11	54.0 - 54.9	8/50(5")	--	--				Grey, wet. hard, Silty CLAY, some sand, little gravel, (Glacial Till).	A-4, CL WC=8.7% LL=23.0 PL=14.7 PI=8.3
55											
										Probable cobbles/gravel based on drill rig beahviour 56 to 58 ft.	
	11D	17/8	59.0 - 60.4	26/24/50(5")	--	--				Grey, wet, very dense, fine to coarse SAND, some silt, some gravel, medium plasticity fines, (Glacial Till).	A-2(0), SM WC=11.3%
60											
	12D	20/10	64.0 - 65.7	27/27/34/50(2")	61	78				Grey, wet, hard, Gravelly Silty CLAY, trace sand, (Glacial Till).	
65											
	13D	2/2	69.0 - 69.2	50(2")	--	--				Grey and brown, wet, hard, Gravelly SILT, some sand, (Glacial Till). Reddish sandy clay in bottom 1".	
70											
	R1	30/19	72.0 - 74.5	--			NQ			R1: Cobble/Boulder: Grey and reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, hard, slightly to moderate weathered. Cobble matrix, rounded edges, sand and clay infilling. 63% Recovery R1: Core Times (min:sec) 72.0-73.0 ft (8:56)	
	14D	5/5	74.5 - 74.9	50(5")	--	--	SPIN				
75											

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Samples R2 and R3 were cored outside casing. After R3, 3-in was driven to 92 ft, but core barrel was pinched at 86.2 ft.
3. Water level measured before drilling activities on 4/10 and 4/11 and had an average of 26.1 ft bgs.
4. Borehole backfilled with bentonite chips, soil cuttings, and gravel. Top patched with cold patch asphalt.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Mill Cove New Bridge #6205 carries Route 1 over Mill Cove
Location: Robbinston, Maine

Boring No.: BB-RMC-104
WIN: 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	36.8	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	4/9/2024 - 4/11/2024	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447529.6, E 2492163.4	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	26.1 ft bgs.
Hammer Efficiency Factor: 0.765		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
75										73.0-74.0 ft (11:05) 74.0-74.5 ft (4:55) Grey and reddish brown, wet, very dense, Sandy GRAVEL, some silt, (Glacial Till). Possible boulder/cobbles.	
	15D	3/1	79.0 - 79.3	50(3")	--	--				Grey and reddish brown, wet, very dense, Gravelly fine to coarse SAND, little silt, (Glacial Till).	
80											
	16D	4/4	84.0 - 84.3	50(4")	--	--				Possible boulder/cobbles. Brown and grey, wet, very dense, Gravelly fine to coarse SAND, some silt, (Glacial Till).	
85											
								-52.2		No Recovery 89.0	
	MD	0/0	89.0 - 89.0	50(0")	--	--	NQ				
90	R2	17/11	89.0 - 90.4	RQD = 65%						Approximate Top of Bedrock at Elev. -52.2 ft. R2: Bedrock: Grey and reddish brown, medium to coarse grained, GRANODIORITE, hard, fresh to slightly weathered, low angle, open joint at 8.5" with sand infilling. [Perry Formation] Rock Quality: Fair 65% Recovery R2: Core Times (min:sec) 80.0-90 ft (8:40) 90.0-90.4 ft (2:47)	
	R3	16/6	90.4 - 91.7	RQD = 0%				-55.2		R3: Bedrock: Grey and reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, hard, moderate weathered, low angle to mod. dipping close to open joint with sand infilling. 0-3" gravel/ cobbles. [Perry Formation] Rock Quality: Very Poor 38% Recovery R3: Core Times (min:sec) 90.4-91.4 ft (9:31) 91.4-91.7 ft (3:27) At 86.2' core barrel did not get thru casing. Abandon hole. 92.0	
95											
100											

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Samples R2 and R3 were cored outside casing. After R3, 3-in was driven to 92 ft, but core barrel was pinched at 86.2 ft.
3. Water level measured before drilling activities on 4/10 and 4/11 and had an average of 26.1 ft bgs.
4. Borehole backfilled with bentonite chips, soil cuttings, and gravel. Top patched with cold patch asphalt.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Mill Cove New Bridge #6205 carries Route 1 over Mill Cove
Location: Robbinston, Maine

Boring No.: BB-RMC-104
WIN: 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	36.8	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	G. McDougal	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	M. Schoeff	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lbs/30"
Date Start/Finish:	4/9/2024 - 4/11/2024	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N 447529.6, E 2492163.4	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	26.1 ft bgs.
Hammer Efficiency Factor: 0.765		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
100										**Bottom of Exploration at 92.0 feet below ground surface.**	
105											
110											
115											
120											
125											

Remarks:

1. Automatic hammer NEBC D-28. Energy Transfer Ratio = 0.765.
2. Samples R2 and R3 were cored outside casing. After R3, 3-in was driven to 92 ft, but core barrel was pinched at 86.2 ft.
3. Water level measured before drilling activities on 4/10 and 4/11 and had an average of 26.1 ft bgs.
4. Borehole backfilled with bentonite chips, soil cuttings, and gravel. Top patched with cold patch asphalt.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Mill Cove New Bridge (#6205) carries Route 1 over Mill Cove
Location: Robbinston, Maine

Boring No.: BB-RMC-201
WIN: 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	42.3	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	B. Enos	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	S. Carvajal	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lb/30"
Date Start/Finish:	5/12/25 - 5/12/25	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N: 447010.7, E: 2492023.4	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	18.2 ft bgs
Hammer Efficiency Factor: 0.834		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
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SSA = Solid Stem Auger
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WOH = weight of 140lb. hammer
WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
$S_{u/r}$ = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane 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
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G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA	41.5		10" ASPHALT — 0.8	
	1D	24/24	1.0 - 3.0	34/29/22/18	51	71				Light brown, dry, very dense, fine to coarse SAND, some gravel, little silt, slight hydrocarbon odor, (Fill).	
5	2D	24/10	4.0 - 6.0	13/18/26/25	44	61	SPIN			Brown, damp, very dense, fine to coarse SAND, some silt, trace gravel, (Fill).	
							SPIN				
							39				
							38				
							63				
10	3D	24/24	9.0 - 11.0	5/4/5/3	9	13	48			Grey, moist, stiff, Silty CLAY, (Fill).	A-6, CL WC=26.8% LL=37.6 PL=21.9 PI=15.7
							58				
							83			Rolled ahead of casing from 11 ft to 39 ft.	
							81				
							83				
15	4D	23/11	14.0 - 15.9	10/21/49/50(5")	70	97	77			Light brown to grey, moist, very dense, fine to coarse SAND, some silt, little gravel, (Fill).	
							77				
							60				
							61				
							94			Rattling from 17 ft to 19 ft.	
20	5D	24/8	19.0 - 21.0	50/41/38/51	79	110	98			Brown to red, wet, very dense, fine to coarse SAND, some silt, little gravel, (Fill).	A-2(0), SM WC=8.5%
							49				
							62				
							63				
							62			Rattling from 22 ft to 24 ft.	
25	6D	16/7	24.0 - 25.3	43/54/50(4")	--	--	46			Grey to red, wet, Sandy GRAVEL, some silt, (Fill).	

Remarks:

1. Automatic hammer NEBC D-23. Energy Transfer Ratio = 0.834.
2. The boring coordinates and elevation were estimated using tape ties and a topographic survey provided by MaineDOT, and should be considered accurate to the degree implied.
3. Advance SSA to 4.0 ft; switch to drive and the degree implied.wash; advance 4-in casing to 39 ft. Telescope 3-in casing for coring to 42.1 ft.
4. Water level measured at end of drilling.
5. Borehole backfilled with soil cuttings, gravel, and patched with cold patch asphalt.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Mill Cove New Bridge (#6205) carries Route 1 over Mill Cove
Location: Robbinston, Maine

Boring No.: BB-RMC-201
WIN: 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	42.3	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	B. Enos	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	S. Carvajal	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lb/30"
Date Start/Finish:	5/12/25 - 5/12/25	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NQ-2"
Boring Location:	N: 447010.7, E: 2492023.4	**Casing ID/OD:**	HW-4" & NW-3"	**Water Level*:**	18.2 ft bgs
Hammer Efficiency Factor: 0.834		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
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WC = Water Content, percent
LL = Liquid Limit
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G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25							47				
							61				
							90	15.3		27.0 Rattling at 27 ft.	
							91				
	7D	24/8	29.0 - 31.0	20/22/22/41	44	61	63			Grey, wet, very dense, fine to coarse SAND, some gravel, some silt, (Glacil Till).	A-2(0), SM WC=8.2%
30							50				
							103				
							74				
							140				
	8D	3/2	34.0 - 34.3	50(3")	--	--	110			Grey, wet, Gravelly fine to coarse SAND, little silt, (Glacial Till).	
35							94				
							102				
							130			Rattling from 37 ft to 38 ft.	
							289				
	9D	22/5	39.0 - 40.8	55/45/34/50(4")	79	110				Grey, wet, very dense, Sandy GRAVEL, little silt, (Glacial Till).	
40											
								0.7		41.6	
	R1	60/60	42.1 - 47.1	RQD = 100%			CORE			Approx. Top of Bedrock at Elev. 0.7 ft. R1: Bedrock: Grey and reddish brown, fine to coarse grained, cobble and pebble alluvial CONGLOMERATE, quartz fragments, hard, slighty weathered. Joints are horizontal to low angle, close to mod. close, open with silt infilling. [Perry Formation] Rock Quality: Excellent 100% Recovery R1: Core Times (min:sec) 42.1-43.1 ft (3:47) 43.1-44.1 ft (2:36) 44.1-45.1 ft (2:35) 45.1-46.1 ft (2:16) 46.1-47.1 ft (2:32)	
45											
								-4.8			
										47.1	
										Bottom of Exploration at 47.1 feet below ground surface.	
50											

Remarks:

1. Automatic hammer NEBC D-23. Energy Transfer Ratio = 0.834.
2. The boring coordinates and elevation were estimated using tape ties and a topographic survey provided by MaineDOT, and should be considered accurate to the degree implied.
3. Advance SSA to 4.0 ft; switch to drive and the degree implied.wash; advance 4-in casing to 39 ft. Telescope 3-in casing for coring to 42.1 ft.
4. Water level measured at end of drilling.
5. Borehole backfilled with soil cuttings, gravel, and patched with cold patch asphalt.

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Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Mill Cove New Bridge (#6205) carries Route 1 over Mill Cove
Location: Robbinston, Maine

Boring No.: BB-RMC-202
WIN: 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	37.2	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	B. Enos	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	S. Carvajal	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lb/30"
Date Start/Finish:	5/13/25 - 5/13/25	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NA
Boring Location:	N: 447208.5, E: 2492057.5	**Casing ID/OD:**	4.00"/4.50"	**Water Level*:**	7.1 ft bgs
Hammer Efficiency Factor: 0.834		**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

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WOR/C = Weight of Rods or Casing
WO1P = Weight of One Person
$S_{u/r}$ = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60}=(Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N60	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							SSA	36.5		9" ASPHALT ——— 0.8	
	1D	24/12	1.0 - 3.0	25/21/18/12	39	54				Light brown to dark grey, dry, very dense, fine to coarse SAND, some gravel, trace silt, slight hydrocarbon odor, (Fill).	
	2D	24/24	4.0 - 6.0	24/40/30/15	70	97	PUSH			Light brown, damp, very dense, fine to coarse SAND, some silt, little gravel, (Fill).	A-2(0), SM WC=6.8%
5							76				
							223				
							108				
							120				
	3D	24/8	9.0 - 11.0	10/16/22/18	38	53	48			Brown to reddish brown, wet, very dense, fine to coarse SAND, some gravel, some silt, (Fill).	
10							101				
							144				
							78				
							58				
	4D	24/10	14.0 - 16.0	3/4/8/13	12	17	SPIN			Brown to grey, wet, very stiff, Silty CLAY, little gravel, (Fill).	A-6, CL WC=28.1% LL=33.6 PL=20.1 PI=13.5
15							SPIN				
							90			Rolled ahead of casing from 16 ft to bottom of exploration.	
							102			Rattling at 17 ft to 18 ft.	
							51				
	5D	24/3	19.0 - 21.0	20/22/30/41	52	72	90			Brown to grey, wet, very dense, Silty GRAVEL, little sand, (Fill).	
20							103				
							109				
							135				
							113			Rattling 22 ft to 23 ft.	
25	6D	24/12	24.0 - 26.0	29/33/32/25	65	90	108			Brown to reddish brown, wet, very dense, Gravelly fine to coarse SAND, little silt, (Fill).	

Remarks:
1. Automatic hammer NEBC D-23. Energy Transfer Ratio = 0.834.
2. The boring coordinates and elevation were estimated using tape ties and a topographic survey provided by MaineDOT, and should be considered accurate to the degree implied.
3. Advance SSA to 4.0 ft; switch to drive and wash; advance 4-in casing to 39 ft.
4. Water level measured at end of drilling.
5. Borehole backfilled with soil cuttings, gravel, and patched with cold patch asphalt.

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

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

Maine Department of Transportation

Soil/Rock Exploration Log
US CUSTOMARY UNITS

Project: Mill Cove New Bridge (#6205) carries Route 1 over Mill Cove
Location: Robbinston, Maine

Boring No.: BB-RMC-202
WIN: 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	37.2	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	B. Enos	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	S. Carvajal	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lb/30"
Date Start/Finish:	5/13/25 - 5/13/25	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NA
Boring Location:	N: 447208.5, E: 2492057.5	**Casing ID/OD:**	4.00"/4.50"	**Water Level*:**	7.1 ft bgs
Hammer Efficiency Factor: 0.834		**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
$S_{u/r}$ = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60}=(Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
25							116				
							153				
							235				
							163			Rattling at 28 ft.	
	7D	24/3	29.0 - 31.0	18/30/33/36	63	88	132			Reddish brown to black, wet, very dense, Sandy GRAVEL, little silt, strong hydrocarbon odor, (Fill).	
30							110				
							147				
							105			Rattling from 31 ft to 33 ft.	
							172				
	8D	24/17	34.0 - 36.0	6/6/6/3	12	17	94			Reddish brown, wet, medium dense, fine to coarse SAND, little gravel, trace silt, (Fill).	
35							122				
							121	0.2		37.0	
							263				
							300				
	9D	5/3	39.0 - 39.4	50(3")	--	--				Grey, wet, GRAVEL, little sand, little silt, (Glacial Till).	
40											
	10D	24/12	44.0 - 46.0	36/50/45/41	95	132				Grey, wet, hard, SILT, little gravel, little sand, (Glacial Till).	
45											
	11D	12/6	49.0 - 50.0	45/110(6")	--	--				Grey, wet, Silty GRAVEL, some sand, (Glacial Till).	
50											

Remarks:

1. Automatic hammer NEBC D-23. Energy Transfer Ratio = 0.834.
2. The boring coordinates and elevation were estimated using tape ties and a topographic survey provided by MaineDOT, and should be considered accurate to the degree implied.
3. Advance SSA to 4.0 ft; switch to drive and wash; advance 4-in casing to 39 ft.
4. Water level measured at end of drilling.
5. Borehole backfilled with soil cuttings, gravel, and patched with cold patch asphalt.

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

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

Maine Department of Transportation Soil/Rock Exploration Log US CUSTOMARY UNITS	**Project:** Mill Cove New Bridge (#6205) carries Route 1 over Mill Cove **Location:** Robbinston, Maine	**Boring No.:** BB-RMC-202 **WIN:** 026630.06

Driller:	New England Boring Contractors	**Elevation (ft.)**	37.2	**Auger ID/OD:**	5" Solid Stem Auger
Operator:	B. Enos	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	S. Carvajal	**Rig Type:**	Mobile B-53	**Hammer Wt./Fall:**	140 lb/30"
Date Start/Finish:	5/13/25 - 5/13/25	**Drilling Method:**	Drive & Wash	**Core Barrel:**	NA
Boring Location:	N: 447208.5, E: 2492057.5	**Casing ID/OD:**	4.00"/4.50"	**Water Level*:**	7.1 ft bgs
Hammer Efficiency Factor:	0.834	**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
$S_{u/r}$ = Peak/Remolded Field Vane Undrained Shear Strength (psf)
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw Field SPT N-value
Hammer Efficiency Factor = Rig Specific Annual Calibration Value
N_{60} = SPT N-uncorrected Corrected for Hammer Efficiency
N_{60}=(Hammer Efficiency Factor/60%)*N-uncorrected
T_v = Pocket Torvane Shear Strength (psf)
WC = Water Content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
50											
	12D	24/13	54.0 - 56.0	22/33/41/51	74	103				Grey, wet, hard, SILT & CLAY, some sand, trace gravel, (Glacial Till).	A-4, CL WC=10.4% LL=23.8 PL=16.1 PI=7.7
55											
								-18.8		56.0 **Bottom of Exploration at 56.0 feet below ground surface.**	
60											
65											
70											
75											

Remarks:
1. Automatic hammer NEBC D-23. Energy Transfer Ratio = 0.834.
2. The boring coordinates and elevation were estimated using tape ties and a topographic survey provided by MaineDOT, and should be considered accurate to the degree implied.
3. Advance SSA to 4.0 ft; switch to drive and wash; advance 4-in casing to 39 ft.
4. Water level measured at end of drilling.
5. Borehole backfilled with soil cuttings, gravel, and patched with cold patch asphalt.

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.

B.2. Rock Core Photographs

MaineDOT

Mill Cove New Bridge #6205 carrying Route 1 over Mill Cove

Robbinston, ME

Rock Core Photographs

Boring No.	Run	Depth (ft)	Penetration (in)	Recovery (in)	RQD (in)	RQD (%)	Rock Type	Box Row
BB-RMC-102	R1	82.0-84.3	28	28	0	0	Conglomerate	1
BB-RMC-102	R2	84.3-84.7	5	5	0	0	Conglomerate	1
BB-RMC-102	R3	84.7-88.0	40	40	26	65	Conglomerate	1-2
BB-RMC-102	R4	88.0-93.0	60	60	53	88	Conglomerate	2-3
BB-RMC-101	R1	14.0-18.5	54	32	--	--	Boulder	4
BB-RMC-101	R2	18.5-23.5	60	3	--	--	Boulder	4

Notes:

1. "Box Row" indicates the section of the box where core run is contained: 1 = top, 4 = bottom.
2. Top of core at left. Increasing depth left to right.

MaineDOT

Mill Cove New Bridge #6205 carrying Route 1 over Mill Cove

Robbinston, ME

Rock Core Photographs

Boring No.	Run	Depth (ft)	Penetration (in)	Recovery (in)	RQD (in)	RQD (%)	Rock Type	Box Row
BB-RMC-101	R3	79.0-81.8	34	30	9	26	Conglomerate	1
BB-RMC-101	R4	81.3-81.8	6	6	0	0	Conglomerate	1
BB-RMC-101	R5	81.8-84.3	30	30	13	43	Conglomerate	1-2
BB-RMC-101	R6	84.3-85.1	9	9	4.5	50	Conglomerate	2
BB-RMC-101	R7	85.0-85.4	5	4.5	0	0	Conglomerate	2
BB-RMC-101	R8	85.4-85.8	5	5	0	0	Conglomerate	2
BB-RMC-101	R9	85.8-86.1	4	4	0	0	Conglomerate	2
BB-RMC-101	R10	86.1-89.1	36	31	19	53	Conglomerate	2-3
BB-RMC-103	R1	75.0-77.1	25	16	0	0	Conglomerate	3
BB-RMC-103	R2	77.1-81.0	47	47	30	64	Conglomerate	3-4
BB-RMC-103	R3	81.0-83.0	24	24	20	83	Conglomerate	4

Notes:

1. “Box Row” indicates the section of the box where core run is contained: 1 = top, 4 = bottom.
2. Top of core at left. Increasing depth left to right.

MaineDOT

Mill Cove New Bridge #6205 carrying Route 1 over Mill Cove

Robbinston, ME

Rock Core Photographs

Boring No.	Run	Depth (ft)	Penetration (in)	Recovery (in)	RQD (in)	RQD (%)	Rock Type	Box Row
BB-RMC-103	R4	83.0-86.0	36	36	15	42	Conglomerate	1
BB-RMC-104	R1	72.0-74.5	30	19	--	--	Boulder	1
BB-RMC-104	R2	89.0-90.4	17	11	11	65	Granodiorite	2
BB-RMC-104	R3	90.4-91.7	16	6	0	0	Conglomerate	2

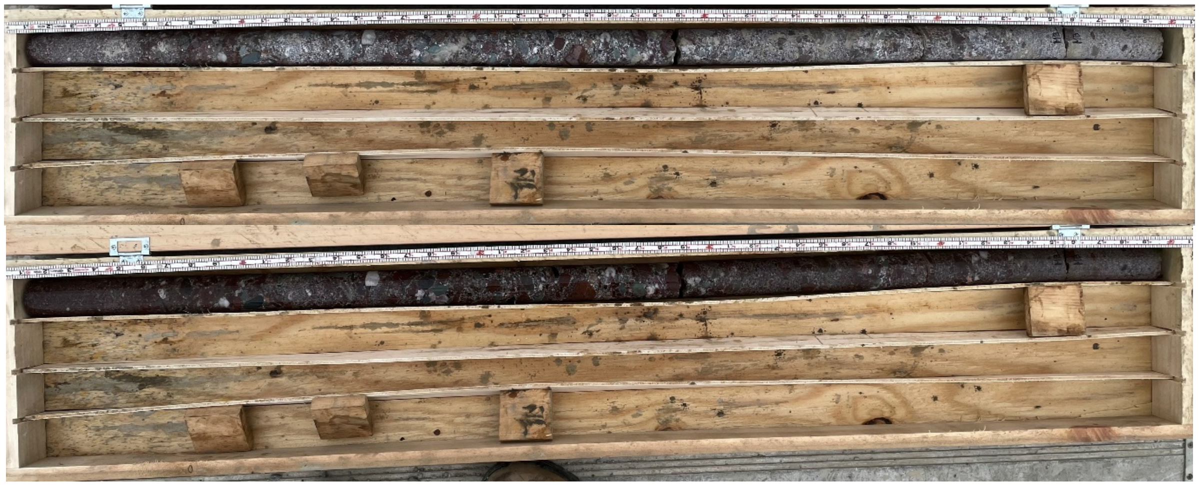
Notes:

1. "Box Row" indicates the section of the box where core run is contained: 1 = top, 4 = bottom.
2. Top of core at left. Increasing depth left to right.

MaineDOT

Mill Cove New Bridge #6205 carrying Route 1 over Mill Cove
Robbinston, ME
Rock Core Photographs

Boring No.	Run	Depth (ft)	Penetration (in)	Recovery (in)	RQD (in)	RQD (%)	Rock Type	Box Row
BB-RMC-201	R1	42.1-47.1	60	60	60	100	Conglomerate	1



Notes:

1. "Box Row" indicates the section of the box where core run is contained: 1 = top, 4 = bottom.
2. Top of core at left. Increasing depth left to right.
3. Top photo is dry, bottom photo is wet

B.3. Automatic Hammer Calibration Report Summary Tables

TABLE 3 - SUMMARY OF SPT TEST RESULTS
MOBIL B53 - NEBC DRILL RIG #28 (SERIAL NUMBER D28-2/21)

SPT Analyzer Results

PDA-S Ver. 2022.35.2 - Printed: 4/23/2023

Summary of SPT Test Results

Project: Mobil B53 D-28, Test Date: 4/21/2023

BPM: Blows/Minute
FMX: Maximum Force
AMX: Maximum Acceleration
VMX: Maximum Velocity

DMX: Maximum Displacement
DFN: Final Displacement
EMX: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	**N Value**	**N60 Value**	Average BPM bpm	Average FMX kips	Average AMX g's	Average VMX ft/s	Average DMX in	Average DFN in	Average EMX ft-lb	Average ETR %
19.00	**12-19-20-25**	**39**	**49**	50.0	39	3725	14.2	0.42	0.31	252	72.0
24.00	**8-39-26-26**	**65**	**82**	52.7	37	4030	15.1	0.33	0.18	268	76.6
29.00	**5-8-11-13**	**19**	**24**	54.3	40	4426	15.5	0.67	0.63	277	79.2
34.00	**8-7-8-6**	**15**	**19**	54.3	39	3041	14.4	0.83	0.80	270	77.1
39.00	**3-4-6-5**	**10**	**12**	54.2	39	2906	14.4	1.22	1.20	279	79.7
44.00	**11-14-23-15**	**37**	**47**	54.2	40	2694	12.9	0.41	0.32	275	78.7
			Overall Average Values:	52.8	39	3598	14.4	0.49	0.39	268	76.5
			Standard Deviation:	1.6	1	700	1.1	0.26	0.28	11	3.1
			Overall Maximum Value:	55.1	40	5470	17.0	1.50	1.50	288	82.3
			Overall Minimum Value:	49.7	36	2058	12.2	0.25	0.15	240	68.7

Summary of SPT Test Results

Project: Mobil B-53 Drill 23, Test Date: 5/17/2024

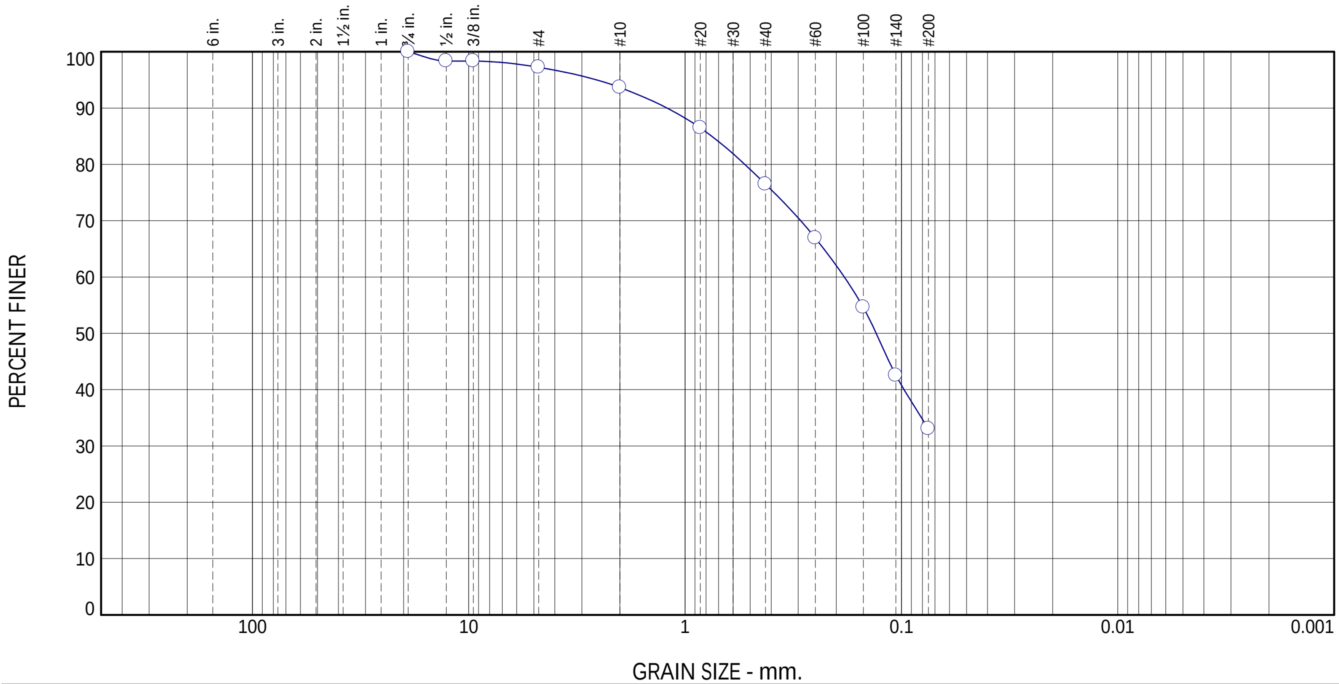
BPM: Blows/Minute
FMX: Maximum Force
AMX: Maximum Acceleration
VMX: Maximum Velocity

DMX: Maximum Displacement
DFN: Final Displacement
EMX: Maximum Energy
ETR: Energy Transfer Ratio - Rated

Instr. Length ft	Blows Applied /6"	**N Value**	**N60 Value**	Average BPM bpm	Average FMX kips	Average AMX g's	Average VMX ft/s	Average DMX in	Average DFN in	Average EMX ft-lb	Average ETR %
19.00	**5-6-5-3**	**11**	**15**	55.6	43	2146	21.3	1.26	1.09	280	80.1
23.00	**7-8-6-7**	**14**	**19**	55.7	42	2272	16.4	0.92	0.86	297	84.8
29.00	**2-6-4-3**	**10**	**13**	55.7	41	2174	17.2	1.37	1.20	288	82.3
31.00	**6-6-5-2**	**11**	**15**	55.7	42	2288	15.0	1.24	1.09	296	84.6
31.00	**3-10-11-9**	**21**	**29**	55.6	42	2130	14.5	0.63	0.57	294	84.1
			Overall Average Values:	55.7	42	2195	16.5	1.01	0.90	292	83.4
			Standard Deviation:	0.1	1	155	2.4	0.34	0.27	8	2.4
			Overall Maximum Value:	56.0	46	2719	21.7	1.77	1.50	313	89.3
			Overall Minimum Value:	55.4	40	1937	14.1	0.60	0.54	275	78.5

Appendix C Laboratory Testing

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.8	3.5	17.2	43.4	33.1	

Test Results (ASTM D6913)			
Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
.75	100.0		
.5	98.3		
.375	98.3		
#4	97.2		
#10	93.7		
#20	86.5		
#40	76.5		
#60	66.9		
#100	54.6		
#140	42.5		
#200	33.1		

* (no specification provided)

Material Description

Brown silty fine to medium SAND, trace coarse sand and fine gravel.

Atterberg (ASTM D4318)

PL= LL= PI=

Coefficients

D_{90}= 1.2106 D_{85}= 0.7516
D_{60}= 0.1834 D_{50}= 0.1308
D_{30}= D_{15}=
D_{10}=
C_u= C_c=

Sieve Test (ASTM D6913)

Test Date: 5/1/2024 Technician: sjr

Test Notes

Entire sample tested. Moisture Content = 13.9 %

Hydrometer Test

Test Date: ____________ Technician: ____________

Test Notes

USCS (ASTM D2487)

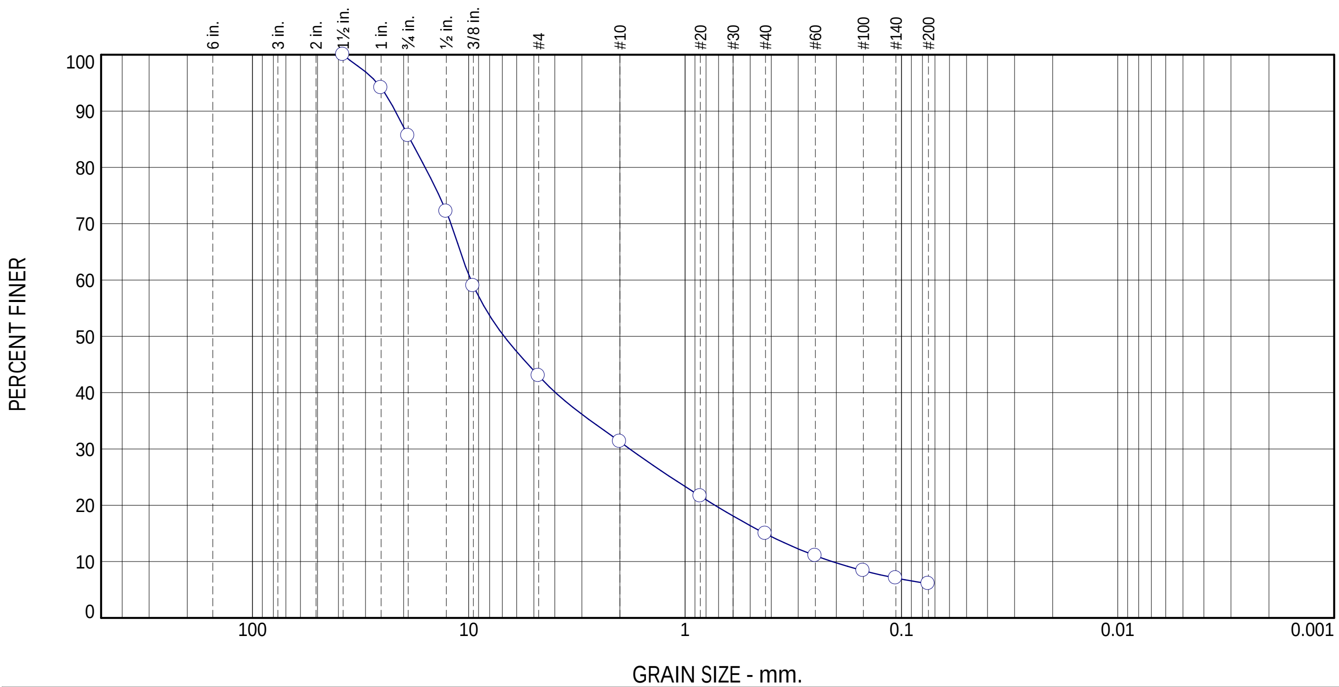
SM

Date Sampled: 3/25-4/11/2024
Date Received: 4/26/2024
Checked By: sjr
Title: ____________

Source of Sample: BB-RMC-101 Depth: 4.0-6.0
Sample Number: 2D

Soil Metrics LLC Cape Elizabeth, Maine	Client: GEI Consultants Project: WIN 026630.06 Mill Cove New Bridge (#6205) Project No: GEI PN 2400963, Task 3.1 Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.4	42.6	11.7	16.3	8.9	6.1	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
1.5	100.0		
1	94.1		
.75	85.6		
.5	72.2		
.375	59.0		
#4	43.0		
#10	31.3		
#20	21.6		
#40	15.0		
#60	11.0		
#100	8.4		
#140	7.1		
#200	6.1		

* (no specification provided)

Material Description

Brown sandy GRAVEL, trace silt.

Atterberg (ASTM D4318)

PL= LL= PI=

Coefficients

D_{90}= 21.8508 D_{85}= 18.6729
D_{60}= 9.7951 D_{50}= 6.8630
D_{30}= 1.8019 D_{15}= 0.4272
D_{10}= 0.2090
C_u= 46.86 C_c= 1.59

Sieve Test (ASTM D6913)

Test Date: 5/1/2025 Technician: sjr

Test Notes

Entire sample tested. Moisture Content = 6.9 %

Hydrometer Test

Test Date: ____________ Technician: ____________

Test Notes

USCS (ASTM D2487)

GW

Date Sampled: 3/25-4/11/2024
Date Received: 4/26/2024
Checked By: sjr
Title: ____________

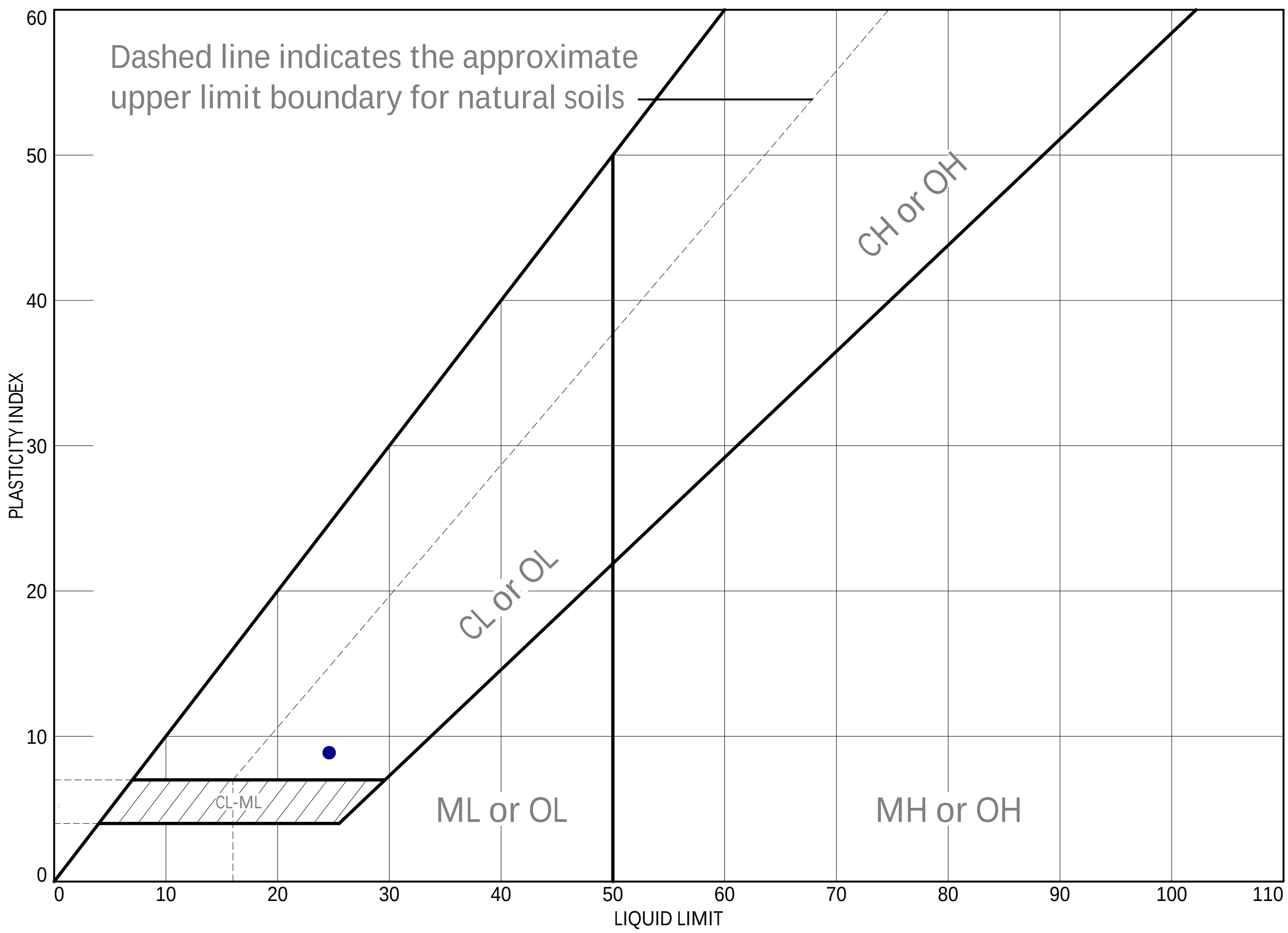
Source of Sample: BB-RMC-101 Depth: 24.0-26.0
Sample Number: 4D

Soil Metrics LLC

Cape Elizabeth, Maine

Client: GEI Consultants
Project: WIN 026630.06 Mill Cove New Bridge (#6205)
Project No: GEI PN 2400963, Task 3.1 Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Limits performed on material passing No 40 sieve. Natural Moisture Content = 10.4 %	24.7	15.9	8.8			

Project No. GEI PN 2400963, Task 3.1 Client: GEI Consultants

Project: WIN 026630.06 Mill Cove New Bridge (#6205)

● Source of Sample: BB-RMC-101 Depth: 44.0-46.0 Sample Number: 8D

Remarks:

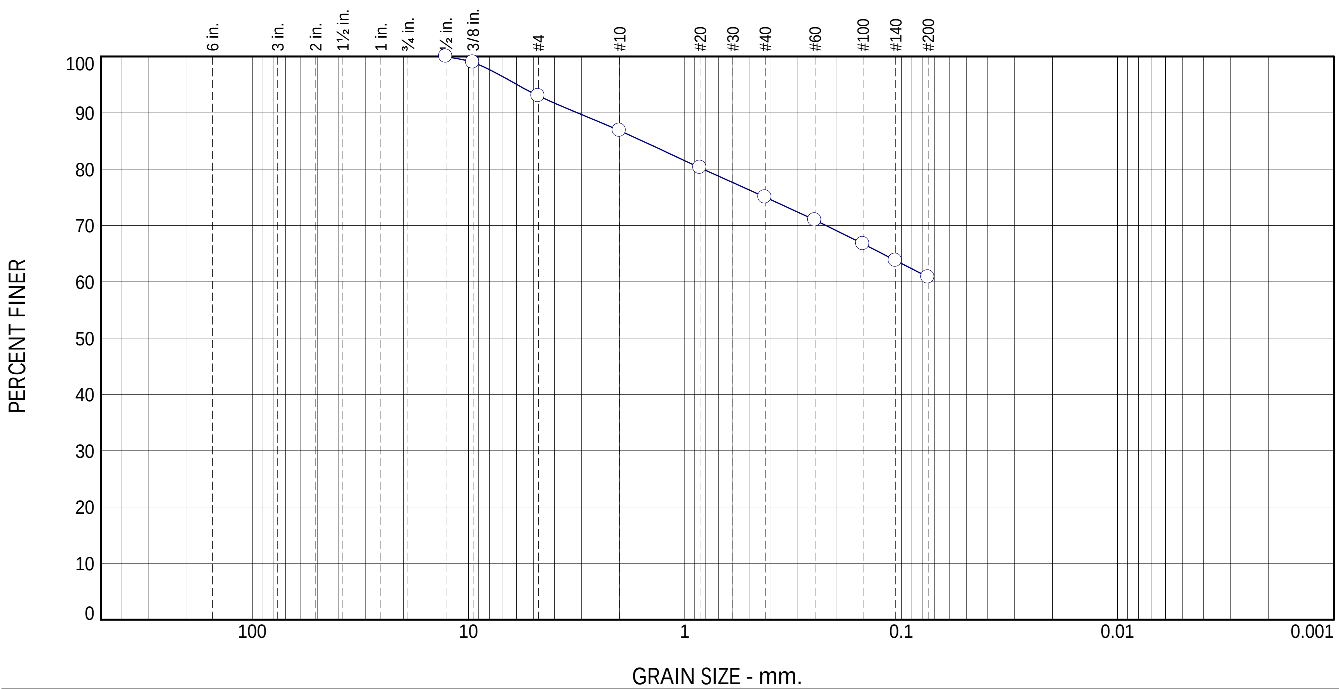
Soil Metrics LLC

Cape Elizabeth, Maine

Figure

Tested By: sjr Checked By: sjr

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.0	6.2	11.8	14.2	60.8	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
.5	100.0		
.375	99.0		
#4	93.0		
#10	86.8		
#20	80.2		
#40	75.0		
#60	70.9		
#100	66.7		
#140	63.8		
#200	60.8		

* (no specification provided)

Material Description

Sandy SILT/Clay with trace gravel.

Atterberg (ASTM D4318)

PL= 15.5 LL= 23.8 PI= 8.3

Coefficients

D_{90}= 3.1350 D_{85}= 1.5704
D_{60}= D_{50}=
D_{30}= D_{15}=
D_{10}=
C_u= C_c=

Sieve Test (ASTM D6913)

Test Date: 5/1/2024 Technician: sjr

Test Notes

Entire sample tested. Moisture Content = 11.2 %. Atterberg Limits performed on material passing No 40 sieve.

USCS (ASTM D2487)

CL/ML

Hydrometer Test

Test Date: ____________ Technician: ____________

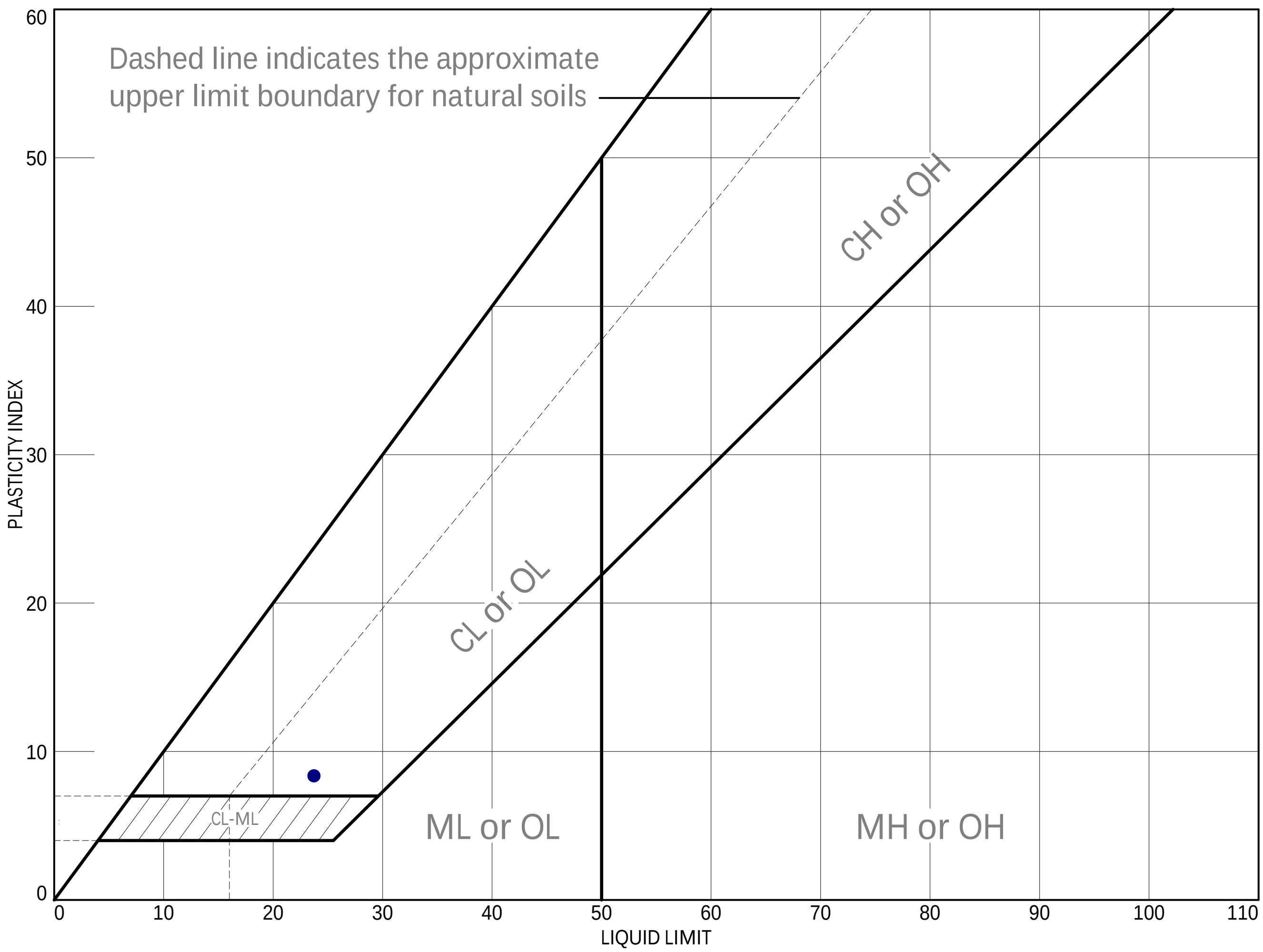
Test Notes

Date Sampled: 3/25-4/11/2024
Date Received: 4/26/2024
Checked By: sjr
Title: ____________

Source of Sample: BB-RMC-101 Depth: 54.0-56.0
Sample Number: 10D

Soil Metrics LLC Cape Elizabeth, Maine	Client: GEI Consultants Project: WIN 026630.06 Mill Cove New Bridge (#6205) Project No: GEI PN 2400963, Task 3.1 Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Sandy SILT/Clay with trace gravel.	23.8	15.5	8.3	75.0	60.8	CL/ML

Project No. GEI PN 2400963, Task 3.1 Client: GEI Consultants

Project: WIN 026630.06 Mill Cove New Bridge (#6205)

● Source of Sample: BB-RMC-101 Depth: 54.0-56.0 Sample Number: 10D

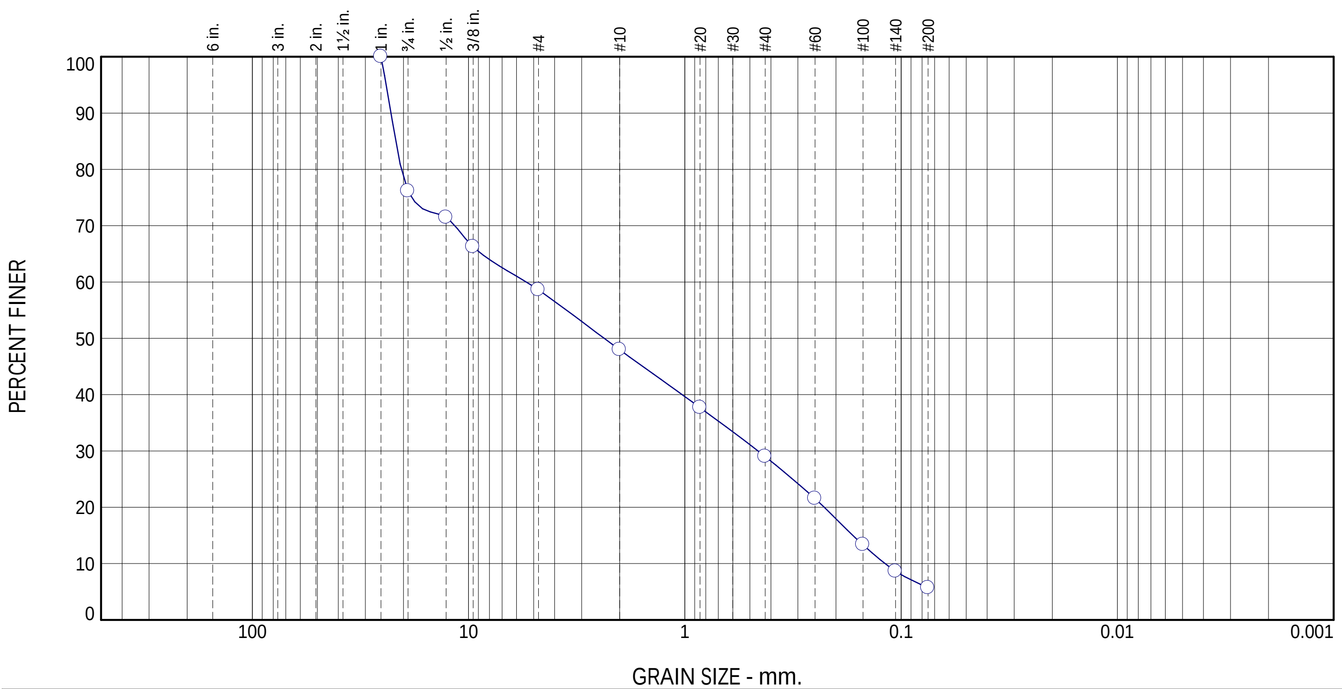
Remarks:

Soil Metrics LLC

Cape Elizabeth, Maine

Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	23.9	17.5	10.6	19.0	23.3	5.7	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
1	100.0		
.75	76.1		
.5	71.5		
.375	66.2		
#4	58.6		
#10	48.0		
#20	37.7		
#40	29.0		
#60	21.5		
#100	13.3		
#140	8.6		
#200	5.7		

* (no specification provided)

Material Description

Brown gravelly fine to coarse SAND, trace silt

Atterberg (ASTM D4318)

PL= LL= PI=

Coefficients

D_{90}= 22.8520 D_{85}= 21.7033
D_{60}= 5.4054 D_{50}= 2.3604
D_{30}= 0.4586 D_{15}= 0.1672
D_{10}= 0.1187
C_u= 45.54 C_c= 0.33

Sieve Test (ASTM D6913)

Test Date: 5/1/2024 Technician: sjr

Test Notes

Entire sample tested. Mointure Content = 10.3 %

Hydrometer Test

Test Date: ______ Technician: ______

Test Notes

USCS (ASTM D2487)

SW

Date Sampled: 3/25-4/11/2024
Date Received: 4/26/2024
Checked By: sjr
Title: ______

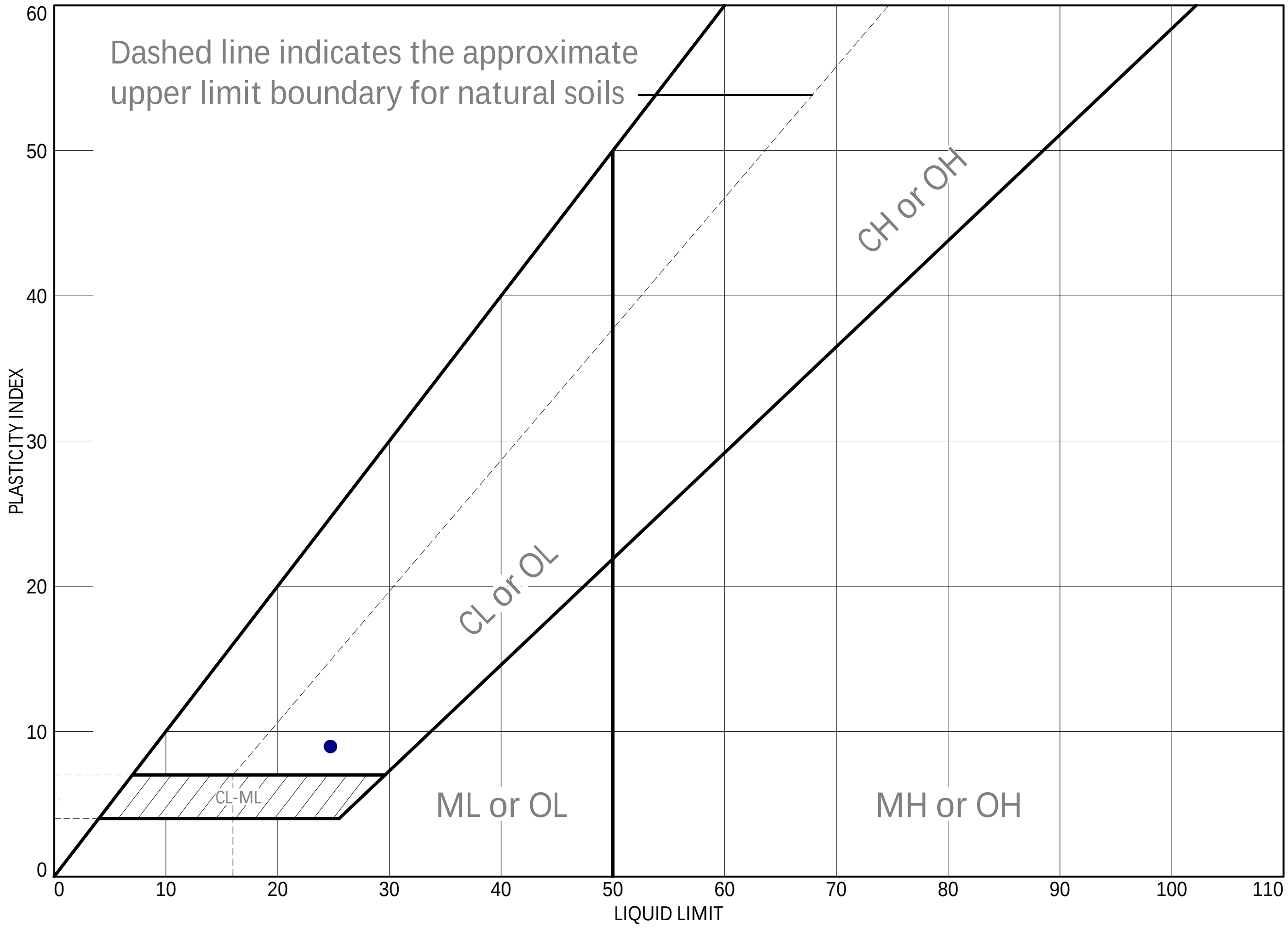
Source of Sample: BB-RMC-102 Depth: 9.0-11.0
Sample Number: 3D

Soil Metrics LLC

Cape Elizabeth, Maine

Client: GEI Consultants
Project: WIN 026630.06 Mill Cove New Bridge (#6205)
Project No: GEI PN 2400963, Task 3.1 Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Atterberg Limits performed on material passing No 40 sieve. Moisture Content = 10.0%	24.8	15.9	8.9			

Project No. GEI PN 2400963, Task 3.1 Client: GEI Consultants

Project: WIN 026630.06 Mill Cove New Bridge (#6205)

● Source of Sample: BB-RMC-102 Depth: 39.0-41.0 Sample Number: 9D

Remarks:

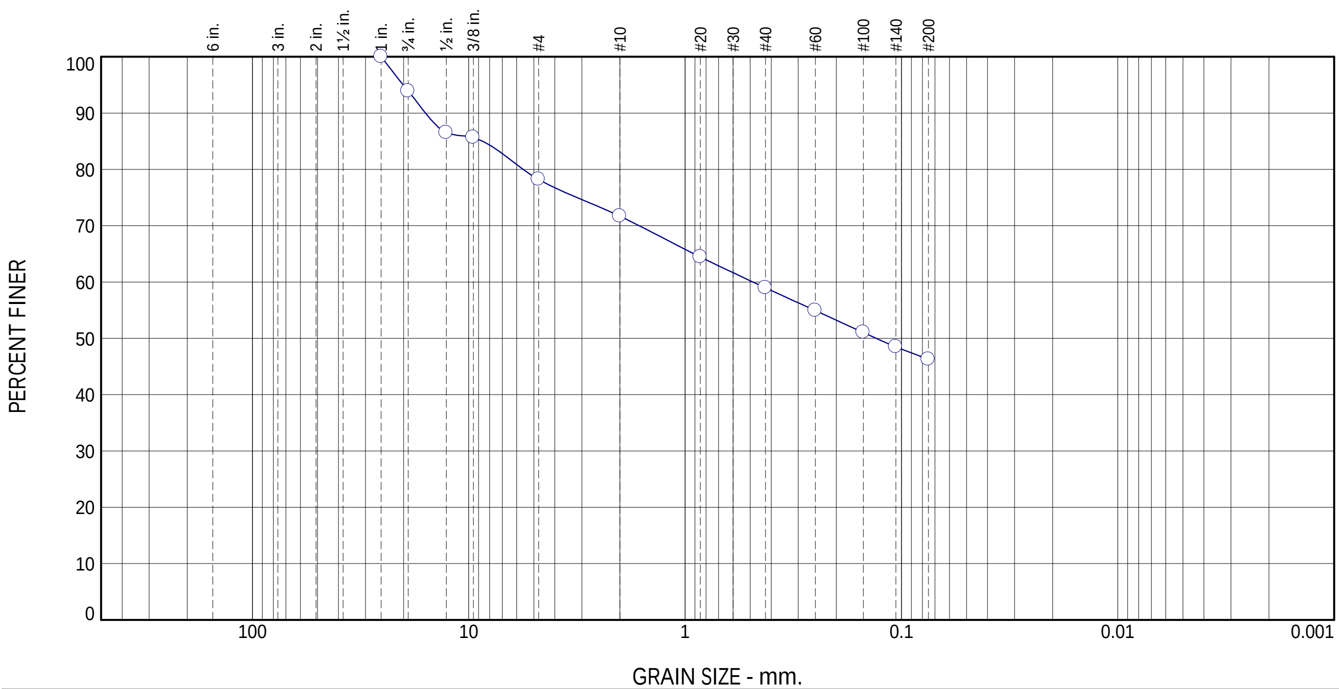
Soil Metrics LLC

Cape Elizabeth, Maine

Figure

Tested By: sjr Checked By: sjr

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.1	15.7	6.5	12.7	12.7	46.3	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
1	100.0		
.75	93.9		
.5	86.5		
.375	85.7		
#4	78.2		
#10	71.7		
#20	64.5		
#40	59.0		
#60	54.9		
#100	51.0		
#140	48.5		
#200	46.3		

* (no specification provided)

Material Description

Sandy Gravelly SILT.

Atterberg (ASTM D4318)

PL= LL= PI=

Coefficients

D_{90}= 15.8490 D_{85}= 8.6026
D_{60}= 0.4855 D_{50}= 0.1308
D_{30}= D_{15}=
D_{10}=
C_u= C_c=

Sieve Test (ASTM D6913)

Test Date: 5/1/2024 Technician: sjr

Test Notes

Entire sample tested. Moisture Content = 12.3 %

Hydrometer Test

Test Date: ______ Technician: ______

Test Notes

USCS (ASTM D2487)

ML/SM

Date Sampled: 3/25-4/11/2024
Date Received: 4/26/2024
Checked By: sjr
Title:

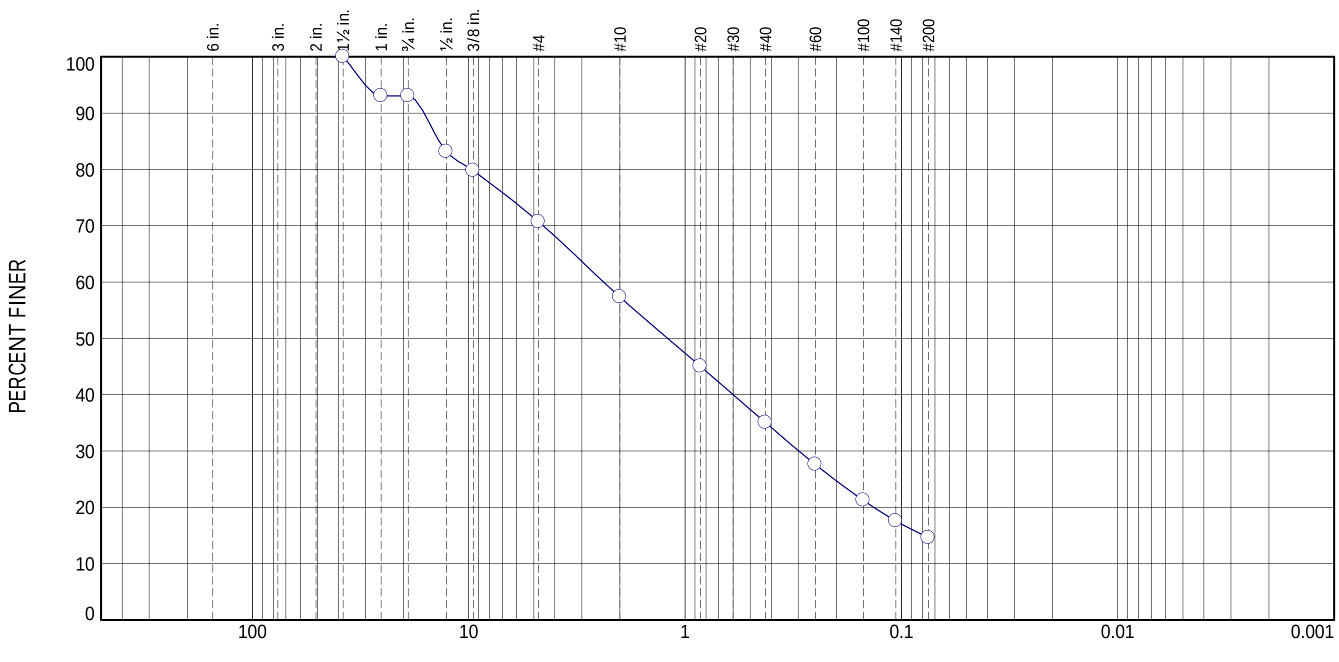
Source of Sample: BB-RMC-102 Depth: 64.0-66.0
Sample Number: 14D

Soil Metrics LLC

Cape Elizabeth, Maine

Client: GEI Consultants
Project: WIN 026630.06 Mill Cove New Bridge (#6205)
Project No: GEI PN 2400963, Task 3.1 Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.9	22.4	13.4	22.3	20.4	14.6	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
1.5	100.0		
1	93.1		
.75	93.1		
.5	83.1		
.375	79.8		
#4	70.7		
#10	57.3		
#20	45.0		
#40	35.0		
#60	27.6		
#100	21.2		
#140	17.6		
#200	14.6		

* (no specification provided)

Material Description

Gravelly fine to coarse SAND, little silt.

Sieve Test (ASTM D6913)

Test Date: 5/1/2024 Technician: sjr

Test Notes

Entire sample tested. Moisture Content = 9.3%

Hydrometer Test

Test Date: ______ Technician: ______

Test Notes

Atterberg (ASTM D4318)

PL= LL= PI=

Coefficients

D_{90}= 16.0508 D_{85}= 13.7174

D_{60}= 2.3821 D_{50}= 1.2038

D_{30}= 0.2983 D_{15}= 0.0788

D_{10}=

C_u= C_c=

USCS (ASTM D2487)

SM

Date Sampled: 3/25-4/11/2024

Date Received: 4/26/2024

Checked By: sjr

Title: ______

Source of Sample: BB-RMC-103 Depth: 14.0-16.0

Sample Number: 4D

Soil Metrics LLC

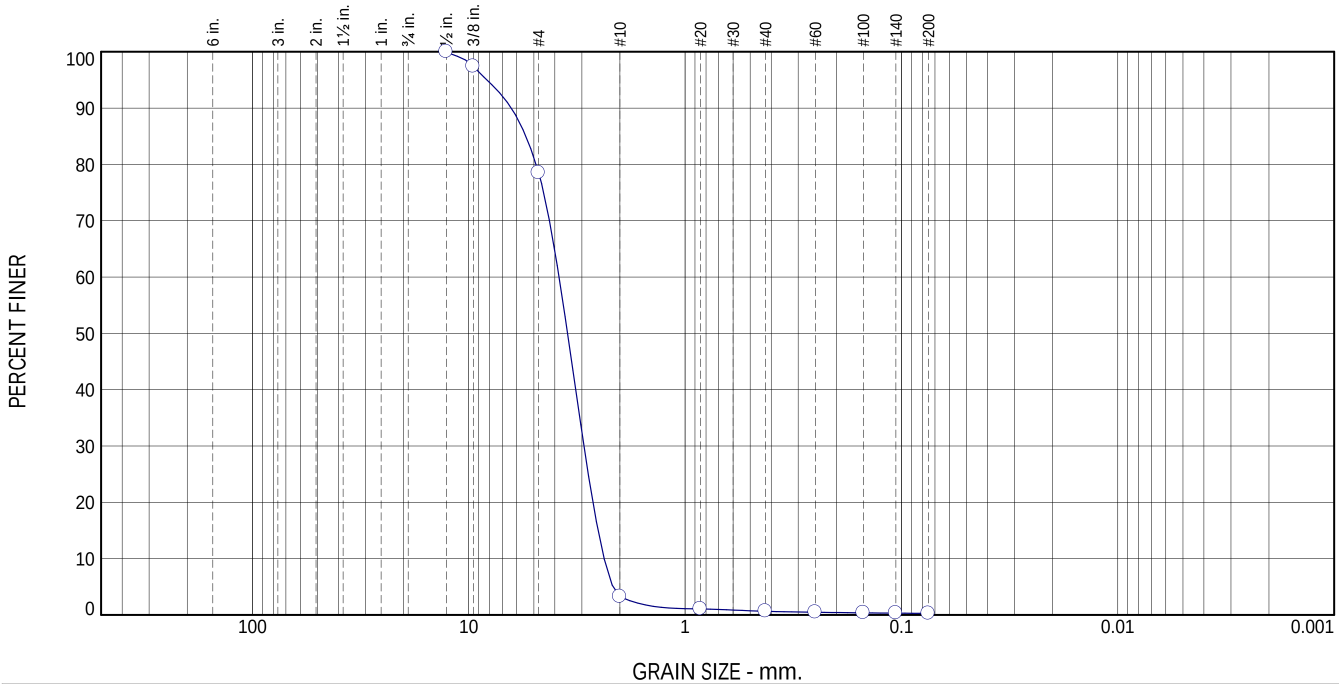
Cape Elizabeth, Maine

Client: GEI Consultants

Project: WIN 026630.06 Mill Cove New Bridge (#6205)

Project No: GEI PN 2400963, Task 3.1 Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	21.5	75.3	2.6	0.3	0.3	

Test Results (ASTM D6913)			
Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
.5	100.0		
.375	97.4		
#4	78.5		
#10	3.2		
#20	1.1		
#40	0.6		
#60	0.5		
#100	0.4		
#140	0.3		
#200	0.3		

* (no specification provided)

Material Description

Coarse SAND, little fine gravel, trace medium to fine sand and silt.

Atterberg (ASTM D4318)

PL= LL= PI=

Coefficients

D_{90}= 6.3555 D_{85}= 5.4392
D_{60}= 3.8226 D_{50}= 3.4935
D_{30}= 2.9348 D_{15}= 2.5246
D_{10}= 2.3665
C_u= 1.62 C_c= 0.95

Sieve Test (ASTM D6913)

Test Date: 5/1/2024 Technician: sjr

Test Notes

Entire sample tested. Moisture Content = 9.3 %

USCS (ASTM D2487)

SP

Hydrometer Test

Test Date: ______ Technician: ______

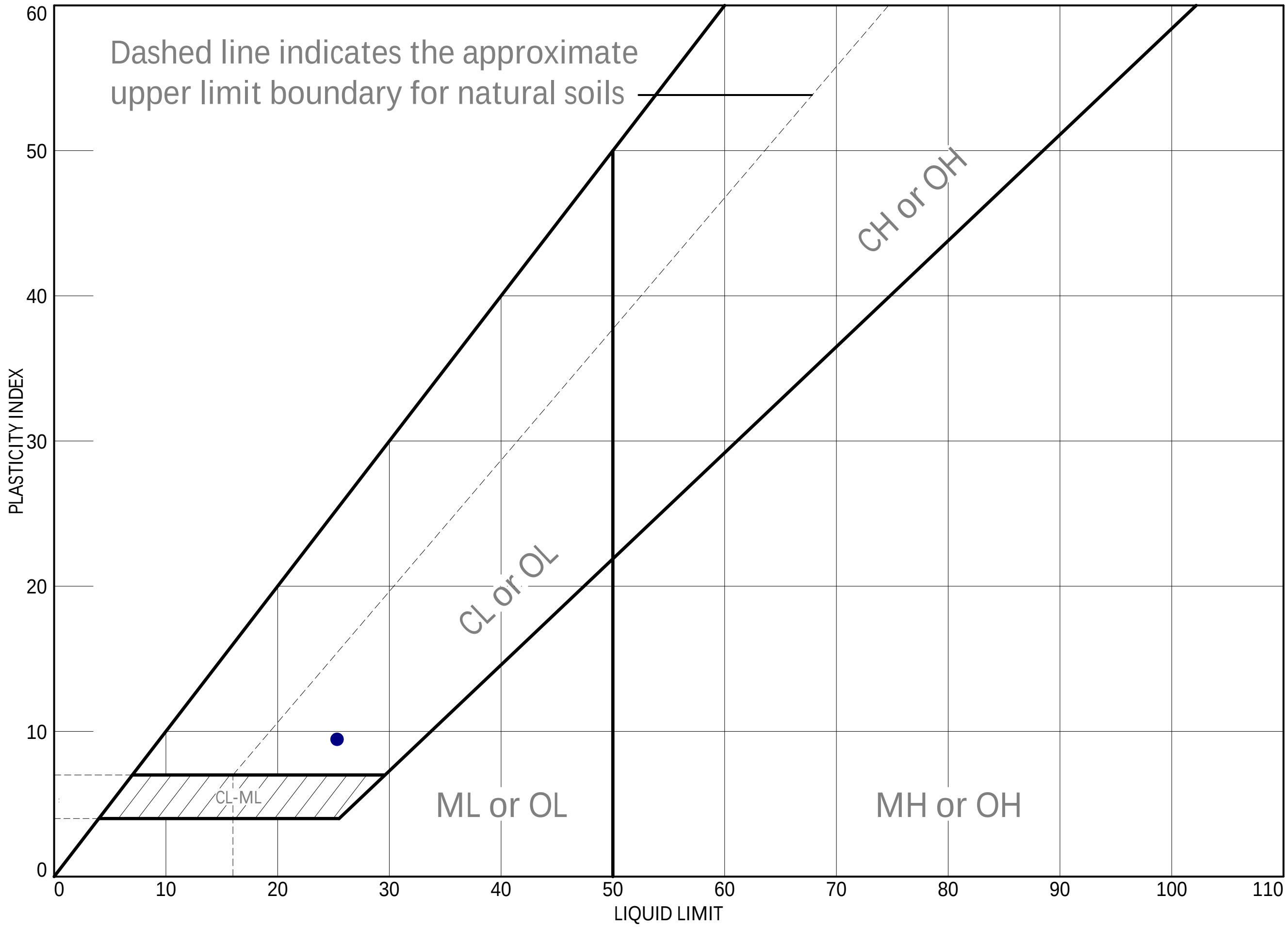
Test Notes

Date Sampled: 3/25-4/11/2024
Date Received: 4/26/2024
Checked By: sjr
Title: ______

Source of Sample: BB-RMC-103 Depth: 34.0-35.9
Sample Number: 8D (5"-11")

Soil Metrics LLC Cape Elizabeth, Maine	Client: GEI Consultants Project: WIN 026630.06 Mill Cove New Bridge (#6205) Project No: GEI PN 2400963, Task 3.1 Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Atterberg Limits performed on material passing No 40 sieve. Moisture content = 10.7 %	25.4	16.0	9.4	72.7		CL/ML

Project No. GEI PN 2400963, Task 3.1 Client: GEI Consultants

Project: WIN 026630.06 Mill Cove New Bridge (#6205)

● Source of Sample: BB-RMC-103 Depth: 39.0-41.0 Sample Number: 9D

Remarks:

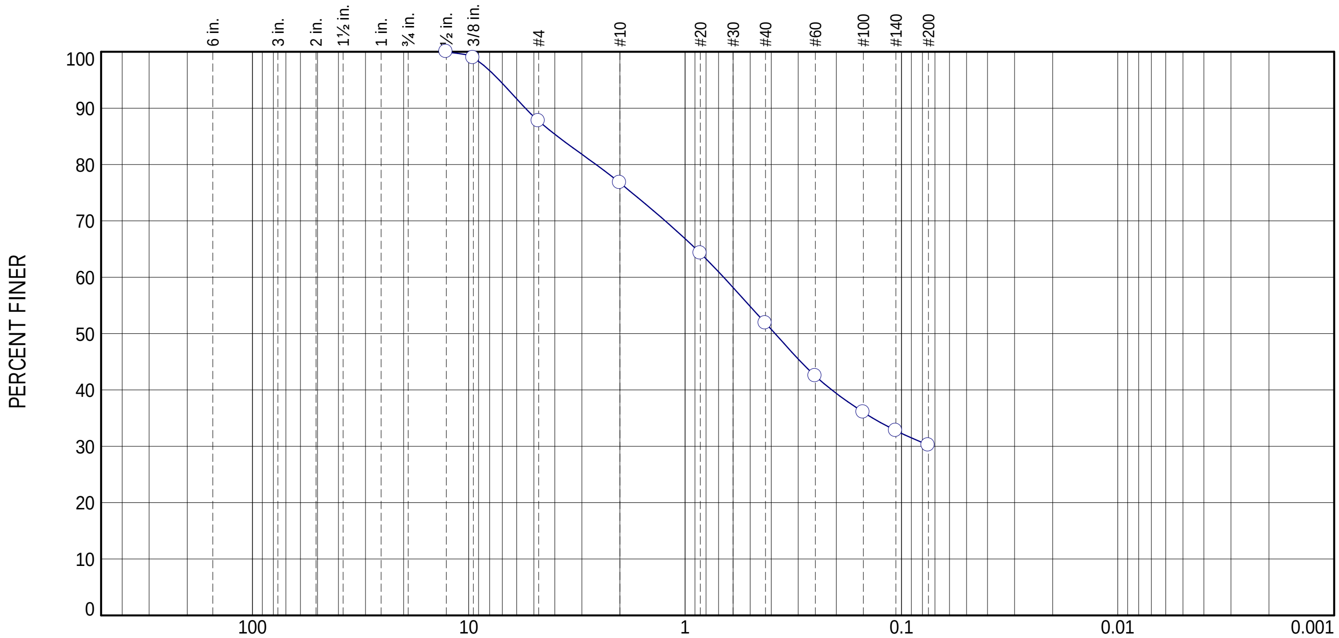
Soil Metrics LLC

Cape Elizabeth, Maine

Figure

Tested By: sjr

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.3	11.0	24.8	21.7	30.2	

Test Results (ASTM D6913)			
Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
.5	100.0		
.375	98.9		
#4	87.7		
#10	76.7		
#20	64.3		
#40	51.9		
#60	42.5		
#100	36.0		
#140	32.8		
#200	30.2		

* (no specification provided)

Material Description

Silty fine to coarse SAND, little fine gravel.

Atterberg (ASTM D4318)

PL= LL= PI=

Coefficients

D_{90}= 5.4742 D_{85}= 3.8844
D_{60}= 0.6635 D_{50}= 0.3835
D_{30}= D_{15}=
D_{10}=
C_u= C_c=

Sieve Test (ASTM D6913)

Test Date: 5/1/2024 Technician: sjr

Test Notes

Entire sample tested. Moisture Content = 14.3 %

Hydrometer Test

Test Date: ______ Technician: ______

Test Notes

USCS (ASTM D2487)

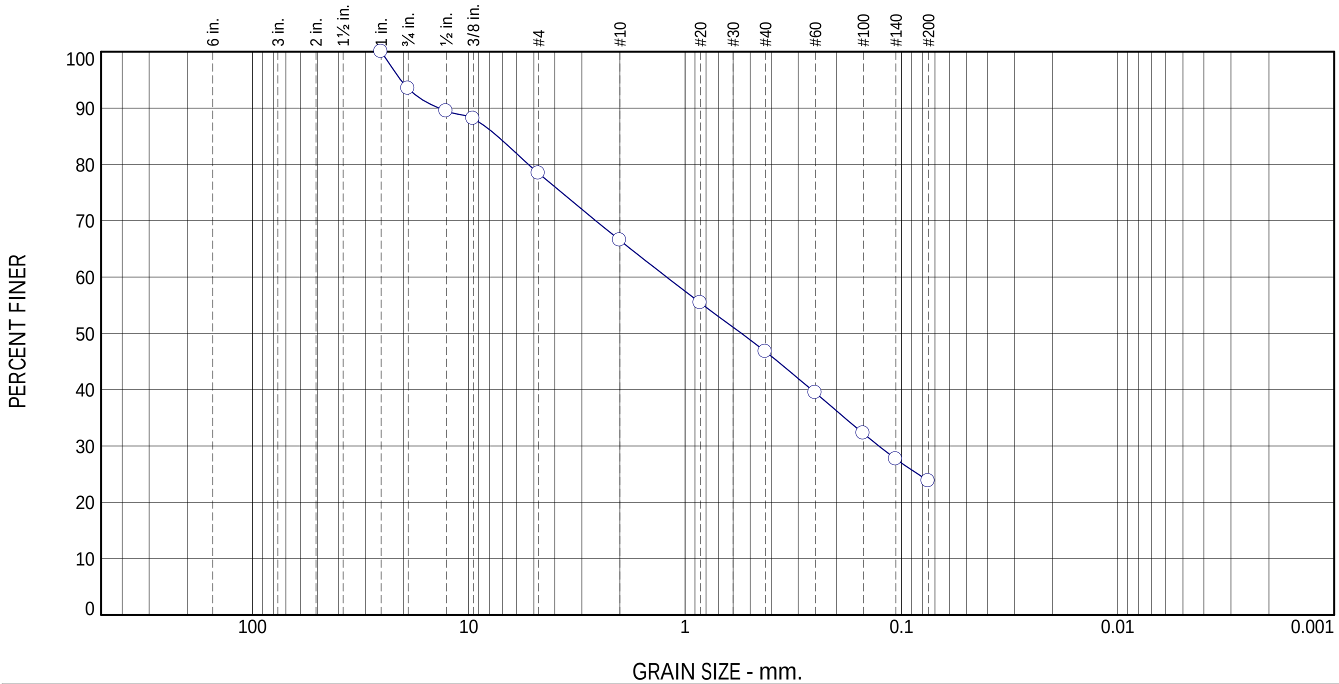
SM

Date Sampled: 3/23-4/11/2024
Date Received: 4/26/2024
Checked By: sjr
Title: ______

Source of Sample: BB-RMC-103 Depth: 74.0-74.7
Sample Number: 16D

Soil Metrics LLC Cape Elizabeth, Maine	Client: GEI Consultants Project: WIN 026630.06 Mill Cove New Bridge (#6205) Project No: GEI PN 2400963, Task 3.1 Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.5	15.1	11.9	19.8	22.9	23.8	

Test Results (ASTM D6913)			
Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
1	100.0		
.75	93.5		
.5	89.5		
.375	88.1		
#4	78.4		
#10	66.5		
#20	55.4		
#40	46.7		
#60	39.4		
#100	32.2		
#140	27.7		
#200	23.8		

* (no specification provided)

Material Description

Silty Gravelly fine to coarse SAND.

Atterberg (ASTM D4318)

PL= LL= PI=

Coefficients

D_{90}= 13.7016 D_{85}= 7.3623
D_{60}= 1.2173 D_{50}= 0.5493
D_{30}= 0.1272 D_{15}=
D_{10}=
C_u= C_c=

Sieve Test (ASTM D6913)

Test Date: 5/1/2024 Technician: sjr

Test Notes

Entire sample tested. Moisture Content = 10.4 %

Hydrometer Test

Test Date: ____ Technician: ____

Test Notes

USCS (ASTM D2487)

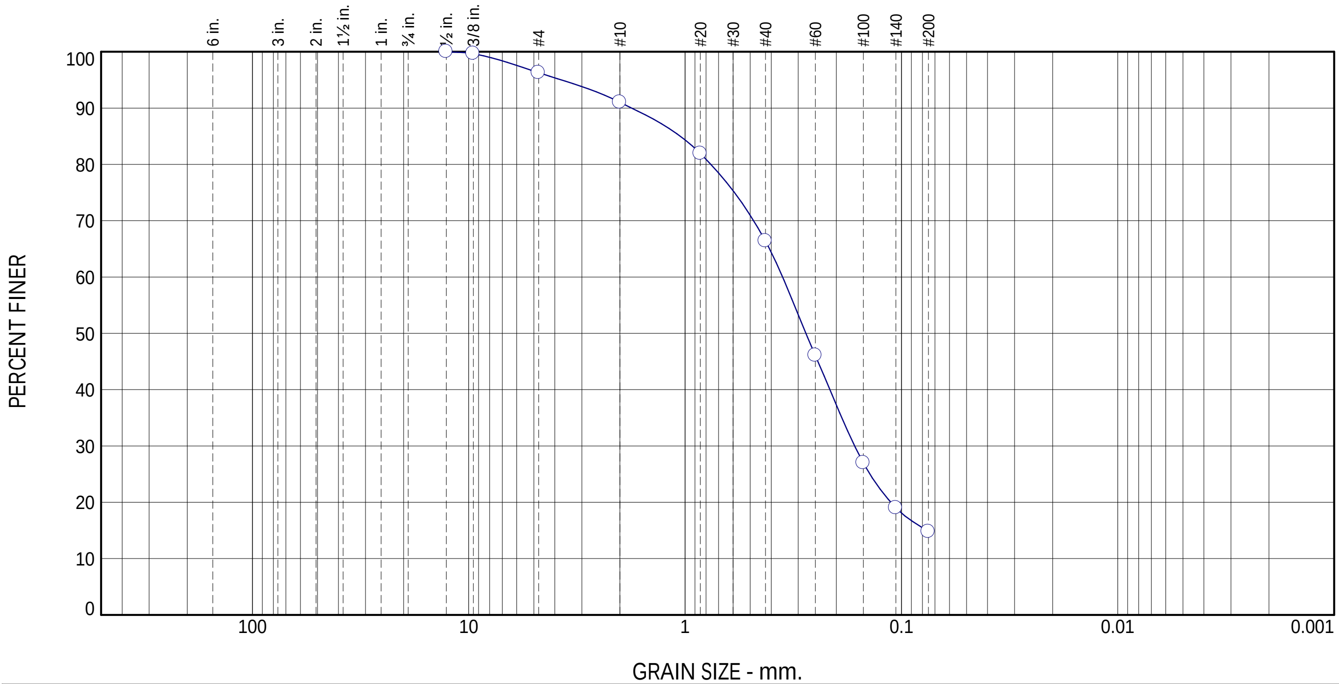
SM

Date Sampled: 3/25-4/11/2024
Date Received: 4/26/2024
Checked By: sjr
Title:

Source of Sample: BB-RMC-104 Depth: 14.0-16.0
Sample Number: 3D

Soil Metrics LLC Cape Elizabeth, Maine	Client: GEI Consultants Project: WIN 026630.06 Mill Cove New Bridge (#6205) Project No: GEI PN 2400963, Task 3.1 Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.7	5.3	24.6	51.7	14.7	

Test Results (ASTM D6913)			
Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
.5	100.0		
.375	99.7		
#4	96.3		
#10	91.0		
#20	81.9		
#40	66.4		
#60	46.0		
#100	27.0		
#140	19.0		
#200	14.7		

* (no specification provided)

Material Description

Fine to medium SAND, little silt, trace coarse sand and fine gravel.

Atterberg (ASTM D4318)

PL= LL= PI=

Coefficients

D_{90}= 1.7640 D_{85}= 1.0518
D_{60}= 0.3541 D_{50}= 0.2765
D_{30}= 0.1646 D_{15}= 0.0766
D_{10}=
C_u= C_c=

Sieve Test (ASTM D6913)

Test Date: 5/1/2024 Technician: sjr

Test Notes

Entire sample tested. Moisture Content=15.3 %

USCS (ASTM D2487)

SM

Hydrometer Test

Test Date: ____________ Technician: ____________

Test Notes

Date Sampled: 3/25-4/11/2024
Date Received: 4/26/2024
Checked By: sjr
Title: ____________

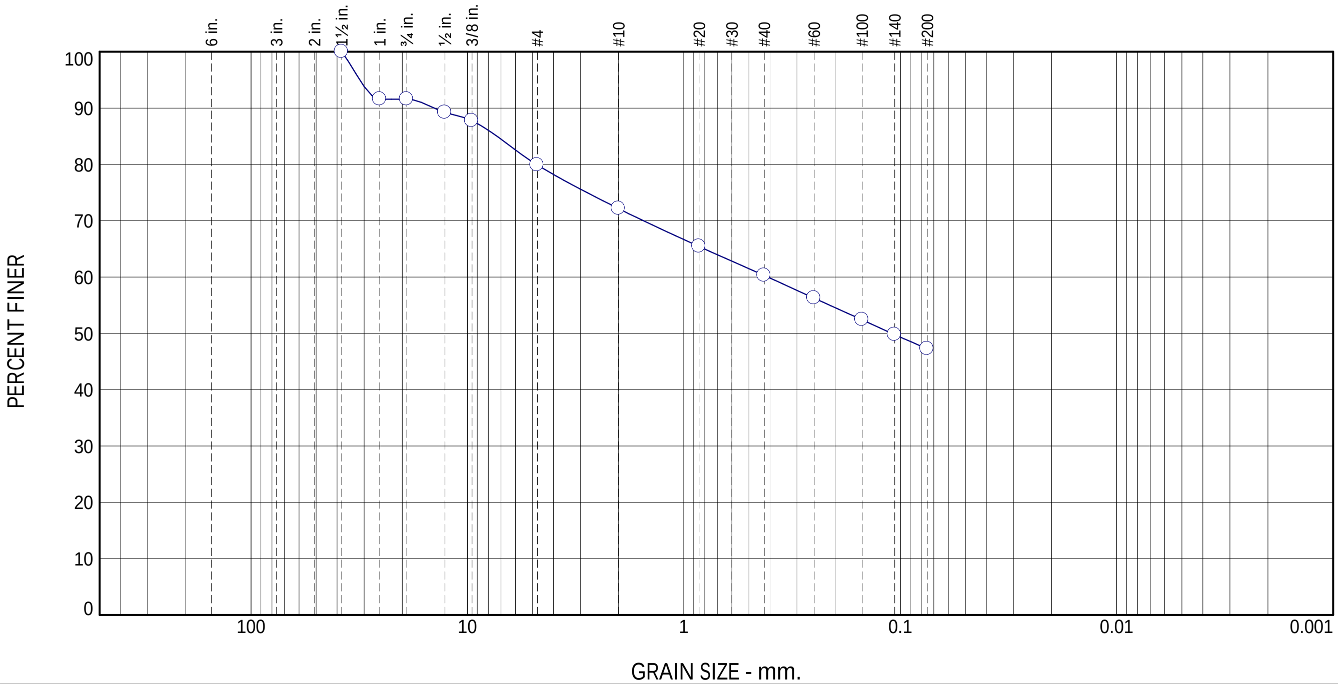
Source of Sample: BB-RMC-104 Depth: 29.0-31.0
Sample Number: 5D

Soil Metrics LLC

Cape Elizabeth, Maine

Client: GEI Consultants
Project: WIN 026630.06 Mill Cove New Bridge (#6205)
Project No: GEI PN 2400963, Task 3.1 Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	8.4	11.7	7.8	11.8	13.0	47.3	

Test Results (ASTM D6913)			
Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
1.5	100.0		
1	91.6		
.75	91.6		
.5	89.2		
.375	87.8		
#4	79.9		
#10	72.1		
#20	65.4		
#40	60.3		
#60	56.2		
#100	52.4		
#140	49.8		
#200	47.3		

* (no specification provided)

Material Description

Sandy SILT, little fine to coarse gravel

Atterberg (ASTM D4318)

PL= LL= PI=

Coefficients

D_{90}= 14.2296 D_{85}= 7.3013
D_{60}= 0.4097 D_{50}= 0.1096
D_{30}= D_{15}=
D_{10}=
C_u= C_c=

Sieve Test (ASTM D6913)

Test Date: 5/1/2024 Technician: sjr

Test Notes

Entire sample tested. Moisture Content = 10.8 %

Hydrometer Test

Test Date: ______ Technician: ______

Test Notes

USCS (ASTM D2487)

ML

Date Sampled: 3/25-4/11/2024
Date Received: 4/26/2024
Checked By: sjr
Title: ______

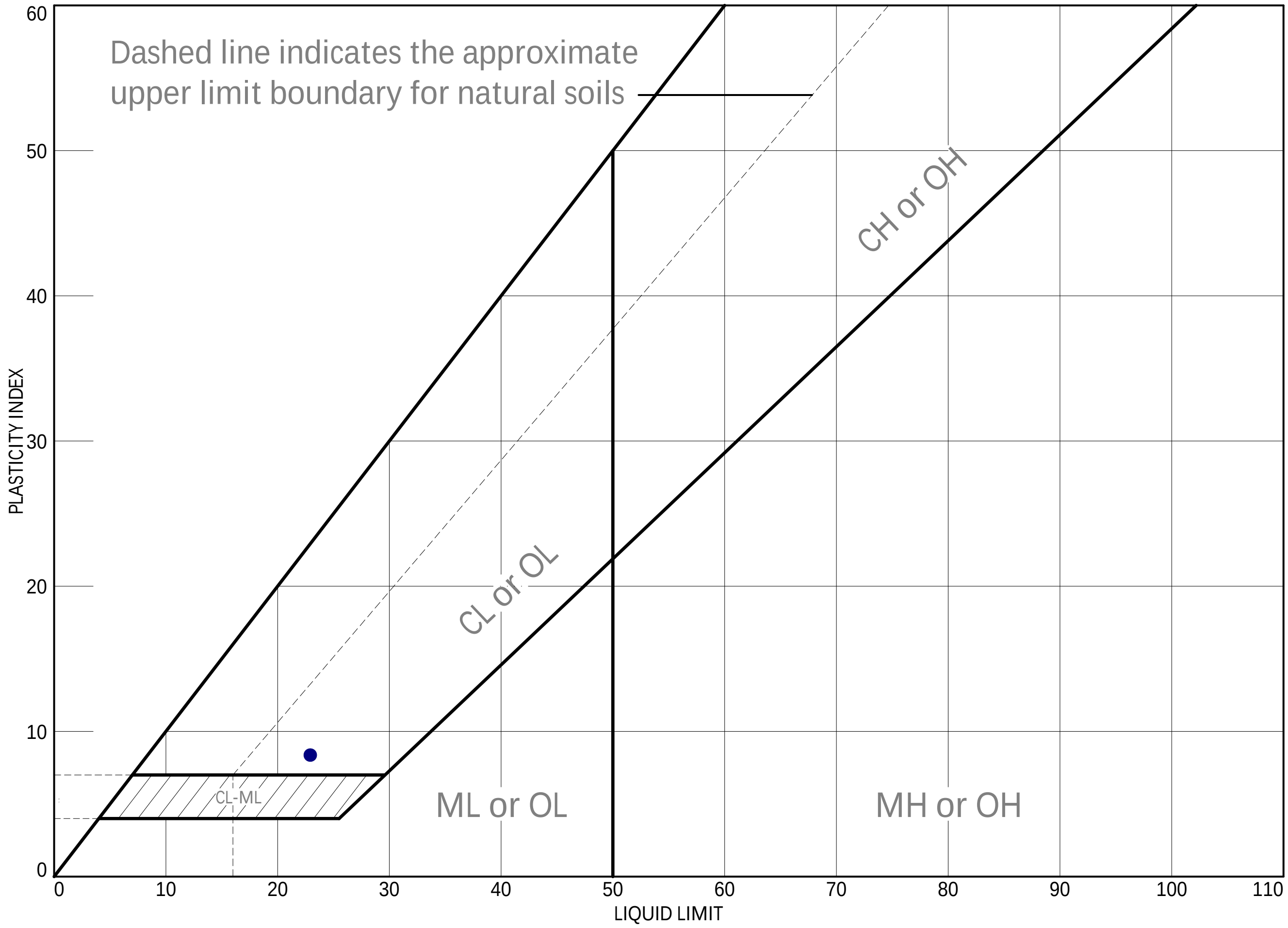
Source of Sample: BB-RMC-104 Depth: 49.0-51.0
Sample Number: 9D

Soil Metrics LLC

Cape Elizabeth, Maine

Client: GEI Consultants
Project: WIN 026630.06 Mill Cove New Bridge (#6205)
Project No: GEI PN 2400963, Task 3.1 Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Atterberg Limits performed on material passing No 40 sieve. Moisture content = 8.7%	23.0	14.7	8.3	64.4		CL/ML

Project No. GEI PN 2400963, Task 3.1 Client: GEI Consultants

Project: WIN 026630.06 Mill Cove New Bridge (#6205)

● Source of Sample: BB-RMC-104 Depth: 54.0-54.9 Sample Number: 10D

Remarks:

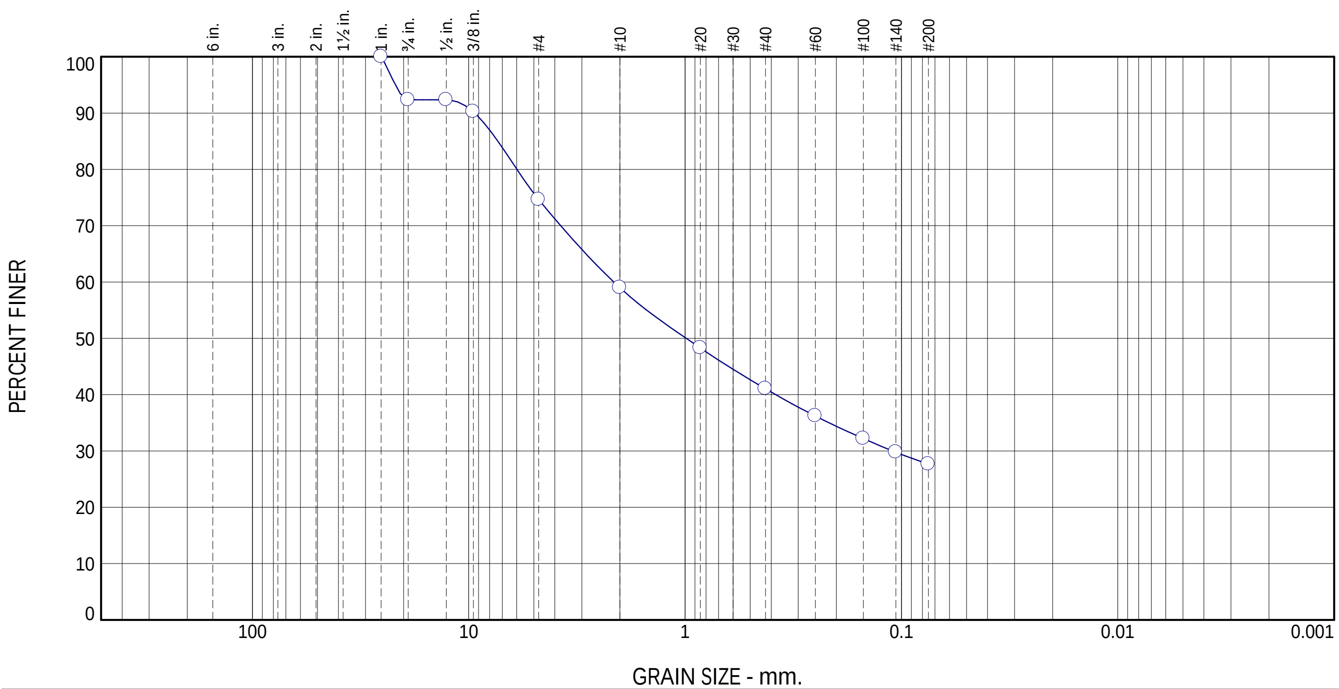
Soil Metrics LLC

Cape Elizabeth, Maine

Figure

Tested By: sjr Checked By: sjr

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.6	17.8	15.6	18.0	13.4	27.6	

Test Results (ASTM D6913)			
Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
1	100.0		
.75	92.4		
.5	92.4		
.375	90.2		
#4	74.6		
#10	59.0		
#20	48.3		
#40	41.0		
#60	36.2		
#100	32.2		
#140	29.8		
#200	27.6		

* (no specification provided)

Material Description

Silty fine to coarse SAND, some fine to coarse gravel.

Atterberg (ASTM D4318)

PL= LL= PI=

Coefficients

D_{90}= 9.3751 D_{85}= 7.3283
D_{60}= 2.1347 D_{50}= 0.9880
D_{30}= 0.1099 D_{15}=
D_{10}=
C_u= C_c=

Sieve Test (ASTM D6913)

Test Date: 5/1/2024 Technician: sjr

Test Notes

Entire sample tested. Moisture Content = 11.3%

USCS (ASTM D2487)

SM

Hydrometer Test

Test Date: ______ Technician: ______

Test Notes

Date Sampled: 3/25-4/11/2024
Date Received: 4/26/2024
Checked By: sjr
Title: ______

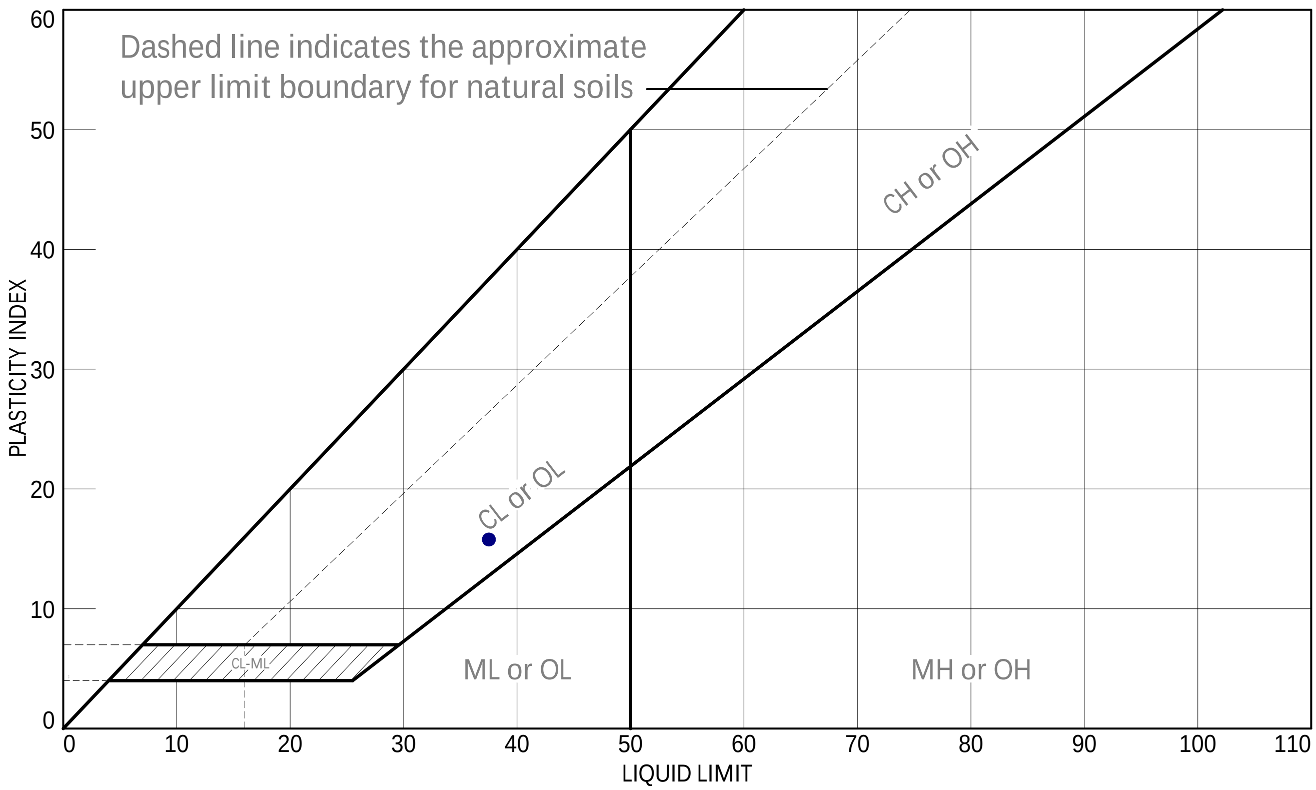
Source of Sample: BB-RMC-104 Depth: 59.0-60.4
Sample Number: 11D

Soil Metrics LLC

Cape Elizabeth, Maine

Client: GEI Consultants
Project: WIN 026630.06 Mill Cove New Bridge (#6205)
Project No: GEI PN 2400963, Task 3.1 Figure

LIQUID AND PLASTIC LIMITS TEST REPORT

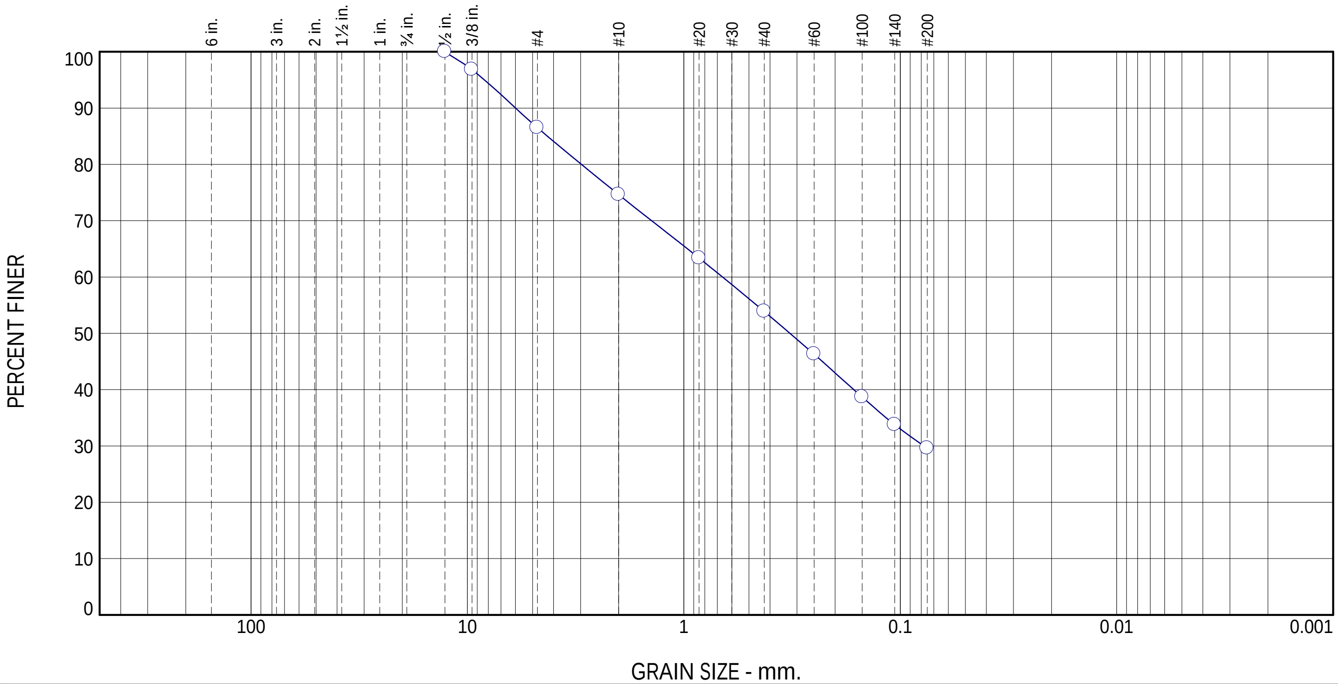


SOIL DATA									
	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	BB-RMC-201	3D	9-11	26.8	21.9	37.6	15.7	0.3	CL

Soil Metrics LLC Cape Elizabeth, Maine	Client: GEI Consultants Project: WIN 026630.06 Mill Cove New Bridge (#6205) Robbinston, ME Project No.: GEI PN 2502334, Task 3.1 Figure

Tested By: sjr Checked By: sjr

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	13.5	11.9	20.7	24.3	29.6	

Test Results (ASTM D6913)			
Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
.5	100.0		
.375	96.8		
#4	86.5		
#10	74.6		
#20	63.4		
#40	53.9		
#60	46.3		
#100	38.7		
#140	33.8		
#200	29.6		

* (no specification provided)

Material Description

Gravelly silty fine to coarse SAND

Atterberg (ASTM D4318)

PL= LL= PI=

Coefficients

D_{90}= 5.9896 D_{85}= 4.2657
D_{60}= 0.6626 D_{50}= 0.3231
D_{30}= 0.0777 D_{15}=
D_{10}=
C_u= C_c=

Sieve Test (ASTM D6913)

Test Date: 5/23/2025 Technician: sjr

Test Notes

Entire sample tested. As-received moisture content = 8.5%

Hydrometer Test

Test Date: ______ Technician: ______

Test Notes

USCS (ASTM D2487)

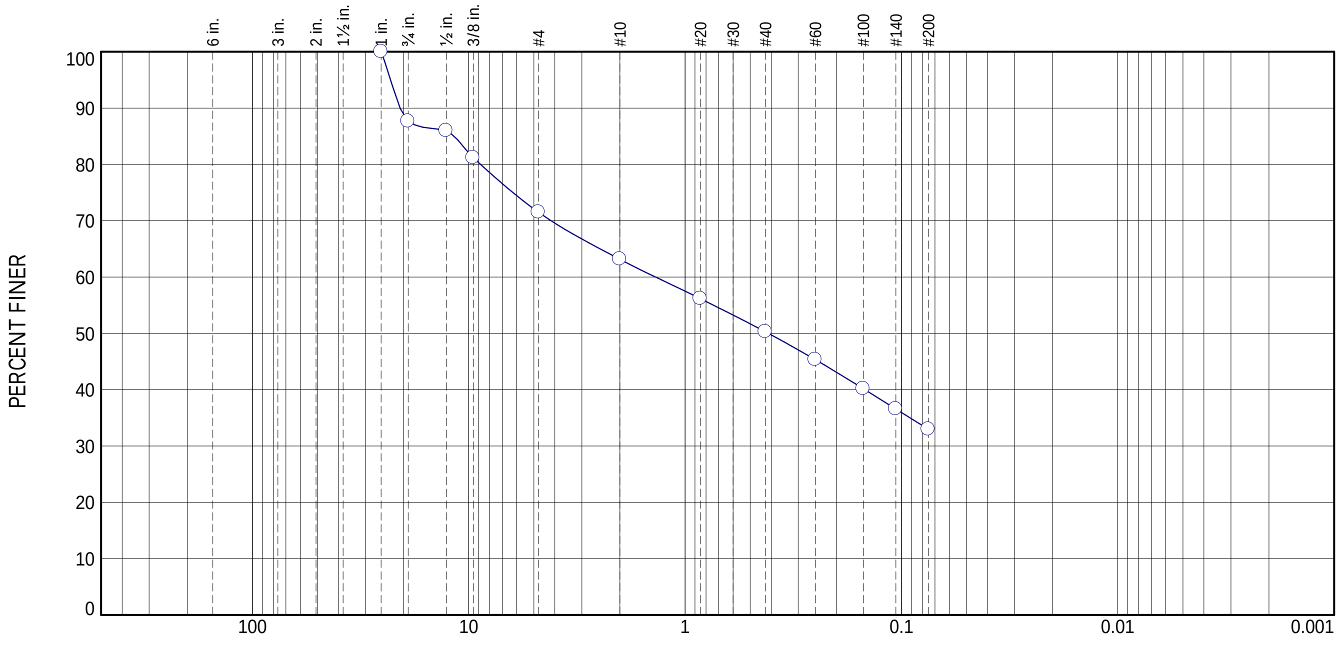
SM

Date Sampled: 5/12-5/13/2025
Date Received: 5/22/2025
Checked By: sjr
Title: ______

Source of Sample: BB-RMC-201 Depth: 19-21
Sample Number: 5D

Soil Metrics LLC Cape Elizabeth, Maine	Client: GEI Consultants Project: WIN 026630.06 Mill Cove New Bridge (#6205) Robbinston, ME Project No: GEI PN 2502334, Task 3.1 Figure

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.4	16.1	8.4	12.8	17.3	33.0	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
1	100.0		
.75	87.6		
.5	86.0		
.375	81.2		
#4	71.5		
#10	63.1		
#20	56.2		
#40	50.3		
#60	45.3		
#100	40.2		
#140	36.5		
#200	33.0		

* (no specification provided)

Material Description

Silty gravelly fine to coarse SAND.

Atterberg (ASTM D4318)

PL= LL= PI=

Coefficients

D_{90}= 20.7626 D_{85}= 11.6509
D_{60}= 1.3721 D_{50}= 0.4127
D_{30}= D_{15}=
D_{10}=
C_u= C_c=

Sieve Test (ASTM D6913)

Test Date: 5/23/2025 Technician: sjr

Test Notes

Entire sample tested. As-received moisture content = 8.2%

Hydrometer Test

Test Date: ____________ Technician: ____________

Test Notes

USCS (ASTM D2487)

SM

Date Sampled: 5/12-5/13/2025
Date Received: 5/22/2023
Checked By: sjr
Title: ____________

Source of Sample: BB-RMC-201 Depth: 29-31
Sample Number: 7D

Soil Metrics LLC

Cape Elizabeth, Maine

Client: GEI Consultants
Project: WIN 026630.06 Mill Cove New Bridge (#6205)
Robbinston, ME
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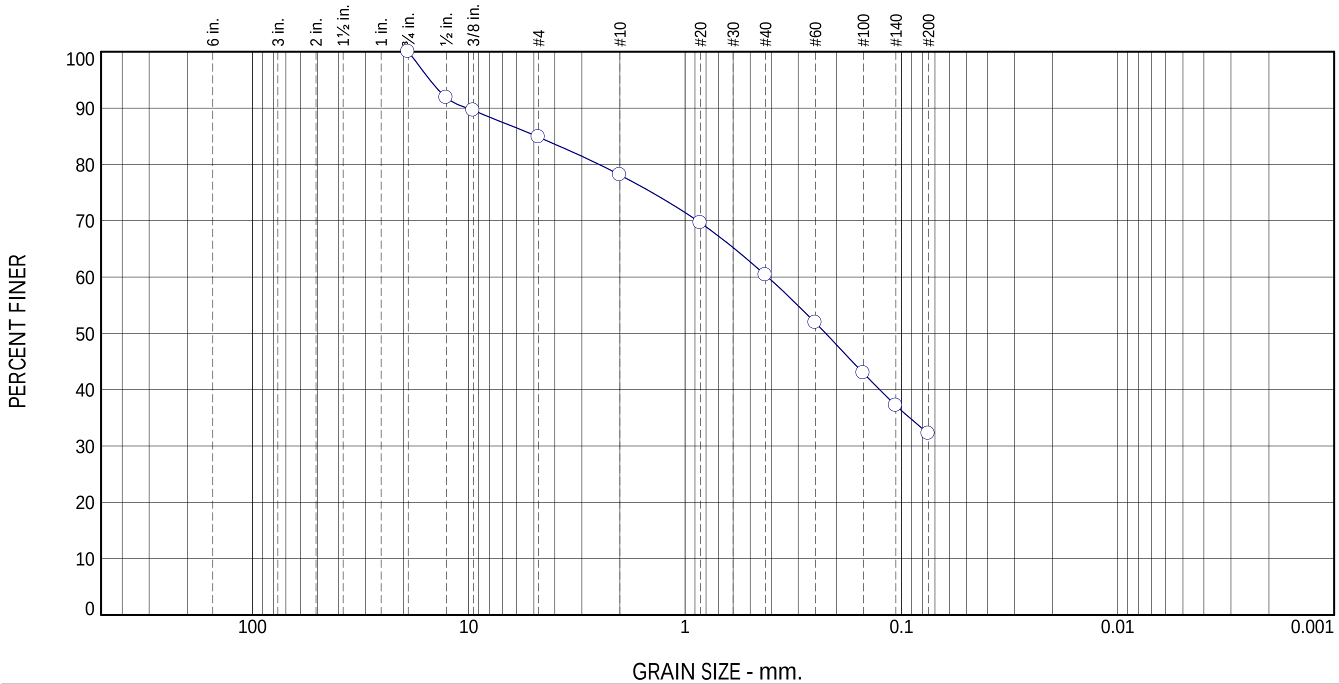
Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	15.2	6.7	17.8	28.1	32.2	

Test Results (ASTM D6913)			
Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
.75	100.0		
.5	91.8		
.375	89.6		
#4	84.8		
#10	78.1		
#20	69.6		
#40	60.3		
#60	51.9		
#100	43.0		
#140	37.2		
#200	32.2		

* (no specification provided)

Material Description

Silty gravelly fine to coarse SAND.

Atterberg (ASTM D4318)

PL= LL= PI=

Coefficients

D_{90}= 10.1318 D_{85}= 4.8532
D_{60}= 0.4151 D_{50}= 0.2240
D_{30}= D_{15}=
D_{10}=
C_u= C_c=

Sieve Test (ASTM D6913)

Test Date: 5/23/2025 Technician: sjr

Test Notes

Entire sample tested. As-received moisture content = 6.8%.

Hydrometer Test

Test Date: ____________ Technician: ____________

Test Notes

USCS (ASTM D2487)

SM

Date Sampled: 5/12-5/13/2025
Date Received: 5/22/2025
Checked By: sjr
Title: ____________

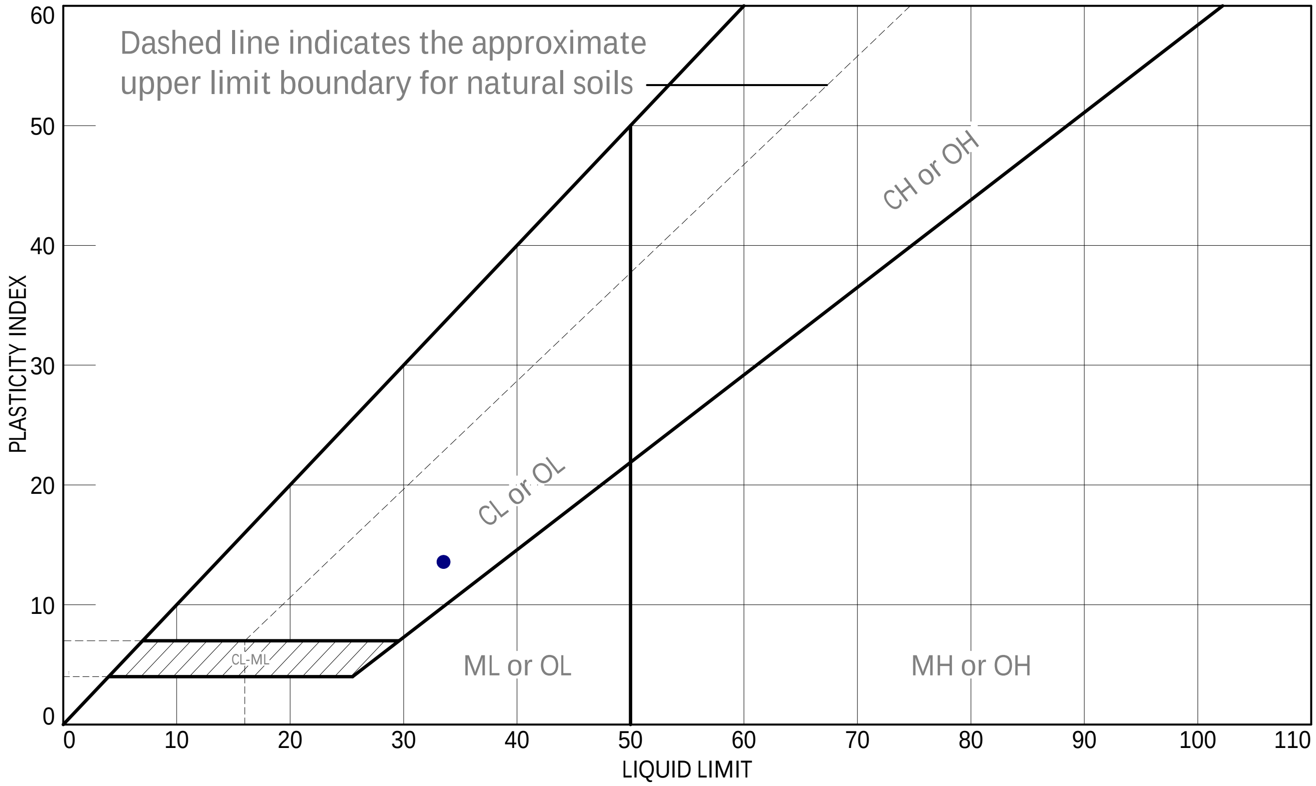
Source of Sample: BB-RMC-202 Depth: 4-6
Sample Number: 2D

Soil Metrics LLC

Cape Elizabeth, Maine

Client: GEI Consultants
Project: WIN 026630.06 Mill Cove New Bridge (#6205)
Robbinston, ME
Project No: GEI PN 2502334, Task 3.1 Figure

LIQUID AND PLASTIC LIMITS TEST REPORT

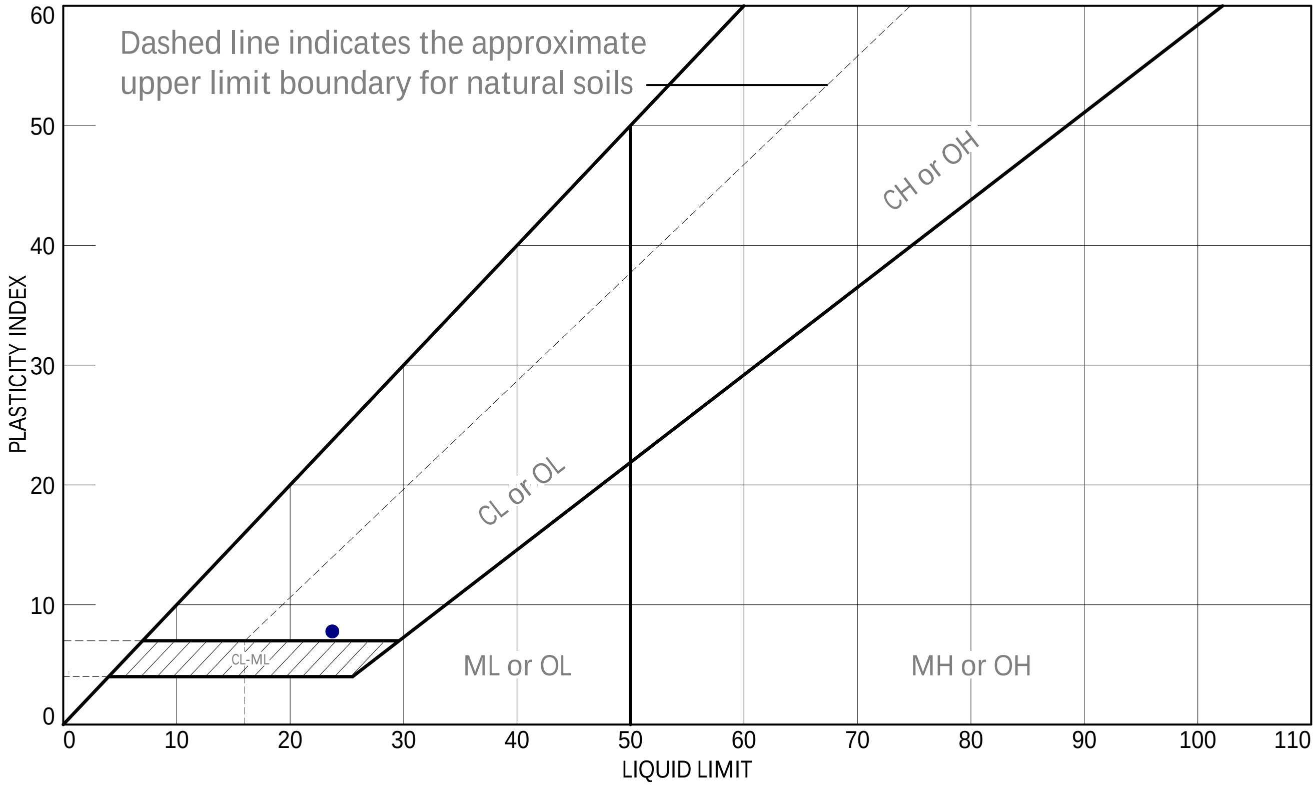


SOIL DATA									
	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	BB-RMC-202	4D	14-16	28.1	20.1	33.6	13.5	0.6	CL

Soil Metrics LLC Cape Elizabeth, Maine	Client: GEI Consultants Project: WIN 026630.06 Mill Cove New Bridge (#6205) Robbinston, ME Project No.: GEI PN 2502334, Task 3.1 Figure

Tested By: sjr Checked By: sjr

LIQUID AND PLASTIC LIMITS TEST REPORT



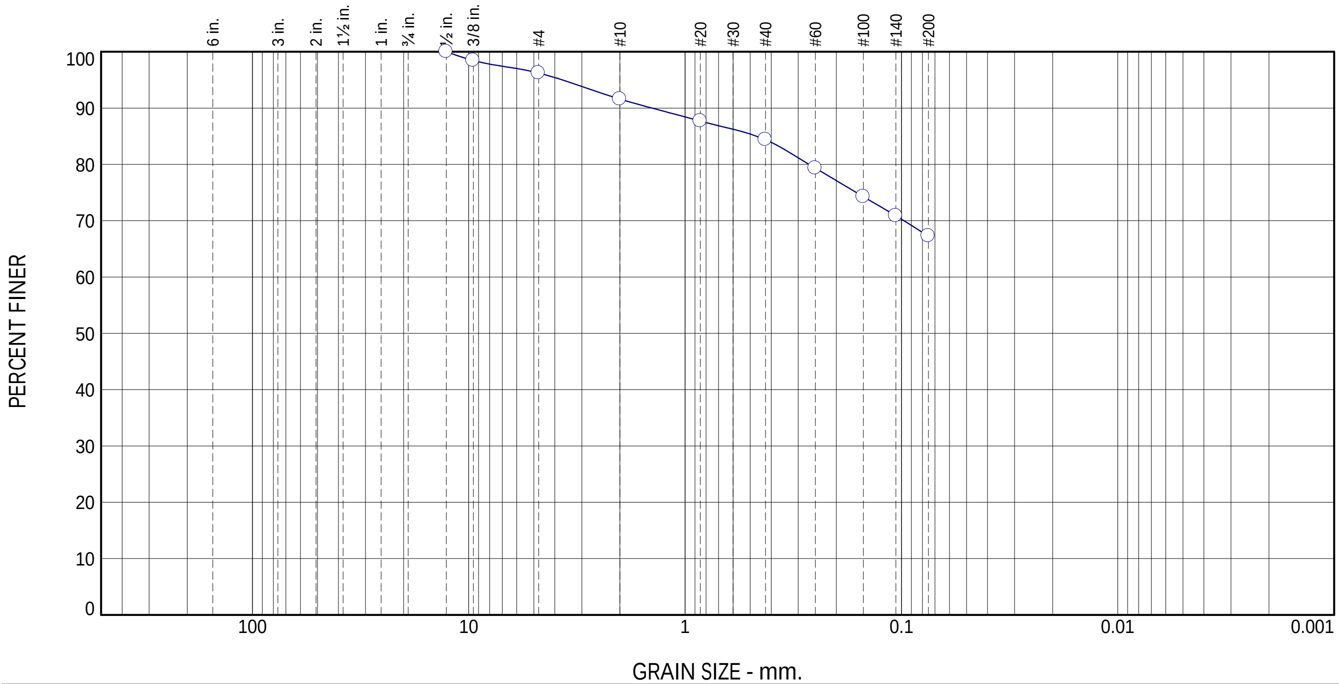
SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
●	BB-RMC-202	12D	54-56	10.4	16.1	23.8	7.7	-0.7	CL

Soil Metrics LLC Cape Elizabeth, Maine	Client: GEI Consultants Project: WIN 026630.06 Mill Cove New Bridge (#6205) Robbinston, ME Project No.: GEI PN 2502334, Task 3.1 Figure

Tested By: SJR Checked By: SJR

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.8	4.6	7.2	17.1	67.3	

Test Results (ASTM D6913)

Sieve Size or Diam. (mm.)	Finer (%)	Spec.* (%)	Out of Spec. (%)
.5	100.0		
.375	98.4		
#4	96.2		
#10	91.6		
#20	87.7		
#40	84.4		
#60	79.3		
#100	74.3		
#140	70.9		
#200	67.3		

* (no specification provided)

Material Description

CLAY with sand and trace gravel.

Atterberg (ASTM D4318)

PL= 16.1 LL= 23.8 PI= 7.7

Coefficients

D_{90}= 1.4215 D_{85}= 0.4666
D_{60}= D_{50}=
D_{30}= D_{15}=
D_{10}=
C_u= C_c=

Sieve Test (ASTM D6913)

Test Date: 5/23/2025 Technician: sjr

Test Notes
Entire sample tested. Sample air dried for Atterberg Limits. Air dried as-received moisture content of entire sample = 10.4%.

Hydrometer Test

Test Date: ________ Technician: ________

Test Notes

USCS (ASTM D2487)

CL

Date Sampled: 5/12-5/13/2025
Date Received: 5/22/2025
Checked By: sjr
Title: ________

Source of Sample: BB-RMC-202 Depth: 54-56
Sample Number: 12D

Soil Metrics LLC
Cape Elizabeth, Maine

Client: GEI Consultants
Project: WIN 026630.06 Mill Cove New Bridge (#6205)
Robbinston, ME
Project No: GEI PN 2502334, Task 3.1 Figure

Appendix D Geotechnical Calculations

D.1 Recommended Soil Properties

D.2 Earth Pressure Coefficients

D.3 Site Class Evaluation

D.4 Frost Depth Calculation

D.5 LPile Analyses

D.6 APile Analyses

D.7 Wave Equation Analyses

D.8 Slope Stability Analyses

D.1. Recommended Soil Properties

Soil Properties Selection

Purpose:
The purpose of this evaluation is to select representative soil properties for the design of the proposed bridge replacement project. The soil properties will be used in our engineering analyses.

Approach:
We selected values for the engineering properties of soils. Values were selected for the general soil layers observed in the borings.

Unit Weight
We selected a saturated (total) unit weight in pounds per cubic foot (pcf). The buoyant unit weight can then be determined by subtracting the unit weight of fresh water (approximately 62.4 pcf).

Angle of Internal Friction
We selected an angle of internal friction (ϕ) in degrees. We used Mohr-Coulomb drained properties for each soil.

Subsurface Investigation and SPT Correlations for Observed Soil Layers:
We reviewed Standard Penetration Test (SPT) N-Values collected during our subsurface investigation. We estimated angles of internal friction for the soils below based on N-Values corrected for overburden and hammer efficiency ($N1_{60}$). SPTs for borings BB-RMC-101 through BB-RMC-104 were performed with an automatic hammer with a measured efficiency of 76.5 percent. SPTs for borings BB-RMC-201 and BB-RMC-202 were performed with an automatic hammer with a measured efficiency of 83.4 percent.

A summary of corrected N-Values based on general soil type is shown below. We did not include refusals due to cobbles or boulders, and we limited the uncorrected (field) N-value to a maximum of 100 blows per foot.

Results:
We selected the following soil properties for each layer/soil type based on the references provided in the following pages and our engineering judgment:

Soil Type	Average $N1_{60}$ (Blows/ft)	Bulk Unit Weight (γ) (pcf)	Cohesion (c') (lb/ft^2)	Friction Angle (ϕ') (deg)
Fill	67	125	0	34
Fill (Silty Clay)[1]	17	120	0	30
Glacial Till	54	130	0	36

1. Undrained shear strength of 2000 psf

References:

1. AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020.
2. Terzaghi, K., Peck, R.B., 1968. Soil Mechanics in Engineering Practice, 2nd Edition, John Wiley & Sons, New York.
3. Caltrans Geotechnical Manual, March 2021.
4. NAVFAC Design Manual 7.01 Soil Mechanics, Naval Facilities Engineering Command, September 1986.
5. MaineDOT Bridge Design Guide, August 2003, Updated 2018.
6. Holtz and Kovacs, 2010. An Introduction to Geotechnical Engineering, 2nd Edition.

AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020
Table 10.4.6.2.4-1 recommends using the following correlation to select friction angles of granular soils:

Table 10.4.6.2.4-1—Correlation of *SPT* $N1_{60}$ Values to Drained Friction Angle of Granular Soils (modified after Bowles, 1977)

$N1_{60}$	ϕ_f
<4	25–30
4	27–32
10	30–35
30	35–40
50	38–43

Soil Mechanics in Engineering Practice

Karl Terzaghi and Ralph Peck compiled various parameters of soils into the tables below:

Table 6.3
Porosity, Void Ratio, and Unit Weight of Typical Soils in Natural State

Description	Porosity, n (%)	Void ratio, e	Water content, w (%)	Unit weight grams/cm³ γ_d	Unit weight grams/cm³ γ	Unit weight lb/ft³ γ_d	Unit weight lb/ft³ γ
1. Uniform sand, loose	46	0.85	32	1.43	1.89	90	118
2. Uniform sand, dense	34	0.51	19	1.75	2.09	109	130
3. Mixed-grained sand, loose	40	0.67	25	1.59	1.99	99	124
4. Mixed-grained sand, dense	30	0.43	16	1.86	2.16	116	135
5. Glacial till, very mixed-grained	20	0.25	9	2.12	2.32	132	145
6. Soft glacial clay	55	1.2	45	–	1.77	–	110
7. Stiff glacial clay	37	0.6	22	–	2.07	–	129
8. Soft slightly organic clay	66	1.9	70	–	1.58	–	98
9. Soft very organic clay	75	3.0	110	–	1.43	–	89
10. Soft bentonite	84	5.2	194	–	1.27	–	80

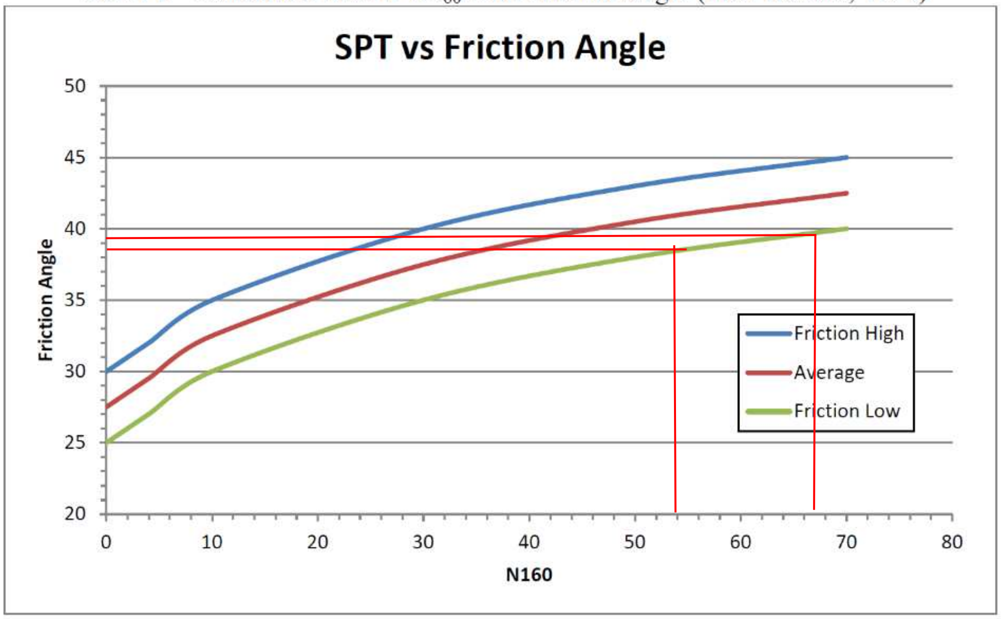
w = water content when saturated, in per cent of dry weight.
γ_d = unit weight in dry state.
γ = unit weight in saturated state.

Table 17.1
Representative Values of ϕ for Sands and Silts

Material	*Degrees Loose*	*Degrees Dense*
Sand, round grains, uniform	27.5	34
Sand, angular grains, well graded	33	45
Sandy gravels	35	50
Silty sand	27–33	30–34
Inorganic silt	27–30	30–35

Caltrans Geotechnical Manual (March 2021)

Chart 1: Correlation of SPT $N1_{60}$ with Friction Angle (after Bowles, 1977)



Choose the friction angle (expressed to the nearest degree) based upon the soil type, particle size(s), and rounding or angularity. Experience should be used to select specific values within the ranges. In general, finer materials or materials with significant (about 30+ %) silt-sized material will fall in the lower portion of the range. Coarser materials with less than 5% fines will fall in the upper portion of the range. The extreme range of phi angles for any $N1_{60}$ is five degrees, so the adjustment factors for particle size and roundness should be only a degree or two. The following bullets provide help in determining which value to select for a given $N1_{60}$ and soil type:

- Use the maximum value for GW
- Use the average for GM and SP
- Use the minimum for SC
- Use the minimum + 0.5 for ML
- Use the average +1 for SW
- Use the average -1 for GC
- Use the Maximum -1 for GP

Values may also be increased with increasing grain size and/or particle angularity, and decreased with decreasing grain size and/or increasing roundness. For example, an SP with $N1_{60}$ = 30 could be assigned phi angles of 37, 38 or 39 degrees for fine, medium and coarse grain sizes respectively.

NAVFAC Design Manual 7.01 Soil Mechanics

TABLE 6
Typical Values of Soil Index Properties

	Particle Size and Gradation				Voids(1)					Unit Weight(2) (lb./cu.ft.)						
	Approximate Size Range (mm)		Approx. D_{10} (mm)	Approx. Range Uniform Coefficient C_u	Void Ratio			Porosity (%)		Dry Weight			Wet Weight		Submerged Weight	
	D_{max}	D_{min}			e_{max} loose	e_{cr}	e_{min} dense	n_{max} loose	n_{min} dense	Min loose	100% Mod. AASHO	Max dense	Min loose	Max dense	Min loose	Max dense
GRANULAR MATERIALS																
Uniform Materials																
a. Equal spheres (theoretical values)	-	-	-	1.0	0.92	-	0.35	47.6	26	-	-	-	-	-	-	-
b. Standard Ottawa SAND	0.84	0.59	0.67	1.1	0.80	0.75	0.50	44	33	92	-	110	93	131	57	69
c. Clean, uniform SAND (fine or medium)	-	-	-	1.2 to 2.0	1.0	0.80	0.40	50	29	83	115	118	84	136	52	73
d. Uniform, inorganic SILT	0.05	0.005	0.012	1.2 to 2.0	1.1	-	0.40	52	29	80	-	118	81	136	51	73
Well-graded Materials																
a. Silty SAND	2.0	0.005	0.02	5 to 10	0.90	-	0.30	47	23	87	122	127	88	142	54	79
b. Clean, fine to coarse SAND	2.0	0.05	0.09	4 to 6	0.95	0.70	0.20	49	17	85	132	138	86	148	53	86
c. Micaceous SAND	-	-	-	-	1.2	-	0.40	55	29	76	-	120	77	139	48	76
d. Silty SAND & GRAVEL	100	0.005	0.02	15 to 300	0.85	-	0.14	46	12	89	-	146(3)	90	155(3)	56	92
MIXED SOILS																
Sandy or Silty CLAY	2.0	0.001	0.003	10 to 30	1.8	-	0.25	64	20	60	130	135	100	147	38	85
Skip-graded Silty CLAY with stones or rk fgmts	250	0.001	-	-	1.0	-	0.20	50	17	84	-	140	115	151	53	89
Well-graded GRAVEL, SAND, SILT & CLAY mixture	250	0.001	0.002	25 to 1000	0.70	-	0.13	41	11	100	140	148(4)	125	156(4)	62	94
CLAY SOILS																
CLAY (30%-50% clay sizes)	0.05	0.5μ	0.001	-	2.4	-	0.50	71	33	50	105	112	94	133	31	71
Colloidal CLAY (-0.002 mm: 50%)	0.01	10Å	-	-	12	-	0.60	92	37	13	90	106	71	128	8	66
ORGANIC SOILS																
Organic SILT	-	-	-	-	3.0	-	0.55	75	35	40	-	110	87	131	25	69
Organic CLAY (30% - 50% clay sizes)	-	-	-	-	4.4	-	0.70	81	41	30		100	81	125	18	62

N Value (blows/ft or 305 mm)	Relative Density	Approximate $\bar{\phi}_{tc}$ (degrees) (a)	(b)
0 to 4	very loose	< 28	< 30
4 to 10	loose	28 to 30	30 to 35
10 to 30	medium	30 to 36	35 to 40
30 to 50	dense	36 to 41	40 to 45
> 50	very dense	> 41	> 45

a - Source: Peck, Hanson, and Thornburn (12), p. 310.
b - Source: Meyerhof (13), p. 17.

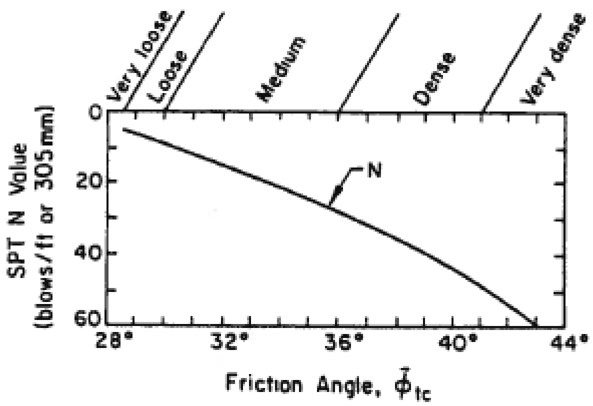
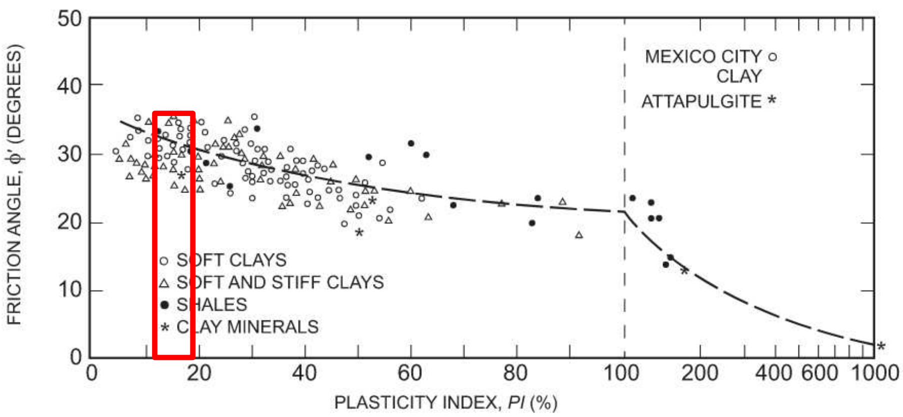


Figure 4-12. N versus $\bar{\phi}_{tc}$

Source: Peck, Hanson, and Thornburn (12), p. 310.

Holtz and Kovacs "An Introduction to Geotechnical Engineering"



Relationship Between ϕ' and *PI* (after Terzaghi *et alia*, 1996)

Source: Federal Highway Administration. National Highway Institute. *Soils and Foundations, Reference Manual*. Vol. I. FHWA-NHI-06-088. Washington, DC: U.S. Department of Transportation, December 2006, Fig. 5-21, p. 5-56. www.fhwa.dot.gov/engineering/geotech/pubs/nhi06088.pdf.

MaineDOT Bridge Design Guide:

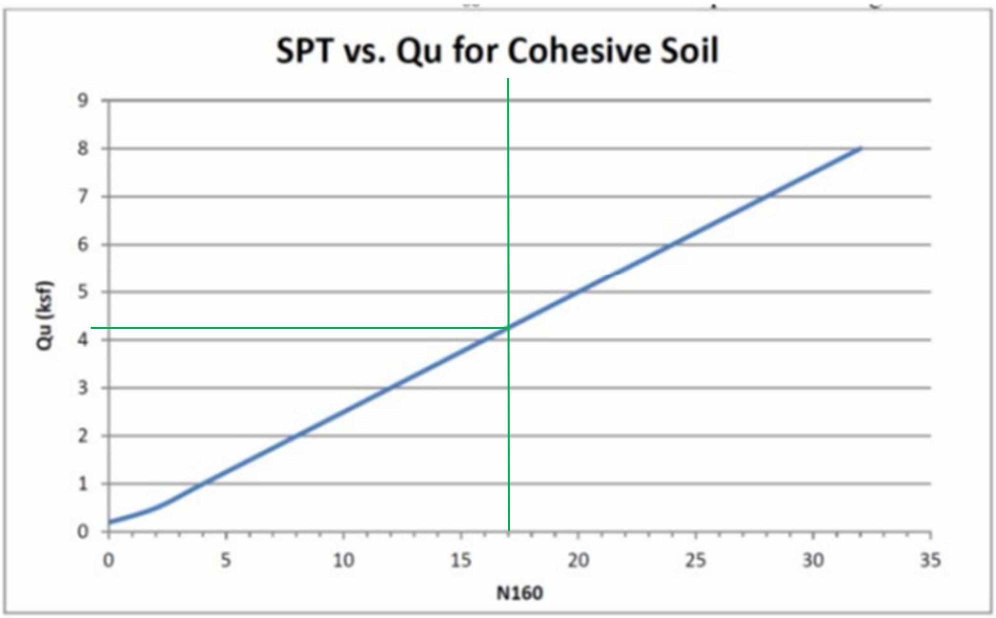
Table 3-3 Material Classification

Soil Type	Soil Description	Internal Angle of Friction of Soil, ϕ	Soil Total Unit Weight (pcf)	Coeff. of Friction, tan δ, Concrete to Soil	Interface Friction, Angle, Concrete to Soil δ
1	Very loose to loose silty sand and gravel Very loose to loose sand Very loose to medium density sandy silt Stiff to very stiff clay or clayey silt	29° *	100	0.35	19°
2	Medium density silty sand and gravel Medium density to dense sand Dense to very dense sandy silt	33°	120	0.40	22°
3	Dense to very dense silty sand and gravel Very dense sand	36°	130	0.45	24°
4	Granular underwater backfill Granular borrow	32°	125	0.45	24°
5	Gravel Borrow	36°	135	0.50	27°

* The value given for the internal angle of friction (ϕ) for stiff to very stiff silty clay or clayey silt should be used with caution due to the large possible variation with different moisture contents.

<u>Caltrans Geotechnical Manual (March 2021):</u>

Chart 3: Correlation of SPT $N1_{60}$ to Unconfined Compressive Strength
(after Bowles, 1977)



q_u=4.2 ksf, s_u=(1/2)q_u=2.1ksf=2100psf

<u>Terzaghi, K., Peck, R.B., 1968. Soil Mechanics in Engineering Practice, 2nd Edition, John Wiley & Sons, New York:</u>

Table 5.3 Penetration Resistance and Soil Properties on Basis of the Standard Penetration Test

Sands (Fairly Reliable)		Clays (Rather Unreliable)	
Number of Blows per ft, *N*	Relative Density	Number of Blows per ft, *N*	Consistency
		Below 2	Very soft
0–4	Very loose	2–4	Soft
4–10	Loose	4–8	Medium
10–30	Medium	8–15	Stiff
30–50	Dense	15–30	Very stiff
Over 50	Very dense	Over 30	Hard

Table 1.5 Qualitative and Quantitative Expressions for Consistency of Clays

Consistency	Field Identification	Unconfined Compressive Strength q_u (tons/sq ft)
Very soft	Easily penetrated several inches by fist	Less than 0.25
Soft	Easily penetrated several inches by thumb	0.25–0.5
Medium	Can be penetrated several inches by thumb with moderate effort	0.5 –1.0
Stiff	Readily indented by thumb but penetrated only with great effort	1.0 –2.0
Very stiff	Readily indented by thumbnail	2.0 –4.0
Hard	Indented with difficulty by thumbnail	Over 4.0

q_u=2tons/sqft=4000psf, s_u=(1/2)q_u=(1/2)4000psf=2000psf

GEI Consultants

Client: Thornton Tomasetti
Project: WIN 026630.06 Mill Cove New Bridge (#6205)
Project No.: 2502334
Subject: Corrected Blow Counts

Prepared By: M. Johnescu
Date: 7/25/2025
Checked By: A. Espinosa
Date: 8/2/2025

Summary of Corrected Blow Counts by Layer

Fill

Boring	No. Values	N_{60} Avg.	N_{60} Max.	N_{60} Min.	$N1_{60}$ Avg.	$N1_{60}$ Max.	$N1_{60}$ Min.
BB-RMC-101	6	50	77	13	60	95	11
BB-RMC-102	7	43	108	13	48	111	11
BB-RMC-103	7	51	98	27	60	104	24
BB-RMC-104	4	54	74	43	67	82	35
BB-RMC-201	4	85	110	61	102	120	85
BB-RMC-202	7	67	97	17	79	135	15

Average N_{60}: 57 **Average $N1_{60}$: 67**

Glacial Till

Boring	No. Values	N_{60} Avg.	N_{60} Max.	N_{60} Min.	$N1_{60}$ Avg.	$N1_{60}$ Max.	$N1_{60}$ Min.
BB-RMC-101	6	78	98	66	56	76	44
BB-RMC-102	8	62	84	40	44	62	30
BB-RMC-103	8	76	101	54	58	85	39
BB-RMC-104	5	54	78	43	39	51	32
BB-RMC-201	2	86	110	61	71	88	53
BB-RMC-202	2	118	132	103	96	111	80

Average N_{60}: 72 **Average $N1_{60}$: 54**

Fill (Silty Clay)

Boring	No. Values	N_{60} Avg.	N_{60} Max.	N_{60} Min.	$N1_{60}$ Avg.	$N1_{60}$ Max.	$N1_{60}$ Min.
BB-RMC-201	1	13	13	13	14	14	14
BB-RMC-202	1	17	17	17	19	19	19

Average N_{60}: 15 **Average $N1_{60}$: 17**

GEI Consultants

Client: Thornton Tomasetti
Project: WIN 026630.06 Mill Cove New Bridge (#6205)
Project No.: 2502334
Subject: Corrected Blow Counts

Prepared By: M. Johnescu
Date: 7/25/2025
Checked By: A. Espinosa
Date: 8/2/2025

References: 1) American Association of State Highway and Transportation Officials (AASHTO) "LRFD Bridge Design Specifications, 9th Edition, 2020"

Equations:

Ref. 1 Eqn. No.	Equation		
10.4.6.2.4-2	$N_{60} = (ER / 60\%) * N$	where: N_{60} =	SPT blow count corrected for hammer efficiency (blows/ft)
		ER =	hammer efficiency expressed as percent of theoretical free fall energy
		N =	Uncorrected SPT blow count (blows/ft)
10.4.6.2.4-3	$N1_{60} = C_N * N_{60}$	where: $N1_{60}$ =	SPT blow count corrected for overburden and hammer efficiency (blows/ft)
		C_N =	$0.77 * \log_{10}(40/\sigma'_v)$ $[C_N < 2.0]$
		σ'_v =	vertical effective stress (ksf)

Assumptions:

Ground Surface El.: 35.8 ft
Groundwater El.: 17.3 ft
Depth to Groundwater: 18.5 ft (BB-RMC-101)
Average Total Unit Weight of Soil: 125 pcf

Hammer Type	ER (%)	C_E = ER / 60%
Donut	45	0.75
Safety	60	1.00
Automatic	76.5	1.28

Boring:	***BB-RMC-101***			**Corrected Blow Counts**				**Overburden Correction**					**Hammer Efficiency Correction**		
Depth (ft)	**El. (ft)**	**Layer Name**	**N**	**N_{60}**	**$N1_{60}$**	**Avg. N_{60}**	**Avg. $N1_{60}$**	**σ_v (psf)**	**u (psf)**	**σ'_v (psf)**	**σ'_v (ksf)**	**C_N**	**Hammer Type**	**ER (%)**	**C_E**
2	33.8	Fill	44	56	95	50	60	250	0	250	0.3	1.70	Automatic	76.5	1.28
5	30.8	Fill	38	48	67			625	0	625	0.6	1.39	Automatic	76.5	1.28
10	25.8	Fill	60	77	89			1,250	0	1,250	1.3	1.16	Automatic	76.5	1.28
25	10.8	Fill	45	57	52			3,125	406	2,719	2.7	0.90	Automatic	76.5	1.28
30	5.8	Fill	40	51	44			3,750	718	3,032	3.0	0.86	Automatic	76.5	1.28
35	0.8	Fill	10	13	11			4,375	1,030	3,345	3.3	0.83	Automatic	76.5	1.28
45	-9.2	Glacial Till	77	98	76	78	56	5,625	1,654	3,971	4.0	0.77	Automatic	76.5	1.28
50	-14.2	Glacial Till	63	80	60			6,250	1,966	4,284	4.3	0.75	Automatic	76.5	1.28
55	-19.2	Glacial Till	57	73	53			6,875	2,278	4,597	4.6	0.72	Automatic	76.5	1.28
60	-24.2	Glacial Till	58	74	52			7,500	2,590	4,910	4.9	0.70	Automatic	76.5	1.28
65	-29.2	Glacial Till	60	77	52			8,125	2,902	5,223	5.2	0.68	Automatic	76.5	1.28
70	-34.2	Glacial Till	52	66	44			8,750	3,214	5,536	5.5	0.66	Automatic	76.5	1.28

Client: Thornton Tomasetti	**Prepared By:** M. Johnescu
Project: WIN 026630.06 Mill Cove New Bridge (#6205)	**Date:** 7/25/2025
Project No.: 2502334	**Checked By:** A. Espinosa
Subject: Corrected Blow Counts	**Date:** 8/2/2025

References: 1) American Association of State Highway and Transportation Officials (AASHTO) "LRFD Bridge Design Specifications, 9th Edition, 2020"

Equations:

Ref. 1 Eqn. No.	Equation		
10.4.6.2.4-2	$N_{60} = (ER / 60\%) * N$	where: N_{60} =	SPT blow count corrected for hammer efficiency (blows/ft)
		ER =	hammer efficiency expressed as percent of theoretical free fall energy
		N =	Uncorrected SPT blow count (blows/ft)
10.4.6.2.4-3	$N1_{60} = C_N * N_{60}$	where: $N1_{60}$ =	SPT blow count corrected for overburden and hammer efficiency (blows/ft)
		C_N =	$0.77 * \log_{10}(40/\sigma'_v)$ $[C_N < 2.0]$
		σ'_v =	vertical effective stress (ksf)

Assumptions:

Ground Surface El.:	37.2	ft
Groundwater El.:	18.7	ft
Depth to Groundwater:	18.5	ft
Average Total Unit Weight of Soil:	125	pcf

Hammer Type	ER (%)	C_E = ER / 60%
Donut	45	0.75
Safety	60	1.00
Automatic	76.5	1.28

Boring: ***BB-RMC-102***

				Corrected Blow Counts				Overburden Correction					Hammer Efficiency Correction		
Depth (ft)	El. (ft)	Layer Name	N	N_{60}	$N1_{60}$	Avg. N_{60}	Avg. $N1_{60}$	σ_v (psf)	u (psf)	σ'_v (psf)	σ'_v (ksf)	C_N	Hammer Type	ER (%)	C_E
2	35.2	Fill	29	37	63	43	48	250	0	250	0.3	1.70	Automatic	76.5	1.28
5	32.2	Fill	31	40	55			625	0	625	0.6	1.39	Automatic	76.5	1.28
10	27.2	Fill	16	20	24			1,250	0	1,250	1.3	1.16	Automatic	76.5	1.28
15	22.2	Fill	85	108	111			1,875	0	1,875	1.9	1.02	Automatic	76.5	1.28
20	17.2	Fill	27	34	32			2,500	94	2,406	2.4	0.94	Automatic	76.5	1.28
30	7.2	Fill	10	13	11			3,750	718	3,032	3.0	0.86	Automatic	76.5	1.28
35	2.2	Fill	41	52	43			4,375	1,030	3,345	3.3	0.83	Automatic	76.5	1.28
40	-2.8	Glacial Till	42	54	43	62	44	5,000	1,342	3,658	3.7	0.80	Automatic	76.5	1.28
45	-7.8	Glacial Till	63	80	62			5,625	1,654	3,971	4.0	0.77	Automatic	76.5	1.28
50	-12.8	Glacial Till	31	40	30			6,250	1,966	4,284	4.3	0.75	Automatic	76.5	1.28
55	-17.8	Glacial Till	53	68	49			6,875	2,278	4,597	4.6	0.72	Automatic	76.5	1.28
60	-22.8	Glacial Till	34	43	30			7,500	2,590	4,910	4.9	0.70	Automatic	76.5	1.28
65	-27.8	Glacial Till	45	57	39			8,125	2,902	5,223	5.2	0.68	Automatic	76.5	1.28
70	-32.8	Glacial Till	52	66	44			8,750	3,214	5,536	5.5	0.66	Automatic	76.5	1.28
75	-37.8	Glacial Till	66	84	54			9,375	3,526	5,849	5.8	0.64	Automatic	76.5	1.28

GEI Consultants	**Client:** Thornton Tomasetti **Project:** WIN 026630.06 Mill Cove New Bridge (#6205) **Project No.:** 2502334 **Subject:** Corrected Blow Counts	**Prepared By:** M. Johnescu **Date:** 7/25/2025 **Checked By:** A. Espinosa **Date:** 8/2/2025

References: 1) American Association of State Highway and Transportation Officials (AASHTO) "LRFD Bridge Design Specifications, 9th Edition, 2020"

Equations:

Ref. 1 Eqn. No.	Equation	
10.4.6.2.4-2	$N_{60} = (ER / 60\%) * N$	where: N_{60} = SPT blow count corrected for hammer efficiency (blows/ft) ER = hammer efficiency expressed as percent of theoretical free fall energy N = Uncorrected SPT blow count (blows/ft)
10.4.6.2.4-3	$N1_{60} = C_N * N_{60}$	where: $N1_{60}$ = SPT blow count corrected for overburden and hammer efficiency (blows/ft) $C_N = 0.77 * \log_{10}(40/\sigma'_v)$ $[C_N < 2.0]$ σ'_v = vertical effective stress (ksf)

Assumptions:

Ground Surface El.:	36.0	ft
Groundwater El.:	23.7	ft
Depth to Groundwater:	12.3	ft
Average Total Unit Weight of Soil:	125	pcf

Hammer Type	ER (%)	C_E = ER / 60%
Donut	45	0.75
Safety	60	1.00
Automatic	76.5	1.28

Boring: ***BB-RMC-103***

Depth (ft)	El. (ft)	Layer Name	N	Corrected Blow Counts: N_{60}	$N1_{60}$	Avg. N_{60}	Avg. $N1_{60}$	Overburden Correction: σ_v (psf)	u (psf)	σ'_v (psf)	σ'_v (ksf)	C_N	Hammer Efficiency Correction: Hammer Type	ER (%)	C_E
2	34.0	Fill	42	54	91			250	0	250	0.3	1.70	Automatic	76.5	1.28
5	31.0	Fill	39	50	69			625	0	625	0.6	1.39	Automatic	76.5	1.28
10	26.0	Fill	31	40	46			1,250	0	1,250	1.3	1.16	Automatic	76.5	1.28
15	21.0	Fill	77	98	104	51	60	1,875	168	1,707	1.7	1.05	Automatic	76.5	1.28
20	16.0	Fill	41	52	52			2,500	480	2,020	2.0	1.00	Automatic	76.5	1.28
25	11.0	Fill	26	33	32			3,125	792	2,333	2.3	0.95	Automatic	76.5	1.28
30	6.0	Fill	21	27	24			3,750	1,104	2,646	2.6	0.91	Automatic	76.5	1.28
35	1.0	Glacial Till	77	98	85			4,375	1,416	2,959	3.0	0.87	Automatic	76.5	1.28
40	-4.0	Glacial Till	51	65	54			5,000	1,728	3,272	3.3	0.84	Automatic	76.5	1.28
45	-9.0	Glacial Till	46	59	47			5,625	2,040	3,585	3.6	0.81	Automatic	76.5	1.28
50	-14.0	Glacial Till	49	62	49			6,250	2,352	3,898	3.9	0.78	Automatic	76.5	1.28
55	-19.0	Glacial Till	79	101	76	76	58	6,875	2,664	4,211	4.2	0.75	Automatic	76.5	1.28
60	-24.0	Glacial Till	42	54	39			7,500	2,976	4,524	4.5	0.73	Automatic	76.5	1.28
65	-29.0	Glacial Till	61	78	55			8,125	3,288	4,837	4.8	0.71	Automatic	76.5	1.28
70	-34.0	Glacial Till	70	89	61			8,750	3,600	5,150	5.1	0.69	Automatic	76.5	1.28

GEI Consultants	**Client:** Thornton Tomasetti **Project:** WIN 026630.06 Mill Cove New Bridge (#6205) **Project No.:** 2502334 **Subject:** Corrected Blow Counts	**Prepared By:** M. Johnescu **Date:** 7/25/2025 **Checked By:** A. Espinosa **Date:** 8/2/2025

References: 1) American Association of State Highway and Transportation Officials (AASHTO) "LRFD Bridge Design Specifications, 9th Edition, 2020"

Equations:

Ref. 1 Eqn. No.	Equation		
10.4.6.2.4-2	$N_{60} = (ER / 60\%) * N$	where:	N_{60} = SPT blow count corrected for hammer efficiency (blows/ft) ER = hammer efficiency expressed as percent of theoretical free fall energy N = Uncorrected SPT blow count (blows/ft)
10.4.6.2.4-3	$N1_{60} = C_N * N_{60}$	where:	$N1_{60}$ = SPT blow count corrected for overburden and hammer efficiency (blows/ft) $C_N = 0.77 * \log_{10}(40/\sigma'_v)$ $[C_N < 2.0]$ σ'_v = vertical effective stress (ksf)

Assumptions:

Ground Surface El.:	36.8	ft
Groundwater El.:	10.7	ft
Depth to Groundwater:	26.1	ft
Average Total Unit Weight of Soil:	125	pcf

Hammer Type	ER (%)	C_E = ER / 60%
Donut	45	0.75
Safety	60	1.00
Automatic	76.5	1.28

Boring: ***BB-RMC-104***

Depth (ft)	El. (ft)	Layer Name	N	Corrected Blow Counts: N_{60}	$N1_{60}$	Avg. N_{60}	Avg. $N1_{60}$	Overburden Correction: σ_v (psf)	u (psf)	σ'_v (psf)	σ'_v (ksf)	C_N	Hammer Efficiency Correction: Hammer Type	ER (%)	C_E
2	34.8	Fill	38	48	82	54	67	250	0	250	0.3	1.70	Automatic	76.5	1.28
5	31.8	Fill	41	52	73			625	0	625	0.6	1.39	Automatic	76.5	1.28
15	21.8	Fill	58	74	76			1,875	0	1,875	1.9	1.02	Automatic	76.5	1.28
30	6.8	Fill	34	43	35			3,750	243	3,507	3.5	0.81	Automatic	76.5	1.28
35	1.8	Glacial Till	34	43	34	54	39	4,375	555	3,820	3.8	0.79	Automatic	76.5	1.28
40	-3.2	Glacial Till	45	57	44			5,000	867	4,133	4.1	0.76	Automatic	76.5	1.28
45	-8.2	Glacial Till	34	43	32			5,625	1,179	4,446	4.4	0.73	Automatic	76.5	1.28
50	-13.2	Glacial Till	40	51	36			6,250	1,491	4,759	4.8	0.71	Automatic	76.5	1.28
64.9	-28.1	Glacial Till	61	78	51			8,113	2,421	5,691	5.7	0.65	Automatic	76.5	1.28

GEI Consultants	**Client:** Thornton Tomasetti **Project:** WIN 026630.06 Mill Cove New Bridge (#6205) **Project No.:** 2502334 **Subject:** Corrected Blow Counts	**Prepared By:** M. Johnescu **Date:** 7/25/2025 **Checked By:** A. Espinosa **Date:** 8/2/2025

References: 1) American Association of State Highway and Transportation Officials (AASHTO) "LRFD Bridge Design Specifications, 9th Edition, 2020"

Equations:

Ref. 1 Eqn. No.	Equation		
10.4.6.2.4-2	N_{60} = (ER / 60%) * N	where: N_{60} =	SPT blow count corrected for hammer efficiency (blows/ft)
		ER =	hammer efficiency expressed as percent of theoretical free fall energy
		N =	Uncorrected SPT blow count (blows/ft)
10.4.6.2.4-3	$N1_{60} = C_N * N_{60}$	where: $N1_{60}$ =	SPT blow count corrected for overburden and hammer efficiency (blows/ft)
		C_N =	$0.77 * \log_{10}(40/\sigma'_v)$ [C_N < 2.0]
		σ'_v =	vertical effective stress (ksf)

Assumptions:

Ground Surface El.:	42.3	ft
Groundwater El.:	24.1	ft
Depth to Groundwater:	18.2	ft
Average Total Unit Weight of Soil:	125	pcf

Hammer Type	ER (%)	C_E = ER / 60%
Donut	45	0.75
Safety	60	1.00
Automatic	83.4	1.39

Boring:		***BB-RMC-201***		**Corrected Blow Counts**				**Overburden Correction**					**Hammer Efficiency Correction**		
Depth (ft)	**El. (ft)**	**Layer Name**	**N**	**N_{60}**	**$N1_{60}$**	**Avg. N_{60}**	**Avg. $N1_{60}$**	**σ_v (psf)**	**u (psf)**	**σ'_v (psf)**	**σ'_v (ksf)**	**C_N**	**Hammer Type**	**ER (%)**	**C_E**
2	40.3	Fill	51	71	120			250	0	250	0.3	1.70	Automatic	83.4	1.39
5	37.3	Fill	44	61	85			625	0	625	0.6	1.39	Automatic	83.4	1.39
10	32.3	Fill (Silty Clay)	9	13	14	70	85	1,250	0	1,250	1.3	1.16	Automatic	83.4	1.39
15	27.3	Fill	70	97	100			1,875	0	1,875	1.9	1.02	Automatic	83.4	1.39
20	22.3	Fill	79	110	104			2,500	112	2,388	2.4	0.94	Automatic	83.4	1.39
30	12.3	Glacial Till	44	61	53	86	71	3,750	736	3,014	3.0	0.86	Automatic	83.4	1.39
39.9	2.4	Glacial Till	79	110	88			4,988	1,354	3,633	3.6	0.80	Automatic	83.4	1.39

GEI Consultants

Client: Thornton Tomasetti
Project: WIN 026630.06 Mill Cove New Bridge (#6205)
Project No.: 2502334
Subject: Corrected Blow Counts

Prepared By: M. Johnescu
Date: 7/25/2025
Checked By: A. Espinosa
Date: 8/2/2025

References: 1) American Association of State Highway and Transportation Officials (AASHTO) "LRFD Bridge Design Specifications, 9th Edition, 2020"

Equations:

Ref. 1 Eqn. No.	Equation	
10.4.6.2.4-2	$N_{60} = (ER / 60\%) * N$	where: N_{60} = SPT blow count corrected for hammer efficiency (blows/ft) ER = hammer efficiency expressed as percent of theoretical free fall energy N = Uncorrected SPT blow count (blows/ft)
10.4.6.2.4-3	$N1_{60} = C_N * N_{60}$	where: $N1_{60}$ = SPT blow count corrected for overburden and hammer efficiency (blows/ft) $C_N = 0.77 * \log_{10}(40/\sigma'_v)$ $[C_N < 2.0]$ σ'_v = vertical effective stress (ksf)

Assumptions:

Ground Surface El.: 37.2 ft
Groundwater El.: 30.1 ft
Depth to Groundwater: 7.1 ft
Average Total Unit Weight of Soil: 125 pcf

Hammer Type	ER (%)	C_E = ER / 60%
Donut	45	0.75
Safety	60	1.00
Automatic	83.4	1.39

Boring: ***BB-RMC-202***

Depth (ft)	El. (ft)	Layer Name	N	Corrected Blow Counts N_{60}	$N1_{60}$	Avg. N_{60}	Avg. $N1_{60}$	Overburden Correction σ_v (psf)	u (psf)	σ'_v (psf)	σ'_v (ksf)	C_N	Hammer Efficiency Correction Hammer Type	ER (%)	C_E
2	35.2	Fill	39	54	92	61	72	250	0	250	0.3	1.70	Automatic	83.4	1.39
5	32.2	Fill	70	97	135			625	0	625	0.6	1.39	Automatic	83.4	1.39
10	27.2	Fill	38	53	64			1,250	181	1,069	1.1	1.21	Automatic	83.4	1.39
15	22.2	Fill (Silty Clay)	12	17	19			1,875	493	1,382	1.4	1.13	Automatic	83.4	1.39
20	17.2	Fill	52	72	76			2,500	805	1,695	1.7	1.06	Automatic	83.4	1.39
25	12.2	Fill	65	90	90			3,125	1,117	2,008	2.0	1.00	Automatic	83.4	1.39
30	7.2	Fill	63	88	83			3,750	1,429	2,321	2.3	0.95	Automatic	83.4	1.39
35	2.2	Fill	12	17	15			4,375	1,741	2,634	2.6	0.91	Automatic	83.4	1.39
45	-7.8	Glacial Till	95	132	111	118	96	5,625	2,365	3,260	3.3	0.84	Automatic	83.4	1.39
55	-17.8	Glacial Till	74	103	80			6,875	2,989	3,886	3.9	0.78	Automatic	83.4	1.39

D.2. Earth Pressure Coefficients

CALCULATE EARTH PRESSURE COEFFICIENTS

Calculations of earth pressure coefficients assigned to soils listed in Soil Properties table of the report are provided in this packet. Active, at-rest, and passive pressures were determined for different soils.

Equations/references utilized for these calculations are provided at the back of this calculation.

	Existing Fill	Existing Fill (Silty Clay)	Glacial Till	Granular Borrow	Gravel Borrow
Friction angle, ϕ (deg)	34	30	36	32	36
Angle of friction between soil and wall, δ (deg)	23	20	24	24	27
Slope of backfill behind wall, β (deg)	0	0	0	0	0
Slope of backfill in front of wall, α (deg) (for passive - enter as neg)	0	0	0	0	0
Angle of back face of wall to horz, θ (deg)	90	90	90	90	90
δ/ϕ	0.7	0.7	0.7	0.8	0.8
β/ϕ	0.0	0.0	0.0	0.0	0.0
Γ	2.93	2.68	3.05	2.87	3.12
Active earth pressure coefficient (Rankine method, MaineDOT BDG 3.6.5.2 and AASHTO C3.11.5.3-1), Ka[1]	0.28	0.33	0.26	0.31	0.26
Active earth pressure coefficient (Coloumb method, AASHTO LRFD 3.11.5.3-1), Ka[1]	0.25	0.30	0.23	0.27	0.24
At-rest earth pressure coefficient (AASHTO LRFD 3.11.5.2-1), Ko	0.44	0.50	0.41	0.47	0.41
Passive earth pressure coefficient[2] (FHWA NHI-06-089 Figure 10-4, Assuming a wall rotation of 0.02 for dense granular soil and stiff cohesive soil. The bridge designer should use MassDOT BDM Figure 3.10.8-1)	5.8	5.8	5.8	5.8	5.8

1. For long-heel cantilever walls, use Rankine active earth pressure in accordance with MaineDOT BDG 3.6.5.2 and AASHTO LRFD Figure C3.11.5.3-1.

2. Passive earth pressure for walls should be neglected for cases outlined in MaineDOT BDG 3.6.9. MaineDOT BDG 5.4.2.11 recommends abutment and wingwall reinforcement be sized assuming passive earth pressure on the backface of the wall. Design passive earth pressure coefficient should be calculated using MassDOT BDM Figure 3.10.8-1 and NHI-06-089 Figure 10-4, and the more stringent value should apply. However, passive earth pressure should be no less than Rankine passive earth pressure, regardless of wall rotation.

From AASHTO LRFD 2021:

3.11.5.2—At-Rest Lateral Earth Pressure Coefficient, k_o

For normally consolidated soils, vertical wall, and level ground, the coefficient of at-rest lateral earth pressure may be taken as:

$$k_o = 1 - \sin \phi'_f \qquad (3.11.5.2\text{-}1)$$

where:

ϕ'_f = effective friction angle of soil
k_o = coefficient of at-rest lateral earth pressure

3.11.5.3—Active Lateral Earth Pressure Coefficient, k_a

Values for the coefficient of active lateral earth pressure may be taken as:

$$k_a = \frac{\sin^2(\theta + \phi'_f)}{\Gamma\,[\sin^2\theta \sin(\theta - \delta)]} \qquad (3.11.5.3\text{-}1)$$

in which:

$$\Gamma = \left[1 + \sqrt{\frac{\sin(\phi'_f + \delta)\sin(\phi'_f - \beta)}{\sin(\theta - \delta)\sin(\theta + \beta)}} \right]^2 \qquad (3.11.5.3\text{-}2)$$

where:

δ = friction angle between fill and wall (degrees)
β = angle of fill to the horizontal as shown in Figure 3.11.5.3-1 (degrees)
θ = angle of back face of wall to the horizontal as shown in Figure 3.11.5.3-1 (degrees)
ϕ'_f = effective angle of internal friction (degrees)

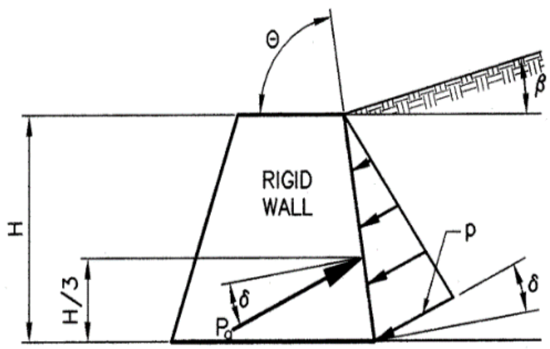


Figure 3.11.5.3-1—Notation for Coulomb Active Earth Pressure

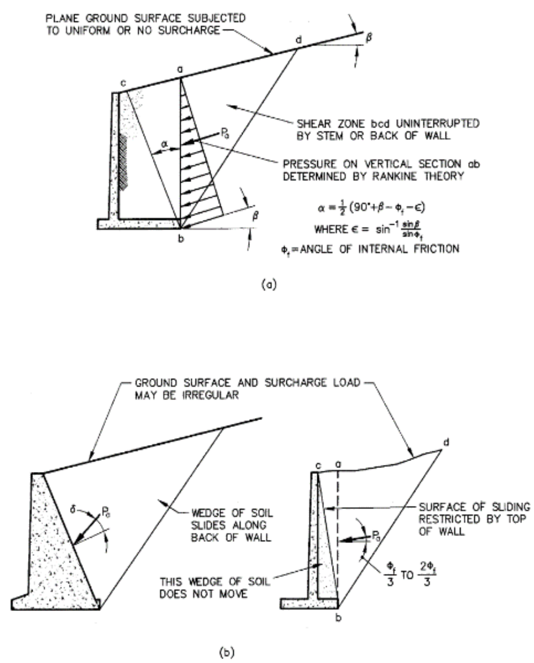
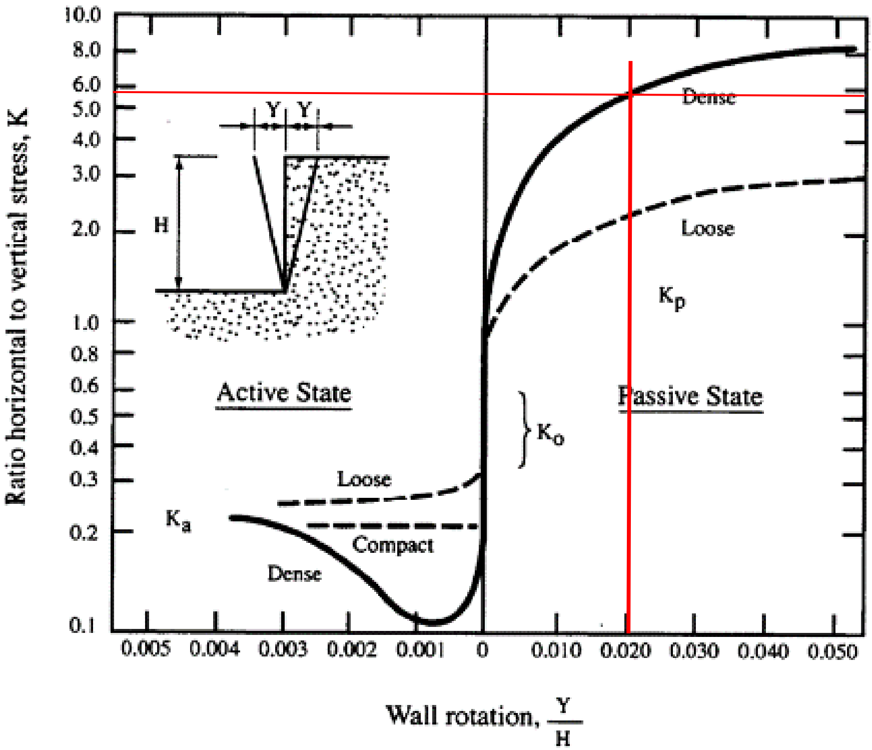


Figure C3.11.5.3-1—Application of (a) Rankine and (b) Coulomb Earth Pressure Theories in Retaining Wall Design

From FHWA NHI-06-089:



Magnitude of Wall Rotation to Reach Failure

Soil type and condition	Rotation, Y/H	
	Active	Passive
Dense cohesionless	0.001	0.02
Loose cohesionless	0.004	0.06
Stiff cohesive	0.010	0.02
Soft cohesive	0.020	0.04

Figure 10-4. Effect of wall movement on wall pressures (after Canadian Geotechnical Society, 1992).

From MaineDOT BDG 2003:

Table 3-3 Material Classification

Soil Type	Soil Description	Internal Angle of Friction of Soil, ϕ	Soil Total Unit Weight (pcf)	Coeff. of Friction, tan δ, Concrete to Soil	Interface Friction, Angle, Concrete to Soil δ
1	Very loose to loose silty sand and gravel Very loose to loose sand Very loose to medium density sandy silt Stiff to very stiff clay or clayey silt	29° *	100	0.35	19°
2	Medium density silty sand and gravel Medium density to dense sand Dense to very dense sandy silt	33°	120	0.40	22°
3	Dense to very dense silty sand and gravel Very dense sand	36°	130	0.45	24°
4	Granular underwater backfill Granular borrow	32°	125	0.45	24°
5	Gravel Borrow	36°	135	0.50	27°

* The value given for the internal angle of friction (ϕ) for stiff to very stiff silty clay or clayey silt should be used with caution due to the large possible variation with different moisture contents.

For a sloped backfill surface where $\beta > 0°$, the coefficient of active earth pressure (Rankine), K_a, may be taken as:

$$K_a = \cos\beta \cdot \frac{\cos\beta - \sqrt{\cos^2\beta - \cos^2\phi}}{\cos\beta + \sqrt{\cos^2\beta - \cos^2\phi}}$$

From MassDOT BDM:

$$K = 0.43 + 5.7[1 - e^{-190(\delta_T/H)}]$$

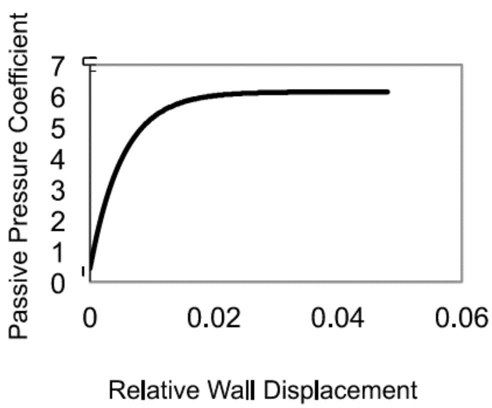


Figure 3.10.8-1: Plot of Passive Pressure Coefficient, K, vs. Relative Wall Displacement, δ_T/H.

D.3. Site Class Evaluation

Site Class Evaluation - Mill Cove New Bridge over Mill Cove

Purpose: Evaluate seismic design criteria in accordance with 2020 AASHTO LRFD Seismic Bridge Design. Evaluate borings based on N_{60} values.

Point	BB-RMC-101		
	N_i	Layer (d_i)	d_i/N_i
1	56	4	0.07
2	48	5	0.10
3	77	15	0.19
4	57	5	0.09
5	51	5	0.10
6	13	10	0.77
7	98	5	0.05
8	80	5	0.06
9	73	5	0.07
10	74	5	0.07
11	77	5	0.06
12	66	9	0.14
13	100	22	0.22
	Σ =	100	2.0
		$\bar{N}$	**50**

Point	BB-RMC-102		
	N_i	Layer (d_i)	d_i/N_i
1	37	4	0.11
2	40	5	0.13
3	20	5	0.25
4	100	5	0.05
5	34	10	0.29
6	13	5	0.38
7	52	5	0.10
8	54	5	0.09
9	80	5	0.06
10	40	5	0.13
11	68	5	0.07
12	43	5	0.12
13	57	5	0.09
14	66	5	0.08
15	84	6	0.08
16	100	20	0.20
	Σ =	100	2.2
		$\bar{N}$	**45**

Point	BB-RMC-201		
	N_i	Layer (d_i)	d_i/N_i
1	71	4	0.06
2	61	5	0.08
3	13	5	0.38
4	97	5	0.05
5	100	10	0.10
6	61	10	0.16
7	100	3	0.03
8	100	58	0.58
9			
10			
11			
12			
13			
14			
15			
16			
	Σ =	100	1.4
		$\bar{N}$	**69**

Point	BB-RMC-103		
	N_i	Layer (d_i)	d_i/N_i
1	54	4	0.07
2	50	5	0.10
3	40	5	0.13
4	98	5	0.05
5	52	5	0.10
6	33	5	0.15
7	27	5	0.19
8	98	5	0.05
9	65	5	0.08
10	59	5	0.08
11	62	5	0.08
12	100	5	0.05
13	54	5	0.09
14	78	5	0.06
15	89	6	0.06
16	100	25	0.25
	Σ =	100	1.6
		$\bar{N}$	**62**

Point	BB-RMC-104		
	N_i	Layer (d_i)	d_i/N_i
1	48	4	0.08
2	52	10	0.19
3	74	15	0.20
4	43	5	0.12
5	43	5	0.12
6	57	5	0.09
7	43	5	0.12
8	51	15	0.29
9	78	25	0.32
10	100	11	0.11
	Σ =	100	1.6
		$\bar{N}$	**61**

$$\bar{N} = \frac{\sum d_i}{\sum {d_i}/{N_i}}$$

From AASHTO

N-values are N60 values (i.e., corrected for hammer energy)

Avg. $\bar{N}$ 58

From AASHTO Table 3.10.3.1-1 N > 50
Use Site Class C

Site Seismic Coefficients

Horizontal Peak Ground Acceleration,	PGA =	0.080	USGS Seismic Design Maps (AASHTO Figs. 3.10.2.1-1,-2, and -3)
Horizontal Response Spectral Acceleration (0.2 sec),	S_s =	0.160	
Horizontal Response Spectral Acceleration (1 sec),	S_1 =	0.041	

F_{PGA} =	1.2	AASHTO Table 3.10.3.2-1
F_A =	1.2	AASHTO Table 3.10.3.2-2
F_V =	1.7	AASHTO Table 3.10.3.2-3

Design Response Spectra

Acceleration Coefficient,	$A_s = PGA \times F_{PGA}$	A_S =	0.096	AASHTO Eq. 3.10.4.2-2
Design Spectral Acceleration (0.2 sec),	$S_{DS} = S_S \times F_A$	S_{DS} =	0.192	AASHTO Eq. 3.10.4.2-3
Design Spectral Acceleration (1 sec),	$S_{D1} = S_1 \times F_V$	S_{D1} =	0.070	AASHTO Eq. 3.10.4.2-6

From AASHTO Table 3.10.6-1
Seismic Zone 1

AASHTO Tables:

Table 3.4.2.3-1—Values of F_{pga} and F_a as a Function of Site Class and Mapped Peak Ground Acceleration or Short-Period Spectral Acceleration Coefficient

Site Class	Mapped Peak Ground Acceleration or Spectral Response Acceleration Coefficient at Short Periods				
	$PGA \leq 0.10$ $S_s \leq 0.25$	$PGA = 0.20$ $S_s = 0.50$	$PGA = 0.30$ $S_s = 0.75$	$PGA = 0.40$ $S_s = 1.00$	$PGA \geq 0.50$ $S_s \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	a	a	a	a	a

Note: Use straight line interpolation for intermediate values of PGA and S_s, where PGA is the peak ground acceleration and S_s is the spectral acceleration coefficient at 0.2 sec obtained from the ground motion maps.

[a] Site-specific response geotechnical investigation and dynamic site response analyses should be considered (Article 3.4.3).

Table 3.4.2.3-2—Values of F_v as a Function of Site Class and Mapped 1-sec Period Spectral Acceleration Coefficient

Site Class	Mapped Spectral Response Acceleration Coefficient at 1-sec Periods				
	$S_1 \leq 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 \geq 0.5$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	a	a	a	a	a

Note: Use straight line interpolation for intermediate values of S_1, where S_1 is the spectral acceleration coefficient at 1.0 sec obtained from the ground motion maps.

[a] Site-specific response geotechnical investigation and dynamic site response analyses should be considered (Article 3.4.3).

Table 3.10.6-1—Seismic Zones

Acceleration Coefficient, S_{D1}	Seismic Zone
$S_{D1} \leq 0.15$	1
$0.15 < S_{D1} \leq 0.30$	2
$0.30 < S_{D1} \leq 0.50$	3
$0.50 < S_{D1}$	4

D.4. Frost Depth Calculation

5.2 General

5.2.1 Frost

Any foundation placed on seasonally frozen soils must be embedded below the depth of frost penetration to provide adequate frost protection and to minimize the potential for freeze/thaw movements. Fine-grained soils with low cohesion tend to be most frost susceptible. Soils containing a high percentage of particles smaller than the No. 200 sieve also tend to promote frost penetration.

In order to estimate the depth of frost penetration at a site, Table 5-1 has been developed using the Modified Berggren equation and Figure 5-1 Maine Design Freezing Index Map. The use of Table 5-1 assumes site specific, uniform soil conditions where the Geotechnical Designer has evaluated subsurface conditions. Coarse-grained soils are defined as soils with sand as the major constituent. Fine-grained soils are those having silt and/or clay as the major constituent. If the make-up of the soil is not easily discerned, consult the Geotechnical Designer for assistance. In the event that specific site soil conditions vary, the depth of frost penetration should be calculated by the Geotechnical Designer.

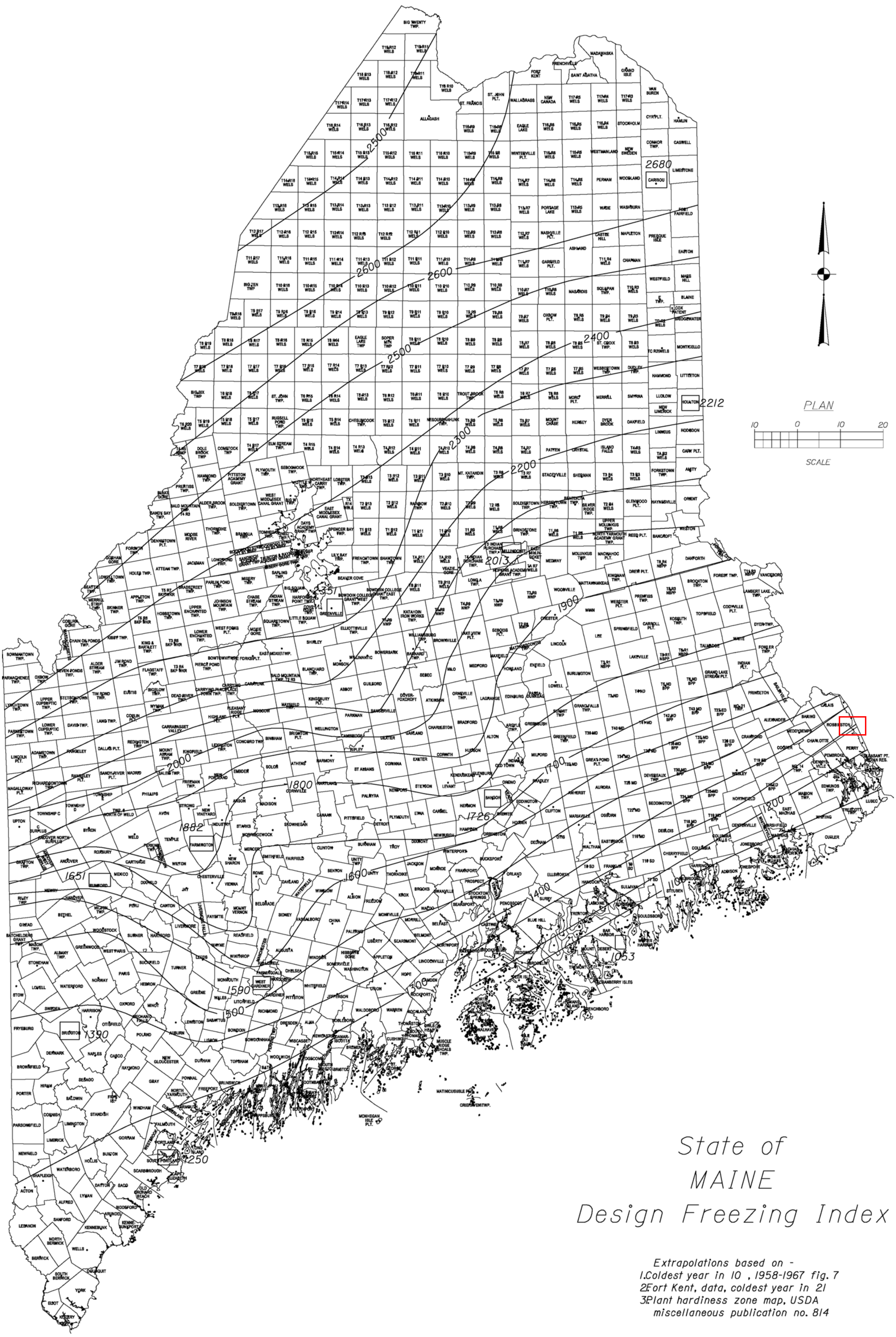
Table 5-1 Depth of Frost Penetration

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

Design Freezing Index based on Figure 5-1: 1300
Material Based on Laboratory Testing: Granular & Cohesive
Avg. Moisture Content based on Laboratory Testing: 12%
Avg. Frost Penetration = (76.3"+54.2")/2 = 65.25" = 5.4'

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.

Figure 5-1 Maine Design Freezing Index Map



Example 5-1 illustrates how to use Table 5-1 and Figure 5-1 to determine the depth of frost penetration:

Example 5-1 Depth of Frost Penetration

Given:	Site location is Freeport, Maine
Soil conditions:	Silty fine to coarse Sand

Step 1. From Figure 5-1 Design Freezing Index = 1300 degree-days
Step 2. From laboratory results: soil water content = 28% and major constituent Sand
Step 3. From Table 5-1: Depth of frost penetration = 56 inches = 4.7 feet

Spread footings founded on bedrock require no minimum embedment depth. Pile supported footings will be embedded for frost protection. The minimum depth of embedment will be calculated using the techniques discussed in Example 5-1. Pile supported integral abutments will be embedded no less than 4.0 feet for frost protection.

Riprap is not to be considered as contributing to the overall thickness of soils required for frost protection.

The final depth of footing embedment may be controlled by the calculated scour depth and be deeper than the depth required for frost protection. Refer to Section 2.3.11 Scour for information regarding scour depth.

5.2.2 Seal Cofferdams

Seal cofferdams are used when a substructure unit must be constructed with its foundation more than 4 feet below the water table, to counteract the buoyant forces produced during pumping of the cofferdam. Once the cofferdam is constructed, the seal is placed under water and water is then pumped out of the cofferdam. This provides a dry platform for construction of the spread footing, or in the case of a pile foundation, the distribution slab. When a seal is needed, the top of footing or distribution slab is located approximately at streambed, and the depth of seal is calculated based upon the buoyancy of the concrete under the expected water surface during construction. The following formula can be used:

$$145 \cdot y = 62.4 \cdot z$$

where:

145 lb/ft^3 =	unit weight of concrete
62.4 lb/ft^3 =	unit weight of water
y =	the depth of seal from top of seal to bottom of seal
z =	the depth of water from water surface to bottom of seal

D.5. LPile Analyses

Lpile Input Summary
Geotechnical Design Report
Mill Cove New Bridge #6205
WIN 026630.06
Robbinston, Maine

Abutment 1						
Stratum	**Soil Model**	**Top of Layer Elevation (NAVD88 ft)**	**Effective Unit Weight (pcf)**	**Friction Angle (deg)**	**k (pci)**	**Length Along Pile (ft)**
Existing Fill Above GWT	Sand (Reese)	22.8	125.0	34	122	0
Existing Fill Below GWT	Sand (Reese)	10.7	62.6	34	75	12.1
Glacial Till	Sand (Reese)	-6.2	67.6	36	97	29
Bedrock	--	-42.6	--	--	--	65.4

Notes:
1) pcf = lbs per cubic foot, deg = degrees, pci = lbs per cubic inch
2) Top of pile elevation is approximately El. 22.8 for proposed Abutment 1 based on Sheet 3, "Interpretive Subsurface Profile," dated June, 2025.
3) Groundwater at El. 10.7 based on boring BB-RMC-104
4) Top of layer elevation based on Boring BB-RMC-101
5) Correlations between the horizontal modulus of subgrade reaction (k) and the soil internal friction angle of a given stratum are based on Figure 3.34 presented in the 2022 LPile Technical Manual.

Abutment 2						
Stratum	**Soil Model**	**Top of Layer Elevation (NAVD88 ft)**	**Effective Unit Weight (pcf)**	**Friction Angle (deg)**	**k (pci)**	**Length Along Pile (ft)**
Existing Fill Above GWT	Sand (Reese)	24	125.0	34	122	0
Existing Fill Below GWT	Sand (Reese)	10.7	62.6	34	75	13.3
Glacial Till	Sand (Reese)	4.8	67.6	36	97	19.2
Bedrock	--	-52.2	--	--	--	76.2

Notes:
1) pcf = lbs per cubic foot, deg = degrees, pci = lbs per cubic inch
2) Top of pile elevation is approximately El. 24 for proposed Abutment 2 based on Sheet 3, "Interpretive Subsurface Profile," dated June, 2025.
3) Groundwater at El. 10.7 based on boring BB-RMC-104
4) Top of layer elevation based on Boring BB-RMC-104
5) Correlations between the horizontal modulus of subgrade reaction (k) and the soil internal friction angle of a given stratum are based on Figure 3.34 presented in the 2022 LPile Technical Manual.

Lpile Output Summary
Geotechnical Design Report
Mill Cove New Bridge #6205
WIN 026630.06
Robbinston, Maine

Abutment 1								
H-Pile Size	**Load Case #**	**Lateral Deflection (in)**	**Maximum Factored Axial Load (kips)**	**Shear Force at Pile Head (kips)**	**Moment at Pile Head (in-kips)**	**Total Stress at Pile Head (ksi)**	**Bending Stress at Pile Head (ksi)**	**Axial Stress at Pile Head (ksi)**
HP 14x117	1	0.4752	359	47.2	2402	50.8	40.4	10.4
HP 14x117	2	0.57024	359	53.8	2783	57.2	46.8	10.4

Notes:

1) Lateral deflection and maximum factored axial load were provided to GEI by Thornton Tomasetti on April 16, 2025

2) Load Case #1 uses the unfactored thermal contraction movement, Load Case #2 uses the thermal contraction movement with a 1.2 factor

Abutment 2								
H-Pile Size	**Load Case #**	**Lateral Deflection (in)**	**Maximum Factored Axial Load (kips)**	**Shear Force at Pile Head (kips)**	**Moment at Pile Head (in-kips)**	**Total Stress at Pile Head (ksi)**	**Bending Stress at Pile Head (ksi)**	**Axial Stress at Pile Head (ksi)**
HP 14x117	1	0.4752	359	47.3	2397	50.7	40.3	10.4
HP 14x117	2	0.57024	359	53.8	2776	57.1	46.7	10.4

Notes:

1) Lateral deflection and maximum factored axial load were provided to GEI by Thornton Tomasetti on April 16, 2025

2) Load Case #1 uses the unfactored thermal contraction movement, Load Case #2 uses the thermal contraction movement with a 1.2 factor

Thornton Tomasetti

Project:	Robbinston - Mill Cove		
W.O.:	P24771	Sheet:	
Calc By:	ESB	Date:	4/2/2025
Check By:	MJM	Date:	4/15/2025

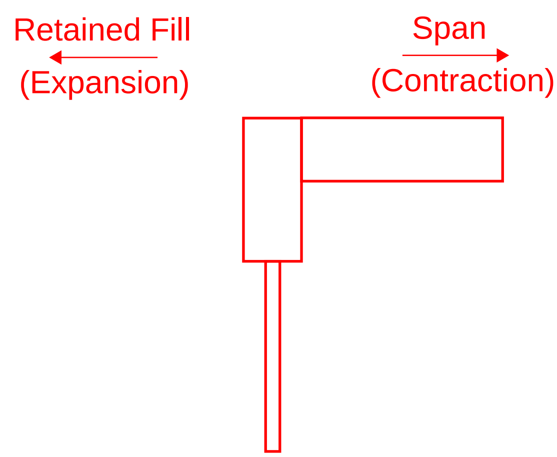
Summary of Unfactored Pile Loads:

DC	201	k/pile
DW	13	k/pile
LL+I, STR I	52	k/pile
LL+I, others	44	k/pile

Note: Loads do not include weight of steel H-pile

Summary of Factored Pile Loads:

STRENGTH I =	359	k/pile
SERVICE I =	257	k/pile



<u>Thermal Contraction - Temperature Fall (toward span)</u>

Δfall =	0.4752	in

<u>Thermal Expansion - Temperature Rise (into backfill)</u>

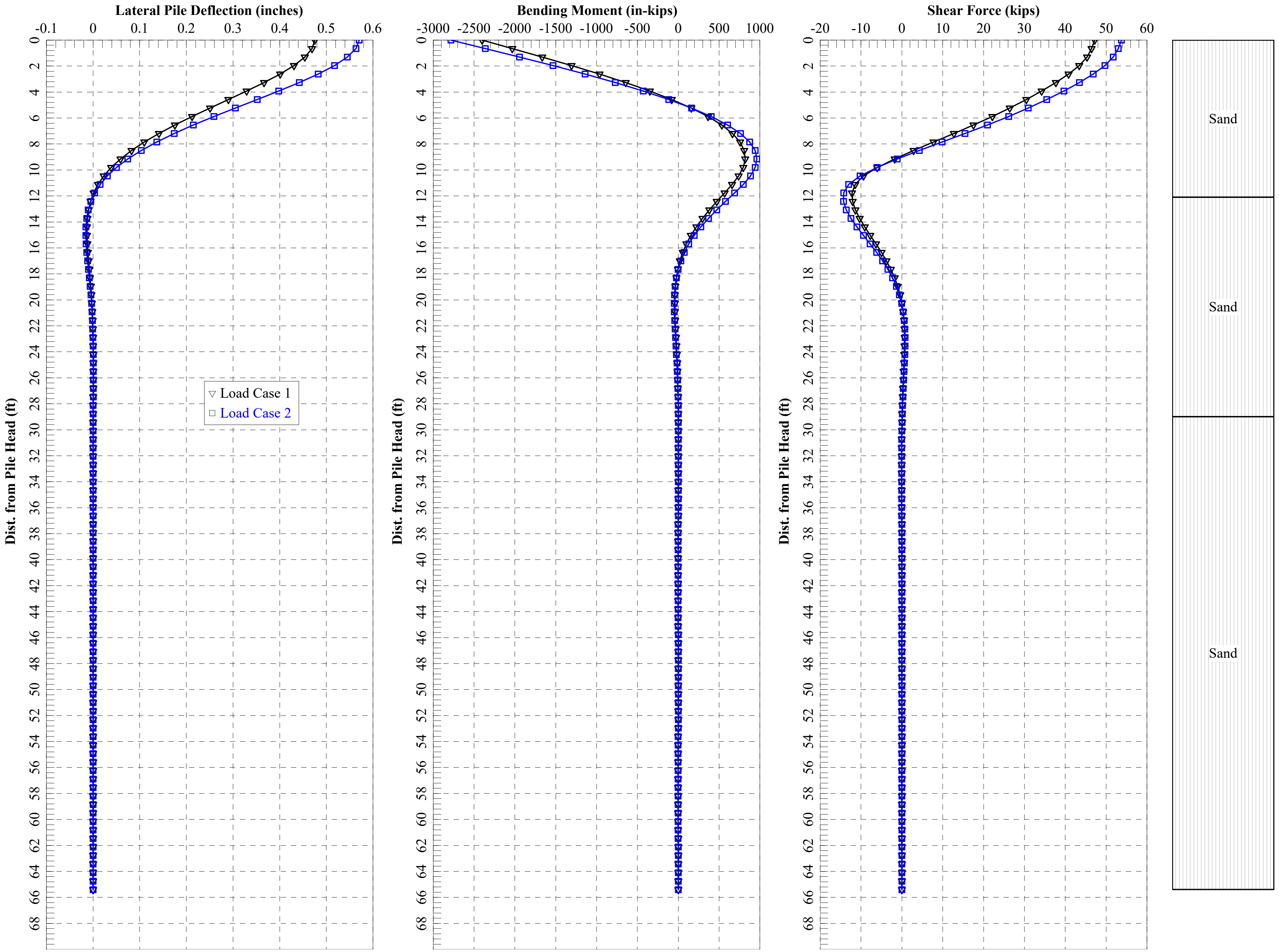
Δrise =	0.396	in

<u>Total Thermal Movement Range at Each Abutment</u>

Δrange =	0.594	in

Note: Thermal movements do NOT include load factors

Mill Cove New Bridge
Abutment 1 14x117



```
================================================================================

                     LPile for Windows, Version 2022-12.010

                 Analysis of Individual Piles and Drilled Shafts
                Subjected to Lateral Loading Using the p-y Method
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================================================================================

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--------------------------------------------------------------------------------
                             Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations:
\Working\THORNTON TOMASETTI\2502334 MaineDOT Downeast Bridges Phase II\09_Engineering\03_Robbinston\07_Lpile\Pile Runs\Existing
Conditions No Corrosion\

Name of input data file:
Robbinston Abutment 1 HP14x117 2025-07-09.lp12d

Name of output report file:
Robbinston Abutment 1 HP14x117 2025-07-09.lp12o

Name of plot output file:
Robbinston Abutment 1 HP14x117 2025-07-09.lp12p

Name of runtime message file:
Robbinston Abutment 1 HP14x117 2025-07-09.lp12r
```

```
--------------------------------------------------------------------------------
                            Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  July 9, 2025               Time:   8:04:40


--------------------------------------------------------------------------------
                                  Problem Title
--------------------------------------------------------------------------------

Project Name: Mill Cove New Bridge #6205

Job Number: 2502334

Client: Thornton Tomasetti

Engineer: M. Johnescu

Description: Lateral Pile Analysis Abutment 1 HP14x117



--------------------------------------------------------------------------------
                           Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed               =          500
 - Deflection tolerance for convergence               =   1.0000E-05 in
 - Maximum allowable deflection                       =     100.0000 in
 - Number of pile increments                          =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
```

- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

```
Number of pile sections defined                       =           1
Total length of pile                                  =      65.400 ft
Depth of ground surface below top of pile             =      0.0000 ft
```

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	14.9000
2	65.400	14.9000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

```
   Section 1 is a H weak axis steel pile
   Length of section                                  =    65.400000 ft
   Pile width                                         =    14.200000 in
```

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

```
   Distance from top of pile to top of layer          =       0.0000 ft
   Distance from top of pile to bottom of layer       =    12.100000 ft
   Effective unit weight at top of layer              =   125.000000 pcf
   Effective unit weight at bottom of layer           =   125.000000 pcf
   Friction angle at top of layer                     =    34.000000 deg.
   Friction angle at bottom of layer                  =    34.000000 deg.
   Subgrade k at top of layer                         =   122.000000 pci
   Subgrade k at bottom of layer                      =   122.000000 pci
```

Layer 2 is sand, p-y criteria by Reese et al., 1974

```
   Distance from top of pile to top of layer          =    12.100000 ft
   Distance from top of pile to bottom of layer       =    29.000000 ft
   Effective unit weight at top of layer              =    62.600000 pcf
   Effective unit weight at bottom of layer           =    62.600000 pcf
   Friction angle at top of layer                     =    34.000000 deg.
   Friction angle at bottom of layer                  =    34.000000 deg.
   Subgrade k at top of layer                         =    75.000000 pci
   Subgrade k at bottom of layer                      =    75.000000 pci
```

Layer 3 is sand, p-y criteria by Reese et al., 1974

```
   Distance from top of pile to top of layer          =    29.000000 ft
   Distance from top of pile to bottom of layer       =    65.400000 ft
   Effective unit weight at top of layer              =    67.600000 pcf
   Effective unit weight at bottom of layer           =    67.600000 pcf
   Friction angle at top of layer                     =    36.000000 deg.
   Friction angle at bottom of layer                  =    36.000000 deg.
   Subgrade k at top of layer                         =    97.000000 pci
   Subgrade k at bottom of layer                      =    97.000000 pci
```

(Depth of the lowest soil layer extends 0.000 ft below the pile tip)

Summary of Input Soil Properties

```
Layer        Soil Type          Layer      Effective    Angle of
```

Num.	Name (p-y Curve Type)	Depth ft	Unit Wt. pcf	Friction deg.	kpy pci
1	Sand	0.00	125.0000	34.0000	122.0000
	(Reese, et al.)	12.1000	125.0000	34.0000	122.0000
2	Sand	12.1000	62.6000	34.0000	75.0000
	(Reese, et al.)	29.0000	62.6000	34.0000	75.0000
3	Sand	29.0000	67.6000	36.0000	97.0000
	(Reese, et al.)	65.4000	67.6000	36.0000	97.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	5	y = 0.475200 in	S = 0.0000 in/in	359000.	N.A.	Yes
2	5	y = 0.570240 in	S = 0.0000 in/in	359000.	N.A.	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel H Weak Axis:

Length of Section	=	65.400000 ft
Flange Width	=	14.900000 in
Section Depth	=	14.200000 in
Flange Thickness	=	0.805000 in
Web Thickness	=	0.805000 in
Yield Stress of Pipe	=	50.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	34.123950 sq. in.
Moment of Inertia	=	444.363799 in^4
Elastic Bending Stiffness	=	12886550. kip-in^2
Plastic Modulus, Z	=	91.398684in^3
Plastic Moment Capacity = Fy Z	=	4570.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	1706.197 kips
Nominal Axial Tensile Capacity	=	-1706.197 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	359.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 359.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000452	58.2652123	12886018.	87.6818047	11.4875896	
0.00000904	116.5304245	12886018.	47.5659024	12.4547090	

0.00001356	174.7956368	12886018.	34.1939349	13.4218282	
0.00001809	233.0608491	12886018.	27.5079512	14.3889475	
0.00002261	291.3260613	12886018.	23.4963609	15.3560669	
0.00002713	349.5912736	12886018.	20.8219675	16.3231862	
0.00003165	407.8564859	12886018.	18.9116864	17.2903055	
0.00003617	466.1216981	12886018.	17.4789756	18.2574249	
0.00004069	524.3869104	12886018.	16.3646450	19.2245442	
0.00004522	582.6521226	12886018.	15.4731805	20.1916635	
0.00004974	640.9173349	12886018.	14.7438004	21.1587828	
0.00005426	699.1825472	12886018.	14.1359837	22.1259022	
0.00005878	757.4477594	12886018.	13.6216773	23.0930215	
0.00006330	815.7129717	12886018.	13.1808432	24.0601408	
0.00006782	873.9781840	12886018.	12.7987870	25.0272601	
0.00007235	932.2433962	12886018.	12.4644878	25.9943795	
0.00007687	990.5086085	12886018.	12.1695179	26.9614988	
0.00008139	1049.	12886018.	11.9073225	27.9286181	
0.00008591	1107.	12886018.	11.6727266	28.8957375	
0.00009043	1165.	12886018.	11.4615902	29.8628568	
0.00009495	1224.	12886018.	11.2705621	30.8299761	
0.00009947	1282.	12886018.	11.0969002	31.7970954	
0.0001040	1340.	12886018.	10.9383393	32.7642148	
0.0001085	1398.	12886018.	10.7929919	33.7313341	
0.0001130	1457.	12886018.	10.6592722	34.6984534	
0.0001176	1515.	12886018.	10.5358386	35.6655728	
0.0001221	1573.	12886018.	10.4215483	36.6326921	
0.0001266	1631.	12886018.	10.3154216	37.5998114	
0.0001311	1690.	12886018.	10.2166140	38.5669308	
0.0001356	1748.	12886018.	10.1243935	39.5340501	
0.0001402	1806.	12886018.	10.0381227	40.5011694	
0.0001447	1864.	12886018.	9.9572439	41.4682887	
0.0001492	1923.	12886018.	9.8812668	42.4354081	
0.0001537	1981.	12886018.	9.8097590	43.4025274	
0.0001583	2039.	12886018.	9.7423373	44.3696467	
0.0001628	2098.	12886018.	9.6786612	45.3367661	
0.0001673	2156.	12886018.	9.6184272	46.3038854	
0.0001718	2214.	12886018.	9.5613633	47.2710047	
0.0001763	2272.	12886018.	9.5072258	48.2381241	
0.0001854	2389.	12884362.	9.4071003	50.0000000	Y
0.0001944	2499.	12851103.	9.3206951	50.0000000	Y
0.0002035	2602.	12785778.	9.2470206	50.0000000	Y
0.0002125	2698.	12696269.	9.1841036	50.0000000	Y
0.0002216	2789.	12589010.	9.1302729	50.0000000	Y
0.0002306	2875.	12469261.	9.0840988	50.0000000	Y
0.0002396	2957.	12340783.	9.0444437	50.0000000	Y
0.0002487	3035.	12205262.	9.0105875	50.0000000	Y
0.0002577	3110.	12066853.	8.9813937	50.0000000	Y
0.0002668	3181.	11925645.	8.9565085	50.0000000	Y
0.0002758	3250.	11783649.	8.9352449	50.0000000	Y
0.0002849	3316.	11642228.	8.9170591	50.0000000	Y
0.0002939	3380.	11499330.	8.9011209	50.0000000	Y
0.0003029	3438.	11347866.	8.8856672	50.0000000	Y
0.0003120	3491.	11190077.	8.8706326	50.0000000	Y
0.0003210	3540.	11027757.	8.8559319	50.0000000	Y
0.0003301	3585.	10862285.	8.8414500	50.0000000	Y
0.0003391	3627.	10695783.	8.8272919	50.0000000	Y
0.0003482	3666.	10529388.	8.8134080	50.0000000	Y
0.0003572	3702.	10364059.	8.7997523	50.0000000	Y
0.0003662	3736.	10199715.	8.7863700	50.0000000	Y
0.0003753	3767.	10036671.	8.7732994	50.0000000	Y
0.0003843	3796.	9876530.	8.7603404	50.0000000	Y
0.0003934	3823.	9718964.	8.7477614	50.0000000	Y
0.0004024	3849.	9564433.	8.7355595	50.0000000	Y
0.0004115	3873.	9412911.	8.7232916	50.0000000	Y
0.0004205	3895.	9263698.	8.7114496	50.0000000	Y
0.0004296	3917.	9118876.	8.6997054	50.0000000	Y
0.0004386	3937.	8976283.	8.6883905	50.0000000	Y
0.0004476	3956.	8837366.	8.6769597	50.0000000	Y
0.0004567	3974.	8701985.	8.6661993	50.0000000	Y
0.0004657	3991.	8568962.	8.6551299	50.0000000	Y
0.0004748	4007.	8440061.	8.6445363	50.0000000	Y
0.0004838	4022.	8313359.	8.6340587	50.0000000	Y
0.0004929	4037.	8190700.	8.6237275	50.0000000	Y
0.0005019	4050.	8070205.	8.6136070	50.0000000	Y
0.0005109	4064.	7953237.	8.6038254	50.0000000	Y
0.0005200	4076.	7838888.	8.5937828	50.0000000	Y
0.0005290	4088.	7727714.	8.5844725	50.0000000	Y
0.0005381	4099.	7618417.	8.5748793	50.0000000	Y
0.0005742	4140.	7209768.	8.5387808	50.0000000	Y
0.0006104	4174.	6838318.	8.5046015	50.0000000	Y
0.0006466	4203.	6501032.	8.4727279	50.0000000	Y
0.0006828	4229.	6193692.	8.4426804	50.0000000	Y
0.0007189	4251.	5912565.	8.4143118	50.0000000	Y
0.0007551	4270.	5654480.	8.3876436	50.0000000	Y
0.0007913	4287.	5417405.	8.3619805	50.0000000	Y
0.0008274	4301.	5198393.	8.3381796	50.0000000	Y
0.0008636	4315.	4996319.	8.3152796	50.0000000	Y
0.0008998	4327.	4808941.	8.2939946	50.0000000	Y
0.0009360	4338.	4634386.	8.2732026	50.0000000	Y
0.0009721	4348.	4472275.	8.2534542	50.0000000	Y
0.0010083	4356.	4320548.	8.2349704	50.0000000	Y

Summary of Results for Nominal Moment Capacity for Section 1

Load	Axial	Nominal Moment

No.	Thrust kips	Capacity in-kips
1	359.0000000000	4356.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	214899.
2	12.1000	12.1000	Yes	No	214899.	1656387.
3	29.0000	27.9619	Yes	No	1871286.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.475200 inches

Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 359000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.4752	-2401844.	47188.	0.00	50789.	1.29E+10	0.00	0.00	0.00
0.6540	0.4695	-2032541.	46440.	-0.00135	44597.	1.29E+10	-90.181	1508.	0.00
1.3080	0.4540	-1665304.	45321.	-0.00248	38440.	1.29E+10	-194.977	3370.	0.00
1.9620	0.4306	-1307217.	43416.	-0.00338	32437.	1.29E+10	-290.717	5299.	0.00
2.6160	0.4009	-964794.	40826.	-0.00407	26696.	1.29E+10	-369.240	7228.	0.00
3.2700	0.3666	-643456.	37719.	-0.00456	21308.	1.29E+10	-422.539	9045.	0.00
3.9240	0.3293	-347039.	34236.	-0.00487	16339.	1.29E+10	-465.110	11086.	0.00
4.5780	0.2903	-78673.	30449.	-0.00500	11839.	1.29E+10	-499.856	13515.	0.00
5.2320	0.2509	159041.	26430.	-0.00497	13187.	1.29E+10	-524.480	16408.	0.00
5.8860	0.2122	364179.	22140.	-0.00481	16626.	1.29E+10	-568.655	21028.	0.00
6.5400	0.1753	533667.	17547.	-0.00454	19468.	1.29E+10	-601.834	26938.	0.00
7.1940	0.1410	665173.	12725.	-0.00417	21672.	1.29E+10	-627.105	34905.	0.00
7.8480	0.1098	756913.	7784.	-0.00374	23211.	1.29E+10	-632.029	45159.	0.00
8.5020	0.08229	808427.	2892.	-0.00326	24074.	1.29E+10	-614.732	58624.	0.00
9.1560	0.05862	820692.	-1772.	-0.00277	24280.	1.29E+10	-573.894	76838.	0.00
9.8100	0.03886	796202.	-6019.	-0.00227	23869.	1.29E+10	-508.359	102666.	0.00
10.4640	0.02291	739035.	-9391.	-0.00181	22911.	1.29E+10	-350.959	120226.	0.00
11.1180	0.01049	658984.	-11438.	-0.00138	21569.	1.29E+10	-170.768	127740.	0.00
11.7720	0.00122	567285.	-12191.	-0.00101	20031.	1.29E+10	-21.081	135254.	0.00
12.4260	-0.00533	473313.	-12040.	-6.91E-04	18456.	1.29E+10	59.6490	87767.	0.00
13.0800	-0.00963	382204.	-11361.	-4.31E-04	16928.	1.29E+10	113.3445	92387.	0.00
13.7340	-0.01210	297420.	-10329.	-2.24E-04	15507.	1.29E+10	149.5150	97006.	0.00
14.3880	-0.01314	221334.	-9075.	-6.59E-05	14231.	1.29E+10	170.1825	101625.	0.00
15.0420	-0.01313	155350.	-7710.	4.88E-05	13125.	1.29E+10	177.7598	106245.	0.00
15.6960	-0.01238	100048.	-6326.	1.27E-04	12198.	1.29E+10	174.8343	110864.	0.00
16.3500	-0.01114	55342.	-4997.	1.74E-04	11448.	1.29E+10	163.9842	115483.	0.00
17.0040	-0.00965	20641.	-3774.	1.97E-04	10867.	1.29E+10	147.6352	120103.	0.00
17.6580	-0.00805	-5001.	-2692.	2.02E-04	10604.	1.29E+10	127.9562	124722.	0.00
18.3120	-0.00648	-22755.	-1771.	1.93E-04	10902.	1.29E+10	106.7928	129341.	0.00
18.9660	-0.00502	-33892.	-1016.	1.76E-04	11089.	1.29E+10	85.6357	133961.	0.00
19.6200	-0.00372	-39696.	-422.600	1.54E-04	11186.	1.29E+10	65.6170	138580.	0.00
20.2740	-0.00260	-41391.	21.3843	1.29E-04	11214.	1.29E+10	47.5288	143199.	0.00
20.9280	-0.00169	-40087.	332.9009	1.04E-04	11193.	1.29E+10	31.8587	147819.	0.00
21.5820	-9.70E-04	-36753.	531.8239	8.08E-05	11137.	1.29E+10	18.8352	152438.	0.00
22.2360	-4.24E-04	-32195.	638.9987	5.98E-05	11060.	1.29E+10	8.4775	157057.	0.00
22.8900	-3.14E-05	-27060.	674.8032	4.17E-05	10974.	1.29E+10	0.6470	161677.	0.00
23.5440	2.31E-04	-21838.	658.0967	2.68E-05	10887.	1.29E+10	-4.905	166296.	0.00
24.1980	3.90E-04	-16881.	605.5272	1.51E-05	10803.	1.29E+10	-8.492	170915.	0.00
24.8520	4.68E-04	-12419.	531.1505	6.13E-06	10729.	1.29E+10	-10.462	175535.	0.00
25.5060	4.86E-04	-8579.	446.3034	-2.63E-07	10664.	1.29E+10	-11.161	180154.	0.00
26.1600	4.64E-04	-5412.	359.6765	-4.52E-06	10611.	1.29E+10	-10.916	184773.	0.00
26.8140	4.15E-04	-2908.	277.5269	-7.06E-06	10569.	1.29E+10	-10.020	189393.	0.00

27.4680	3.53E-04	-1016.	203.9805	-8.25E-06	10538.	1.29E+10	-8.723	194012.	0.00
28.1220	2.86E-04	340.0546	141.3798	-8.46E-06	10526.	1.29E+10	-7.230	198631.	0.00
28.7760	2.20E-04	1250.	90.6403	-7.97E-06	10541.	1.29E+10	-5.700	203251.	0.00
29.4300	1.61E-04	1808.	46.6950	-7.04E-06	10551.	1.29E+10	-5.499	268845.	0.00
30.0840	1.10E-04	2023.	10.0621	-5.88E-06	10554.	1.29E+10	-3.837	274820.	0.00
30.7380	6.83E-05	1999.	-14.582	-4.65E-06	10554.	1.29E+10	-2.443	280794.	0.00
31.3920	3.66E-05	1820.	-29.413	-3.49E-06	10551.	1.29E+10	-1.336	286768.	0.00
32.0460	1.35E-05	1557.	-36.639	-2.46E-06	10547.	1.29E+10	-0.505	292743.	0.00
32.7000	-2.04E-06	1259.	-38.317	-1.60E-06	10542.	1.29E+10	0.07760	298717.	0.00
33.3540	-1.16E-05	964.3175	-36.244	-9.25E-07	10537.	1.29E+10	0.4505	304691.	0.00
34.0080	-1.66E-05	695.5235	-31.905	-4.20E-07	10532.	1.29E+10	0.6555	310666.	0.00
34.6620	-1.82E-05	465.9064	-26.453	-6.59E-08	10528.	1.29E+10	0.7339	316640.	0.00
35.3160	-1.76E-05	280.6886	-20.736	1.61E-07	10525.	1.29E+10	0.7232	322614.	0.00
35.9700	-1.57E-05	139.5313	-15.326	2.89E-07	10523.	1.29E+10	0.6554	328589.	0.00
36.6240	-1.31E-05	38.5044	-10.571	3.44E-07	10521.	1.29E+10	0.5563	334563.	0.00
37.2780	-1.03E-05	-28.324	-6.641	3.47E-07	10521.	1.29E+10	0.4453	340537.	0.00
37.9320	-7.61E-06	-67.680	-3.575	3.17E-07	10522.	1.29E+10	0.3359	346512.	0.00
38.5860	-5.28E-06	-86.230	-1.327	2.71E-07	10522.	1.29E+10	0.2371	352486.	0.00
39.2400	-3.36E-06	-90.032	0.2055	2.17E-07	10522.	1.29E+10	0.1535	358460.	0.00
39.8940	-1.87E-06	-84.227	1.1490	1.64E-07	10522.	1.29E+10	0.08697	364435.	0.00
40.5480	-7.88E-07	-72.921	1.6362	1.16E-07	10522.	1.29E+10	0.03719	370409.	0.00
41.2020	-5.17E-08	-59.198	1.7919	7.58E-08	10521.	1.29E+10	0.00248	376383.	0.00
41.8560	4.02E-07	-45.222	1.7249	4.40E-08	10521.	1.29E+10	-0.01957	382358.	0.00
42.5100	6.39E-07	-32.373	1.5241	2.04E-08	10521.	1.29E+10	-0.03161	388332.	0.00
43.1640	7.21E-07	-21.415	1.2578	3.99E-09	10521.	1.29E+10	-0.03624	394306.	0.00
43.8180	7.01E-07	-12.653	0.9752	-6.39E-09	10521.	1.29E+10	-0.03577	400281.	0.00
44.4720	6.21E-07	-6.072	0.7087	-1.21E-08	10521.	1.29E+10	-0.03215	406255.	0.00
45.1260	5.12E-07	-1.461	0.4771	-1.44E-08	10520.	1.29E+10	-0.02687	412229.	0.00
45.7800	3.95E-07	1.4979	0.2890	-1.44E-08	10520.	1.29E+10	-0.02106	418204.	0.00
46.4340	2.86E-07	3.1565	0.1457	-1.30E-08	10521.	1.29E+10	-0.01546	424178.	0.00
47.0880	1.92E-07	3.8573	0.04372	-1.08E-08	10521.	1.29E+10	-0.01052	430152.	0.00
47.7420	1.16E-07	3.9036	-0.02292	-8.46E-09	10521.	1.29E+10	-0.00646	436127.	0.00
48.3960	5.92E-08	3.5453	-0.06136	-6.19E-09	10521.	1.29E+10	-0.00334	442101.	0.00
49.0500	1.91E-08	2.9754	-0.07874	-4.20E-09	10521.	1.29E+10	-0.00109	448075.	0.00
49.7040	-6.71E-09	2.3330	-0.08151	-2.58E-09	10521.	1.29E+10	3.88E-04	454050.	0.00
50.3580	-2.14E-08	1.7106	-0.07506	-1.35E-09	10520.	1.29E+10	0.00126	460024.	0.00
51.0120	-2.80E-08	1.1625	-0.06362	-4.78E-10	10520.	1.29E+10	0.00166	465998.	0.00
51.6660	-2.89E-08	0.7147	-0.05028	9.32E-11	10520.	1.29E+10	0.00174	471973.	0.00
52.3200	-2.65E-08	0.3728	-0.03712	4.24E-10	10520.	1.29E+10	0.00161	477947.	0.00
52.9740	-2.23E-08	0.1297	-0.02540	5.77E-10	10520.	1.29E+10	0.00137	483921.	0.00
53.6280	-1.74E-08	-0.02907	-0.01574	6.08E-10	10520.	1.29E+10	0.00109	489896.	0.00
54.2820	-1.27E-08	-0.121	-0.00831	5.62E-10	10520.	1.29E+10	8.04E-04	495870.	0.00
54.9360	-8.60E-09	-0.163	-0.00300	4.76E-10	10520.	1.29E+10	5.50E-04	501844.	0.00
55.5900	-5.26E-09	-0.171	4.93E-04	3.75E-10	10520.	1.29E+10	3.40E-04	507819.	0.00
56.2440	-2.72E-09	-0.157	0.00253	2.75E-10	10520.	1.29E+10	1.78E-04	513793.	0.00
56.8980	-9.44E-10	-0.132	0.00347	1.87E-10	10520.	1.29E+10	6.25E-05	519767.	0.00
57.5520	2.04E-10	-0.104	0.00366	1.15E-10	10520.	1.29E+10	-1.37E-05	525742.	0.00
58.2060	8.56E-10	-0.07555	0.00338	6.01E-11	10520.	1.29E+10	-5.80E-05	531716.	0.00
58.8600	1.15E-09	-0.05089	0.00285	2.16E-11	10520.	1.29E+10	-7.86E-05	537690.	0.00
59.5140	1.20E-09	-0.03099	0.00221	-3.32E-12	10520.	1.29E+10	-8.28E-05	543665.	0.00
60.1680	1.10E-09	-0.01613	0.00159	-1.77E-11	10520.	1.29E+10	-7.67E-05	549639.	0.00
60.8220	9.18E-10	-0.00596	0.00103	-2.44E-11	10520.	1.29E+10	-6.50E-05	555613.	0.00
61.4760	7.12E-10	2.08E-04	5.77E-04	-2.61E-11	10520.	1.29E+10	-5.10E-05	561588.	0.00
62.1300	5.08E-10	0.00324	2.33E-04	-2.51E-11	10520.	1.29E+10	-3.67E-05	567562.	0.00
62.7840	3.18E-10	0.00400	-2.70E-06	-2.29E-11	10520.	1.29E+10	-2.33E-05	573536.	0.00
63.4380	1.48E-10	0.00332	-1.37E-04	-2.07E-11	10520.	1.29E+10	-1.10E-05	579511.	0.00
64.0920	-5.90E-12	0.00197	-1.78E-04	-1.91E-11	10520.	1.29E+10	4.40E-07	585485.	0.00
64.7460	-1.51E-10	6.35E-04	-1.32E-04	-1.83E-11	10520.	1.29E+10	1.14E-05	591459.	0.00
65.4000	-2.92E-10	0.00	0.00	-1.81E-11	10520.	1.29E+10	2.23E-05	298717.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection              =     0.47520000 inches
Computed slope at pile head       =       0.000000 radians
Maximum bending moment            =     -2401844. inch-lbs
Maximum shear force               =         47188. lbs
Depth of maximum bending moment   =       0.000000 feet below pile head
Depth of maximum shear force      =       0.000000 feet below pile head
Number of iterations              =              7
Number of zero deflection points  =              7
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

```
Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head                            =      0.570240 inches
Rotation of pile head                                =    0.000E+00 radians
Axial load on pile head                              =      359000.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5702	-2783445.	53784.	0.00	57186.	1.26E+10	0.00	0.00	0.00
0.6540	0.5634	-2362281.	52971.	-0.00160	50125.	1.26E+10	-97.546	1359.	0.00
1.3080	0.5451	-1942978.	51756.	-0.00293	43096.	1.29E+10	-212.034	3053.	0.00

1.9620	0.5174	-1533401.	49682.	-0.00399	36229.	1.29E+10	-316.481	4800.	0.00
2.6160	0.4825	-1140685.	46861.	-0.00480	29645.	1.29E+10	-402.564	6548.	0.00
3.2700	0.4420	-770806.	43470.	-0.00539	23443.	1.29E+10	-461.575	8195.	0.00
3.9240	0.3979	-428033.	39649.	-0.00575	17697.	1.29E+10	-512.100	10100.	0.00
4.5780	0.3518	-116066.	35456.	-0.00592	12466.	1.29E+10	-556.558	12417.	0.00
5.2320	0.3051	161820.	30960.	-0.00590	13233.	1.29E+10	-589.191	15158.	0.00
5.8860	0.2591	403141.	26135.	-0.00573	17279.	1.29E+10	-640.462	19397.	0.00
6.5400	0.2151	604322.	20947.	-0.00542	20652.	1.29E+10	-681.490	24863.	0.00
7.1940	0.1740	762493.	15477.	-0.00501	23304.	1.29E+10	-712.618	32143.	0.00
7.8480	0.1365	875465.	9850.	-0.00451	25198.	1.29E+10	-721.350	41469.	0.00
8.5020	0.1032	942505.	4251.	-0.00396	26322.	1.29E+10	-705.519	53640.	0.00
9.1560	0.07444	964475.	-1121.	-0.00337	26690.	1.29E+10	-663.606	69965.	0.00
9.8100	0.05026	943917.	-6058.	-0.00279	26346.	1.29E+10	-594.391	92815.	0.00
10.4640	0.03059	885131.	-10229.	-0.00224	25360.	1.29E+10	-468.665	120226.	0.00
11.1180	0.01516	795960.	-13036.	-0.00172	23865.	1.29E+10	-246.721	127740.	0.00
11.7720	0.00353	690228.	-14243.	-0.00127	22093.	1.29E+10	-60.786	135254.	0.00
12.4260	-0.00480	579567.	-14271.	-8.85E-04	20237.	1.29E+10	53.7331	87767.	0.00
13.0800	-0.01037	471222.	-13581.	-5.65E-04	18421.	1.29E+10	122.0324	92387.	0.00
13.7340	-0.01368	369584.	-12439.	-3.09E-04	16717.	1.29E+10	169.0391	97006.	0.00
14.3880	-0.01522	277723.	-11002.	-1.12E-04	15177.	1.29E+10	197.0668	101625.	0.00
15.0420	-0.01543	197523.	-9409.	3.27E-05	13832.	1.29E+10	208.9402	106245.	0.00
15.6960	-0.01471	129853.	-7774.	1.32E-04	12698.	1.29E+10	207.7306	110864.	0.00
16.3500	-0.01336	74755.	-6188.	1.95E-04	11774.	1.29E+10	196.5301	115483.	0.00
17.0040	-0.01165	31632.	-4717.	2.27E-04	11051.	1.29E+10	178.2731	120103.	0.00
17.6580	-0.00979	-564.005	-3407.	2.37E-04	10530.	1.29E+10	155.6043	124722.	0.00
18.3120	-0.00794	-23176.	-2283.	2.29E-04	10909.	1.29E+10	130.7928	129341.	0.00
18.9660	-0.00619	-37692.	-1355.	2.11E-04	11152.	1.29E+10	105.6882	133961.	0.00
19.6200	-0.00463	-45634.	-619.793	1.85E-04	11286.	1.29E+10	81.7113	138580.	0.00
20.2740	-0.00328	-48465.	-64.217	1.57E-04	11333.	1.29E+10	59.8728	143199.	0.00
20.9280	-0.00217	-47525.	330.8739	1.28E-04	11317.	1.29E+10	40.8128	147819.	0.00
21.5820	-0.00128	-43990.	588.5470	9.97E-05	11258.	1.29E+10	24.8531	152438.	0.00
22.2360	-6.02E-04	-38849.	733.3804	7.44E-05	11172.	1.29E+10	12.0566	157057.	0.00
22.8900	-1.11E-04	-32898.	789.6697	5.26E-05	11072.	1.29E+10	2.2883	161677.	0.00
23.5440	2.23E-04	-26751.	780.1024	3.44E-05	10969.	1.29E+10	-4.726	166296.	0.00
24.1980	4.29E-04	-20848.	724.8663	1.99E-05	10870.	1.29E+10	-9.350	170915.	0.00
24.8520	5.36E-04	-15485.	641.1375	8.87E-06	10780.	1.29E+10	-11.988	175535.	0.00
25.5060	5.69E-04	-10835.	542.8834	8.56E-07	10702.	1.29E+10	-13.052	180154.	0.00
26.1600	5.49E-04	-6969.	440.9122	-4.57E-06	10637.	1.29E+10	-12.935	184773.	0.00
26.8140	4.97E-04	-3888.	343.1007	-7.87E-06	10586.	1.29E+10	-11.992	189393.	0.00
27.4680	4.26E-04	-1539.	254.7370	-9.52E-06	10546.	1.29E+10	-10.527	194012.	0.00
28.1220	3.47E-04	163.6439	178.9257	-9.94E-06	10523.	1.29E+10	-8.793	198631.	0.00
28.7760	2.70E-04	1325.	117.0086	-9.49E-06	10543.	1.29E+10	-6.986	203251.	0.00
29.4300	1.98E-04	2054.	62.9189	-8.46E-06	10555.	1.29E+10	-6.798	268845.	0.00
30.0840	1.37E-04	2360.	17.4257	-7.12E-06	10560.	1.29E+10	-4.796	274820.	0.00
30.7380	8.67E-05	2367.	-13.569	-5.68E-06	10560.	1.29E+10	-3.103	280794.	0.00
31.3920	4.78E-05	2179.	-32.603	-4.29E-06	10557.	1.29E+10	-1.748	286768.	0.00
32.0460	1.93E-05	1880.	-42.291	-3.06E-06	10552.	1.29E+10	-0.721	292743.	0.00
32.7000	-1.61E-07	1533.	-45.098	-2.02E-06	10546.	1.29E+10	0.00611	298717.	0.00
33.3540	-1.23E-05	1183.	-43.195	-1.19E-06	10540.	1.29E+10	0.4790	304691.	0.00

34.0080	-1.89E-05	861.3766	-38.386	-5.69E-07	10535.	1.29E+10	0.7464	310666.	0.00
34.6620	-2.13E-05	583.9705	-32.091	-1.28E-07	10530.	1.29E+10	0.8578	316640.	0.00
35.3160	-2.09E-05	358.3925	-25.359	1.59E-07	10526.	1.29E+10	0.8580	322614.	0.00
35.9700	-1.88E-05	185.0436	-18.908	3.24E-07	10524.	1.29E+10	0.7859	328589.	0.00
36.6240	-1.58E-05	59.7817	-13.184	3.99E-07	10521.	1.29E+10	0.6729	334563.	0.00
37.2780	-1.25E-05	-24.137	-8.413	4.09E-07	10521.	1.29E+10	0.5430	340537.	0.00
37.9320	-9.36E-06	-74.573	-4.661	3.79E-07	10522.	1.29E+10	0.4132	346512.	0.00
38.5860	-6.56E-06	-99.433	-1.884	3.26E-07	10522.	1.29E+10	0.2945	352486.	0.00
39.2400	-4.23E-06	-105.981	0.03076	2.64E-07	10522.	1.29E+10	0.1934	358460.	0.00
39.8940	-2.42E-06	-100.437	1.2298	2.01E-07	10522.	1.29E+10	0.1122	364435.	0.00
40.5480	-1.08E-06	-87.811	1.8697	1.44E-07	10522.	1.29E+10	0.05089	370409.	0.00
41.2020	-1.60E-07	-71.899	2.0996	9.51E-08	10522.	1.29E+10	0.00769	376383.	0.00
41.8560	4.14E-07	-55.391	2.0507	5.63E-08	10521.	1.29E+10	-0.02017	382358.	0.00
42.5100	7.24E-07	-40.030	1.8310	2.73E-08	10521.	1.29E+10	-0.03580	388332.	0.00
43.1640	8.42E-07	-26.805	1.5246	6.90E-09	10521.	1.29E+10	-0.04229	394306.	0.00
43.8180	8.32E-07	-16.138	1.1922	-6.18E-09	10521.	1.29E+10	-0.04243	400281.	0.00
44.4720	7.45E-07	-8.058	0.8744	-1.35E-08	10521.	1.29E+10	-0.03855	406255.	0.00
45.1260	6.19E-07	-2.338	0.5955	-1.67E-08	10521.	1.29E+10	-0.03253	412229.	0.00
45.7800	4.83E-07	1.3831	0.3669	-1.70E-08	10520.	1.29E+10	-0.02571	418204.	0.00
46.4340	3.52E-07	3.5176	0.1913	-1.55E-08	10521.	1.29E+10	-0.01905	424178.	0.00
47.0880	2.39E-07	4.4728	0.06510	-1.31E-08	10521.	1.29E+10	-0.01311	430152.	0.00
47.7420	1.47E-07	4.6131	-0.01844	-1.03E-08	10521.	1.29E+10	-0.00818	436127.	0.00
48.3960	7.74E-08	4.2415	-0.06764	-7.61E-09	10521.	1.29E+10	-0.00436	442101.	0.00
49.0500	2.78E-08	3.5943	-0.09096	-5.22E-09	10521.	1.29E+10	-0.00159	448075.	0.00
49.7040	-4.64E-09	2.8432	-0.09613	-3.26E-09	10521.	1.29E+10	2.69E-04	454050.	0.00
50.3580	-2.35E-08	2.1038	-0.08968	-1.76E-09	10521.	1.29E+10	0.00138	460024.	0.00
51.0120	-3.22E-08	1.4455	-0.07677	-6.77E-10	10520.	1.29E+10	0.00191	465998.	0.00
51.6660	-3.41E-08	0.9026	-0.06122	3.80E-11	10520.	1.29E+10	0.00205	471973.	0.00
52.3200	-3.16E-08	0.4844	-0.04561	4.60E-10	10520.	1.29E+10	0.00193	477947.	0.00
52.9740	-2.69E-08	0.1841	-0.03155	6.64E-10	10520.	1.29E+10	0.00166	483921.	0.00
53.6280	-2.12E-08	-0.01451	-0.01985	7.16E-10	10520.	1.29E+10	0.00132	489896.	0.00
54.2820	-1.56E-08	-0.131	-0.01077	6.71E-10	10520.	1.29E+10	9.88E-04	495870.	0.00
54.9360	-1.07E-08	-0.187	-0.00422	5.74E-10	10520.	1.29E+10	6.83E-04	501844.	0.00
55.5900	-6.63E-09	-0.201	1.50E-04	4.56E-10	10520.	1.29E+10	4.29E-04	507819.	0.00
56.2440	-3.53E-09	-0.188	0.00274	3.37E-10	10520.	1.29E+10	2.31E-04	513793.	0.00
56.8980	-1.33E-09	-0.160	0.00399	2.32E-10	10520.	1.29E+10	8.83E-05	519767.	0.00
57.5520	1.02E-10	-0.126	0.00431	1.45E-10	10520.	1.29E+10	-6.84E-06	525742.	0.00
58.2060	9.35E-10	-0.09286	0.00404	7.78E-11	10520.	1.29E+10	-6.33E-05	531716.	0.00
58.8600	1.32E-09	-0.06325	0.00344	3.03E-11	10520.	1.29E+10	-9.07E-05	537690.	0.00
59.5140	1.41E-09	-0.03912	0.00270	0.00	10520.	1.29E+10	-9.77E-05	543665.	0.00
60.1680	1.31E-09	-0.02093	0.00195	-1.92E-11	10520.	1.29E+10	-9.17E-05	549639.	0.00
60.8220	1.11E-09	-0.00835	0.00129	-2.81E-11	10520.	1.29E+10	-7.85E-05	555613.	0.00
61.4760	8.68E-10	-5.94E-04	7.34E-04	-3.08E-11	10520.	1.29E+10	-6.21E-05	561588.	0.00
62.1300	6.25E-10	0.00334	3.13E-04	-3.00E-11	10520.	1.29E+10	-4.52E-05	567562.	0.00
62.7840	3.97E-10	0.00448	2.14E-05	-2.76E-11	10520.	1.29E+10	-2.90E-05	573536.	0.00
63.4380	1.91E-10	0.00383	-1.48E-04	-2.51E-11	10520.	1.29E+10	-1.41E-05	579511.	0.00
64.0920	3.72E-12	0.00230	-2.05E-04	-2.32E-11	10520.	1.29E+10	-2.78E-07	585485.	0.00
64.7460	-1.73E-10	7.49E-04	-1.55E-04	-2.23E-11	10520.	1.29E+10	1.30E-05	591459.	0.00
65.4000	-3.46E-10	0.00	0.00	-2.21E-11	10520.	1.29E+10	2.63E-05	298717.	0.00

```
* This analysis computed pile response using nonlinear moment-curvature rela-
  tionships. Values of total stress due to combined axial and bending stresses
  are computed only for elastic sections only and do not equal the actual
  stresses in concrete and steel. Stresses in concrete and steel may be inter-
  polated from the output for nonlinear bending properties relative to the
  magnitude of bending moment developed in the pile.


Output Summary for Load Case No. 2:

Pile-head deflection            =     0.57024000 inches
Computed slope at pile head     =       0.000000 radians
Maximum bending moment          =      -2783445. inch-lbs
Maximum shear force             =         53784. lbs
Depth of maximum bending moment =       0.000000 feet below pile head
Depth of maximum shear force    =       0.000000 feet below pile head
Number of iterations            =              8
Number of zero deflection points =             7


--------------------------------------------------------------------------------
            Summary of Pile-head Responses for Conventional Analyses
--------------------------------------------------------------------------------

Definitions of Pile-head Loading Conditions:

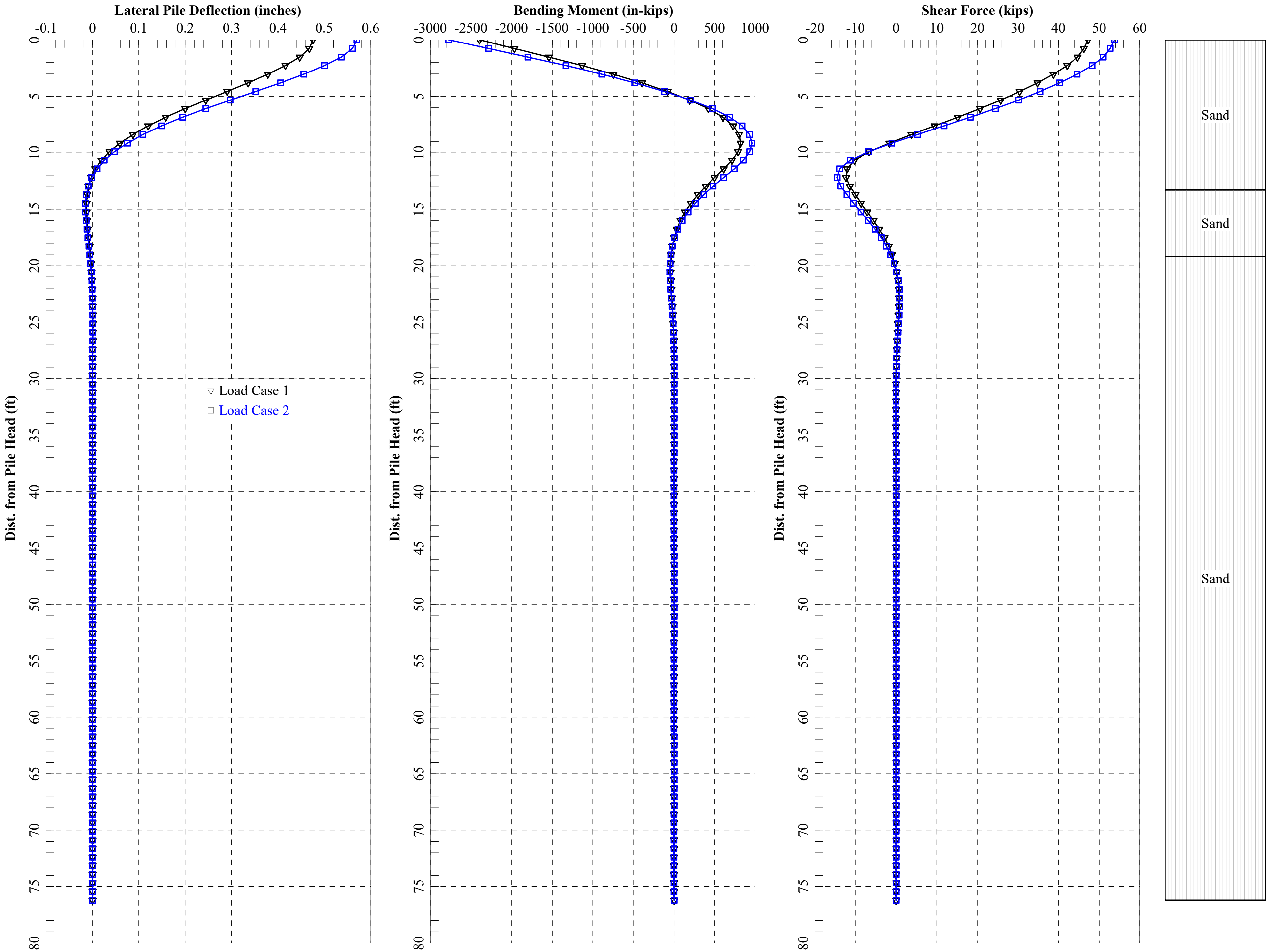
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians


Load Load                Load                 Axial    Pile-head  Pile-head  Max Shear Max Moment
Case Type   Pile-head    Type     Pile-head   Loading  Deflection  Rotation    in Pile    in Pile
 No.  1      Load 1       2        Load 2       lbs      inches     radians      lbs       in-lbs
---- ----- ---------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
  1  y, in     0.4752   S, rad         0.00    359000.     0.4752       0.00     47188.  -2401844.
  2  y, in     0.5702   S, rad         0.00    359000.     0.5702       0.00     53784.  -2783445.


Maximum pile-head deflection = 0.5702400000 inches
Maximum pile-head rotation   = 0.0000000000 radians = 0.000000 deg.

The analysis ended normally.
```

Mill Cove New Bridge
Abutment 2 14x117



```
===============================================================================

                    LPile for Windows, Version 2022-12.010

                Analysis of Individual Piles and Drilled Shafts
               Subjected to Lateral Loading Using the p-y Method
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-------------------------------------------------------------------------------
                             Files Used for Analysis
-------------------------------------------------------------------------------

Path to file locations:
\Working\THORNTON TOMASETTI\2502334 MaineDOT Downeast Bridges Phase II\09_Engineering\03_Robbinston\07_Lpile\Pile Runs\Existing
Conditions No Corrosion\

Name of input data file:
Robbinston Abutment 2 HP14x117 2025-07-09.lp12d

Name of output report file:
Robbinston Abutment 2 HP14x117 2025-07-09.lp12o

Name of plot output file:
Robbinston Abutment 2 HP14x117 2025-07-09.lp12p

Name of runtime message file:
Robbinston Abutment 2 HP14x117 2025-07-09.lp12r

-------------------------------------------------------------------------------
                            Date and Time of Analysis
-------------------------------------------------------------------------------

               Date:  July 9, 2025               Time:   8:18:19


-------------------------------------------------------------------------------
                                  Problem Title
-------------------------------------------------------------------------------

Project Name: Mill Cove New Bridge #6205

Job Number: 2502334

Client: Thornton Tomasetti

Engineer: M. Johnescu

Description: Lateral Pile Analysis Abutment 2 HP14x117



-------------------------------------------------------------------------------
                           Program Options and Settings
-------------------------------------------------------------------------------

Computational Options:
 - Conventional Analysis
Engineering Units Used for Data Input and Computations:
 - US Customary System Units (pounds, feet, inches)

Analysis Control Options:
 - Maximum number of iterations allowed               =          500
 - Deflection tolerance for convergence               =   1.0000E-05 in
 - Maximum allowable deflection                       =     100.0000 in
 - Number of pile increments                          =          100

Loading Type and Number of Cycles of Loading:
 - Static loading specified

 - Use of p-y modification factors for p-y curves not selected
 - Analysis uses layering correction (Method of Georgiadis)
 - No distributed lateral loads are entered
 - Loading by lateral soil movements acting on pile not selected
 - Input of shear resistance at the pile tip not selected
 - Input of moment resistance at the pile tip not selected
```

- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

```
Number of pile sections defined                        =           1
Total length of pile                                   =      76.200 ft
Depth of ground surface below top of pile              =      0.0000 ft
```

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	14.9000
2	76.200	14.9000

Input Structural Properties for Pile Sections:

Pile Section No. 1:

```
   Section 1 is a H weak axis steel pile
   Length of section                                   =    76.200000 ft
   Pile width                                          =    14.200000 in
```

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

```
   Distance from top of pile to top of layer           =       0.0000 ft
   Distance from top of pile to bottom of layer        =    13.300000 ft
   Effective unit weight at top of layer               =   125.000000 pcf
   Effective unit weight at bottom of layer            =   125.000000 pcf
   Friction angle at top of layer                      =    34.000000 deg.
   Friction angle at bottom of layer                   =    34.000000 deg.
   Subgrade k at top of layer                          =   122.000000 pci
   Subgrade k at bottom of layer                       =   122.000000 pci
```

Layer 2 is sand, p-y criteria by Reese et al., 1974

```
   Distance from top of pile to top of layer           =    13.300000 ft
   Distance from top of pile to bottom of layer        =    19.200000 ft
   Effective unit weight at top of layer               =    62.600000 pcf
   Effective unit weight at bottom of layer            =    62.600000 pcf
   Friction angle at top of layer                      =    34.000000 deg.
   Friction angle at bottom of layer                   =    34.000000 deg.
   Subgrade k at top of layer                          =    75.000000 pci
   Subgrade k at bottom of layer                       =    75.000000 pci
```

Layer 3 is sand, p-y criteria by Reese et al., 1974

```
   Distance from top of pile to top of layer           =    19.200000 ft
   Distance from top of pile to bottom of layer        =    76.200000 ft
   Effective unit weight at top of layer               =    67.600000 pcf
   Effective unit weight at bottom of layer            =    67.600000 pcf
   Friction angle at top of layer                      =    36.000000 deg.
   Friction angle at bottom of layer                   =    36.000000 deg.
   Subgrade k at top of layer                          =    97.000000 pci
   Subgrade k at bottom of layer                       =    97.000000 pci
```

(Depth of the lowest soil layer extends 0.000 ft below the pile tip)

Summary of Input Soil Properties

Layer   Soil Type   Layer   Effective   Angle of

Num.	Name (p-y Curve Type)	Depth ft	Unit Wt. pcf	Friction deg.	kpy pci
1	Sand	0.00	125.0000	34.0000	122.0000
	(Reese, et al.)	13.3000	125.0000	34.0000	122.0000
2	Sand	13.3000	62.6000	34.0000	75.0000
	(Reese, et al.)	19.2000	62.6000	34.0000	75.0000
3	Sand	19.2000	67.6000	36.0000	97.0000
	(Reese, et al.)	76.2000	67.6000	36.0000	97.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Top y vs. Pile Length	Run Analysis
1	5	y = 0.475200 in	S = 0.0000 in/in	359000.	N.A.	Yes
2	5	y = 0.570240 in	S = 0.0000 in/in	359000.	N.A.	Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Steel H Weak Axis:

Length of Section	=	76.200000 ft
Flange Width	=	14.900000 in
Section Depth	=	14.200000 in
Flange Thickness	=	0.805000 in
Web Thickness	=	0.805000 in
Yield Stress of Pipe	=	50.000000 ksi
Elastic Modulus	=	29000. ksi
Cross-sectional Area	=	34.123950 sq. in.
Moment of Inertia	=	444.363799 in^4
Elastic Bending Stiffness	=	12886550. kip-in^2
Plastic Modulus, Z	=	91.398684in^3
Plastic Moment Capacity = Fy Z	=	4570.in-kip

Axial Structural Capacities:

Nom. Axial Structural Capacity = Fy As	=	1706.197 kips
Nominal Axial Tensile Capacity	=	-1706.197 kips

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	359.000

Definition of Run Messages:

Y = part of pipe section has yielded.

Axial Thrust Force = 359.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Total Stress ksi	Run Msg
0.00000452	58.2652123	12886018.	87.6818047	11.4875896	
0.00000904	116.5304245	12886018.	47.5659024	12.4547090	

0.00001356	174.7956368	12886018.	34.1939349	13.4218282	
0.00001809	233.0608491	12886018.	27.5079512	14.3889475	
0.00002261	291.3260613	12886018.	23.4963609	15.3560669	
0.00002713	349.5912736	12886018.	20.8219675	16.3231862	
0.00003165	407.8564859	12886018.	18.9116864	17.2903055	
0.00003617	466.1216981	12886018.	17.4789756	18.2574249	
0.00004069	524.3869104	12886018.	16.3646450	19.2245442	
0.00004522	582.6521226	12886018.	15.4731805	20.1916635	
0.00004974	640.9173349	12886018.	14.7438004	21.1587828	
0.00005426	699.1825472	12886018.	14.1359837	22.1259022	
0.00005878	757.4477594	12886018.	13.6216773	23.0930215	
0.00006330	815.7129717	12886018.	13.1808432	24.0601408	
0.00006782	873.9781840	12886018.	12.7987870	25.0272601	
0.00007235	932.2433962	12886018.	12.4644878	25.9943795	
0.00007687	990.5086085	12886018.	12.1695179	26.9614988	
0.00008139	1049.	12886018.	11.9073225	27.9286181	
0.00008591	1107.	12886018.	11.6727266	28.8957375	
0.00009043	1165.	12886018.	11.4615902	29.8628568	
0.00009495	1224.	12886018.	11.2705621	30.8299761	
0.00009947	1282.	12886018.	11.0969002	31.7970954	
0.0001040	1340.	12886018.	10.9383393	32.7642148	
0.0001085	1398.	12886018.	10.7929919	33.7313341	
0.0001130	1457.	12886018.	10.6592722	34.6984534	
0.0001176	1515.	12886018.	10.5358386	35.6655728	
0.0001221	1573.	12886018.	10.4215483	36.6326921	
0.0001266	1631.	12886018.	10.3154216	37.5998114	
0.0001311	1690.	12886018.	10.2166140	38.5669308	
0.0001356	1748.	12886018.	10.1243935	39.5340501	
0.0001402	1806.	12886018.	10.0381227	40.5011694	
0.0001447	1864.	12886018.	9.9572439	41.4682887	
0.0001492	1923.	12886018.	9.8812668	42.4354081	
0.0001537	1981.	12886018.	9.8097590	43.4025274	
0.0001583	2039.	12886018.	9.7423373	44.3696467	
0.0001628	2098.	12886018.	9.6786612	45.3367661	
0.0001673	2156.	12886018.	9.6184272	46.3038854	
0.0001718	2214.	12886018.	9.5613633	47.2710047	
0.0001763	2272.	12886018.	9.5072258	48.2381241	
0.0001854	2389.	12884362.	9.4071003	50.0000000	Y
0.0001944	2499.	12851103.	9.3206951	50.0000000	Y
0.0002035	2602.	12785778.	9.2470206	50.0000000	Y
0.0002125	2698.	12696269.	9.1841036	50.0000000	Y
0.0002216	2789.	12589010.	9.1302729	50.0000000	Y
0.0002306	2875.	12469261.	9.0840988	50.0000000	Y
0.0002396	2957.	12340783.	9.0444437	50.0000000	Y
0.0002487	3035.	12205262.	9.0105875	50.0000000	Y
0.0002577	3110.	12066853.	8.9813937	50.0000000	Y
0.0002668	3181.	11925645.	8.9565085	50.0000000	Y
0.0002758	3250.	11783649.	8.9352449	50.0000000	Y
0.0002849	3316.	11642228.	8.9170591	50.0000000	Y
0.0002939	3380.	11499330.	8.9011209	50.0000000	Y
0.0003029	3438.	11347866.	8.8856672	50.0000000	Y
0.0003120	3491.	11190077.	8.8706326	50.0000000	Y
0.0003210	3540.	11027757.	8.8559319	50.0000000	Y
0.0003301	3585.	10862285.	8.8414500	50.0000000	Y
0.0003391	3627.	10695783.	8.8272919	50.0000000	Y
0.0003482	3666.	10529388.	8.8134080	50.0000000	Y
0.0003572	3702.	10364059.	8.7997523	50.0000000	Y
0.0003662	3736.	10199715.	8.7863700	50.0000000	Y
0.0003753	3767.	10036671.	8.7732994	50.0000000	Y
0.0003843	3796.	9876530.	8.7603404	50.0000000	Y
0.0003934	3823.	9718964.	8.7477614	50.0000000	Y
0.0004024	3849.	9564433.	8.7355595	50.0000000	Y
0.0004115	3873.	9412911.	8.7232916	50.0000000	Y
0.0004205	3895.	9263698.	8.7114496	50.0000000	Y
0.0004296	3917.	9118876.	8.6997054	50.0000000	Y
0.0004386	3937.	8976283.	8.6883905	50.0000000	Y
0.0004476	3956.	8837366.	8.6769597	50.0000000	Y
0.0004567	3974.	8701985.	8.6661993	50.0000000	Y
0.0004657	3991.	8568962.	8.6551299	50.0000000	Y
0.0004748	4007.	8440061.	8.6445363	50.0000000	Y
0.0004838	4022.	8313359.	8.6340587	50.0000000	Y
0.0004929	4037.	8190700.	8.6237275	50.0000000	Y
0.0005019	4050.	8070205.	8.6136070	50.0000000	Y
0.0005109	4064.	7953237.	8.6038254	50.0000000	Y
0.0005200	4076.	7838888.	8.5937828	50.0000000	Y
0.0005290	4088.	7727714.	8.5844725	50.0000000	Y
0.0005381	4099.	7618417.	8.5748793	50.0000000	Y
0.0005742	4140.	7209768.	8.5387808	50.0000000	Y
0.0006104	4174.	6838318.	8.5046015	50.0000000	Y
0.0006466	4203.	6501032.	8.4727279	50.0000000	Y
0.0006828	4229.	6193692.	8.4426804	50.0000000	Y
0.0007189	4251.	5912565.	8.4143118	50.0000000	Y
0.0007551	4270.	5654480.	8.3876436	50.0000000	Y
0.0007913	4287.	5417405.	8.3619805	50.0000000	Y
0.0008274	4301.	5198393.	8.3381796	50.0000000	Y
0.0008636	4315.	4996319.	8.3152796	50.0000000	Y
0.0008998	4327.	4808941.	8.2939946	50.0000000	Y
0.0009360	4338.	4634386.	8.2732026	50.0000000	Y
0.0009721	4348.	4472275.	8.2534542	50.0000000	Y
0.0010083	4356.	4320548.	8.2349704	50.0000000	Y

Summary of Results for Nominal Moment Capacity for Section 1

Load	Axial	Nominal Moment

No.	Thrust kips	Capacity in-kips
1	359.0000000000	4356.

Note that the values in the above table are not factored by a strength reduction factor for LRFD.

The value of the strength reduction factor depends on the provisions of the LRFD code being followed.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to the LRFD structural design standard being followed.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	279636.
2	13.3000	13.3000	Yes	No	279636.	465453.
3	19.2000	18.7745	Yes	No	745089.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.475200 inches

Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 359000.0 lbs

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.4752	-2397403.	47255.	0.00	50714.	1.29E+10	0.00	0.00	0.00
0.7620	0.4674	-1967498.	46219.	-0.00155	43507.	1.29E+10	-107.247	2098.	0.00
1.5240	0.4469	-1541976.	44684.	-0.00279	36373.	1.29E+10	-228.543	4677.	0.00
2.2860	0.4163	-1131970.	42117.	-0.00374	29499.	1.29E+10	-332.977	7314.	0.00
3.0480	0.3784	-747169.	38742.	-0.00441	23047.	1.29E+10	-405.072	9788.	0.00
3.8100	0.3357	-394497.	34808.	-0.00482	17134.	1.29E+10	-455.389	12406.	0.00
4.5720	0.2904	-78982.	30443.	-0.00498	11845.	1.29E+10	-499.466	15730.	0.00
5.3340	0.2445	194955.	25725.	-0.00494	13789.	1.29E+10	-532.428	19910.	0.00
6.0960	0.2000	423920.	20649.	-0.00472	17628.	1.29E+10	-577.731	26418.	0.00
6.8580	0.1582	603592.	15190.	-0.00436	20640.	1.29E+10	-616.237	35627.	0.00
7.6200	0.1203	730333.	9481.	-0.00388	22765.	1.29E+10	-632.629	48096.	0.00
8.3820	0.08712	802477.	3754.	-0.00334	23974.	1.29E+10	-619.874	65058.	0.00
9.1440	0.05918	820922.	-1713.	-0.00276	24284.	1.29E+10	-575.807	88969.	0.00
9.9060	0.03656	789310.	-6626.	-0.00219	23754.	1.29E+10	-498.830	124755.	0.00
10.6680	0.01907	714151.	-10268.	-0.00166	22494.	1.29E+10	-297.778	142811.	0.00
11.4300	0.00620	612430.	-12104.	-0.00119	20788.	1.29E+10	-103.822	153011.	0.00
12.1920	-0.00268	500602.	-12360.	-7.94E-04	18913.	1.29E+10	47.9013	163212.	0.00
12.9540	-0.00832	391613.	-11419.	-4.78E-04	17086.	1.29E+10	157.8537	173413.	0.00
13.7160	-0.01142	294910.	-10053.	-2.34E-04	15465.	1.29E+10	141.0030	112877.	0.00
14.4780	-0.01261	209310.	-8657.	-5.54E-05	14030.	1.29E+10	164.2810	119148.	0.00
15.2400	-0.01243	136959.	-7126.	6.75E-05	12817.	1.29E+10	170.5565	125419.	0.00
16.0020	-0.01137	78549.	-5597.	1.44E-04	11837.	1.29E+10	163.7964	131690.	0.00
16.7640	-0.00980	33651.	-4172.	1.84E-04	11085.	1.29E+10	147.8906	137961.	0.00
17.5260	-0.00801	1041.	-2918.	1.96E-04	10538.	1.29E+10	126.3855	144232.	0.00
18.2880	-0.00622	-21005.	-1873.	1.89E-04	10873.	1.29E+10	102.3148	150503.	0.00
19.0500	-0.00456	-34446.	-1048.	1.69E-04	11098.	1.29E+10	78.1170	156774.	0.00
19.8120	-0.00312	-41276.	-361.583	1.42E-04	11212.	1.29E+10	71.9452	210871.	0.00
20.5740	-0.00195	-41994.	180.9752	1.13E-04	11225.	1.29E+10	46.7247	218982.	0.00
21.3360	-0.00105	-38708.	514.3786	8.43E-05	11169.	1.29E+10	26.1982	227092.	0.00
22.0980	-4.10E-04	-33141.	682.3563	5.88E-05	11076.	1.29E+10	10.5423	235203.	0.00
22.8600	2.01E-05	-26615.	728.1055	3.76E-05	10967.	1.29E+10	-0.536	243313.	0.00
23.6220	2.77E-04	-20072.	690.7778	2.10E-05	10857.	1.29E+10	-7.629	251423.	0.00
24.3840	4.05E-04	-14120.	603.4090	8.89E-06	10757.	1.29E+10	-11.481	259534.	0.00
25.1460	4.40E-04	-9095.	492.0428	6.49E-07	10673.	1.29E+10	-12.877	267644.	0.00
25.9080	4.16E-04	-5126.	375.7583	-4.40E-06	10606.	1.29E+10	-12.557	275755.	0.00
26.6700	3.60E-04	-2194.	267.3162	-6.99E-06	10557.	1.29E+10	-11.162	283865.	0.00
27.4320	2.88E-04	-190.946	174.1674	-7.84E-06	10524.	1.29E+10	-9.212	291976.	0.00
28.1940	2.16E-04	1042.	99.6134	-7.54E-06	10538.	1.29E+10	-7.095	300086.	0.00
28.9560	1.51E-04	1680.	43.9604	-6.57E-06	10549.	1.29E+10	-5.078	308197.	0.00
29.7180	9.60E-05	1890.	5.5599	-5.30E-06	10552.	1.29E+10	-3.321	316307.	0.00
30.4800	5.36E-05	1817.	-18.327	-3.99E-06	10551.	1.29E+10	-1.903	324417.	0.00
31.2420	2.31E-05	1581.	-30.861	-2.78E-06	10547.	1.29E+10	-0.838	332528.	0.00

32.0040	2.73E-06	1271.	-35.159	-1.77E-06	10542.	1.29E+10	-0.102	340638.	0.00
32.7660	-9.36E-06	949.2596	-33.991	-9.85E-07	10536.	1.29E+10	0.3569	348749.	0.00
33.5280	-1.53E-05	655.4922	-29.632	-4.15E-07	10531.	1.29E+10	0.5965	356859.	0.00
34.2900	-1.70E-05	410.0735	-23.811	-3.74E-08	10527.	1.29E+10	0.6768	364970.	0.00
35.0520	-1.60E-05	220.2902	-17.737	1.86E-07	10524.	1.29E+10	0.6515	373080.	0.00
35.8140	-1.36E-05	84.4702	-12.176	2.94E-07	10522.	1.29E+10	0.5649	381190.	0.00
36.5760	-1.06E-05	-4.313	-7.533	3.23E-07	10521.	1.29E+10	0.4507	389301.	0.00
37.3380	-7.65E-06	-55.406	-3.953	3.02E-07	10521.	1.29E+10	0.3324	397411.	0.00
38.1000	-5.07E-06	-78.579	-1.405	2.54E-07	10522.	1.29E+10	0.2248	405522.	0.00
38.8620	-3.00E-06	-82.774	0.2431	1.97E-07	10522.	1.29E+10	0.1357	413632.	0.00
39.6240	-1.47E-06	-75.427	1.1734	1.41E-07	10522.	1.29E+10	0.06776	421743.	0.00
40.3860	-4.27E-07	-62.239	1.5750	9.19E-08	10522.	1.29E+10	0.02008	429853.	0.00
41.1480	2.11E-07	-47.226	1.6206	5.30E-08	10521.	1.29E+10	-0.01010	437964.	0.00
41.9100	5.43E-07	-32.949	1.4534	2.46E-08	10521.	1.29E+10	-0.02647	446074.	0.00
42.6720	6.61E-07	-20.809	1.1823	5.51E-09	10521.	1.29E+10	-0.03281	454184.	0.00
43.4340	6.43E-07	-11.363	0.8836	-5.90E-09	10521.	1.29E+10	-0.03253	462295.	0.00
44.1960	5.53E-07	-4.611	0.6049	-1.16E-08	10521.	1.29E+10	-0.02843	470405.	0.00
44.9580	4.32E-07	-0.224	0.3716	-1.33E-08	10520.	1.29E+10	-0.02260	478516.	0.00
45.7200	3.10E-07	2.2732	0.1930	-1.26E-08	10521.	1.29E+10	-0.01647	486626.	0.00
46.4820	2.02E-07	3.3879	0.06770	-1.06E-08	10521.	1.29E+10	-0.01093	494737.	0.00
47.2440	1.17E-07	3.5806	-0.01160	-8.08E-09	10521.	1.29E+10	-0.00641	502847.	0.00
48.0060	5.43E-08	3.2289	-0.05479	-5.66E-09	10521.	1.29E+10	-0.00304	510957.	0.00
48.7680	1.30E-08	2.6158	-0.07204	-3.59E-09	10521.	1.29E+10	-7.39E-04	519068.	0.00
49.5300	-1.13E-08	1.9349	-0.07244	-1.98E-09	10521.	1.29E+10	6.53E-04	527178.	0.00
50.2920	-2.31E-08	1.3041	-0.06326	-8.26E-10	10520.	1.29E+10	0.00135	535289.	0.00
51.0540	-2.64E-08	0.7833	-0.04989	-8.55E-11	10520.	1.29E+10	0.00157	543399.	0.00
51.8160	-2.47E-08	0.3922	-0.03591	3.32E-10	10520.	1.29E+10	0.00149	551510.	0.00
52.5780	-2.04E-08	0.1245	-0.02340	5.15E-10	10520.	1.29E+10	0.00125	559620.	0.00
53.3400	-1.53E-08	-0.03920	-0.01337	5.45E-10	10520.	1.29E+10	9.47E-04	567730.	0.00
54.1020	-1.04E-08	-0.124	-0.00604	4.87E-10	10520.	1.29E+10	6.55E-04	575841.	0.00
54.8640	-6.35E-09	-0.153	-0.00119	3.89E-10	10520.	1.29E+10	4.05E-04	583951.	0.00
55.6260	-3.28E-09	-0.148	0.00163	2.83E-10	10520.	1.29E+10	2.13E-04	592062.	0.00
56.3880	-1.18E-09	-0.125	0.00296	1.86E-10	10520.	1.29E+10	7.74E-05	600172.	0.00
57.1500	1.14E-10	-0.09517	0.00327	1.08E-10	10520.	1.29E+10	-7.57E-06	608283.	0.00
57.9120	7.89E-10	-0.06579	0.00300	5.05E-11	10520.	1.29E+10	-5.32E-05	616393.	0.00
58.6740	1.04E-09	-0.04070	0.00243	1.27E-11	10520.	1.29E+10	-7.08E-05	624504.	0.00
59.4360	1.02E-09	-0.02144	0.00178	-9.34E-12	10520.	1.29E+10	-7.07E-05	632614.	0.00
60.1980	8.67E-10	-0.00805	0.00118	-1.98E-11	10520.	1.29E+10	-6.07E-05	640724.	0.00
60.9600	6.59E-10	2.94E-04	6.90E-04	-2.26E-11	10520.	1.29E+10	-4.68E-05	648835.	0.00
61.7220	4.54E-10	0.00472	3.27E-04	-2.08E-11	10520.	1.29E+10	-3.26E-05	656945.	0.00
62.4840	2.79E-10	0.00641	8.50E-05	-1.68E-11	10520.	1.29E+10	-2.03E-05	665056.	0.00
63.2460	1.46E-10	0.00639	-5.72E-05	-1.23E-11	10520.	1.29E+10	-1.08E-05	673166.	0.00
64.0080	5.49E-11	0.00545	-1.25E-04	-8.08E-12	10520.	1.29E+10	-4.09E-06	681277.	0.00
64.7700	-1.37E-12	0.00415	-1.43E-04	-4.68E-12	10520.	1.29E+10	1.04E-07	689387.	0.00
65.5320	-3.07E-11	0.00286	-1.32E-04	-2.19E-12	10520.	1.29E+10	2.34E-06	697497.	0.00
66.2940	-4.14E-11	0.00175	-1.07E-04	0.00	10520.	1.29E+10	3.20E-06	705608.	0.00
67.0560	-4.08E-11	9.04E-04	-7.77E-05	0.00	10520.	1.29E+10	3.19E-06	713718.	0.00
67.8180	-3.44E-11	3.24E-04	-5.07E-05	0.00	10520.	1.29E+10	2.71E-06	721829.	0.00
68.5800	-2.58E-11	-2.92E-05	-2.89E-05	0.00	10520.	1.29E+10	2.06E-06	729939.	0.00
69.3420	-1.75E-11	-2.10E-04	-1.30E-05	0.00	10520.	1.29E+10	1.41E-06	738050.	0.00
70.1040	-1.05E-11	-2.73E-04	-2.68E-06	0.00	10520.	1.29E+10	8.54E-07	746160.	0.00
70.8660	-5.23E-12	-2.64E-04	3.19E-06	0.00	10520.	1.29E+10	4.32E-07	754270.	0.00
71.6280	-1.71E-12	-2.18E-04	5.82E-06	0.00	10520.	1.29E+10	1.43E-07	762381.	0.00
72.3900	0.00	-1.59E-04	6.32E-06	0.00	10520.	1.29E+10	-3.30E-08	770491.	0.00
73.1520	1.46E-12	-1.03E-04	5.60E-06	0.00	10520.	1.29E+10	-1.25E-07	778602.	0.00
73.9140	1.86E-12	-5.74E-05	4.30E-06	0.00	10520.	1.29E+10	-1.60E-07	786712.	0.00
74.6760	1.89E-12	-2.48E-05	2.81E-06	0.00	10520.	1.29E+10	-1.65E-07	794823.	0.00
75.4380	1.76E-12	-5.96E-06	1.35E-06	0.00	10520.	1.29E+10	-1.55E-07	802933.	0.00
76.2000	1.59E-12	0.00	0.00	0.00	10520.	1.29E+10	-1.41E-07	405522.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

```
Pile-head deflection              =     0.47520000 inches
Computed slope at pile head       =       0.000000 radians
Maximum bending moment            =      -2397403. inch-lbs
Maximum shear force               =         47255. lbs
Depth of maximum bending moment   =       0.000000 feet below pile head
Depth of maximum shear force      =       0.000000 feet below pile head
Number of iterations              =              8
Number of zero deflection points  =              8
```

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

```
Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head                             =     0.570240 inches
Rotation of pile head                                 =    0.000E+00 radians
Axial load on pile head                               =     359000.0 lbs
```

Depth X feet	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. p lb/inch	Soil Spr. Es*H lb/inch	Distrib. Lat. Load lb/inch
0.00	0.5702	-2776044.	53824.	0.00	57062.	1.26E+10	0.00	0.00	0.00
0.7620	0.5610	-2286012.	52697.	-0.00184	48847.	1.26E+10	-116.268	1895.	0.00
1.5240	0.5367	-1800257.	51029.	-0.00330	40703.	1.29E+10	-248.604	4236.	0.00

2.2860	0.5006	-1331096.	48234.	-0.00442	32837.	1.29E+10	-362.770	6626.	0.00
3.0480	0.4559	-889166.	44556.	-0.00520	25428.	1.29E+10	-441.777	8860.	0.00
3.8100	0.4055	-482102.	40247.	-0.00569	18603.	1.29E+10	-500.557	11289.	0.00
4.5720	0.3519	-115769.	35417.	-0.00590	12461.	1.29E+10	-556.020	14450.	0.00
5.3340	0.2975	204344.	30140.	-0.00587	13946.	1.29E+10	-598.076	18381.	0.00
6.0960	0.2445	473974.	24424.	-0.00563	18467.	1.29E+10	-652.245	24392.	0.00
6.8580	0.1946	687963.	18246.	-0.00522	22055.	1.29E+10	-698.955	32848.	0.00
7.6200	0.1491	841909.	11754.	-0.00467	24636.	1.29E+10	-720.893	44213.	0.00
8.3820	0.1091	933618.	5209.	-0.00404	26173.	1.29E+10	-710.654	59573.	0.00
9.1440	0.07513	963732.	-1083.	-0.00337	26678.	1.29E+10	-665.713	81027.	0.00
9.9060	0.04743	935939.	-6799.	-0.00270	26212.	1.29E+10	-584.326	112663.	0.00
10.6680	0.02580	857109.	-11312.	-0.00206	24890.	1.29E+10	-402.901	142811.	0.00
11.4300	0.00973	742594.	-13899.	-0.00149	22970.	1.29E+10	-162.829	153011.	0.00
12.1920	-0.00152	612735.	-14519.	-0.00101	20793.	1.29E+10	27.0852	163212.	0.00
12.9540	-0.00879	483714.	-13633.	-6.24E-04	18630.	1.29E+10	166.6959	173413.	0.00
13.7160	-0.01292	367503.	-12142.	-3.22E-04	16682.	1.29E+10	159.5333	112877.	0.00
14.4780	-0.01467	263776.	-10538.	-9.77E-05	14943.	1.29E+10	191.1876	119148.	0.00
15.2400	-0.01471	175420.	-8742.	5.81E-05	13461.	1.29E+10	201.7655	125419.	0.00
16.0020	-0.01361	103525.	-6923.	1.57E-04	12256.	1.29E+10	196.0023	131690.	0.00
16.7640	-0.01184	47777.	-5211.	2.11E-04	11321.	1.29E+10	178.5945	137961.	0.00
17.5260	-0.00975	6851.	-3690.	2.30E-04	10635.	1.29E+10	153.8658	144232.	0.00
18.2880	-0.00763	-21226.	-2413.	2.25E-04	10876.	1.29E+10	125.5492	150503.	0.00
19.0500	-0.00564	-38756.	-1397.	2.04E-04	11170.	1.29E+10	96.6767	156774.	0.00
19.8120	-0.00390	-48112.	-543.674	1.73E-04	11327.	1.29E+10	89.9641	210871.	0.00
20.5740	-0.00248	-49834.	138.7007	1.38E-04	11356.	1.29E+10	59.2866	218982.	0.00
21.3360	-0.00137	-46483.	565.7147	1.04E-04	11300.	1.29E+10	34.1110	227092.	0.00
22.0980	-5.73E-04	-40171.	789.0533	7.33E-05	11194.	1.29E+10	14.7382	235203.	0.00
22.8600	-3.31E-05	-32534.	860.4657	4.75E-05	11066.	1.29E+10	0.8812	243313.	0.00
23.6220	2.96E-04	-24747.	827.3288	2.72E-05	10935.	1.29E+10	-8.129	251423.	0.00
24.3840	4.64E-04	-17582.	729.9726	1.22E-05	10815.	1.29E+10	-13.165	259534.	0.00
25.1460	5.18E-04	-11477.	600.4704	1.85E-06	10713.	1.29E+10	-15.160	267644.	0.00
25.9080	4.98E-04	-6613.	462.5539	-4.57E-06	10631.	1.29E+10	-15.005	275755.	0.00
26.6700	4.34E-04	-2988.	332.3068	-7.98E-06	10571.	1.29E+10	-13.483	283865.	0.00
27.4320	3.52E-04	-483.032	219.3275	-9.21E-06	10529.	1.29E+10	-11.229	291976.	0.00
28.1940	2.66E-04	1084.	128.0999	-9.00E-06	10539.	1.29E+10	-8.725	300086.	0.00
28.9560	1.87E-04	1919.	59.3766	-7.93E-06	10553.	1.29E+10	-6.306	308197.	0.00
29.7180	1.21E-04	2222.	11.4395	-6.46E-06	10558.	1.29E+10	-4.179	316307.	0.00
30.4800	6.89E-05	2170.	-18.843	-4.90E-06	10557.	1.29E+10	-2.445	324417.	0.00
31.2420	3.11E-05	1909.	-35.191	-3.46E-06	10552.	1.29E+10	-1.131	332528.	0.00
32.0040	5.68E-06	1549.	-41.329	-2.23E-06	10546.	1.29E+10	-0.212	340638.	0.00
32.7660	-9.68E-06	1168.	-40.609	-1.27E-06	10540.	1.29E+10	0.3693	348749.	0.00
33.5280	-1.75E-05	815.1612	-35.804	-5.62E-07	10534.	1.29E+10	0.6816	356859.	0.00
34.2900	-2.00E-05	517.1628	-29.045	-8.93E-08	10529.	1.29E+10	0.7967	364970.	0.00
35.0520	-1.91E-05	284.5713	-21.840	1.95E-07	10525.	1.29E+10	0.7792	373080.	0.00
35.8140	-1.64E-05	116.4698	-15.154	3.37E-07	10522.	1.29E+10	0.6833	381190.	0.00
36.5760	-1.29E-05	5.2276	-9.513	3.81E-07	10521.	1.29E+10	0.5503	389301.	0.00
37.3380	-9.43E-06	-60.011	-5.124	3.61E-07	10521.	1.29E+10	0.4098	397411.	0.00
38.1000	-6.32E-06	-90.845	-1.968	3.08E-07	10522.	1.29E+10	0.2803	405522.	0.00
38.8620	-3.80E-06	-98.029	0.09957	2.41E-07	10522.	1.29E+10	0.1720	413632.	0.00
39.6240	-1.92E-06	-90.604	1.2907	1.74E-07	10522.	1.29E+10	0.08853	421743.	0.00
40.3860	-6.25E-07	-75.566	1.8297	1.15E-07	10522.	1.29E+10	0.02936	429853.	0.00
41.1480	1.80E-07	-57.897	1.9245	6.74E-08	10521.	1.29E+10	-0.00861	437964.	0.00
41.9100	6.09E-07	-40.813	1.7494	3.24E-08	10521.	1.29E+10	-0.02969	446074.	0.00
42.6720	7.73E-07	-26.117	1.4382	8.67E-09	10521.	1.29E+10	-0.03838	454184.	0.00
43.4340	7.67E-07	-14.569	1.0854	-5.77E-09	10521.	1.29E+10	-0.03879	462295.	0.00
44.1960	6.67E-07	-6.230	0.7511	-1.31E-08	10521.	1.29E+10	-0.03432	470405.	0.00
44.9580	5.27E-07	-0.746	0.4682	-1.56E-08	10520.	1.29E+10	-0.02756	478516.	0.00
45.7200	3.81E-07	2.4345	0.2494	-1.50E-08	10521.	1.29E+10	-0.02030	486626.	0.00
46.4820	2.52E-07	3.9126	0.09424	-1.28E-08	10521.	1.29E+10	-0.01363	494737.	0.00
47.2440	1.48E-07	4.2419	-0.00524	-9.88E-09	10521.	1.29E+10	-0.00813	502847.	0.00
48.0060	7.12E-08	3.8816	-0.06060	-7.00E-09	10521.	1.29E+10	-0.00398	510957.	0.00
48.7680	1.98E-08	3.1795	-0.08395	-4.49E-09	10521.	1.29E+10	-0.00113	519068.	0.00
49.5300	-1.09E-08	2.3758	-0.08623	-2.52E-09	10521.	1.29E+10	6.30E-04	527178.	0.00
50.2920	-2.63E-08	1.6191	-0.07632	-1.10E-09	10520.	1.29E+10	0.00154	535289.	0.00
51.0540	-3.11E-08	0.9873	-0.06083	-1.79E-10	10520.	1.29E+10	0.00185	543399.	0.00
51.8160	-2.95E-08	0.5078	-0.04423	3.51E-10	10520.	1.29E+10	0.00178	551510.	0.00
52.5780	-2.47E-08	0.1761	-0.02918	5.94E-10	10520.	1.29E+10	0.00151	559620.	0.00
53.3400	-1.87E-08	-0.02973	-0.01697	6.46E-10	10520.	1.29E+10	0.00116	567730.	0.00
54.1020	-1.29E-08	-0.138	-0.00796	5.86E-10	10520.	1.29E+10	8.11E-04	575841.	0.00
54.8640	-7.97E-09	-0.179	-0.00192	4.73E-10	10520.	1.29E+10	5.09E-04	583951.	0.00
55.6260	-4.22E-09	-0.177	0.00165	3.47E-10	10520.	1.29E+10	2.73E-04	592062.	0.00
56.3880	-1.62E-09	-0.151	0.00338	2.31E-10	10520.	1.29E+10	1.06E-04	600172.	0.00
57.1500	5.49E-12	-0.116	0.00387	1.36E-10	10520.	1.29E+10	-3.65E-07	608283.	0.00
57.9120	8.72E-10	-0.08131	0.00360	6.59E-11	10520.	1.29E+10	-5.87E-05	616393.	0.00
58.6740	1.21E-09	-0.05099	0.00295	1.89E-11	10520.	1.29E+10	-8.26E-05	624504.	0.00
59.4360	1.22E-09	-0.02747	0.00219	-8.92E-12	10520.	1.29E+10	-8.42E-05	632614.	0.00
60.1980	1.05E-09	-0.01092	0.00147	-2.25E-11	10520.	1.29E+10	-7.34E-05	640724.	0.00
60.9600	8.05E-10	-4.77E-04	8.71E-04	-2.66E-11	10520.	1.29E+10	-5.71E-05	648835.	0.00
61.7220	5.61E-10	0.00519	4.26E-04	-2.49E-11	10520.	1.29E+10	-4.03E-05	656945.	0.00
62.4840	3.50E-10	0.00747	1.25E-04	-2.04E-11	10520.	1.29E+10	-2.54E-05	665056.	0.00
63.2460	1.87E-10	0.00761	-5.42E-05	-1.51E-11	10520.	1.29E+10	-1.38E-05	673166.	0.00
64.0080	7.42E-11	0.00658	-1.42E-04	-1.00E-11	10520.	1.29E+10	-5.53E-06	681277.	0.00
64.7700	3.80E-12	0.00507	-1.69E-04	-5.90E-12	10520.	1.29E+10	-2.87E-07	689387.	0.00
65.5320	-3.37E-11	0.00353	-1.59E-04	-2.85E-12	10520.	1.29E+10	2.57E-06	697497.	0.00
66.2940	-4.83E-11	0.00219	-1.30E-04	0.00	10520.	1.29E+10	3.73E-06	705608.	0.00
67.0560	-4.87E-11	0.00116	-9.54E-05	0.00	10520.	1.29E+10	3.80E-06	713718.	0.00
67.8180	-4.16E-11	4.42E-04	-6.30E-05	0.00	10520.	1.29E+10	3.28E-06	721829.	0.00
68.5800	-3.16E-11	-1.06E-06	-3.65E-05	1.09E-12	10520.	1.29E+10	2.52E-06	729939.	0.00
69.3420	-2.16E-11	-2.33E-04	-1.70E-05	1.01E-12	10520.	1.29E+10	1.74E-06	738050.	0.00
70.1040	-1.31E-11	-3.19E-04	-4.17E-06	0.00	10520.	1.29E+10	1.07E-06	746160.	0.00
70.8660	-6.73E-12	-3.15E-04	3.27E-06	0.00	10520.	1.29E+10	5.55E-07	754270.	0.00
71.6280	-2.38E-12	-2.63E-04	6.71E-06	0.00	10520.	1.29E+10	1.98E-07	762381.	0.00
72.3900	0.00	-1.95E-04	7.52E-06	0.00	10520.	1.29E+10	-2.23E-08	770491.	0.00
73.1520	1.65E-12	-1.27E-04	6.77E-06	0.00	10520.	1.29E+10	-1.40E-07	778602.	0.00
73.9140	2.20E-12	-7.14E-05	5.27E-06	0.00	10520.	1.29E+10	-1.89E-07	786712.	0.00
74.6760	2.30E-12	-3.12E-05	3.49E-06	0.00	10520.	1.29E+10	-1.99E-07	794823.	0.00
75.4380	2.19E-12	-7.57E-06	1.70E-06	0.00	10520.	1.29E+10	-1.92E-07	802933.	0.00
76.2000	2.03E-12	0.00	0.00	0.00	10520.	1.29E+10	-1.80E-07	405522.	0.00

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

```
Pile-head deflection            =     0.57024000 inches
Computed slope at pile head     =       0.000000 radians
Maximum bending moment          =      -2776044. inch-lbs
Maximum shear force             =         53824. lbs
Depth of maximum bending moment =       0.000000 feet below pile head
Depth of maximum shear force    =       0.000000 feet below pile head
Number of iterations            =              8
Number of zero deflection points =             8
```

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	y, in	0.4752	S, rad	0.00	359000.	0.4752	0.00	47255.	-2397403.
2	y, in	0.5702	S, rad	0.00	359000.	0.5702	0.00	53824.	-2776044.

Maximum pile-head deflection = 0.5702400000 inches
Maximum pile-head rotation   = 0.0000000000 radians = 0.000000 deg.

The analysis ended normally.

D.6. APile Analyses

APile Input Parameters
Geotechnical Design Report
Mill Cove New Bridge #6205
WIN 026630.06
Robbinston, Maine

Abutment 1							
Stratum	**Soil Model**	**Top of Layer Elevation (NAVD88 ft)**	**Effective Unit Weight (pcf)**	**Friction Angle (deg)/ Su (ksf)**	**Resistance Factor Side Friction**	**Resistance Factor on End Bearing**	**Length Along Pile (ft)**
Existing Fill Above GWT	Sand	22.8	125.0	34	1	1	0
Existing Fill Below GWT	Sand	10.7	62.6	34	1	1	12.1
Glacial Till	Sand	-6.2	67.6	36	1	1	29
Bedrock[6]	Clay	-42.6	107.6	1296			65.4

Notes:

1) pcf = lbs per cubic foot, deg = degrees
2) Top of pile elevation is approx. El. 22.8 for proposed Abutment 1 based on Sheet 3, "Interpretive Subsurface Profile," dated June, 2025
3) Total Pile Length for the analysis is 65.4 ft.
4) Groundwater at El. 10.7 based on boring BB-RMC-104.
5) Top of layer elevation based on Boring BB-RMC-101.
6) Bedrock was modeled as Clay with a total unit weight of 170 lb/ft^3 and an undrained shear strength of 1296000 lb/ft^2 taken as approximately half the average unconfined compressive strength of conglomerate bedrock from table 4.4.8.1.2B in AASHTO Highway Bridges 2002.

Abutment 2							
Stratum	**Soil Model**	**Top of Layer Elevation (NAVD88 ft)**	**Effective Unit Weight (pcf)**	**Friction Angle (deg)/ Su (ksf)**	**Resistance Factor Side Friction**	**Resistance Factor on End Bearing**	**Length Along Pile (ft)**
Existing Fill Above GWT	Sand	24.0	125.0	34	1	1	0.0
Existing Fill Below GWT	Sand	10.7	62.6	34	1	1	13.3
Glacial Till	Sand	4.8	67.6	36	1	1	19.2
Bedrock[6]	Clay	-52.2	107.6	1296			76.2

Notes:

1) pcf = lbs per cubic foot, deg = degrees, pci = lbs per cubic inch
2) Top of pile elevation is approx. El. 24.0 for proposed Abutment 2 based on Sheet 3, "Interpretive Subsurface Profile," dated June, 2025
3) Total Pile Length for the analysis is 76.2 ft.
4) Groundwater at El. 10.7 based on boring BB-RMC-104.
5) Top of layer elevation based on Boring BB-RMC-104.
6) Bedrock was modeled as Clay with a total unit weight of 170 lb/ft^3 and an undrained shear strength of 1296000 lb/ft^2 taken as approximately half the average unconfined compressive strength of conglomerate bedrock from table 4.4.8.1.2B in AASHTO Highway Bridges 2002.

APile Output Summary
Geotechnical Design Report
Mill Cove New Bridge #6205
WIN 026630.06
Robbinston, Maine

Apile Results								
H-Pile Size	**Abutment**	**Plug Model**	**Skin Friction, Qs (kip)**	**End Bearing, Qp (kip)**	**Total Axial Capacity, Qs+Qp (kip)**	**Factored Applied Load (kips)**	**Reqd. Nominal Geotech. Resistance (kips)**	**Depth to Reqd. Nominal Geotech. Resistance (ft)**
HP 14x117	1	No Plug	552.7	817.5	1370.2	359	552.3	63
HP 14x117	1	Half Plug	856.3	817.5	1673.8	359	552.3	46
HP 14x117	1	Full Plug	976.7	817.7	1794.4	359	552.3	38
HP 14x117	2	No Plug	736.9	817.5	1554.4	359	552.3	60
HP 14x117	2	Half Plug	1147.6	817.5	1965.1	359	552.3	45
HP 14x117	2	Full Plug	1355.2	817.7	2172.9	359	552.3	36

Notes:

1) Lateral deflection and maximum factored axial load were provided to GEI by Thornton Tomasetti on April 16, 2025.

2) Length of Pile used in the analysis is 65.4 ft for Abutment 1 and 76.2 ft for Abutment 2.

3) The required nominal geotechnical resistance was calculated using a resistance factor of 0.65, since dynamic testing will be completed on at least one pile per abutment.

4) End bearing resistance estimate corresponds to HP 14x117 steel area bearing on bedrock. Bedrock was modeled as a clay with a strength equal to half the typical unconfined compressive strength of the conglomerate rock.

2002 AASHTO

TABLE 4.4.8.1.2B Typical Range of Uniaxial Compressive Strength (C_o) as a Function of Rock Category and Rock Type

Rock Category	General Description	Rock Type	C_o [1] (ksf)	C_o [1] (psi)
A	Carbonate rocks with well-developed crystal cleavage	Dolostone	700- 6,500	4,800-45,000
		Limestone	500- 6,000	3,500-42,000
		Carbonatite	800- 1,500	5,500-10,000
		Marble	800- 5,000	5,500-35,000
		Tactite-Skarn	2,700- 7,000	19,000-49,000
B	Lithified argillaceous rock	Argillite	600- 3,000	4,200-21,000
		Claystone	30- 170	200- 1,200
		Marlstone	1,000- 4,000	7,600-28,000
		Phyllite	500- 5,000	3,500-35,000
		Siltstone	200- 2,500	1,400-17,000
		Shale[2]	150- 740	1,000- 5,100
		Slate	3,000- 4,400	21,000-30,000
C	Arenaceous rocks with strong crystals and poor cleavage	Conglomerate	700- 4,600	4,800-32,000
		Sandstone	1,400- 3,600	9,700-25,000
		Quartzite	1,300- 8,000	9,000-55,000
D	Fine-grained igneous crystalline rock	Andesite	2,100- 3,800	14,000-26,000
		Diabase	450-12,000	3,100-83,000
E	Coarse-grained igneous and metamorphic crystalline rock	Amphibolite	2,500- 5,800	17,000-40,000
		Gabbro	2,600- 6,500	18,000-45,000
		Gneiss	500- 6,500	3,500-45,000
		Granite	300- 7,000	2,100-49,000
		Quartzdiorite	200- 2,100	1,400-14,000
		Quartzmonzonite	2,700- 3,300	19,000-23,000
		Schist	200- 3,000	1,400-21,000
		Syenite	3,800- 9,000	26,000-62,000

Say Conglomerate Bedrock has a UCS of 18,000 psi.

[1]Range of Uniaxial Compressive Strength values reported by various investigations.
[2]Not including oil shale.

$$\rho = q_o(1 - \nu^2)BI_\rho/E_m, \text{ with } I_\rho = (L/B)^{1/2}/\beta_z \quad (4.4.8.2.2\text{-}2)$$

Values of I_ρ may be computed using the β_z values presented in Table 4.4.7.2.2B from Article 4.4.7.2.2 for rigid footings. Values of Poisson's ratio (υ) for typical rock types are presented in Table 4.4.8.2.2A. Determination of the rock mass modulus (E_m) should be based on the results of in-situ and laboratory tests. Alternatively, values of E_m may be estimated by multiplying the intact rock modulus (E_o) obtained from uniaxial compression tests by a reduction factor (α_E) which accounts for frequency of discontinuities by the rock quality designation (RQD), using the following relationships (Gardner, 1987):

$$E_m = \alpha_E E_o \quad (4.4.8.2.2\text{-}3)$$

$$\alpha_E = 0.0231(RQD) - 1.32 \geq 0.15 \quad (4.4.8.2.2\text{-}4)$$

For preliminary design or when site-specific test data cannot be obtained, guidelines for estimating values of E_o (such as presented in Table 4.4.8.2.2B or Figure 4.4.8.2.2A) may be used. For preliminary analyses or for final design when in-situ test results are not available, a value of $\alpha_E = 0.15$ should be used to estimate E_m.

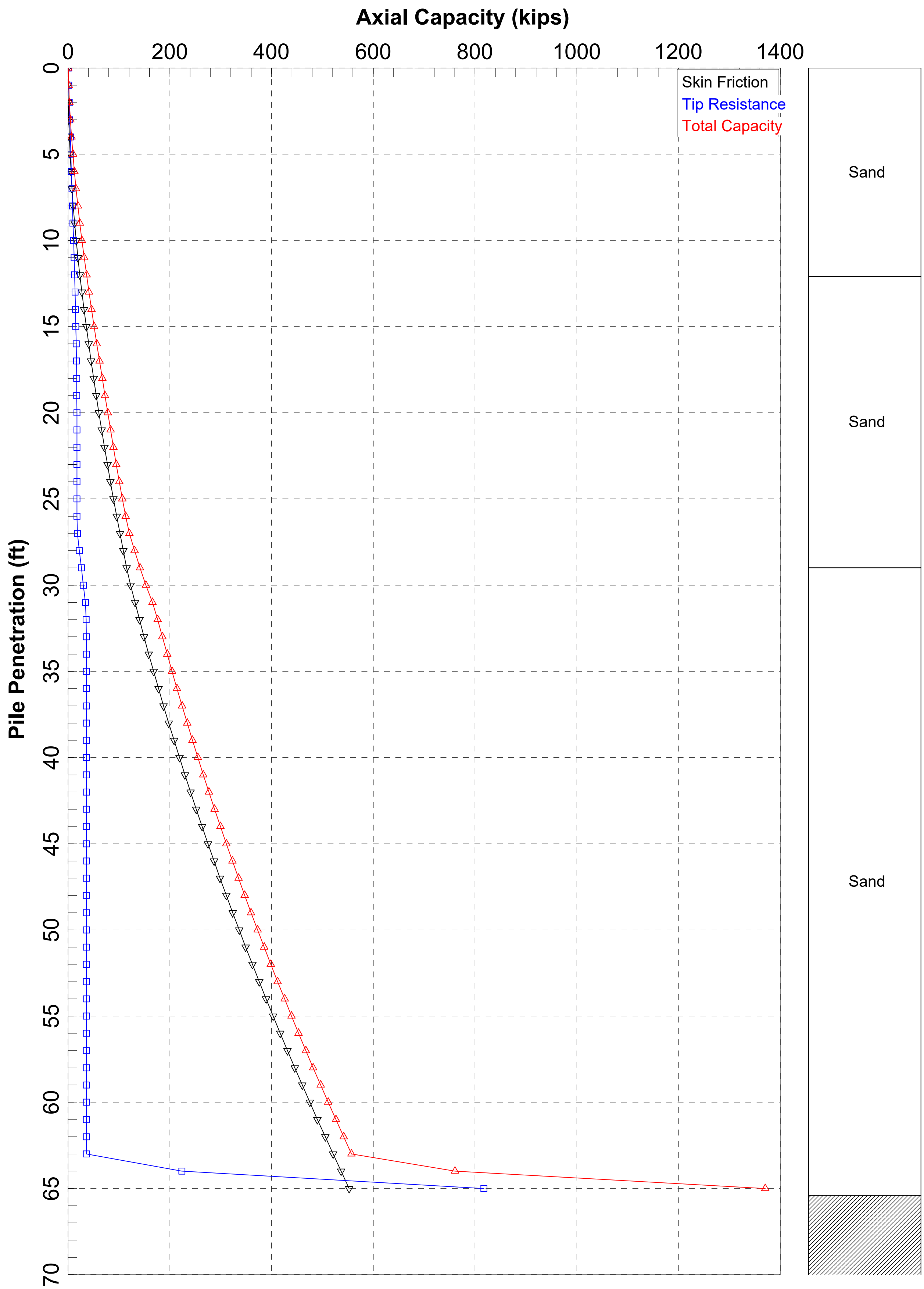
4.4.8.2.3 Tolerable Movement

Refer to Article 4.4.7.2.3.

4.4.9 Overall Stability

The overall stability of footings, slopes, and foundation soil or rock shall be evaluated for footings located on

Mill Cove New Bridge #6205
APile Analysis, Abutment 1
HP 14x117 - No Plug



```
=========================================================================
                              APILE 2025.11.1

                 A Program for Analyzing the Axial Capacity
                 and Short-term Settlement of Driven Piles
                           under Axial Loading.

                       License ID : 500127923
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=========================================================================


Model ran by                : M. Johnescu

Path to file locations      : B:\Working\THORNTON TOMASETTI\2502334 MaineDOT Downeast
Bridges Phase II\09_Engineering\03_Robbinston\06_Apile\No Plug\
Name of input data file     : Abutment 1 HP14x117 2025-07-29.ap11d
Name of output file         : Abutment 1 HP14x117 2025-07-29.ap11o
Name of plot output file    : Abutment 1 HP14x117 2025-07-29.ap11p

-------------------------------------------------------------------------
                     Time and Date of Analysis
-------------------------------------------------------------------------

          Date:  July 30, 2025     Time:  11:54:34



1
     *********************
     * INPUT INFORMATION *
     *********************

     PROJECT DESCRIPTION   :
     Axial Pile Analysis for Mill Cove New Bridge using 14x117 piles in Abu
     DESIGNER   : M. Johnescu
     JOB NUMBER : 2502334

     METHOD FOR UNIT LOAD TRANSFERS :
     - FHWA (Federal Highway Administration)
       Unfactored Unit Side Friction and Unit Side Resistance are used.

     COMPUTATION METHOD(S) FOR PILE CAPACITY :
     - FHWA (Federal Highway Administration)

     TYPE OF LOADING :
     - COMPRESSION

     PILE TYPE :
     H-Pile/Steel Pile

      AVERAGE DEPTH TO ESTIMATE TIP RESISTANCE:
     - USE 1.5 DIAMETERS ABOVE AND BELOW TIP

     DATA FOR AXIAL STIFFNESS :
     - MODULUS OF ELASTICITY     = 0.290E+08 PSI
     - CROSS SECTION AREA        =     34.40 IN2

     NONCIRCULAR PILE PROPERTIES :
     - TOTAL PILE LENGTH, TL     =     65.40 FT.
     - BATTER ANGLE              =      0.00 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.
     - PRINTING INCREMENT        =         1


     SOIL INFORMATIONS :

                       LATERAL    EFFECTIVE    FRICTION      Nq
               SOIL    EARTH      UNIT         ANGLE       FACTOR
```

DEPTH FT.	TYPE	PRESSURE	WEIGHT LB/FT^3	DEGREES	FHWA
0.00	SAND	1.50	125.00	34.00	55.60**
12.10	SAND	1.50	125.00	34.00	55.60**
12.10	SAND	1.50	62.60	34.00	55.60**
29.00	SAND	1.50	62.60	34.00	55.60**
29.00	SAND	1.50	67.60	36.00	77.60**
65.40	SAND	1.50	67.60	36.00	77.60**
65.40	CLAY	0.80*	107.60	0.00	4.80**
76.00	CLAY	0.80*	107.60	0.00	4.80**

* VALUE ASSUMED BY THE PROGRAM
** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

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
0.10E+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
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
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
0.10E+08*	0.10E+08*	1296.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1296.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
WERE SET TO LARGE VALUES INDICATING THAT APILE
USES THE LIMITS SPECIFIED BY EACH SELECTED
CRITERIA (IF ANY).

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
12.10	1.000	1.000
12.10	1.000	1.000
29.00	1.000	1.000
29.00	1.000	1.000
65.40	1.000	1.000
65.40	1.000	1.000
76.00	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.185 *	0.00
12.10	0.185 *	0.00
12.10	0.000	0.00
29.00	0.000	0.00
29.00	0.000	0.00
65.40	0.000	0.00
65.40	0.000	0.90 **
76.00	0.000	0.90 **

* DEFAULT VALUE = 0.01 D
** DEFAULT VALUE = 0.9

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE LENGTH   SKIN   END   ULTIMATE

BELOW GND.	FRICTION	BEARING	CAPACITY
FT.	KIP	KIP	KIP
0.00	0.0	0.6	0.6
1.00	0.2	1.3	1.5
2.00	0.6	2.2	2.9
3.00	1.5	3.3	4.8
4.00	2.6	4.4	7.0
5.00	4.0	5.5	9.5
6.00	5.8	6.6	12.4
7.00	7.9	7.7	15.6
8.00	10.3	8.8	19.2
9.00	13.1	9.9	23.0
10.00	16.2	11.0	27.2
11.00	19.6	12.1	31.7
12.00	23.3	13.1	36.4
13.00	27.3	14.0	41.3
14.00	31.6	14.8	46.4
15.00	36.1	15.4	51.5
16.00	40.7	16.0	56.6
17.00	45.4	16.5	61.9
18.00	50.4	16.9	67.3
19.00	55.5	17.3	72.7
20.00	60.7	17.5	78.2
21.00	66.1	17.6	83.7
22.00	71.7	17.6	89.3
23.00	77.5	17.6	95.0
24.00	83.4	17.6	100.9
25.00	89.4	17.6	107.0
26.00	95.7	17.6	113.2
27.00	102.1	18.7	120.7
28.00	108.6	22.3	130.9
29.00	115.3	26.2	141.5
30.00	123.0	30.2	153.1
31.00	131.6	34.2	165.8
32.00	140.5	35.8	176.3
33.00	149.5	36.1	185.6
34.00	158.8	36.2	195.0
35.00	168.3	36.2	204.5
36.00	178.0	36.2	214.2
37.00	187.9	36.2	224.2
38.00	198.1	36.2	234.3
39.00	208.4	36.2	244.6
40.00	219.0	36.2	255.2
41.00	229.8	36.2	266.0
42.00	240.8	36.2	277.0
43.00	252.0	36.2	288.2
44.00	263.4	36.2	299.6
45.00	275.0	36.2	311.2
46.00	286.9	36.2	323.1
47.00	298.9	36.2	335.2
48.00	311.2	36.2	347.4
49.00	323.7	36.2	359.9
50.00	336.4	36.2	372.6
51.00	349.3	36.2	385.5
52.00	362.5	36.2	398.7
53.00	375.8	36.2	412.0
54.00	389.4	36.2	425.6
55.00	403.1	36.2	439.4
56.00	417.1	36.2	453.3
57.00	431.3	36.2	467.5
58.00	445.7	36.2	482.0
59.00	460.4	36.2	496.6
60.00	475.2	36.2	511.4
61.00	490.3	36.2	526.5
62.00	505.6	36.2	541.8
63.00	521.0	36.2	557.3
64.00	536.7	223.7	760.4
65.00	552.7	817.5	1370.2

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	0.4167E-01		
			0.0000E+00	0.0000E+00
			0.5788E-02	0.2964E-01
			0.9647E-02	0.5743E-01
			0.1447E-01	0.1056E+00
			0.1736E-01	0.1482E+00
			0.1929E-01	0.1853E+00
			0.1929E-01	0.3705E+00
			0.1929E-01	0.5558E+00
			0.1929E-01	0.9263E+00
			0.1929E-01	0.3705E+01
2	10	0.6050E+01		
			0.0000E+00	0.0000E+00
			0.8405E+00	0.2964E-01
			0.1401E+01	0.5743E-01
			0.2101E+01	0.1056E+00
			0.2521E+01	0.1482E+00
			0.2802E+01	0.1853E+00
			0.2802E+01	0.3705E+00
			0.2802E+01	0.5558E+00
			0.2802E+01	0.9263E+00
			0.2802E+01	0.3705E+01
3	10	0.1206E+02		
			0.0000E+00	0.0000E+00
			0.1675E+01	0.2964E-01
			0.2792E+01	0.5743E-01
			0.4188E+01	0.1056E+00
			0.5025E+01	0.1482E+00
			0.5584E+01	0.1853E+00
			0.5584E+01	0.3705E+00
			0.5584E+01	0.5558E+00
			0.5584E+01	0.9263E+00
			0.5584E+01	0.3705E+01
4	10	0.1214E+02		
			0.0000E+00	0.0000E+00
			0.1687E+01	0.5071E-71
			0.2811E+01	0.9825E-71
			0.4217E+01	0.1807E-70
			0.5060E+01	0.2536E-70
			0.5622E+01	0.3169E-70
			0.5622E+01	0.6339E-70
			0.5622E+01	0.9508E-70
			0.5622E+01	0.1585E-69
			0.5622E+01	0.6339E-69
5	10	0.2055E+02		
			0.0000E+00	0.0000E+00
			0.2331E+01	0.5071E-71
			0.3885E+01	0.9825E-71
			0.5828E+01	0.1807E-70
			0.6994E+01	0.2536E-70
			0.7771E+01	0.3169E-70
			0.7771E+01	0.6339E-70
			0.7771E+01	0.9508E-70
			0.7771E+01	0.1585E-69
			0.7771E+01	0.6339E-69
6	10	0.2896E+02		
			0.0000E+00	0.0000E+00
			0.2916E+01	0.5071E-71
			0.4860E+01	0.9825E-71
			0.7290E+01	0.1807E-70
			0.8749E+01	0.2536E-70
			0.9721E+01	0.3169E-70
			0.9721E+01	0.6339E-70
			0.9721E+01	0.9508E-70
			0.9721E+01	0.1585E-69
			0.9721E+01	0.6339E-69
7	10	0.2904E+02		
			0.0000E+00	0.0000E+00
			0.2950E+01	0.5071E-71
			0.4917E+01	0.9825E-71
			0.7375E+01	0.1807E-70
			0.8850E+01	0.2536E-70
			0.9834E+01	0.3169E-70
			0.9834E+01	0.6339E-70

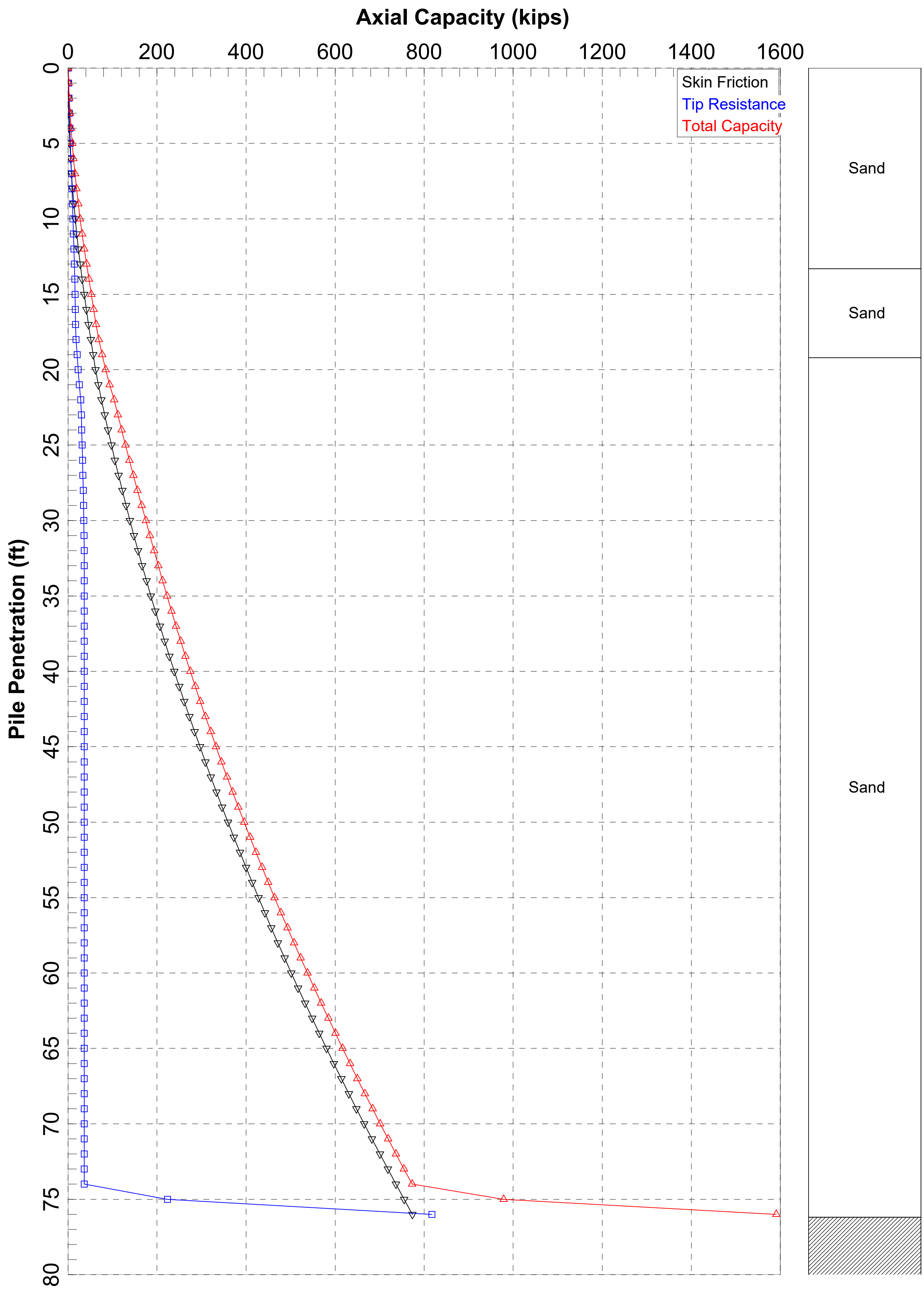
			0.9834E+01	0.9508E-70
			0.9834E+01	0.1585E-69
			0.9834E+01	0.6339E-69
8	10	0.4720E+02		
			0.0000E+00	0.0000E+00
			0.5246E+01	0.5071E-71
			0.8743E+01	0.9825E-71
			0.1311E+02	0.1807E-70
			0.1574E+02	0.2536E-70
			0.1749E+02	0.3169E-70
			0.1749E+02	0.6339E-70
			0.1749E+02	0.9508E-70
			0.1749E+02	0.1585E-69
			0.1749E+02	0.6339E-69
9	10	0.6536E+02		
			0.0000E+00	0.0000E+00
			0.6882E+01	0.5071E-71
			0.1147E+02	0.9825E-71
			0.1721E+02	0.1807E-70
			0.2065E+02	0.2536E-70
			0.2294E+02	0.3169E-70
			0.2294E+02	0.6339E-70
			0.2294E+02	0.9508E-70
			0.2294E+02	0.1585E-69
			0.2294E+02	0.6339E-69
10	10	0.6544E+02		
			0.0000E+00	0.0000E+00
			0.6882E+01	0.5071E-71
			0.1147E+02	0.9825E-71
			0.1721E+02	0.1807E-70
			0.2065E+02	0.2536E-70
			0.2294E+02	0.3169E-70
			0.2065E+02	0.6339E-70
			0.2065E+02	0.9508E-70
			0.2065E+02	0.1585E-69
			0.2065E+02	0.6339E-69
11	10	0.7070E+02		
			0.0000E+00	0.0000E+00
			0.6882E+01	0.5071E-71
			0.1147E+02	0.9825E-71
			0.1721E+02	0.1807E-70
			0.2065E+02	0.2536E-70
			0.2294E+02	0.3169E-70
			0.2065E+02	0.6339E-70
			0.2065E+02	0.9508E-70
			0.2065E+02	0.1585E-69
			0.2065E+02	0.6339E-69
12	10	0.7596E+02		
			0.0000E+00	0.0000E+00
			0.6882E+01	0.5071E-71
			0.1147E+02	0.9825E-71
			0.1721E+02	0.1807E-70
			0.2065E+02	0.2536E-70
			0.2294E+02	0.3169E-70
			0.2065E+02	0.6339E-70
			0.2065E+02	0.9508E-70
			0.2065E+02	0.1585E-69
			0.2065E+02	0.6339E-69

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.5109E+02	0.9263E-02
0.1022E+03	0.1853E-01
0.2044E+03	0.3705E-01
0.4087E+03	0.2408E+00
0.6131E+03	0.7781E+00
0.7357E+03	0.1352E+01
0.8175E+03	0.1853E+01
0.8175E+03	0.2779E+01
0.8175E+03	0.3705E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.5595E+03	0.2886E+00	0.5516E+00	0.1000E-03
0.5645E+03	0.2934E+00	0.5516E+01	0.1000E-02
0.5866E+03	0.3148E+00	0.2758E+02	0.5000E-02
0.6141E+03	0.3415E+00	0.5516E+02	0.1000E-01
0.6693E+03	0.3949E+00	0.1103E+03	0.2000E-01
0.7763E+03	0.5091E+00	0.2174E+03	0.5000E-01
0.8064E+03	0.5628E+00	0.2474E+03	0.8000E-01
0.8265E+03	0.5985E+00	0.2675E+03	0.1000E+00
0.9268E+03	0.7774E+00	0.3678E+03	0.2000E+00
0.1066E+04	0.1187E+01	0.5073E+03	0.5000E+00
0.1177E+04	0.1574E+01	0.6178E+03	0.8000E+00
0.1219E+04	0.1808E+01	0.6605E+03	0.1000E+01
0.1376E+04	0.2931E+01	0.8175E+03	0.2000E+01

Mill Cove New Bridge #6205
APile Analysis, Abutment 2
HP 14x117 - No Plug



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     ==========================================================================
                                  APILE 2025.11.1

                     A Program for Analyzing the Axial Capacity
                     and Short-term Settlement of Driven Piles
                               under Axial Loading.

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     ==========================================================================


     Model ran by                : M. Johnescu

     Path to file locations      : B:\Working\THORNTON TOMASETTI\2502334 MaineDOT Downeast
Bridges Phase II\09_Engineering\03_Robbinston\06_Apile\No Plug\
     Name of input data file     : Abutment 2 HP14x117 2025-08-13.ap11d
     Name of output file         : Abutment 2 HP14x117 2025-08-13.ap11o
     Name of plot output file    : Abutment 2 HP14x117 2025-08-13.ap11p

     --------------------------------------------------------------------------
                        Time and Date of Analysis
     --------------------------------------------------------------------------

               Date:  August 13, 2025     Time:  13:06:28



1
          *********************
          * INPUT INFORMATION *
          *********************

          PROJECT DESCRIPTION   :
          Axial Pile Analysis for Mill Cove New Bridge using 14x117 piles in Abu
          DESIGNER   : M. Johnescu
          JOB NUMBER : 2502334

          METHOD FOR UNIT LOAD TRANSFERS :
          - FHWA (Federal Highway Administration)
            Unfactored Unit Side Friction and Unit Side Resistance are used.

          COMPUTATION METHOD(S) FOR PILE CAPACITY :
          - FHWA (Federal Highway Administration)

          TYPE OF LOADING :
          - COMPRESSION

          PILE TYPE :
          H-Pile/Steel Pile

           AVERAGE DEPTH TO ESTIMATE TIP RESISTANCE:
          - USE 1.5 DIAMETERS ABOVE AND BELOW TIP

          DATA FOR AXIAL STIFFNESS :
          - MODULUS OF ELASTICITY     = 0.290E+08 PSI
          - CROSS SECTION AREA        =     34.40 IN2

          NONCIRCULAR PILE PROPERTIES :
          - TOTAL PILE LENGTH, TL     =     76.20 FT.
          - BATTER ANGLE              =      0.00 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.
          - PRINTING INCREMENT        =        1


          SOIL INFORMATIONS :

                            LATERAL    EFFECTIVE    FRICTION      Nq
                    SOIL    EARTH      UNIT         ANGLE       FACTOR
```

DEPTH FT.	TYPE	PRESSURE	WEIGHT LB/FT^3	DEGREES	FHWA
0.00	SAND	0.80	125.00	34.00	55.60**
13.30	SAND	0.80	125.00	34.00	55.60**
13.30	SAND	0.80	62.60	34.00	55.60**
19.20	SAND	0.80	62.60	34.00	55.60**
19.20	SAND	0.80	67.60	36.00	77.60**
76.20	SAND	0.80	67.60	36.00	77.60**
76.20	CLAY	0.80*	107.60	0.00	4.80**
86.00	CLAY	0.80*	107.60	0.00	4.80**

* VALUE ASSUMED BY THE PROGRAM
** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

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
0.10E+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
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
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
0.10E+08*	0.10E+08*	1296.00	0.00	0.00	0.00	0.00
0.10E+08*	0.10E+08*	1296.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO LARGE VALUES INDICATING THAT APILE
  USES THE LIMITS SPECIFIED BY EACH SELECTED
  CRITERIA (IF ANY).

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
13.30	1.000	1.000
13.30	1.000	1.000
19.20	1.000	1.000
19.20	1.000	1.000
76.20	1.000	1.000
76.20	1.000	1.000
86.00	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.185 *	0.00
13.30	0.185 *	0.00
13.30	0.000	0.00
19.20	0.000	0.00
19.20	0.000	0.00
76.20	0.000	0.00
76.20	0.000	0.90 **
86.00	0.000	0.90 **

* DEFAULT VALUE = 0.01 D
** DEFAULT VALUE = 0.9

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE LENGTH SKIN END ULTIMATE

BELOW GND. FT.	FRICTION KIP	BEARING KIP	CAPACITY KIP
0.00	0.0	0.6	0.6
1.00	0.2	1.3	1.5
2.00	0.6	2.2	2.9
3.00	1.5	3.3	4.8
4.00	2.6	4.4	7.0
5.00	4.0	5.5	9.5
6.00	5.8	6.6	12.4
7.00	7.9	7.7	15.6
8.00	10.3	8.8	19.2
9.00	13.1	9.9	23.0
10.00	16.2	11.0	27.2
11.00	19.6	12.1	31.7
12.00	23.3	13.2	36.5
13.00	27.3	14.2	41.5
14.00	31.7	15.1	46.8
15.00	36.3	15.9	52.2
16.00	41.1	16.5	57.6
17.00	46.0	16.9	62.9
18.00	51.1	17.9	69.0
19.00	56.4	20.4	76.8
20.00	61.8	22.9	84.7
21.00	68.0	25.6	93.6
22.00	75.0	28.4	103.4
23.00	82.3	29.9	112.2
24.00	89.8	30.8	120.6
25.00	97.5	31.7	129.1
26.00	105.4	32.5	137.9
27.00	113.5	33.4	146.9
28.00	121.8	34.3	156.1
29.00	130.4	35.0	165.4
30.00	139.2	35.6	174.7
31.00	148.1	36.0	184.1
32.00	157.3	36.2	193.5
33.00	166.7	36.2	203.0
34.00	176.4	36.2	212.6
35.00	186.2	36.2	222.4
36.00	196.2	36.2	232.5
37.00	206.5	36.2	242.7
38.00	217.0	36.2	253.2
39.00	227.7	36.2	263.9
40.00	238.6	36.2	274.8
41.00	249.7	36.2	285.9
42.00	261.0	36.2	297.2
43.00	272.6	36.2	308.8
44.00	284.3	36.2	320.5
45.00	296.3	36.2	332.5
46.00	308.5	36.2	344.7
47.00	320.9	36.2	357.1
48.00	333.5	36.2	369.7
49.00	346.3	36.2	382.6
50.00	359.4	36.2	395.6
51.00	372.6	36.2	408.9
52.00	386.1	36.2	422.3
53.00	399.8	36.2	436.0
54.00	413.7	36.2	449.9
55.00	427.8	36.2	464.0
56.00	442.1	36.2	478.4
57.00	456.7	36.2	492.9
58.00	471.4	36.2	507.7
59.00	486.4	36.2	522.6
60.00	501.6	36.2	537.8
61.00	517.0	36.2	553.2
62.00	532.6	36.2	568.8
63.00	548.4	36.2	584.7
64.00	564.5	36.2	600.7
65.00	580.7	36.2	616.9
66.00	597.2	36.2	633.4
67.00	613.9	36.2	650.1
68.00	630.8	36.2	667.0
69.00	647.9	36.2	684.1
70.00	665.2	36.2	701.4
71.00	682.8	36.2	719.0
72.00	700.5	36.2	736.7
73.00	718.5	36.2	754.7
74.00	736.7	36.2	772.9
75.00	755.1	223.7	978.7
76.00	773.7	817.5	1591.2

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.

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*************************************************
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING                      *
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T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.4167E-01		
			0.0000E+00	0.0000E+00
			0.5788E-02	0.2964E-01
			0.9647E-02	0.5743E-01
			0.1447E-01	0.1056E+00
			0.1736E-01	0.1482E+00
			0.1929E-01	0.1853E+00
			0.1929E-01	0.3705E+00
			0.1929E-01	0.5558E+00
			0.1929E-01	0.9263E+00
			0.1929E-01	0.3705E+01
2	10	0.6650E+01		
			0.0000E+00	0.0000E+00
			0.9238E+00	0.2964E-01
			0.1540E+01	0.5743E-01
			0.2310E+01	0.1056E+00
			0.2771E+01	0.1482E+00
			0.3079E+01	0.1853E+00
			0.3079E+01	0.3705E+00
			0.3079E+01	0.5558E+00
			0.3079E+01	0.9263E+00
			0.3079E+01	0.3705E+01
3	10	0.1326E+02		
			0.0000E+00	0.0000E+00
			0.1842E+01	0.2964E-01
			0.3070E+01	0.5743E-01
			0.4605E+01	0.1056E+00
			0.5526E+01	0.1482E+00
			0.6139E+01	0.1853E+00
			0.6139E+01	0.3705E+00
			0.6139E+01	0.5558E+00
			0.6139E+01	0.9263E+00
			0.6139E+01	0.3705E+01
4	10	0.1334E+02		
			0.0000E+00	0.0000E+00
			0.1853E+01	0.5071E-71
			0.3089E+01	0.9825E-71
			0.4634E+01	0.1807E-70
			0.5560E+01	0.2536E-70
			0.6178E+01	0.3169E-70
			0.6178E+01	0.6339E-70
			0.6178E+01	0.9508E-70
			0.6178E+01	0.1585E-69
			0.6178E+01	0.6339E-69
5	10	0.1625E+02		
			0.0000E+00	0.0000E+00
			0.2101E+01	0.5071E-71
			0.3502E+01	0.9825E-71
			0.5254E+01	0.1807E-70
			0.6304E+01	0.2536E-70
			0.7005E+01	0.3169E-70
			0.7005E+01	0.6339E-70
			0.7005E+01	0.9508E-70
			0.7005E+01	0.1585E-69
			0.7005E+01	0.6339E-69
6	10	0.1916E+02		
			0.0000E+00	0.0000E+00
			0.2304E+01	0.5071E-71
			0.3840E+01	0.9825E-71
			0.5759E+01	0.1807E-70
			0.6911E+01	0.2536E-70
			0.7679E+01	0.3169E-70
			0.7679E+01	0.6339E-70

			0.7679E+01	0.9508E-70
			0.7679E+01	0.1585E-69
			0.7679E+01	0.6339E-69
7	10	0.1924E+02		
			0.0000E+00	0.0000E+00
			0.2310E+01	0.5071E-71
			0.3849E+01	0.9825E-71
			0.5774E+01	0.1807E-70
			0.6929E+01	0.2536E-70
			0.7698E+01	0.3169E-70
			0.7698E+01	0.6339E-70
			0.7698E+01	0.9508E-70
			0.7698E+01	0.1585E-69
			0.7698E+01	0.6339E-69
8	10	0.4770E+02		
			0.0000E+00	0.0000E+00
			0.5438E+01	0.5071E-71
			0.9063E+01	0.9825E-71
			0.1359E+02	0.1807E-70
			0.1631E+02	0.2536E-70
			0.1813E+02	0.3169E-70
			0.1813E+02	0.6339E-70
			0.1813E+02	0.9508E-70
			0.1813E+02	0.1585E-69
			0.1813E+02	0.6339E-69
9	10	0.7616E+02		
			0.0000E+00	0.0000E+00
			0.8040E+01	0.5071E-71
			0.1340E+02	0.9825E-71
			0.2010E+02	0.1807E-70
			0.2412E+02	0.2536E-70
			0.2680E+02	0.3169E-70
			0.2680E+02	0.6339E-70
			0.2680E+02	0.9508E-70
			0.2680E+02	0.1585E-69
			0.2680E+02	0.6339E-69
10	10	0.7624E+02		
			0.0000E+00	0.0000E+00
			0.8040E+01	0.5071E-71
			0.1340E+02	0.9825E-71
			0.2010E+02	0.1807E-70
			0.2412E+02	0.2536E-70
			0.2680E+02	0.3169E-70
			0.2412E+02	0.6339E-70
			0.2412E+02	0.9508E-70
			0.2412E+02	0.1585E-69
			0.2412E+02	0.6339E-69
11	10	0.8110E+02		
			0.0000E+00	0.0000E+00
			0.8040E+01	0.5071E-71
			0.1340E+02	0.9825E-71
			0.2010E+02	0.1807E-70
			0.2412E+02	0.2536E-70
			0.2680E+02	0.3169E-70
			0.2412E+02	0.6339E-70
			0.2412E+02	0.9508E-70
			0.2412E+02	0.1585E-69
			0.2412E+02	0.6339E-69
12	10	0.8596E+02		
			0.0000E+00	0.0000E+00
			0.8040E+01	0.5071E-71
			0.1340E+02	0.9825E-71
			0.2010E+02	0.1807E-70
			0.2412E+02	0.2536E-70
			0.2680E+02	0.3169E-70
			0.2412E+02	0.6339E-70
			0.2412E+02	0.9508E-70
			0.2412E+02	0.1585E-69
			0.2412E+02	0.6339E-69

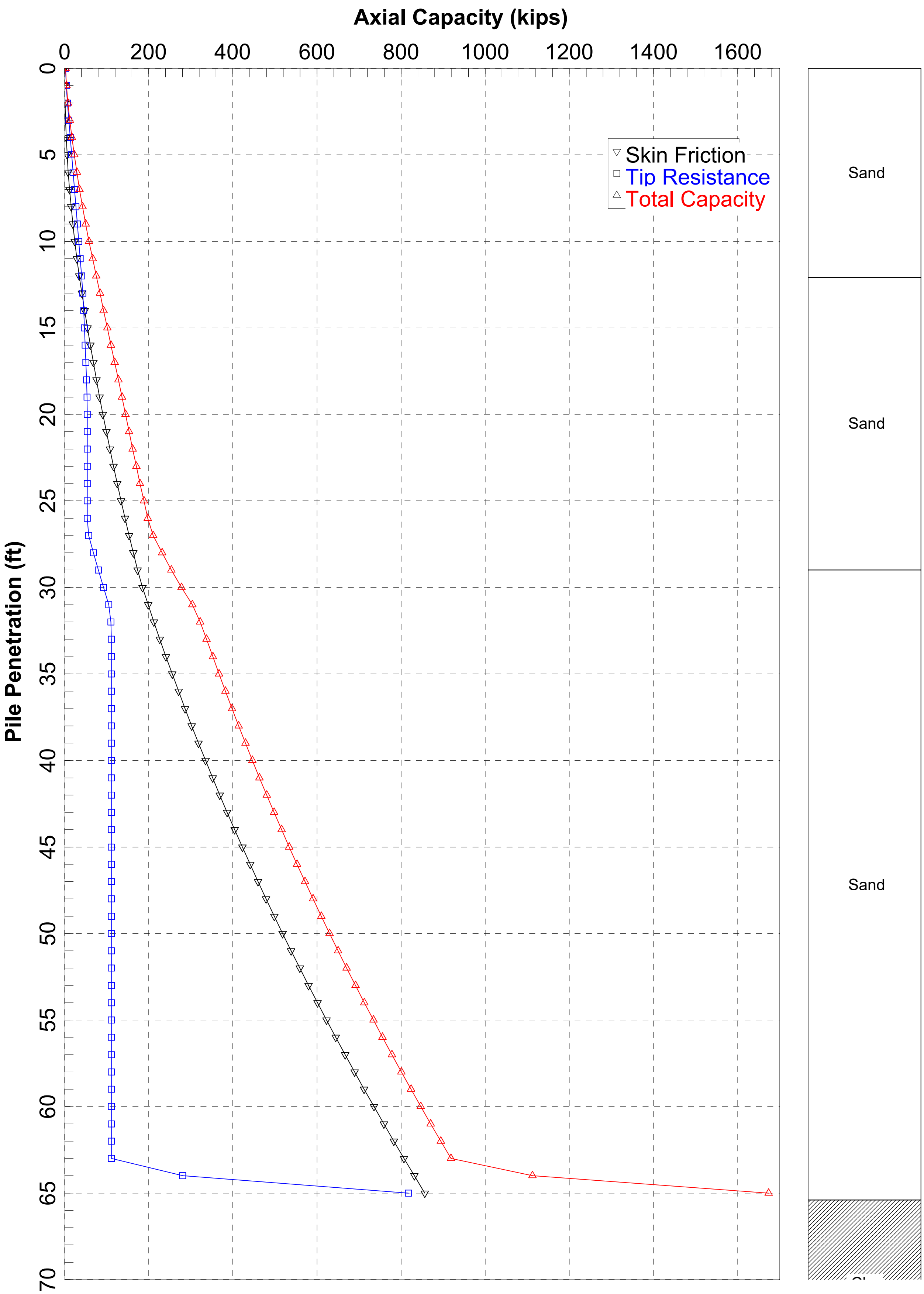
TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.5109E+02	0.9263E-02
0.1022E+03	0.1853E-01
0.2044E+03	0.3705E-01
0.4087E+03	0.2408E+00

0.6131E+03	0.7781E+00
0.7357E+03	0.1352E+01
0.8175E+03	0.1853E+01
0.8175E+03	0.2779E+01
0.8175E+03	0.3705E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.7779E+03	0.4626E+00	0.5516E+00	0.1000E-03
0.7828E+03	0.4680E+00	0.5516E+01	0.1000E-02
0.8049E+03	0.4923E+00	0.2758E+02	0.5000E-02
0.8325E+03	0.5225E+00	0.5516E+02	0.1000E-01
0.8876E+03	0.5831E+00	0.1103E+03	0.2000E-01
0.9947E+03	0.7112E+00	0.2174E+03	0.5000E-01
0.1025E+04	0.7688E+00	0.2474E+03	0.8000E-01
0.1045E+04	0.8072E+00	0.2675E+03	0.1000E+00
0.1145E+04	0.9991E+00	0.3678E+03	0.2000E+00
0.1285E+04	0.1427E+01	0.5073E+03	0.5000E+00
0.1395E+04	0.1828E+01	0.6178E+03	0.8000E+00
0.1438E+04	0.2067E+01	0.6605E+03	0.1000E+01
0.1595E+04	0.3211E+01	0.8175E+03	0.2000E+01

Mill Cove New Bridge #6205
APile Analysis, Abutment 1
HP 14x117 - Half Plug



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==========================================================================

                 APILE for Windows, Version 2023.10.5

                  Serial Number : 264781180


                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.
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==========================================================================


This program is licensed to :

GEI Consultants, Inc.
Woburn, MA, USA

Path to file locations      : C:\Users\juabet3911\OneDrive - GEI Consultants,
Inc\Desktop\Nicolas\Projects\TT_Downeast Phase II\Robbinston\APILE\
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Name of output file         : Hp14X117 Abut 1 - 0.5 plugged.ap10o
Name of plot output file    : Hp14X117 Abut 1 - 0.5 plugged.ap10p

--------------------------------------------------------------------------
                     Time and Date of Analysis
--------------------------------------------------------------------------

          Date:  July 24, 2025     Time:  17:12:25



1
     *********************
     * INPUT INFORMATION *
     *********************

     PROJECT DESCRIPTION   :
     Mill Cove Abutment 1 HP14X117 Partially Plugged
     DESIGNER   : GEI
     JOB NUMBER : 2502334

     METHOD FOR UNIT LOAD TRANSFERS :
     - FHWA (Federal Highway Administration)
       Unfactored Unit Side Friction and Unit Side Resistance are used.

     COMPUTATION METHOD(S) FOR PILE CAPACITY :
```

- FHWA (Federal Highway Administration)

TYPE OF LOADING :
- COMPRESSION

PILE TYPE :
H-Pile/Steel Pile

AVERAGE DEPTH TO ESTIMATE TIP RESISTANCE:
- USE 1.5 DIAMETERS ABOVE AND BELOW TIP

DATA FOR AXIAL STIFFNESS :
- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 105.79 IN2

NONCIRCULAR PILE PROPERTIES :
- TOTAL PILE LENGTH, TL = 65.40 FT.
- BATTER ANGLE = 0.00 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 = 105.79 IN2
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION = 1.00 FT.
- PRINTING INCREMENT = 1

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT^3	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	SAND	0.80*	125.00	34.00	55.60**
12.10	SAND	0.80*	125.00	34.00	55.60**
12.10	SAND	0.80*	62.60	34.00	55.60**
29.00	SAND	0.80*	62.60	34.00	55.60**
29.00	SAND	0.80*	67.60	36.00	77.60**
65.40	SAND	0.80*	67.60	36.00	77.60**
65.40	CLAY	0.80*	107.60	0.00	4.80**
75.00	CLAY	0.80*	107.60	0.00	4.80**

* VALUE ASSUMED BY THE PROGRAM
** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

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

0.10E+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
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
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
0.10E+08*	0.35E+04	1296.00	0.00	0.00	0.00	0.00
0.10E+08*	0.35E+04	1296.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO LARGE VALUES INDICATING THAT APILE
  USES THE LIMITS SPECIFIED BY EACH SELECTED
  CRITERIA (IF ANY).

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
12.10	1.000	1.000
12.10	1.000	1.000
29.00	1.000	1.000
29.00	1.000	1.000
65.40	1.000	1.000
65.40	1.000	1.000
75.00	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.185 *	0.00
12.10	0.185 *	0.00
12.10	0.185 *	0.00
29.00	0.185 *	0.00
29.00	0.185 *	0.00
65.40	0.185 *	0.00
65.40	0.185 *	0.90 **
75.00	0.185 *	0.90 **

* DEFAULT VALUE = 0.01 D
** DEFAULT VALUE = 0.9

1

****
* COMPUTATION RESULT *

****

****
* FED. HWY. METHOD *
****

PILE LENGTH BELOW GND. FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	2.0	2.0
1.00	0.2	4.0	4.3
2.00	1.0	6.8	7.8
3.00	2.2	10.2	12.3
4.00	3.9	13.5	17.4
5.00	6.1	16.9	23.0
6.00	8.7	20.3	29.1
7.00	11.9	23.7	35.6
8.00	15.5	27.1	42.6
9.00	19.7	30.5	50.1
10.00	24.3	33.8	58.1
11.00	29.4	37.2	66.6
12.00	35.0	40.3	75.3
13.00	41.1	43.0	84.1
14.00	47.5	45.4	92.9
15.00	54.2	47.4	101.5
16.00	61.1	49.1	110.2
17.00	68.3	50.7	119.0
18.00	75.7	52.1	127.8
19.00	83.3	53.1	136.4
20.00	91.2	53.7	145.0
21.00	99.4	54.0	153.4
22.00	107.8	54.0	161.8
23.00	116.4	54.0	170.4
24.00	125.3	54.0	179.3
25.00	134.4	54.0	188.4
26.00	143.7	54.0	197.7
27.00	153.3	57.4	210.8
28.00	163.2	68.7	231.8
29.00	173.3	80.5	253.7
30.00	185.0	92.7	277.8
31.00	198.5	105.1	303.6
32.00	212.4	110.0	322.4
33.00	226.5	111.0	337.5
34.00	241.0	111.3	352.4
35.00	255.8	111.4	367.2
36.00	271.0	111.4	382.4

37.00	286.5	111.4	397.9
38.00	302.3	111.4	413.7
39.00	318.5	111.4	429.9
40.00	335.0	111.4	446.4
41.00	351.9	111.4	463.2
42.00	369.0	111.4	480.4
43.00	386.5	111.4	497.9
44.00	404.4	111.4	515.7
45.00	422.6	111.4	533.9
46.00	441.1	111.4	552.4
47.00	459.9	111.4	571.3
48.00	479.1	111.4	590.5
49.00	498.6	111.4	610.0
50.00	518.4	111.4	629.8
51.00	538.6	111.4	650.0
52.00	559.1	111.4	670.5
53.00	580.0	111.4	691.4
54.00	601.2	111.4	712.5
55.00	622.7	111.4	734.1
56.00	644.5	111.4	755.9
57.00	666.7	111.4	778.1
58.00	689.3	111.4	800.6
59.00	712.1	111.4	823.5
60.00	735.3	111.4	846.7
61.00	758.8	111.4	870.2
62.00	782.7	111.4	894.1
63.00	806.9	111.4	918.3
64.00	831.4	280.8	1112.2
65.00	856.3	817.5	1673.8

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.

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*************************************************
* 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	0.4167E-01		
			0.0000E+00	0.0000E+00
			0.8696E-02	0.2964E-01

			0.1449E-01	0.5743E-01
			0.2174E-01	0.1056E+00
			0.2609E-01	0.1482E+00
			0.2899E-01	0.1853E+00
			0.2899E-01	0.3705E+00
			0.2899E-01	0.5558E+00
			0.2899E-01	0.9263E+00
			0.2899E-01	0.3705E+01
2	10	0.6050E+01		
			0.0000E+00	0.0000E+00
			0.1263E+01	0.2964E-01
			0.2105E+01	0.5743E-01
			0.3157E+01	0.1056E+00
			0.3788E+01	0.1482E+00
			0.4209E+01	0.1853E+00
			0.4209E+01	0.3705E+00
			0.4209E+01	0.5558E+00
			0.4209E+01	0.9263E+00
			0.4209E+01	0.3705E+01
3	10	0.1206E+02		
			0.0000E+00	0.0000E+00
			0.2517E+01	0.2964E-01
			0.4195E+01	0.5743E-01
			0.6292E+01	0.1056E+00
			0.7550E+01	0.1482E+00
			0.8389E+01	0.1853E+00
			0.8389E+01	0.3705E+00
			0.8389E+01	0.5558E+00
			0.8389E+01	0.9263E+00
			0.8389E+01	0.3705E+01
4	10	0.1214E+02		
			0.0000E+00	0.0000E+00
			0.2534E+01	0.2964E-01
			0.4224E+01	0.5743E-01
			0.6335E+01	0.1056E+00
			0.7602E+01	0.1482E+00
			0.8447E+01	0.1853E+00
			0.8447E+01	0.3705E+00
			0.8447E+01	0.5558E+00
			0.8447E+01	0.9263E+00
			0.8447E+01	0.3705E+01
5	10	0.2055E+02		
			0.0000E+00	0.0000E+00
			0.3502E+01	0.2964E-01
			0.5837E+01	0.5743E-01
			0.8756E+01	0.1056E+00
			0.1051E+02	0.1482E+00
			0.1167E+02	0.1853E+00
			0.1167E+02	0.3705E+00
			0.1167E+02	0.5558E+00

			0.1167E+02	0.9263E+00
			0.1167E+02	0.3705E+01
6	10	0.2896E+02		
			0.0000E+00	0.0000E+00
			0.4381E+01	0.2964E-01
			0.7302E+01	0.5743E-01
			0.1095E+02	0.1056E+00
			0.1314E+02	0.1482E+00
			0.1460E+02	0.1853E+00
			0.1460E+02	0.3705E+00
			0.1460E+02	0.5558E+00
			0.1460E+02	0.9263E+00
			0.1460E+02	0.3705E+01
7	10	0.2904E+02		
			0.0000E+00	0.0000E+00
			0.4441E+01	0.2964E-01
			0.7402E+01	0.5743E-01
			0.1110E+02	0.1056E+00
			0.1332E+02	0.1482E+00
			0.1480E+02	0.1853E+00
			0.1480E+02	0.3705E+00
			0.1480E+02	0.5558E+00
			0.1480E+02	0.9263E+00
			0.1480E+02	0.3705E+01
8	10	0.4720E+02		
			0.0000E+00	0.0000E+00
			0.8195E+01	0.2964E-01
			0.1366E+02	0.5743E-01
			0.2049E+02	0.1056E+00
			0.2458E+02	0.1482E+00
			0.2732E+02	0.1853E+00
			0.2732E+02	0.3705E+00
			0.2732E+02	0.5558E+00
			0.2732E+02	0.9263E+00
			0.2732E+02	0.3705E+01
9	10	0.6536E+02		
			0.0000E+00	0.0000E+00
			0.1075E+02	0.2964E-01
			0.1792E+02	0.5743E-01
			0.2688E+02	0.1056E+00
			0.3225E+02	0.1482E+00
			0.3584E+02	0.1853E+00
			0.3584E+02	0.3705E+00
			0.3584E+02	0.5558E+00
			0.3584E+02	0.9263E+00
			0.3584E+02	0.3705E+01
10	10	0.6544E+02		
			0.0000E+00	0.0000E+00
			0.1075E+02	0.2964E-01
			0.1792E+02	0.5743E-01

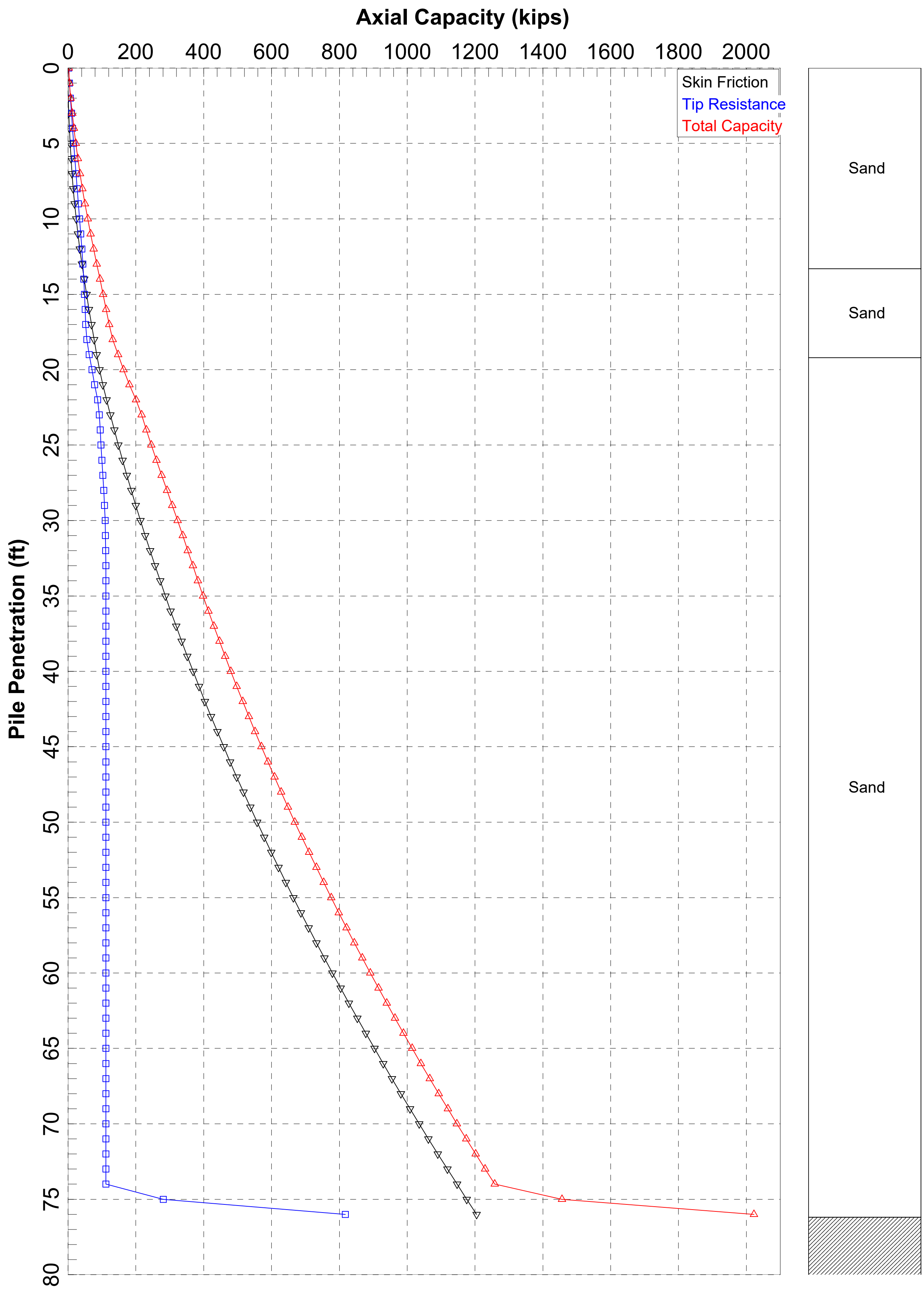
			0.2688E+02	0.1056E+00
			0.3225E+02	0.1482E+00
			0.3584E+02	0.1853E+00
			0.3225E+02	0.3705E+00
			0.3225E+02	0.5558E+00
			0.3225E+02	0.9263E+00
			0.3225E+02	0.3705E+01
11	10	0.7020E+02		
			0.0000E+00	0.0000E+00
			0.1075E+02	0.2964E-01
			0.1792E+02	0.5743E-01
			0.2688E+02	0.1056E+00
			0.3225E+02	0.1482E+00
			0.3584E+02	0.1853E+00
			0.3225E+02	0.3705E+00
			0.3225E+02	0.5558E+00
			0.3225E+02	0.9263E+00
			0.3225E+02	0.3705E+01
12	10	0.7496E+02		
			0.0000E+00	0.0000E+00
			0.1075E+02	0.2964E-01
			0.1792E+02	0.5743E-01
			0.2688E+02	0.1056E+00
			0.3225E+02	0.1482E+00
			0.3584E+02	0.1853E+00
			0.3225E+02	0.3705E+00
			0.3225E+02	0.5558E+00
			0.3225E+02	0.9263E+00
			0.3225E+02	0.3705E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.5109E+02	0.9263E-02
0.1022E+03	0.1853E-01
0.2044E+03	0.3705E-01
0.4087E+03	0.2408E+00
0.6131E+03	0.7781E+00
0.7357E+03	0.1352E+01
0.8175E+03	0.1853E+01
0.8175E+03	0.2779E+01
0.8175E+03	0.3705E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.2188E+01	0.4741E-03	0.5516E+00	0.1000E-03
0.2188E+02	0.4741E-02	0.5516E+01	0.1000E-02
0.1102E+03	0.2379E-01	0.2758E+02	0.5000E-02
0.2193E+03	0.4766E-01	0.5516E+02	0.1000E-01
0.4118E+03	0.9291E-01	0.1103E+03	0.2000E-01
0.7630E+03	0.1900E+00	0.2174E+03	0.5000E-01
0.9288E+03	0.2516E+00	0.2474E+03	0.8000E-01
0.1016E+04	0.2895E+00	0.2675E+03	0.1000E+00
0.1234E+04	0.4399E+00	0.3678E+03	0.2000E+00
0.1373E+04	0.7756E+00	0.5073E+03	0.5000E+00
0.1484E+04	0.1104E+01	0.6178E+03	0.8000E+00
0.1527E+04	0.1315E+01	0.6605E+03	0.1000E+01
0.1684E+04	0.2355E+01	0.8175E+03	0.2000E+01

Mill Cove New Bridge #6205
APile Analysis, Abutment 2
HP 14x117 - Half Plug



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=========================================================================
                              APILE 2025.11.1

                  A Program for Analyzing the Axial Capacity
                  and Short-term Settlement of Driven Piles
                            under Axial Loading.

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                        License Type : Network Version
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=========================================================================


Model ran by                : M. Johnescu

Path to file locations      : B:\Working\THORNTON TOMASETTI\2502334 MaineDOT Downeast
Bridges Phase II\09_Engineering\03_Robbinston\06_Apile\Half Plug\
Name of input data file     : Hp14X117 Abut 2 - 0.5 plugged 2025-08-13.ap11d
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Name of plot output file    : Hp14X117 Abut 2 - 0.5 plugged 2025-08-13.ap11p

-------------------------------------------------------------------------
                     Time and Date of Analysis
-------------------------------------------------------------------------

          Date:  August 13, 2025     Time:  13:16:18


1
          *********************
          * INPUT INFORMATION *
          *********************

          PROJECT DESCRIPTION   :
          Mill Cove Abutment 2 HP14X117 Partially Plugged
          DESIGNER   : GEI
          JOB NUMBER : 2502334

          METHOD FOR UNIT LOAD TRANSFERS :
          - FHWA (Federal Highway Administration)
            Unfactored Unit Side Friction and Unit Side Resistance are used.

          COMPUTATION METHOD(S) FOR PILE CAPACITY :
          - FHWA (Federal Highway Administration)

          TYPE OF LOADING :
          - COMPRESSION

          PILE TYPE :
          H-Pile/Steel Pile

           AVERAGE DEPTH TO ESTIMATE TIP RESISTANCE:
          - USE 1.5 DIAMETERS ABOVE AND BELOW TIP

          DATA FOR AXIAL STIFFNESS :
          - MODULUS OF ELASTICITY     = 0.290E+08 PSI
          - CROSS SECTION AREA        =    105.79 IN2

          NONCIRCULAR PILE PROPERTIES :
          - TOTAL PILE LENGTH, TL     =     76.20 FT.
          - BATTER ANGLE              =      0.00 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          =    105.79 IN2
          - INCREMENT OF PILE LENGTH
            USED IN COMPUTATION       =      1.00 FT.
          - PRINTING INCREMENT        =         1


          SOIL INFORMATIONS :

                             LATERAL    EFFECTIVE    FRICTION      Nq
                    SOIL     EARTH      UNIT         ANGLE       FACTOR
```

DEPTH FT.	TYPE	PRESSURE	WEIGHT LB/FT^3	DEGREES	FHWA
0.00	SAND	0.80*	125.00	34.00	55.60**
13.30	SAND	0.80*	125.00	34.00	55.60**
13.30	SAND	0.80*	62.60	34.00	55.60**
19.20	SAND	0.80*	62.60	34.00	55.60**
19.20	SAND	0.80*	67.60	36.00	77.60**
76.20	SAND	0.80*	67.60	36.00	77.60**
76.20	CLAY	0.80*	107.60	0.00	4.80**
85.00	CLAY	0.80*	107.60	0.00	4.80**

* VALUE ASSUMED BY THE PROGRAM
** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

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
0.10E+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
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
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
0.10E+08*	0.35E+04	1296.00	0.00	0.00	0.00	0.00
0.10E+08*	0.35E+04	1296.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
WERE SET TO LARGE VALUES INDICATING THAT APILE
USES THE LIMITS SPECIFIED BY EACH SELECTED
CRITERIA (IF ANY).

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
13.30	1.000	1.000
13.30	1.000	1.000
19.20	1.000	1.000
19.20	1.000	1.000
76.20	1.000	1.000
76.20	1.000	1.000
85.00	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.185 *	0.00
13.30	0.185 *	0.00
13.30	0.185 *	0.00
19.20	0.185 *	0.00
19.20	0.185 *	0.00
76.20	0.185 *	0.00
76.20	0.185 *	0.90 **
85.00	0.185 *	0.90 **

* DEFAULT VALUE = 0.01 D
** DEFAULT VALUE = 0.9

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****
* COMPUTATION RESULT *
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****
* FED. HWY. METHOD *
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PILE LENGTH   SKIN   END   ULTIMATE

BELOW GND. FT.	FRICTION KIP	BEARING KIP	CAPACITY KIP
0.00	0.0	2.0	2.0
1.00	0.2	4.0	4.3
2.00	1.0	6.8	7.8
3.00	2.2	10.2	12.3
4.00	3.9	13.5	17.4
5.00	6.1	16.9	23.0
6.00	8.7	20.3	29.1
7.00	11.9	23.7	35.6
8.00	15.5	27.1	42.6
9.00	19.7	30.5	50.1
10.00	24.3	33.8	58.1
11.00	29.4	37.2	66.6
12.00	35.0	40.6	75.6
13.00	41.1	43.7	84.7
14.00	47.6	46.4	94.0
15.00	54.5	48.8	103.3
16.00	61.7	50.7	112.4
17.00	69.1	52.1	121.2
18.00	76.8	55.2	131.9
19.00	84.7	62.7	147.4
20.00	92.8	70.5	163.4
21.00	102.4	78.7	181.0
22.00	113.4	87.3	200.7
23.00	124.7	92.0	216.8
24.00	136.4	94.7	231.1
25.00	148.4	97.4	245.8
26.00	160.8	100.0	260.8
27.00	173.5	102.7	276.2
28.00	186.5	105.4	291.9
29.00	199.9	107.7	307.5
30.00	213.5	109.4	323.0
31.00	227.6	110.6	338.2
32.00	241.9	111.2	353.2
33.00	256.6	111.4	368.0
34.00	271.6	111.4	383.0
35.00	287.0	111.4	398.4
36.00	302.7	111.4	414.1
37.00	318.7	111.4	430.1
38.00	335.1	111.4	446.5
39.00	351.8	111.4	463.2
40.00	368.8	111.4	480.2
41.00	386.2	111.4	497.6
42.00	403.9	111.4	515.3
43.00	421.9	111.4	533.3
44.00	440.3	111.4	551.7
45.00	459.0	111.4	570.4
46.00	478.1	111.4	589.4
47.00	497.4	111.4	608.8
48.00	517.2	111.4	628.5
49.00	537.2	111.4	648.6
50.00	557.6	111.4	668.9
51.00	578.3	111.4	689.7
52.00	599.3	111.4	710.7
53.00	620.7	111.4	732.1
54.00	642.4	111.4	753.8
55.00	664.5	111.4	775.9
56.00	686.9	111.4	798.2
57.00	709.6	111.4	821.0
58.00	732.6	111.4	844.0
59.00	756.0	111.4	867.4
60.00	779.7	111.4	891.1
61.00	803.8	111.4	915.2
62.00	828.2	111.4	939.6
63.00	852.9	111.4	964.3
64.00	878.0	111.4	989.3
65.00	903.4	111.4	1014.7
66.00	929.1	111.4	1040.5
67.00	955.2	111.4	1066.5
68.00	981.6	111.4	1092.9
69.00	1008.3	111.4	1119.7
70.00	1035.4	111.4	1146.7
71.00	1062.8	111.4	1174.1
72.00	1090.5	111.4	1201.9
73.00	1118.6	111.4	1229.9
74.00	1147.0	111.4	1258.3
75.00	1175.7	280.8	1456.5
76.00	1204.8	817.5	2022.3

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.

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**************************************************
* COMPUTE LOAD-DISTRIBUTION AND LOAD-SETTLEMENT *
* CURVES FOR AXIAL LOADING                      *
**************************************************
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T-Z CURVE NO.	NO. OF POINTS	DEPTH TO CURVE FT.	LOAD TRANSFER PSI	PILE MOVEMENT IN.
1	10	0.4167E-01		
			0.0000E+00	0.0000E+00
			0.8696E-02	0.2964E-01
			0.1449E-01	0.5743E-01
			0.2174E-01	0.1056E+00
			0.2609E-01	0.1482E+00
			0.2899E-01	0.1853E+00
			0.2899E-01	0.3705E+00
			0.2899E-01	0.5558E+00
			0.2899E-01	0.9263E+00
			0.2899E-01	0.3705E+01
2	10	0.6650E+01		
			0.0000E+00	0.0000E+00
			0.1388E+01	0.2964E-01
			0.2313E+01	0.5743E-01
			0.3470E+01	0.1056E+00
			0.4164E+01	0.1482E+00
			0.4627E+01	0.1853E+00
			0.4627E+01	0.3705E+00
			0.4627E+01	0.5558E+00
			0.4627E+01	0.9263E+00
			0.4627E+01	0.3705E+01
3	10	0.1326E+02		
			0.0000E+00	0.0000E+00
			0.2767E+01	0.2964E-01
			0.4612E+01	0.5743E-01
			0.6918E+01	0.1056E+00
			0.8302E+01	0.1482E+00
			0.9224E+01	0.1853E+00
			0.9224E+01	0.3705E+00
			0.9224E+01	0.5558E+00
			0.9224E+01	0.9263E+00
			0.9224E+01	0.3705E+01
4	10	0.1334E+02		
			0.0000E+00	0.0000E+00
			0.2785E+01	0.2964E-01
			0.4641E+01	0.5743E-01
			0.6961E+01	0.1056E+00
			0.8354E+01	0.1482E+00
			0.9282E+01	0.1853E+00
			0.9282E+01	0.3705E+00
			0.9282E+01	0.5558E+00
			0.9282E+01	0.9263E+00
			0.9282E+01	0.3705E+01
5	10	0.1625E+02		
			0.0000E+00	0.0000E+00
			0.3157E+01	0.2964E-01
			0.5262E+01	0.5743E-01
			0.7893E+01	0.1056E+00
			0.9472E+01	0.1482E+00
			0.1052E+02	0.1853E+00
			0.1052E+02	0.3705E+00
			0.1052E+02	0.5558E+00
			0.1052E+02	0.9263E+00
			0.1052E+02	0.3705E+01
6	10	0.1916E+02		
			0.0000E+00	0.0000E+00
			0.3461E+01	0.2964E-01
			0.5769E+01	0.5743E-01
			0.8653E+01	0.1056E+00
			0.1038E+02	0.1482E+00
			0.1154E+02	0.1853E+00
			0.1154E+02	0.3705E+00

			0.1154E+02	0.5558E+00
			0.1154E+02	0.9263E+00
			0.1154E+02	0.3705E+01
7	10	0.1924E+02		
			0.0000E+00	0.0000E+00
			0.3470E+01	0.2964E-01
			0.5783E+01	0.5743E-01
			0.8675E+01	0.1056E+00
			0.1041E+02	0.1482E+00
			0.1157E+02	0.1853E+00
			0.1157E+02	0.3705E+00
			0.1157E+02	0.5558E+00
			0.1157E+02	0.9263E+00
			0.1157E+02	0.3705E+01
8	10	0.4770E+02		
			0.0000E+00	0.0000E+00
			0.8495E+01	0.2964E-01
			0.1416E+02	0.5743E-01
			0.2124E+02	0.1056E+00
			0.2548E+02	0.1482E+00
			0.2832E+02	0.1853E+00
			0.2832E+02	0.3705E+00
			0.2832E+02	0.5558E+00
			0.2832E+02	0.9263E+00
			0.2832E+02	0.3705E+01
9	10	0.7616E+02		
			0.0000E+00	0.0000E+00
			0.1256E+02	0.2964E-01
			0.2093E+02	0.5743E-01
			0.3140E+02	0.1056E+00
			0.3768E+02	0.1482E+00
			0.4187E+02	0.1853E+00
			0.4187E+02	0.3705E+00
			0.4187E+02	0.5558E+00
			0.4187E+02	0.9263E+00
			0.4187E+02	0.3705E+01
10	10	0.7624E+02		
			0.0000E+00	0.0000E+00
			0.1256E+02	0.2964E-01
			0.2093E+02	0.5743E-01
			0.3140E+02	0.1056E+00
			0.3768E+02	0.1482E+00
			0.4187E+02	0.1853E+00
			0.3768E+02	0.3705E+00
			0.3768E+02	0.5558E+00
			0.3768E+02	0.9263E+00
			0.3768E+02	0.3705E+01
11	10	0.8060E+02		
			0.0000E+00	0.0000E+00
			0.1256E+02	0.2964E-01
			0.2093E+02	0.5743E-01
			0.3140E+02	0.1056E+00
			0.3768E+02	0.1482E+00
			0.4187E+02	0.1853E+00
			0.3768E+02	0.3705E+00
			0.3768E+02	0.5558E+00
			0.3768E+02	0.9263E+00
			0.3768E+02	0.3705E+01
12	10	0.8496E+02		
			0.0000E+00	0.0000E+00
			0.1256E+02	0.2964E-01
			0.2093E+02	0.5743E-01
			0.3140E+02	0.1056E+00
			0.3768E+02	0.1482E+00
			0.4187E+02	0.1853E+00
			0.3768E+02	0.3705E+00
			0.3768E+02	0.5558E+00
			0.3768E+02	0.9263E+00
			0.3768E+02	0.3705E+01

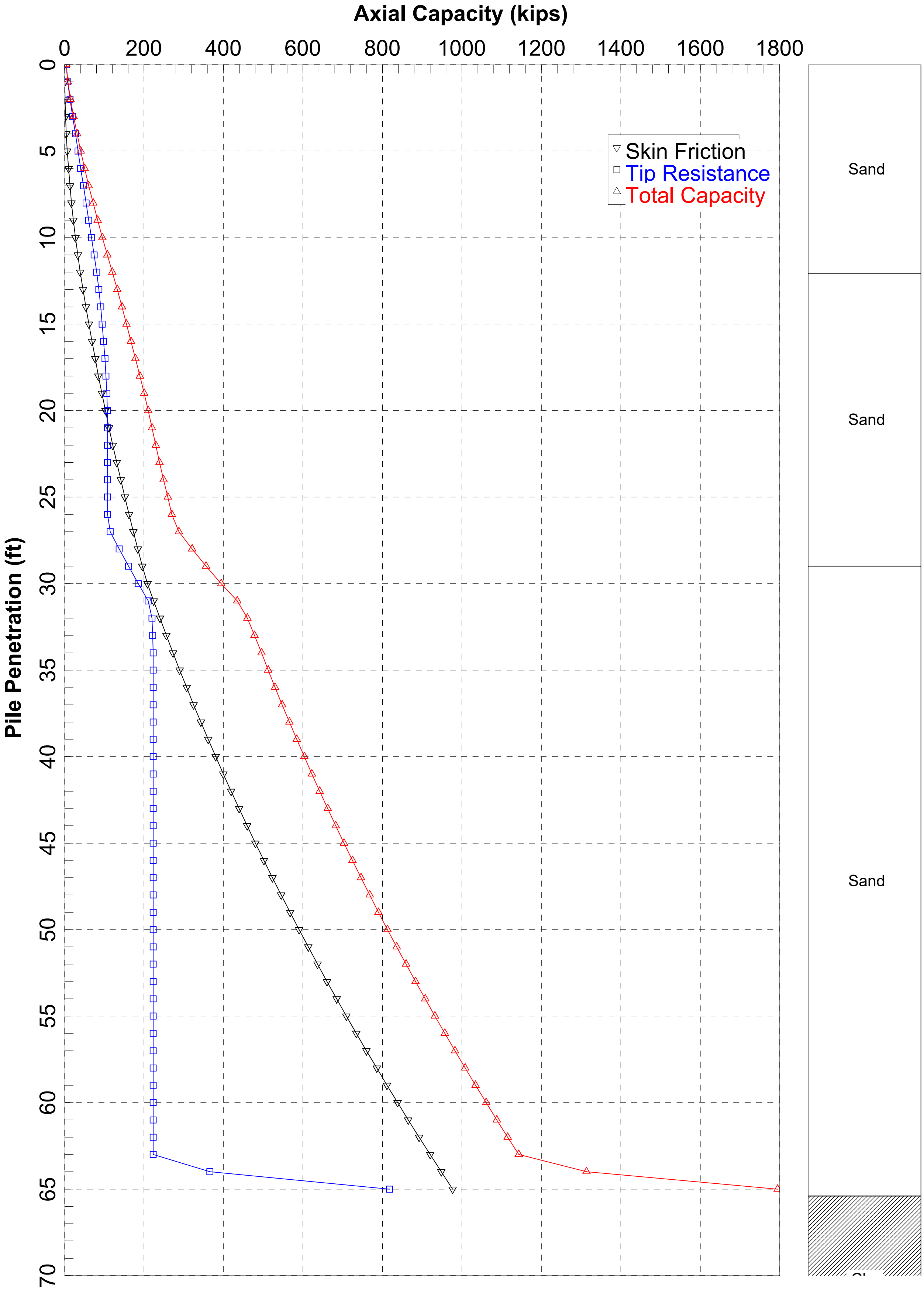
TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.5109E+02	0.9263E-02
0.1022E+03	0.1853E-01
0.2044E+03	0.3705E-01
0.4087E+03	0.2408E+00

0.6131E+03	0.7781E+00
0.7357E+03	0.1352E+01
0.8175E+03	0.1853E+01
0.8175E+03	0.2779E+01
0.8175E+03	0.3705E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.3342E+01	0.6986E-03	0.5516E+00	0.1000E-03
0.3342E+02	0.6986E-02	0.5516E+01	0.1000E-02
0.1689E+03	0.3516E-01	0.2758E+02	0.5000E-02
0.3279E+03	0.6982E-01	0.5516E+02	0.1000E-01
0.5918E+03	0.1327E+00	0.1103E+03	0.2000E-01
0.1044E+04	0.2598E+00	0.2174E+03	0.5000E-01
0.1243E+04	0.3353E+00	0.2474E+03	0.8000E-01
0.1343E+04	0.3798E+00	0.2675E+03	0.1000E+00
0.1578E+04	0.5441E+00	0.3678E+03	0.2000E+00
0.1718E+04	0.8857E+00	0.5073E+03	0.5000E+00
0.1828E+04	0.1219E+01	0.6178E+03	0.8000E+00
0.1871E+04	0.1431E+01	0.6605E+03	0.1000E+01
0.2028E+04	0.2478E+01	0.8175E+03	0.2000E+01

Mill Cove New Bridge #6205
APile Analysis, Abutment 1
HP 14x117 - Full Plug



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====================================================================

              APILE for Windows, Version 2023.10.5

               Serial Number : 264781180


               A Program for Analyzing the Axial Capacity
               and Short-term Settlement of Driven Piles
                         under Axial Loading.
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====================================================================


This program is licensed to :

GEI Consultants, Inc.
Woburn, MA, USA

Path to file locations      : C:\Users\juabet3911\OneDrive - GEI Consultants,
Inc\Desktop\Nicolas\Projects\TT_Downeast Phase II\Robbinston\APILE\
Name of input data file     : Hp14X117 Abut 1_Fully Plugged.ap10d
Name of output file         : Hp14X117 Abut 1_Fully Plugged.ap10o
Name of plot output file    : Hp14X117 Abut 1_Fully Plugged.ap10p

--------------------------------------------------------------------
                     Time and Date of Analysis
--------------------------------------------------------------------

          Date:  July 24, 2025     Time:  17:09:08



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     *********************
     * INPUT INFORMATION *
     *********************

     PROJECT DESCRIPTION   :
     Mill Cove Abutment 1 HP14X117 - Fully Plugged
     DESIGNER   : GEI
     JOB NUMBER : 2502334

     METHOD FOR UNIT LOAD TRANSFERS :
     - FHWA (Federal Highway Administration)
       Unfactored Unit Side Friction and Unit Side Resistance are used.

     COMPUTATION METHOD(S) FOR PILE CAPACITY :
```

- FHWA (Federal Highway Administration)

TYPE OF LOADING :
- COMPRESSION

PILE TYPE :
H-Pile/Steel Pile

AVERAGE DEPTH TO ESTIMATE TIP RESISTANCE:
- USE 1.5 DIAMETERS ABOVE AND BELOW TIP

DATA FOR AXIAL STIFFNESS :
- MODULUS OF ELASTICITY = 0.290E+08 PSI
- CROSS SECTION AREA = 211.58 IN2

NONCIRCULAR PILE PROPERTIES :
- TOTAL PILE LENGTH, TL = 65.40 FT.
- BATTER ANGLE = 0.00 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 = 211.58 IN2
- INCREMENT OF PILE LENGTH
  USED IN COMPUTATION = 1.00 FT.
- PRINTING INCREMENT = 1

SOIL INFORMATIONS :

DEPTH FT.	SOIL TYPE	LATERAL EARTH PRESSURE	EFFECTIVE UNIT WEIGHT LB/FT^3	FRICTION ANGLE DEGREES	Nq FACTOR FHWA
0.00	SAND	0.80*	125.00	34.00	55.60**
12.10	SAND	0.80*	125.00	34.00	55.60**
12.10	SAND	0.80*	62.60	34.00	55.60**
29.00	SAND	0.80*	62.60	34.00	55.60**
29.00	SAND	0.80*	67.60	36.00	77.60**
65.40	SAND	0.80*	67.60	36.00	77.60**
65.40	CLAY	0.80*	107.60	0.00	4.80**
75.00	CLAY	0.80*	107.60	0.00	4.80**

* VALUE ASSUMED BY THE PROGRAM
** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

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

0.10E+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
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
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
0.10E+08*	0.16E+04	1296.00	0.00	0.00	0.00	0.00
0.10E+08*	0.16E+04	1296.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
WERE SET TO LARGE VALUES INDICATING THAT APILE
USES THE LIMITS SPECIFIED BY EACH SELECTED
CRITERIA (IF ANY).

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
12.10	1.000	1.000
12.10	1.000	1.000
29.00	1.000	1.000
29.00	1.000	1.000
65.40	1.000	1.000
65.40	1.000	1.000
75.00	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.185 *	0.00
12.10	0.185 *	0.00
12.10	0.185 *	0.00
29.00	0.185 *	0.00
29.00	0.185 *	0.00
65.40	0.185 *	0.00
65.40	0.185 *	0.90 **
75.00	0.185 *	0.90 **

* DEFAULT VALUE = 0.01 D
** DEFAULT VALUE = 0.9

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****
* COMPUTATION RESULT *

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****
* FED. HWY. METHOD *
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PILE LENGTH BELOW GND. FT.	SKIN FRICTION KIP	END BEARING KIP	ULTIMATE CAPACITY KIP
0.00	0.0	3.9	3.9
1.00	0.3	8.0	8.3
2.00	1.1	13.6	14.7
3.00	2.5	20.3	22.8
4.00	4.4	27.1	31.5
5.00	6.8	33.8	40.7
6.00	9.9	40.6	50.5
7.00	13.4	47.4	60.8
8.00	17.5	54.1	71.7
9.00	22.2	60.9	83.1
10.00	27.4	67.7	95.1
11.00	33.1	74.4	107.6
12.00	39.4	80.6	120.0
13.00	46.3	86.0	132.3
14.00	53.5	90.7	144.3
15.00	61.1	94.7	155.8
16.00	68.9	98.2	167.0
17.00	77.0	101.5	178.4
18.00	85.3	104.2	189.5
19.00	94.0	106.2	200.1
20.00	102.9	107.4	210.3
21.00	112.0	108.0	220.0
22.00	121.5	108.0	229.5
23.00	131.2	108.0	239.2
24.00	141.2	108.0	249.2
25.00	151.5	108.0	259.5
26.00	162.0	108.0	270.1
27.00	172.9	114.9	287.7
28.00	184.0	137.3	321.3
29.00	195.3	160.9	356.3
30.00	208.7	185.5	394.2
31.00	224.2	210.2	434.4
32.00	240.0	220.0	460.0
33.00	256.2	221.9	478.1
34.00	272.8	222.7	495.5
35.00	289.7	222.7	512.5
36.00	307.1	222.7	529.8

37.00	324.8	222.7	547.6
38.00	342.9	222.7	565.7
39.00	361.4	222.7	584.2
40.00	380.3	222.7	603.1
41.00	399.6	222.7	622.3
42.00	419.2	222.7	642.0
43.00	439.3	222.7	662.0
44.00	459.7	222.7	682.4
45.00	480.5	222.7	703.2
46.00	501.6	222.7	724.4
47.00	523.2	222.7	745.9
48.00	545.1	222.7	767.9
49.00	567.5	222.7	790.2
50.00	590.2	222.7	812.9
51.00	613.3	222.7	836.0
52.00	636.7	222.7	859.5
53.00	660.6	222.7	883.3
54.00	684.8	222.7	907.6
55.00	709.4	222.7	932.2
56.00	734.4	222.7	957.2
57.00	759.8	222.7	982.6
58.00	785.6	222.7	1008.3
59.00	811.7	222.7	1034.5
60.00	838.3	222.7	1061.0
61.00	865.2	222.7	1087.9
62.00	892.5	222.7	1115.2
63.00	920.2	222.7	1142.9
64.00	948.2	365.5	1313.7
65.00	976.7	817.7	1794.4

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	0.4167E-01		
			0.0000E+00	0.0000E+00
			0.9804E-02	0.2964E-01

			0.1634E-01	0.5743E-01
			0.2451E-01	0.1056E+00
			0.2941E-01	0.1482E+00
			0.3268E-01	0.1853E+00
			0.3268E-01	0.3705E+00
			0.3268E-01	0.5558E+00
			0.3268E-01	0.9263E+00
			0.3268E-01	0.3705E+01
2	10	0.6050E+01		
			0.0000E+00	0.0000E+00
			0.1424E+01	0.2964E-01
			0.2373E+01	0.5743E-01
			0.3559E+01	0.1056E+00
			0.4271E+01	0.1482E+00
			0.4745E+01	0.1853E+00
			0.4745E+01	0.3705E+00
			0.4745E+01	0.5558E+00
			0.4745E+01	0.9263E+00
			0.4745E+01	0.3705E+01
3	10	0.1206E+02		
			0.0000E+00	0.0000E+00
			0.2837E+01	0.2964E-01
			0.4729E+01	0.5743E-01
			0.7093E+01	0.1056E+00
			0.8512E+01	0.1482E+00
			0.9458E+01	0.1853E+00
			0.9458E+01	0.3705E+00
			0.9458E+01	0.5558E+00
			0.9458E+01	0.9263E+00
			0.9458E+01	0.3705E+01
4	10	0.1214E+02		
			0.0000E+00	0.0000E+00
			0.2857E+01	0.2964E-01
			0.4762E+01	0.5743E-01
			0.7142E+01	0.1056E+00
			0.8571E+01	0.1482E+00
			0.9523E+01	0.1853E+00
			0.9523E+01	0.3705E+00
			0.9523E+01	0.5558E+00
			0.9523E+01	0.9263E+00
			0.9523E+01	0.3705E+01
5	10	0.2055E+02		
			0.0000E+00	0.0000E+00
			0.3949E+01	0.2964E-01
			0.6581E+01	0.5743E-01
			0.9872E+01	0.1056E+00
			0.1185E+02	0.1482E+00
			0.1316E+02	0.1853E+00
			0.1316E+02	0.3705E+00
			0.1316E+02	0.5558E+00

			0.1316E+02	0.9263E+00
			0.1316E+02	0.3705E+01
6	10	0.2896E+02		
			0.0000E+00	0.0000E+00
			0.4939E+01	0.2964E-01
			0.8232E+01	0.5743E-01
			0.1235E+02	0.1056E+00
			0.1482E+02	0.1482E+00
			0.1646E+02	0.1853E+00
			0.1646E+02	0.3705E+00
			0.1646E+02	0.5558E+00
			0.1646E+02	0.9263E+00
			0.1646E+02	0.3705E+01
7	10	0.2904E+02		
			0.0000E+00	0.0000E+00
			0.5011E+01	0.2964E-01
			0.8352E+01	0.5743E-01
			0.1253E+02	0.1056E+00
			0.1503E+02	0.1482E+00
			0.1670E+02	0.1853E+00
			0.1670E+02	0.3705E+00
			0.1670E+02	0.5558E+00
			0.1670E+02	0.9263E+00
			0.1670E+02	0.3705E+01
8	10	0.4720E+02		
			0.0000E+00	0.0000E+00
			0.9376E+01	0.2964E-01
			0.1563E+02	0.5743E-01
			0.2344E+02	0.1056E+00
			0.2813E+02	0.1482E+00
			0.3125E+02	0.1853E+00
			0.3125E+02	0.3705E+00
			0.3125E+02	0.5558E+00
			0.3125E+02	0.9263E+00
			0.3125E+02	0.3705E+01
9	10	0.6536E+02		
			0.0000E+00	0.0000E+00
			0.1230E+02	0.2964E-01
			0.2050E+02	0.5743E-01
			0.3075E+02	0.1056E+00
			0.3690E+02	0.1482E+00
			0.4100E+02	0.1853E+00
			0.4100E+02	0.3705E+00
			0.4100E+02	0.5558E+00
			0.4100E+02	0.9263E+00
			0.4100E+02	0.3705E+01
10	10	0.6544E+02		
			0.0000E+00	0.0000E+00
			0.1230E+02	0.2964E-01
			0.2050E+02	0.5743E-01

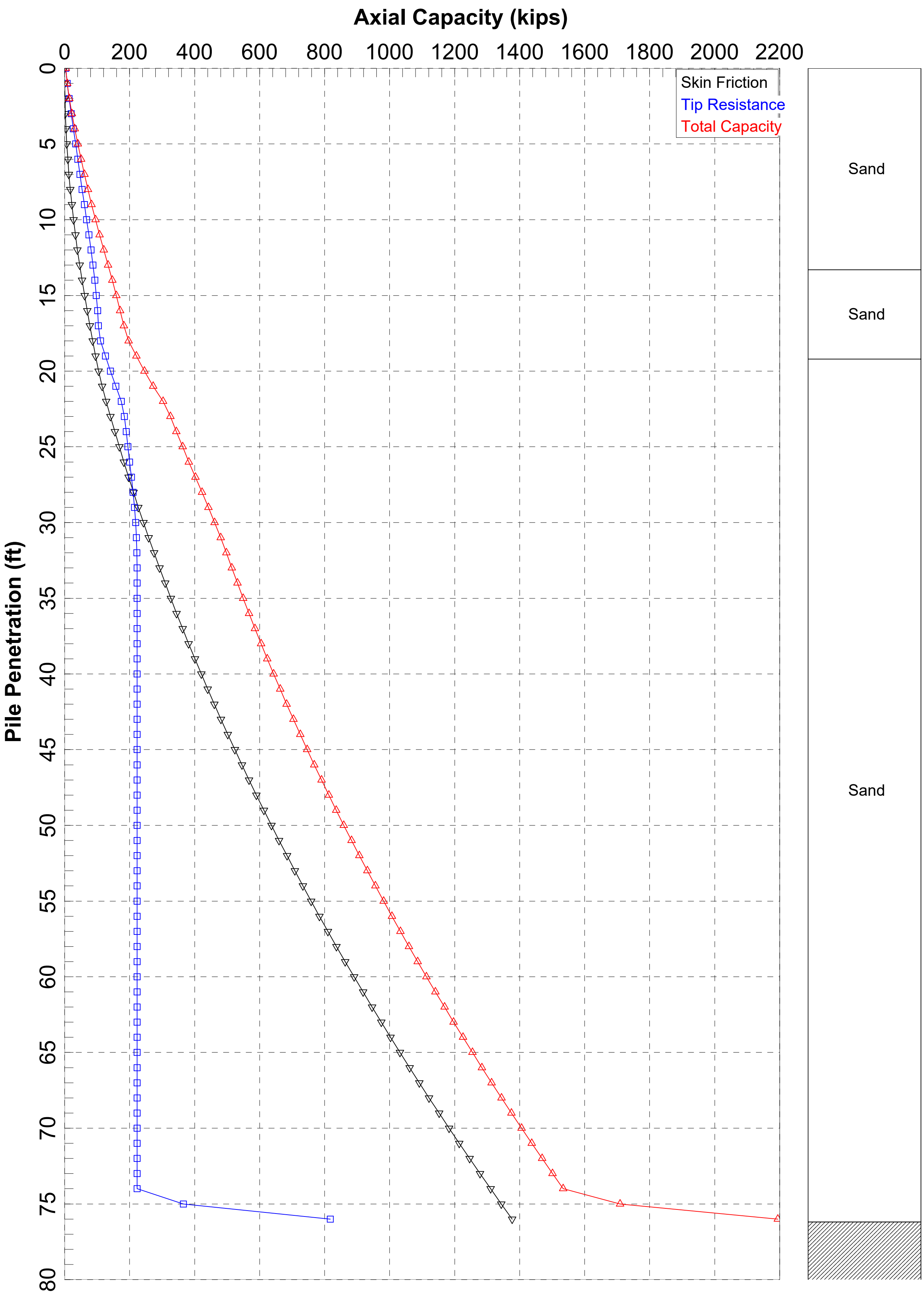
			0.3075E+02	0.1056E+00
			0.3690E+02	0.1482E+00
			0.4100E+02	0.1853E+00
			0.3690E+02	0.3705E+00
			0.3690E+02	0.5558E+00
			0.3690E+02	0.9263E+00
			0.3690E+02	0.3705E+01
11	10	0.7020E+02		
			0.0000E+00	0.0000E+00
			0.1230E+02	0.2964E-01
			0.2050E+02	0.5743E-01
			0.3075E+02	0.1056E+00
			0.3690E+02	0.1482E+00
			0.4100E+02	0.1853E+00
			0.3690E+02	0.3705E+00
			0.3690E+02	0.5558E+00
			0.3690E+02	0.9263E+00
			0.3690E+02	0.3705E+01
12	10	0.7496E+02		
			0.0000E+00	0.0000E+00
			0.1230E+02	0.2964E-01
			0.2050E+02	0.5743E-01
			0.3075E+02	0.1056E+00
			0.3690E+02	0.1482E+00
			0.4100E+02	0.1853E+00
			0.3690E+02	0.3705E+00
			0.3690E+02	0.5558E+00
			0.3690E+02	0.9263E+00
			0.3690E+02	0.3705E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.5111E+02	0.9263E-02
0.1022E+03	0.1853E-01
0.2044E+03	0.3705E-01
0.4089E+03	0.2408E+00
0.6133E+03	0.7781E+00
0.7359E+03	0.1352E+01
0.8177E+03	0.1853E+01
0.8177E+03	0.2779E+01
0.8177E+03	0.3705E+01

LOAD VERSUS SETTLEMENT CURVE
****

TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.1983E+01	0.2794E-03	0.5517E+00	0.1000E-03
0.1983E+02	0.2794E-02	0.5517E+01	0.1000E-02
0.9917E+02	0.1397E-01	0.2759E+02	0.5000E-02
0.1992E+03	0.2799E-01	0.5517E+02	0.1000E-01
0.3906E+03	0.5576E-01	0.1103E+03	0.2000E-01
0.7620E+03	0.1212E+00	0.2174E+03	0.5000E-01
0.9590E+03	0.1691E+00	0.2475E+03	0.8000E-01
0.1071E+04	0.1998E+00	0.2676E+03	0.1000E+00
0.1356E+04	0.3304E+00	0.3679E+03	0.2000E+00
0.1495E+04	0.6482E+00	0.5075E+03	0.5000E+00
0.1606E+04	0.9624E+00	0.6180E+03	0.8000E+00
0.1649E+04	0.1168E+01	0.6607E+03	0.1000E+01
0.1806E+04	0.2188E+01	0.8177E+03	0.2000E+01

Mill Cove New Bridge #6205
APile Analysis, Abutment 2
HP 14x117 - Full Plug



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      ========================================================================

                                 APILE 2025.11.1

                    A Program for Analyzing the Axial Capacity
                    and Short-term Settlement of Driven Piles
                              under Axial Loading.

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      ========================================================================


      Model ran by                : M. Johnescu

      Path to file locations      : B:\Working\THORNTON TOMASETTI\2502334 MaineDOT Downeast
 Bridges Phase II\09_Engineering\03_Robbinston\06_Apile\Plug\
      Name of input data file     : Hp14X117 Abut 2_Fully Plugged 2025-08-13.ap11d
      Name of output file         : Hp14X117 Abut 2_Fully Plugged 2025-08-13.ap11o
      Name of plot output file    : Hp14X117 Abut 2_Fully Plugged 2025-08-13.ap11p

      ------------------------------------------------------------------------
                          Time and Date of Analysis
      ------------------------------------------------------------------------

                Date:  August 13, 2025     Time:  13:23:17



1
           *********************
           * INPUT INFORMATION *
           *********************

           PROJECT DESCRIPTION   :
           Mill Cove Abutment 2 HP14X117 - Fully Plugged
           DESIGNER   : GEI
           JOB NUMBER : 2502334

           METHOD FOR UNIT LOAD TRANSFERS :
           - FHWA (Federal Highway Administration)
             Unfactored Unit Side Friction and Unit Side Resistance are used.

           COMPUTATION METHOD(S) FOR PILE CAPACITY :
           - FHWA (Federal Highway Administration)

           TYPE OF LOADING :
           - COMPRESSION

           PILE TYPE :
           H-Pile/Steel Pile

            AVERAGE DEPTH TO ESTIMATE TIP RESISTANCE:
           - USE 1.5 DIAMETERS ABOVE AND BELOW TIP

           DATA FOR AXIAL STIFFNESS :
           - MODULUS OF ELASTICITY     = 0.290E+08 PSI
           - CROSS SECTION AREA        =    211.58 IN2

           NONCIRCULAR PILE PROPERTIES :
           - TOTAL PILE LENGTH, TL     =     76.20 FT.
           - BATTER ANGLE              =      0.00 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          =    211.58 IN2
           - INCREMENT OF PILE LENGTH
             USED IN COMPUTATION       =      1.00 FT.
           - PRINTING INCREMENT        =         1


           SOIL INFORMATIONS :

                            LATERAL     EFFECTIVE    FRICTION      Nq
                    SOIL    EARTH       UNIT         ANGLE       FACTOR
```

DEPTH FT.	TYPE	PRESSURE	WEIGHT LB/FT^3	DEGREES	FHWA
0.00	SAND	0.80*	125.00	34.00	55.60**
13.30	SAND	0.80*	125.00	34.00	55.60**
13.30	SAND	0.80*	62.60	34.00	55.60**
19.20	SAND	0.80*	62.60	34.00	55.60**
19.20	SAND	0.80*	67.60	36.00	77.60**
76.20	SAND	0.80*	67.60	36.00	77.60**
76.20	CLAY	0.80*	107.60	0.00	4.80**
86.00	CLAY	0.80*	107.60	0.00	4.80**

* VALUE ASSUMED BY THE PROGRAM
** VALUE ESTIMATED BY THE PROGRAM BASED ON FRICTION ANGLE

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
0.10E+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
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
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
0.10E+08*	0.16E+04	1296.00	0.00	0.00	0.00	0.00
0.10E+08*	0.16E+04	1296.00	0.00	0.00	0.00	0.00

* MAXIMUM UNIT FRICTION AND/OR MAXIMUM UNIT BEARING
  WERE SET TO LARGE VALUES INDICATING THAT APILE
  USES THE LIMITS SPECIFIED BY EACH SELECTED
  CRITERIA (IF ANY).

DEPTH FT.	LRFD FACTOR ON UNIT FRICTION	LRFD FACTOR ON UNIT BEARING
0.00	1.000	1.000
13.30	1.000	1.000
13.30	1.000	1.000
19.20	1.000	1.000
19.20	1.000	1.000
76.20	1.000	1.000
76.20	1.000	1.000
86.00	1.000	1.000

DEPTH FT.	Z PEAK IN.	T RESIDUAL
0.00	0.185 *	0.00
13.30	0.185 *	0.00
13.30	0.185 *	0.00
19.20	0.185 *	0.00
19.20	0.185 *	0.00
76.20	0.185 *	0.00
76.20	0.185 *	0.90 **
86.00	0.185 *	0.90 **

* DEFAULT VALUE = 0.01 D
** DEFAULT VALUE = 0.9

1

****
* COMPUTATION RESULT *
****

****
* FED. HWY. METHOD *
****

PILE LENGTH   SKIN   END   ULTIMATE

BELOW GND.	FRICTION	BEARING	CAPACITY
FT.	KIP	KIP	KIP
0.00	0.0	3.9	3.9
1.00	0.3	8.0	8.3
2.00	1.1	13.6	14.7
3.00	2.5	20.3	22.8
4.00	4.4	27.1	31.5
5.00	6.8	33.8	40.7
6.00	9.9	40.6	50.5
7.00	13.4	47.4	60.8
8.00	17.5	54.1	71.7
9.00	22.2	60.9	83.1
10.00	27.4	67.7	95.1
11.00	33.1	74.5	107.6
12.00	39.4	81.2	120.6
13.00	46.3	87.4	133.6
14.00	53.7	92.8	146.5
15.00	61.5	97.5	159.0
16.00	69.6	101.4	171.0
17.00	77.9	104.2	182.1
18.00	86.6	110.3	196.9
19.00	95.5	125.5	220.9
20.00	104.6	141.1	245.7
21.00	115.5	157.3	272.8
22.00	128.1	174.7	302.8
23.00	141.1	184.1	325.2
24.00	154.5	189.4	343.9
25.00	168.2	194.8	363.0
26.00	182.3	200.1	382.4
27.00	196.9	205.4	402.3
28.00	211.8	210.7	422.5
29.00	227.0	215.4	442.4
30.00	242.7	218.9	461.6
31.00	258.7	221.2	480.0
32.00	275.2	222.5	497.6
33.00	292.0	222.7	514.7
34.00	309.2	222.7	531.9
35.00	326.8	222.7	549.5
36.00	344.7	222.7	567.5
37.00	363.1	222.7	585.8
38.00	381.8	222.7	604.5
39.00	400.9	222.7	623.6
40.00	420.4	222.7	643.1
41.00	440.2	222.7	663.0
42.00	460.5	222.7	683.2
43.00	481.1	222.7	703.9
44.00	502.2	222.7	724.9
45.00	523.6	222.7	746.3
46.00	545.3	222.7	768.1
47.00	567.5	222.7	790.3
48.00	590.1	222.7	812.8
49.00	613.0	222.7	835.7
50.00	636.3	222.7	859.0
51.00	660.0	222.7	882.7
52.00	684.1	222.7	906.8
53.00	708.5	222.7	931.3
54.00	733.4	222.7	956.1
55.00	758.6	222.7	981.4
56.00	784.2	222.7	1007.0
57.00	810.2	222.7	1033.0
58.00	836.6	222.7	1059.3
59.00	863.3	222.7	1086.1
60.00	890.5	222.7	1113.2
61.00	918.0	222.7	1140.8
62.00	945.9	222.7	1168.7
63.00	974.2	222.7	1196.9
64.00	1002.9	222.7	1225.6
65.00	1031.9	222.7	1254.7
66.00	1061.4	222.7	1284.1
67.00	1091.2	222.7	1313.9
68.00	1121.4	222.7	1344.1
69.00	1152.0	222.7	1374.7
70.00	1182.9	222.7	1405.7
71.00	1214.3	222.7	1437.0
72.00	1246.0	222.7	1468.8
73.00	1278.1	222.7	1500.9
74.00	1310.6	222.7	1533.4
75.00	1343.5	365.5	1709.0
76.00	1376.8	817.7	2194.5

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.

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*************************************************
* 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	0.4167E-01		
			0.0000E+00	0.0000E+00
			0.9804E-02	0.2964E-01
			0.1634E-01	0.5743E-01
			0.2451E-01	0.1056E+00
			0.2941E-01	0.1482E+00
			0.3268E-01	0.1853E+00
			0.3268E-01	0.3705E+00
			0.3268E-01	0.5558E+00
			0.3268E-01	0.9263E+00
			0.3268E-01	0.3705E+01
2	10	0.6650E+01		
			0.0000E+00	0.0000E+00
			0.1565E+01	0.2964E-01
			0.2608E+01	0.5743E-01
			0.3912E+01	0.1056E+00
			0.4694E+01	0.1482E+00
			0.5216E+01	0.1853E+00
			0.5216E+01	0.3705E+00
			0.5216E+01	0.5558E+00
			0.5216E+01	0.9263E+00
			0.5216E+01	0.3705E+01
3	10	0.1326E+02		
			0.0000E+00	0.0000E+00
			0.3120E+01	0.2964E-01
			0.5200E+01	0.5743E-01
			0.7799E+01	0.1056E+00
			0.9359E+01	0.1482E+00
			0.1040E+02	0.1853E+00
			0.1040E+02	0.3705E+00
			0.1040E+02	0.5558E+00
			0.1040E+02	0.9263E+00
			0.1040E+02	0.3705E+01
4	10	0.1334E+02		
			0.0000E+00	0.0000E+00
			0.3139E+01	0.2964E-01
			0.5232E+01	0.5743E-01
			0.7848E+01	0.1056E+00
			0.9418E+01	0.1482E+00
			0.1046E+02	0.1853E+00
			0.1046E+02	0.3705E+00
			0.1046E+02	0.5558E+00
			0.1046E+02	0.9263E+00
			0.1046E+02	0.3705E+01
5	10	0.1625E+02		
			0.0000E+00	0.0000E+00
			0.3559E+01	0.2964E-01
			0.5932E+01	0.5743E-01
			0.8898E+01	0.1056E+00
			0.1068E+02	0.1482E+00
			0.1186E+02	0.1853E+00
			0.1186E+02	0.3705E+00
			0.1186E+02	0.5558E+00
			0.1186E+02	0.9263E+00
			0.1186E+02	0.3705E+01
6	10	0.1916E+02		
			0.0000E+00	0.0000E+00
			0.3902E+01	0.2964E-01
			0.6503E+01	0.5743E-01
			0.9755E+01	0.1056E+00
			0.1171E+02	0.1482E+00
			0.1301E+02	0.1853E+00
			0.1301E+02	0.3705E+00

			0.1301E+02	0.5558E+00
			0.1301E+02	0.9263E+00
			0.1301E+02	0.3705E+01
7	10	0.1924E+02		
			0.0000E+00	0.0000E+00
			0.3912E+01	0.2964E-01
			0.6520E+01	0.5743E-01
			0.9780E+01	0.1056E+00
			0.1174E+02	0.1482E+00
			0.1304E+02	0.1853E+00
			0.1304E+02	0.3705E+00
			0.1304E+02	0.5558E+00
			0.1304E+02	0.9263E+00
			0.1304E+02	0.3705E+01
8	10	0.4770E+02		
			0.0000E+00	0.0000E+00
			0.9719E+01	0.2964E-01
			0.1620E+02	0.5743E-01
			0.2430E+02	0.1056E+00
			0.2916E+02	0.1482E+00
			0.3240E+02	0.1853E+00
			0.3240E+02	0.3705E+00
			0.3240E+02	0.5558E+00
			0.3240E+02	0.9263E+00
			0.3240E+02	0.3705E+01
9	10	0.7616E+02		
			0.0000E+00	0.0000E+00
			0.1437E+02	0.2964E-01
			0.2395E+02	0.5743E-01
			0.3592E+02	0.1056E+00
			0.4311E+02	0.1482E+00
			0.4790E+02	0.1853E+00
			0.4790E+02	0.3705E+00
			0.4790E+02	0.5558E+00
			0.4790E+02	0.9263E+00
			0.4790E+02	0.3705E+01
10	10	0.7624E+02		
			0.0000E+00	0.0000E+00
			0.1437E+02	0.2964E-01
			0.2395E+02	0.5743E-01
			0.3592E+02	0.1056E+00
			0.4311E+02	0.1482E+00
			0.4790E+02	0.1853E+00
			0.4311E+02	0.3705E+00
			0.4311E+02	0.5558E+00
			0.4311E+02	0.9263E+00
			0.4311E+02	0.3705E+01
11	10	0.8110E+02		
			0.0000E+00	0.0000E+00
			0.1437E+02	0.2964E-01
			0.2395E+02	0.5743E-01
			0.3592E+02	0.1056E+00
			0.4311E+02	0.1482E+00
			0.4790E+02	0.1853E+00
			0.4311E+02	0.3705E+00
			0.4311E+02	0.5558E+00
			0.4311E+02	0.9263E+00
			0.4311E+02	0.3705E+01
12	10	0.8596E+02		
			0.0000E+00	0.0000E+00
			0.1437E+02	0.2964E-01
			0.2395E+02	0.5743E-01
			0.3592E+02	0.1056E+00
			0.4311E+02	0.1482E+00
			0.4790E+02	0.1853E+00
			0.4311E+02	0.3705E+00
			0.4311E+02	0.5558E+00
			0.4311E+02	0.9263E+00
			0.4311E+02	0.3705E+01

TIP LOAD KIP	TIP MOVEMENT IN.
0.0000E+00	0.0000E+00
0.5111E+02	0.9263E-02
0.1022E+03	0.1853E-01
0.2044E+03	0.3705E-01
0.4089E+03	0.2408E+00

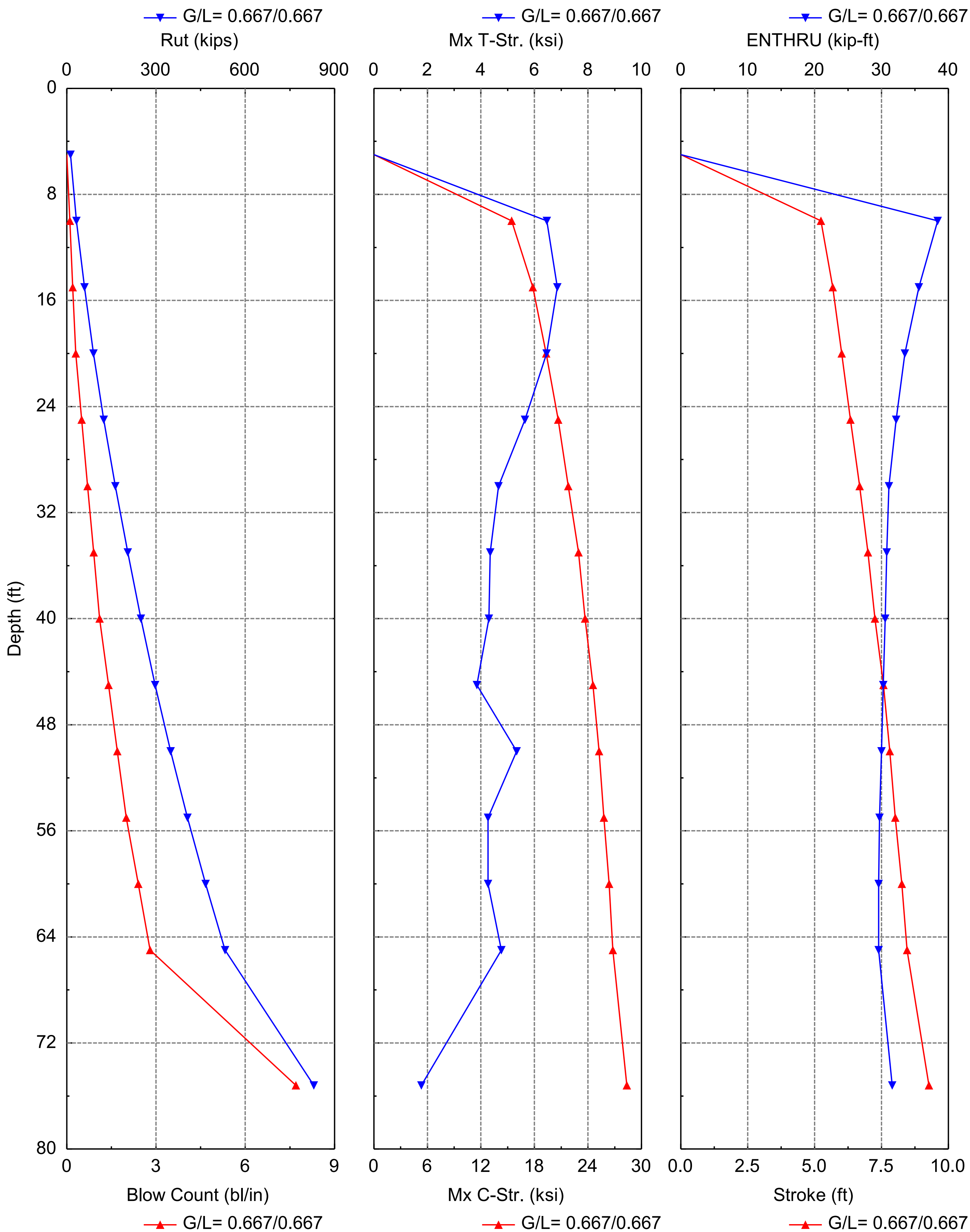
0.6133E+03	0.7781E+00
0.7359E+03	0.1352E+01
0.8177E+03	0.1853E+01
0.8177E+03	0.2779E+01
0.8177E+03	0.3705E+01

LOAD VERSUS SETTLEMENT CURVE
****

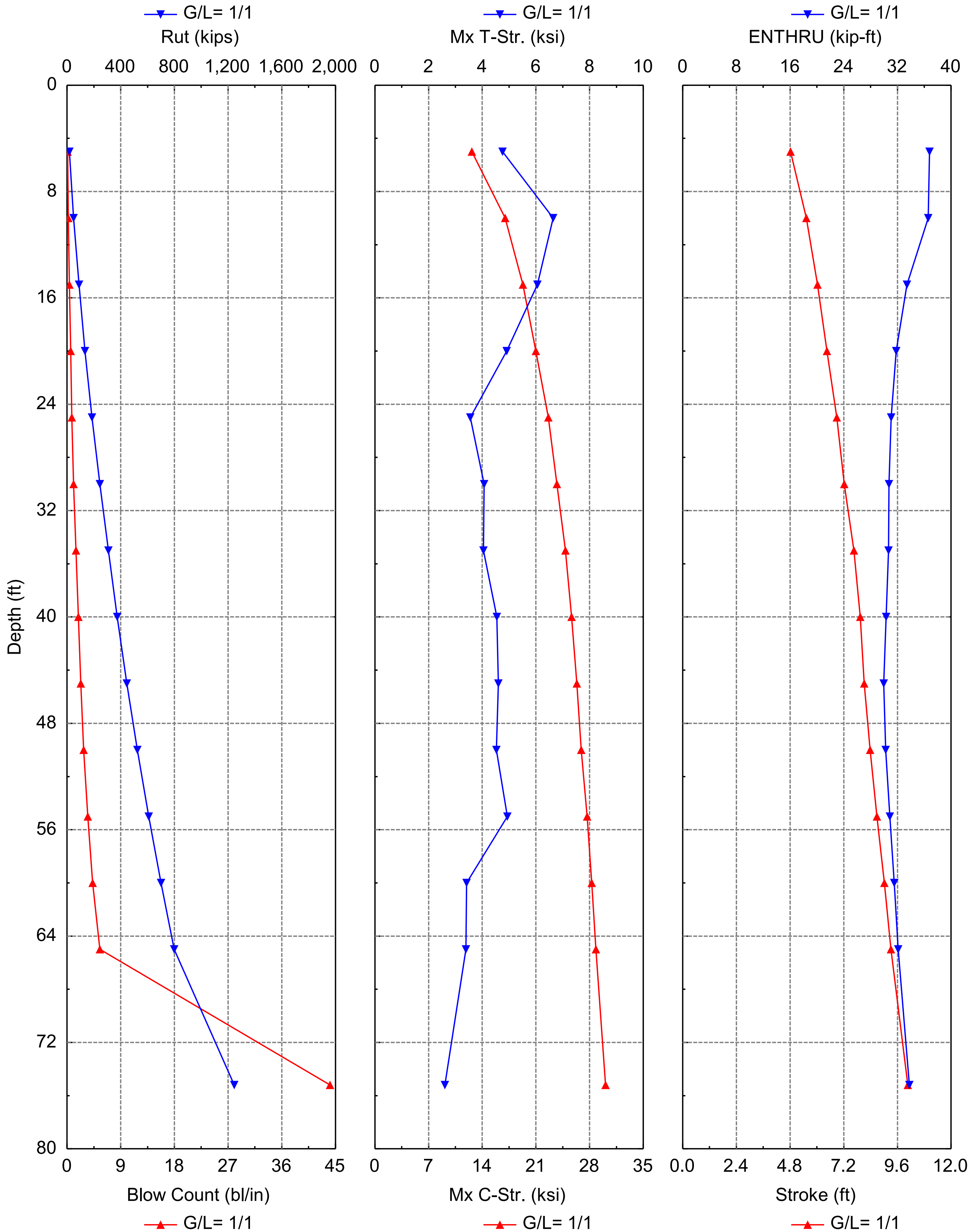
TOP LOAD KIP	TOP MOVEMENT IN.	TIP LOAD KIP	TIP MOVEMENT IN.
0.2827E+01	0.3739E-03	0.5517E+00	0.1000E-03
0.2827E+02	0.3739E-02	0.5517E+01	0.1000E-02
0.1417E+03	0.1871E-01	0.2759E+02	0.5000E-02
0.2841E+03	0.3751E-01	0.5517E+02	0.1000E-01
0.5435E+03	0.7394E-01	0.1103E+03	0.2000E-01
0.1032E+04	0.1556E+00	0.2174E+03	0.5000E-01
0.1292E+04	0.2127E+00	0.2475E+03	0.8000E-01
0.1432E+04	0.2483E+00	0.2676E+03	0.1000E+00
0.1751E+04	0.3889E+00	0.3679E+03	0.2000E+00
0.1891E+04	0.7097E+00	0.5075E+03	0.5000E+00
0.2001E+04	0.1026E+01	0.6180E+03	0.8000E+00
0.2044E+04	0.1233E+01	0.6607E+03	0.1000E+01
0.2201E+04	0.2256E+01	0.8177E+03	0.2000E+01

D.7. Wave Equation Analyses

Driveability Analysis Summary



Driveability Analysis Summary



Gain/Loss Factor at Shaft/Toe = 0.667/0.667

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow Ct bl/in	Mx C-Str. ksi	Mx T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
5.0	12.1	4.1	8.0	0.0	0.000	0.000	12.04	0.0	D 25-32
10.0	32.2	16.4	15.9	0.1	15.454	6.465	5.23	38.4	D 25-32
15.0	59.6	36.8	22.9	0.2	17.814	6.858	5.68	35.6	D 25-32
20.0	89.5	62.5	27.0	0.3	19.313	6.453	6.01	33.5	D 25-32
25.0	123.9	92.6	31.3	0.5	20.662	5.646	6.33	32.2	D 25-32
30.0	162.7	127.0	35.6	0.7	21.795	4.659	6.68	31.1	D 25-32
35.0	205.2	165.9	39.2	0.9	22.947	4.345	6.99	30.8	D 25-32
40.0	249.1	209.2	39.9	1.1	23.686	4.302	7.26	30.6	D 25-32
45.0	296.9	257.0	39.9	1.4	24.556	3.850	7.57	30.3	D 25-32
50.0	349.1	309.2	39.9	1.7	25.239	5.340	7.81	30.0	D 25-32
55.0	405.8	365.8	39.9	2.0	25.796	4.269	8.02	29.7	D 25-32
60.0	466.7	426.7	39.9	2.4	26.377	4.266	8.26	29.6	D 25-32
65.0	532.1	492.2	39.9	2.8	26.792	4.763	8.45	29.6	D 25-32
75.2	830.7	639.5	191.2	7.7	28.360	1.773	9.27	31.6	D 25-32

Total driving time: 34 minutes; Total Number of Blows: 1409 (starting at penetration 5.0 ft)

Gain/Loss Factor at Shaft/Toe = 1.000/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow Ct bl/in	Mx C-Str. ksi	Mx T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
5.0	18.1	6.1	12.0	0.1	12.633	4.760	4.82	36.8	D 25-32
10.0	48.4	24.6	23.8	0.2	16.995	6.644	5.53	36.6	D 25-32
15.0	89.4	55.1	34.3	0.4	19.301	6.052	6.03	33.4	D 25-32
20.0	134.3	93.8	40.5	0.6	20.994	4.912	6.45	31.8	D 25-32
25.0	185.8	138.9	46.9	0.8	22.612	3.554	6.89	31.1	D 25-32
30.0	244.0	190.6	53.4	1.1	23.726	4.073	7.22	30.7	D 25-32
35.0	307.7	248.9	58.8	1.5	24.862	4.047	7.66	30.7	D 25-32
40.0	373.6	313.8	59.9	1.9	25.652	4.541	7.94	30.3	D 25-32
45.0	445.3	385.4	59.9	2.3	26.324	4.603	8.11	29.9	D 25-32
50.0	523.7	463.8	59.9	2.8	26.922	4.529	8.38	30.3	D 25-32
55.0	608.6	548.7	59.9	3.5	27.673	4.936	8.69	30.9	D 25-32
60.0	700.0	640.1	59.9	4.3	28.289	3.420	9.02	31.5	D 25-32
65.0	798.2	738.3	59.9	5.5	28.817	3.392	9.31	32.1	D 25-32
75.2	1245.9	959.3	286.6	44.1	30.087	2.611	10.06	33.8	D 25-32

Total driving time: 112 minutes; Total Number of Blows: 4369 (starting at penetration 5.0 ft)

GRLWEAP: Wave Equation Analysis of Pile Foundations

Mill Cove New Bridge #6205 + Abut. 2 Unplugged 8/13/2025
GEI CONSULTANTS GRLWEAP 14.1.20.1

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity-blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors.

PILE INPUT

Uniform Pile		Pile Type:	H Pile
Pile Length: (ft)	85.200	Pile Penetration: (ft)	75.200
Pile Size: (ft)	1.24	Toe Area: (in²)	34.41

Pile Profile

Lb Top	X-Area	E-Modulus	Spec. Wt	Perim.	Crit. Index
ft	in²	ksi	lb/ft³	ft	-
0.0	34.4	29,000.0	493.4	4.8	0
85.2	34.4	29,000.0	493.4	4.8	0

HAMMER INPUT

ID	10	Made By:	DELMAG
Model	D 25-32	Type:	OED

Hammer Data

ID	Ram Wt	Ram L.	Ram Ar.	Rtd. Stk	Effic.	Rtd. Energy
-	kips	in	in²	ft	-	kip-ft
10	5.510	123.2	214.1	12.0	0.80	66.3

DRIVE SYSTEM FOR DELMAG D 25-32-OED

Type	X-Area	E-Modulus	Thickness	COR	Round-out	Stiffness
-	in²	ksi	in	-	in	kips/in
Hammer C.	415.000	530.000	2.000	0.800	0.120	109976.014
Helmet Wt.	3.100	kips				

SOIL RESISTANCE DISTRIBUTION

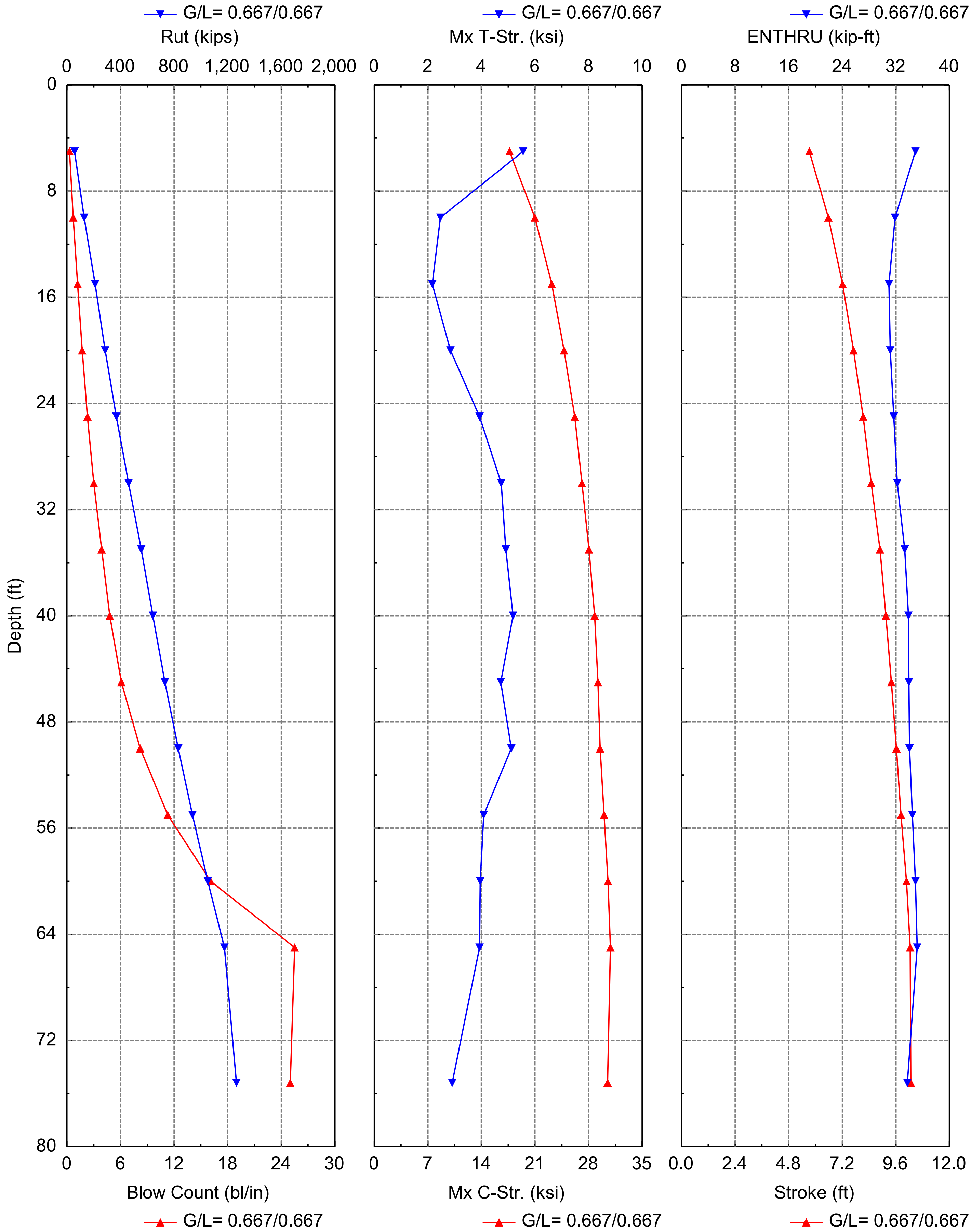
Depth	Unit Rs	Unit Rt	Qs	Qt	Js	Jt	Set. F.	Limit D.	Set. T.	EB Area
ft	ksf	ksf	in	in	s/ft	s/ft	-	ft	Hours	in²
0.0	0.0	5.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
1.0	0.1	11.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
1.0	0.1	11.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
2.0	0.2	20.1	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
2.0	0.2	20.1	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
3.0	0.3	29.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
3.0	0.3	29.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
4.0	0.4	39.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
4.0	0.4	39.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
5.0	0.5	49.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
5.0	0.5	49.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
6.0	0.6	59.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
6.0	0.6	59.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
7.0	0.7	70.0	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
7.0	0.7	70.0	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
8.0	0.8	79.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
8.0	0.8	79.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4

9.0	0.9	89.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
9.0	0.9	89.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
10.0	1.0	99.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
10.0	1.0	99.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
11.0	1.1	109.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
11.0	1.1	109.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
12.0	1.2	119.3	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
12.0	1.2	119.3	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
13.0	1.3	128.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
13.0	1.3	128.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
14.0	1.4	136.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
14.0	1.4	136.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
15.0	1.5	143.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
15.0	1.5	143.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
16.0	1.5	149.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
16.0	1.5	149.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
17.0	1.6	154.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
17.0	1.6	154.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
18.0	1.6	159.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
18.0	1.6	159.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
19.0	1.7	164.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
19.0	1.7	164.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
20.0	1.7	169.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
20.0	1.7	169.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
21.0	1.8	175.0	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
21.0	1.8	175.0	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
22.0	1.8	180.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
22.0	1.8	180.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
23.0	1.9	185.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
23.0	1.9	185.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
24.0	1.9	190.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
24.0	1.9	190.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
25.0	2.0	196.3	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
25.0	2.0	196.3	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
26.0	2.1	201.8	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
26.0	2.1	201.8	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
27.0	2.1	207.2	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
27.0	2.1	207.2	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
28.0	2.2	213.0	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
28.0	2.2	213.0	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
29.0	2.2	217.2	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
29.0	2.2	217.2	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
30.0	2.3	223.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
30.0	2.3	223.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
31.0	2.3	227.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
31.0	2.3	227.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4

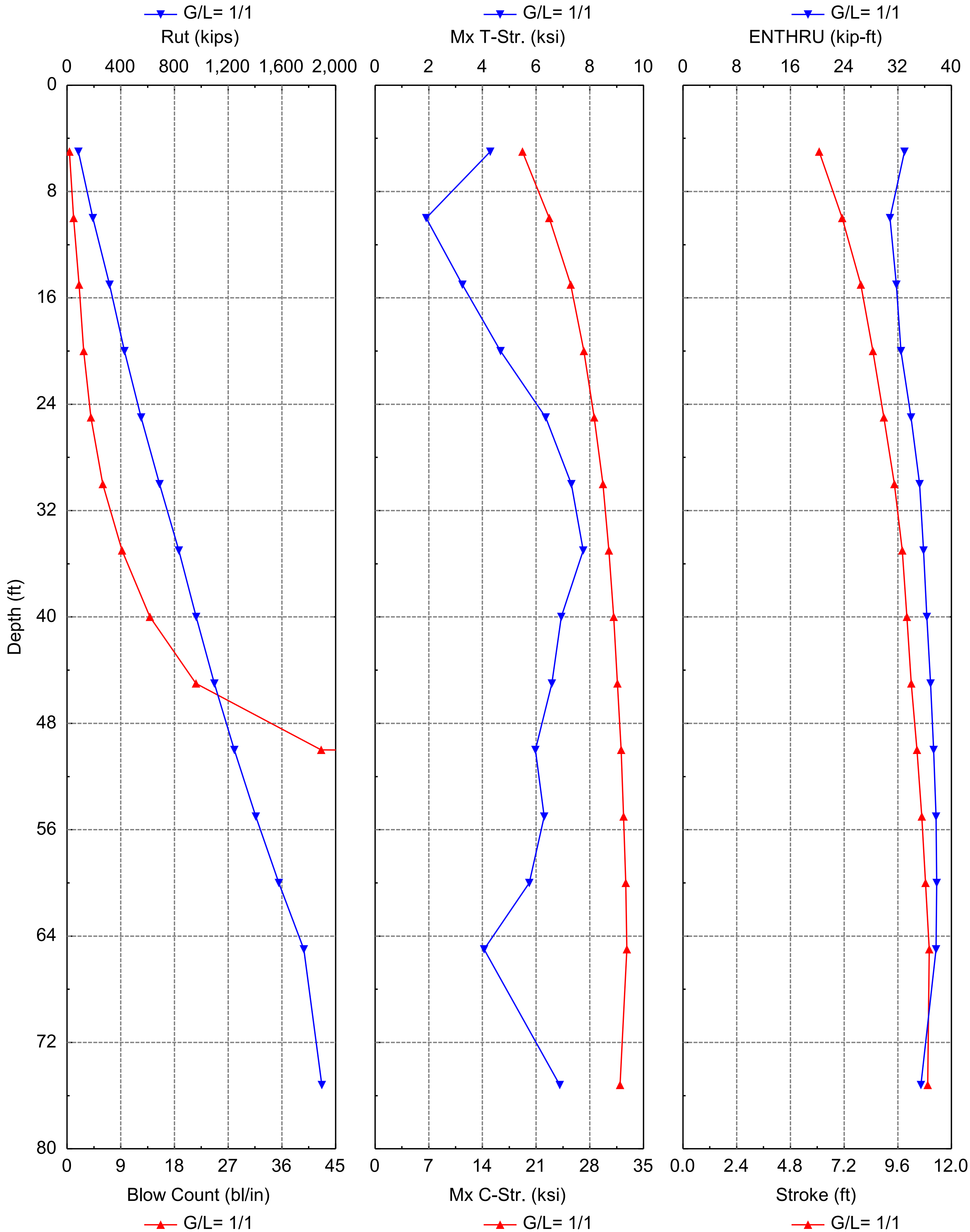
32.0	2.4	233.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
32.0	2.4	233.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
33.1	2.4	240.2	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
33.1	2.4	240.2	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
34.1	2.5	244.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
34.1	2.5	244.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
35.1	2.5	246.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
35.1	2.5	246.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
36.1	2.6	248.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
36.1	2.6	248.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
37.1	2.7	248.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
37.1	2.7	248.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
38.1	2.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
38.1	2.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
39.0	2.8	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
39.0	2.8	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
40.0	2.8	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
40.0	2.8	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
41.0	2.9	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
41.0	2.9	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
42.0	2.9	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
42.0	2.9	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
43.0	3.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
43.0	3.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
44.0	3.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
44.0	3.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
44.9	3.1	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
44.9	3.1	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
45.9	3.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
45.9	3.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
46.9	3.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
46.9	3.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
47.9	3.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
47.9	3.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
48.9	3.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
48.9	3.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
49.9	3.4	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
49.9	3.4	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
50.9	3.4	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
50.9	3.4	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
51.8	3.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
51.8	3.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
53.1	3.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
53.1	3.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
54.1	3.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
54.1	3.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4

55.1	3.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
55.1	3.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
56.1	3.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
56.1	3.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
57.1	3.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
57.1	3.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
58.1	3.8	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
58.1	3.8	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
59.1	3.9	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
59.1	3.9	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
60.0	3.9	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
60.0	3.9	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
61.0	4.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
61.0	4.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
62.0	4.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
62.0	4.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
63.0	4.1	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
63.0	4.1	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
64.0	4.1	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
64.0	4.1	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
65.0	4.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
65.0	4.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
65.9	4.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
65.9	4.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
66.9	4.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
66.9	4.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
67.9	4.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
67.9	4.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
68.9	4.4	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
68.9	4.4	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
69.9	4.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
69.9	4.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
70.9	4.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
70.9	4.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
71.9	4.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
71.9	4.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
73.2	4.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
73.2	4.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
74.1	4.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
74.1	4.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
75.1	4.7	1027.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
75.1	4.7	1027.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
76.1	4.8	3487.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4

Driveability Analysis Summary



Driveability Analysis Summary



Gain/Loss Factor at Shaft/Toe = 0.667/0.667

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow Ct bl/in	Mx C-Str. ksi	Mx T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
5.0	57.0	7.7	49.2	0.2	17.676	5.560	5.72	34.9	D 25-32
10.0	128.8	30.9	97.9	0.7	20.981	2.472	6.58	31.9	D 25-32
15.0	210.6	69.4	141.2	1.2	23.197	2.165	7.21	31.0	D 25-32
20.0	284.9	118.1	166.7	1.7	24.787	2.847	7.71	31.2	D 25-32
25.0	368.0	174.9	193.1	2.3	26.201	3.928	8.13	31.7	D 25-32
30.0	459.8	239.9	219.9	3.0	27.126	4.743	8.49	32.2	D 25-32
35.0	555.4	313.2	242.2	3.9	28.047	4.914	8.88	33.3	D 25-32
40.0	641.5	395.0	246.5	4.8	28.787	5.177	9.15	33.9	D 25-32
45.0	731.7	485.2	246.5	6.1	29.214	4.722	9.40	33.9	D 25-32
50.0	830.3	583.8	246.5	8.2	29.507	5.119	9.63	34.0	D 25-32
55.0	937.1	690.6	246.5	11.3	30.019	4.089	9.83	34.5	D 25-32
60.0	1052.3	805.8	246.5	16.1	30.545	3.958	10.07	34.9	D 25-32
65.0	1176.0	929.5	246.5	25.5	30.849	3.933	10.24	35.2	D 25-32
75.2	1264.9	1207.5	57.4	25.0	30.477	2.909	10.27	33.7	D 25-32

Total driving time: 196 minutes; Total Number of Blows: 7410 (starting at penetration 5.0 ft)

Gain/Loss Factor at Shaft/Toe = 1.000/1.000

Depth ft	Rut kips	Rshaft kips	Rtoe kips	Blow Ct bl/in	Mx C-Str. ksi	Mx T-Str. ksi	Stroke ft	ENTHRU kip-ft	Hammer -
5.0	85.4	11.6	73.8	0.4	19.214	4.289	6.09	33.0	D 25-32
10.0	193.2	46.4	146.8	1.1	22.717	1.902	7.11	30.8	D 25-32
15.0	315.8	104.1	211.6	2.0	25.518	3.255	7.94	31.8	D 25-32
20.0	427.2	177.2	250.0	2.8	27.234	4.676	8.49	32.5	D 25-32
25.0	551.9	262.4	289.5	4.0	28.557	6.356	8.98	34.0	D 25-32
30.0	689.5	359.9	329.6	6.0	29.720	7.315	9.45	35.3	D 25-32
35.0	832.9	469.8	363.1	9.2	30.479	7.753	9.80	35.9	D 25-32
40.0	962.1	592.5	369.6	13.9	31.098	6.940	10.01	36.3	D 25-32
45.0	1097.4	727.8	369.6	21.6	31.585	6.588	10.20	36.9	D 25-32
50.0	1245.2	875.7	369.6	42.6	32.072	5.971	10.46	37.3	D 25-32
55.0	1405.5	1035.9	369.6	9999.0	32.406	6.296	10.67	37.7	D 25-32
60.0	1578.3	1208.7	369.6	9999.0	32.693	5.743	10.84	37.8	D 25-32
65.0	1763.8	1394.2	369.6	9999.0	32.833	4.062	11.01	37.7	D 25-32
75.2	1897.3	1811.2	86.1	9999.0	31.945	6.881	10.94	35.4	D 25-32

Refusal occurred; no driving time output possible.

GRLWEAP: Wave Equation Analysis of Pile Foundations

Mill Cove New Bridge #6205 + Abut. 2 Plugged 8/13/2025
GEI CONSULTANTS GRLWEAP 14.1.20.1

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity-blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of structure and other factors.

PILE INPUT

Uniform Pile		Pile Type:	H Pile
Pile Length: (ft)	85.200	Pile Penetration: (ft)	75.200
Pile Size: (ft)	1.24	Toe Area: (in²)	212.35

Pile Profile

Lb Top	X-Area	E-Modulus	Spec. Wt	Perim.	Crit. Index
ft	in²	ksi	lb/ft³	ft	-
0.0	34.4	29,000.0	493.4	4.8	0
85.2	34.4	29,000.0	493.4	4.8	0

HAMMER INPUT

ID	10	Made By:	DELMAG
Model	D 25-32	Type:	OED

Hammer Data

ID	Ram Wt	Ram L.	Ram Ar.	Rtd. Stk	Effic.	Rtd. Energy
-	kips	in	in²	ft	-	kip-ft
10	5.510	123.2	214.1	12.0	0.80	66.3

DRIVE SYSTEM FOR DELMAG D 25-32-OED

Type	X-Area	E-Modulus	Thickness	COR	Round-out	Stiffness
-	in²	ksi	in	-	in	kips/in
Hammer C.	415.000	530.000	2.000	0.800	0.120	109976.014
Helmet Wt.	3.100	kips				

SOIL RESISTANCE DISTRIBUTION

Depth	Unit Rs	Unit Rt	Qs	Qt	Js	Jt	Set. F.	Limit D.	Set. T.	EB Area
ft	ksf	ksf	in	in	s/ft	s/ft	-	ft	Hours	in²
0.0	0.0	5.8	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
1.0	0.2	11.8	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
1.0	0.2	11.8	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
2.0	0.4	20.0	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
2.0	0.4	20.0	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
3.0	0.6	29.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
3.0	0.6	29.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
4.0	0.8	39.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
4.0	0.8	39.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
5.0	1.0	49.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
5.0	1.0	49.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
6.0	1.1	59.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
6.0	1.1	59.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
7.0	1.3	69.8	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
7.0	1.3	69.8	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
8.0	1.5	79.8	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
8.0	1.5	79.8	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4

9.0	1.7	89.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
9.0	1.7	89.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
10.0	1.9	99.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
10.0	1.9	99.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
11.0	2.1	109.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
11.0	2.1	109.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
12.0	2.3	119.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
12.0	2.3	119.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
13.0	2.5	128.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
13.0	2.5	128.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
14.0	2.7	136.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
14.0	2.7	136.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
15.0	2.8	143.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
15.0	2.8	143.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
16.0	2.9	149.3	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
16.0	2.9	149.3	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
17.0	3.0	154.3	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
17.0	3.0	154.3	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
18.0	3.1	159.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
18.0	3.1	159.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
19.0	3.2	164.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
19.0	3.2	164.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
20.0	3.3	169.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
20.0	3.3	169.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
21.0	3.4	174.8	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
21.0	3.4	174.8	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
22.0	3.5	180.2	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
22.0	3.5	180.2	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
23.0	3.6	185.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
23.0	3.6	185.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
24.0	3.7	190.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
24.0	3.7	190.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
25.0	3.8	196.3	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
25.0	3.8	196.3	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
26.0	3.9	201.8	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
26.0	3.9	201.8	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
27.0	4.0	207.2	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
27.0	4.0	207.2	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
28.0	4.1	213.0	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
28.0	4.1	213.0	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
29.0	4.2	217.2	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
29.0	4.2	217.2	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
30.0	4.3	223.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
30.0	4.3	223.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
31.0	4.4	227.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
31.0	4.4	227.7	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4

32.0	4.5	233.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
32.0	4.5	233.9	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
33.1	4.6	240.2	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
33.1	4.6	240.2	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
34.1	4.7	244.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
34.1	4.7	244.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
35.1	4.8	246.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
35.1	4.8	246.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
36.1	4.9	248.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
36.1	4.9	248.5	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
37.1	5.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
37.1	5.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
38.1	5.1	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
38.1	5.1	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
39.0	5.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
39.0	5.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
40.0	5.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
40.0	5.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
41.0	5.4	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
41.0	5.4	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
42.0	5.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
42.0	5.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
43.0	5.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
43.0	5.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
44.0	5.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
44.0	5.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
44.9	5.8	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
44.9	5.8	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
45.9	5.9	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
45.9	5.9	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
46.9	6.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
46.9	6.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
47.9	6.1	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
47.9	6.1	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
48.9	6.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
48.9	6.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
49.9	6.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
49.9	6.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
50.9	6.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
50.9	6.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
51.8	6.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
51.8	6.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
53.1	6.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
53.1	6.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
54.1	6.8	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
54.1	6.8	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4

55.1	6.9	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
55.1	6.9	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
56.1	7.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
56.1	7.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
57.1	7.1	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
57.1	7.1	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
58.1	7.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
58.1	7.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
59.1	7.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
59.1	7.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
60.0	7.4	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
60.0	7.4	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
61.0	7.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
61.0	7.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
62.0	7.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
62.0	7.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
63.0	7.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
63.0	7.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
64.0	7.8	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
64.0	7.8	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
65.0	7.9	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
65.0	7.9	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
65.9	8.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
65.9	8.0	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
66.9	8.1	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
66.9	8.1	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
67.9	8.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
67.9	8.2	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
68.9	8.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
68.9	8.3	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
69.9	8.4	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
69.9	8.4	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
70.9	8.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
70.9	8.5	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
71.9	8.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
71.9	8.6	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
73.2	8.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
73.2	8.7	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
74.1	8.8	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
74.1	8.8	250.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	212.4
75.1	8.9	340.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
75.1	8.9	340.4	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4
76.1	9.0	626.6	0.10	0.20	0.05	0.15	1.5	0.0	0.0	34.4

D.8. Slope Stability Analyses

Slope Stability Analyses
Mill Cove New Bridge #6205, Robbinston, Maine
WIN 26630.06
August 11, 2025

Slope Stability Results for approx Sta 19+50

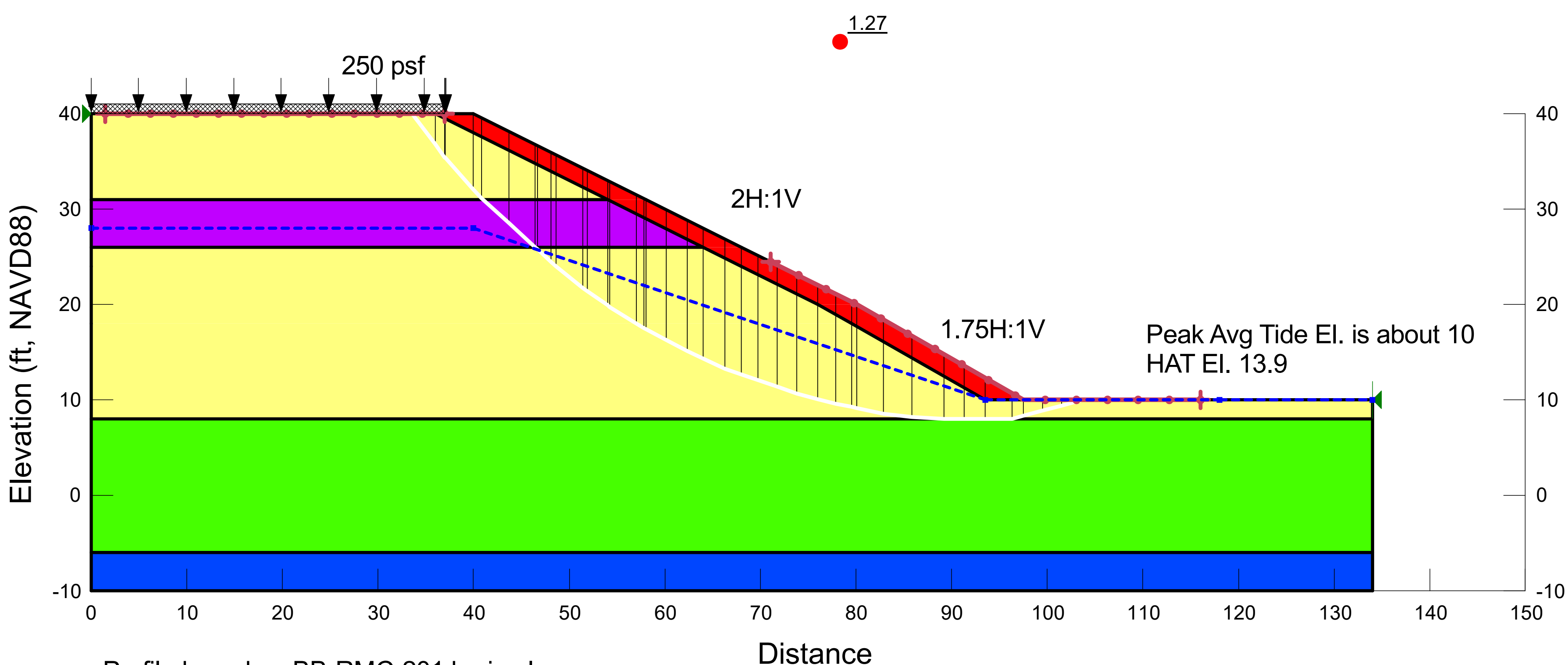
Analysis	Static Loading		Seismic Loading	
	Calculated FS[1]	Min Reqd FS[2]	Calculated FS	Min Reqd FS[3]
34 deg fill; 2H:1V over 1.75H:1V Riprap Slope	1.3	1.3	1.4	1.1
36 deg fill; 2H:1V over 1.75H:1V Riprap Slope	1.4	1.3	1.4	1.1
36 deg fill; 2H:1V over 1.75H:1V Riprap Slope w/ lower phreatic surface	1.4	1.3	1.4	1.1
38 deg fill; 2H:1V over 1.75H:1V Riprap Slope	1.4	1.3	1.5	1.1

Notes:
1. FS provided by SlopeW is rounded to the nearest tenth of a decimal place in the table.
2. MaineDOT requires a minimum FS of 1.3 for slopes without a structural element.
3. Per our discussions with MaineDOT, we understand MaineDOT's preferred minimum FS is 1.1 for pseudo-static conditions.

Assumptions:
1. Silty clay fill material has PI ranging from about 13 to 16, corresponding to a friction angle of about 30 - 32 deg. 30 deg used in analysis.
2. Silty clay fill material has an N60 value of 15 and N160 value of 17, corresponding to an undrained shear strength of about 2000 psf. An undrained shear strength of 2000 psf was used for the seismic loading runs.
3. Fill is generally dense and granular, with N60 values 53+ bpf. Low bound friction angle of 38 deg is justifiable, but fill can be variable. Therefore, we checked a range of friction angles between 34 and 38 deg.
4. Circular slip surface using Spencer method and optimized.
5. Circular slip surfaces selected to extend to roadway, with surcharge and slip surface 3' from edge of top of slope.
6. GW El. based on PGDR and increased for natural abutment.
7. A horizontal seismic coefficient of 0.048g was used for seismic loading runs, and is based off (1/2)As.
8. A 3' thick layer of riprap was extended from the toe of the slope to the top of the slope as shown in the BLP dated August 5, 2025.

Mill Cove New Bridge #6205
Slope Stability Analysis STA 19+50
34 Degree Fill, Slope 2H:1V over 1.75H:1V Riprap Slope

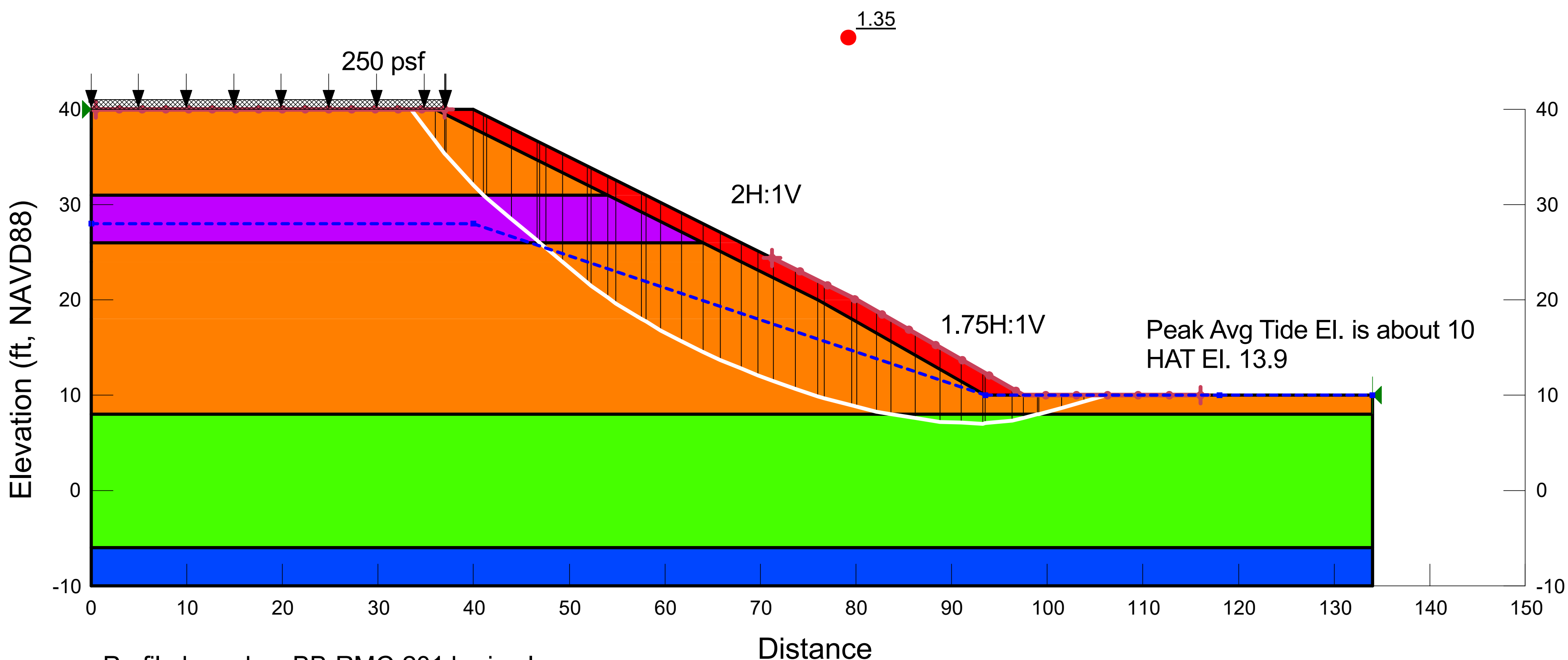
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface
Blue	Conglomerate	High Strength	170				1
Yellow	Fill - 34 deg	Mohr-Coulomb	125	0	34	0	1
Green	Glacial Till	Mohr-Coulomb	130	0	36	0	1
Red	Rip Rap	Mohr-Coulomb	125	0	40	0	1
Purple	Silty Clay	Mohr-Coulomb	120	0	30	0	1



Profile based on BB-RMC-201 boring log
Surcharge load of 250 psf applied

Mill Cove New Bridge #6205
Slope Stability Analysis STA 19+50
36 Degree Fill, Slope 2H:1V over 1.75H:1V Riprap Slope

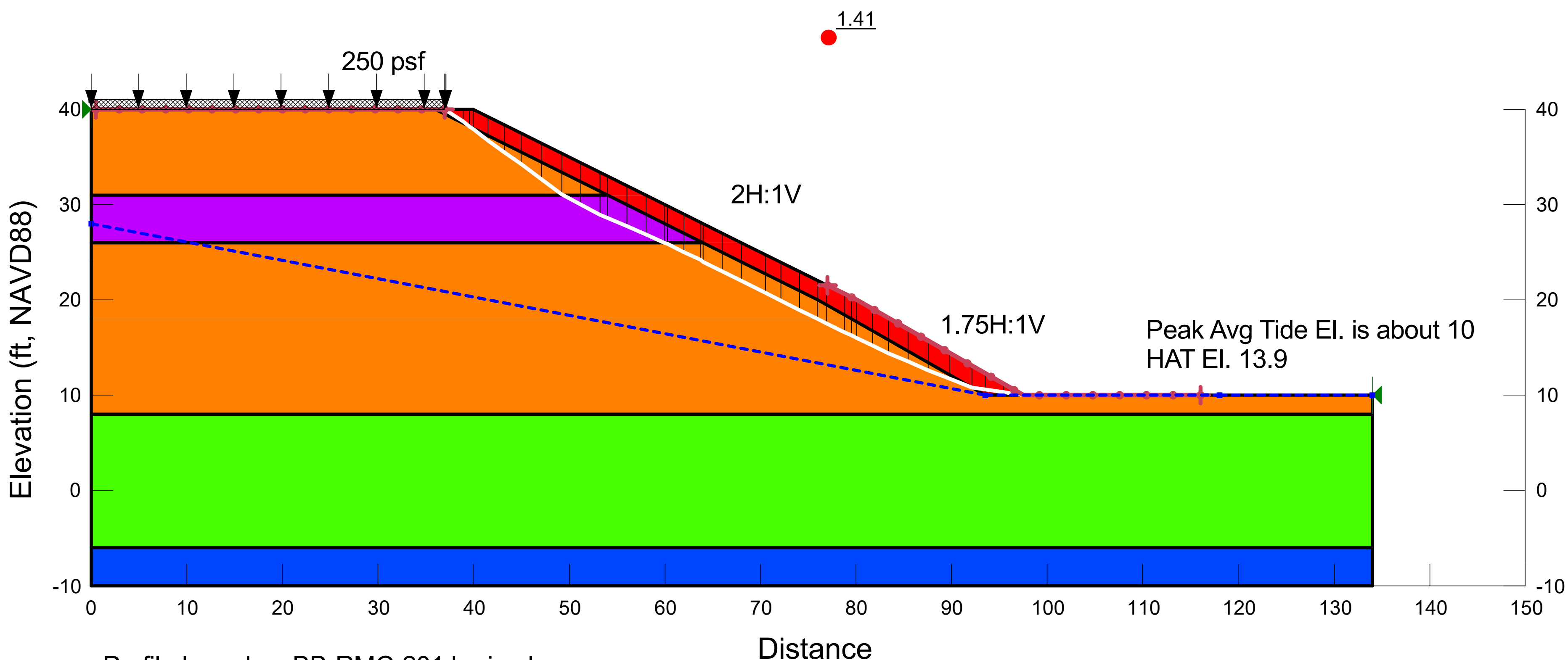
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface
Blue	Conglomerate	High Strength	170				1
Orange	Fill - 36 deg	Mohr-Coulomb	125	0	36	0	1
Green	Glacial Till	Mohr-Coulomb	130	0	36	0	1
Red	Rip Rap	Mohr-Coulomb	125	0	40	0	1
Purple	Silty Clay	Mohr-Coulomb	120	0	30	0	1



Profile based on BB-RMC-201 boring log
Surcharge load of 250 psf applied

Mill Cove New Bridge #6205
Slope Stability Analysis STA 19+50
36 Degree Fill, Slope 2H:1V over 1.75H:1V Riprap Slope with Lower Phreatic Surface

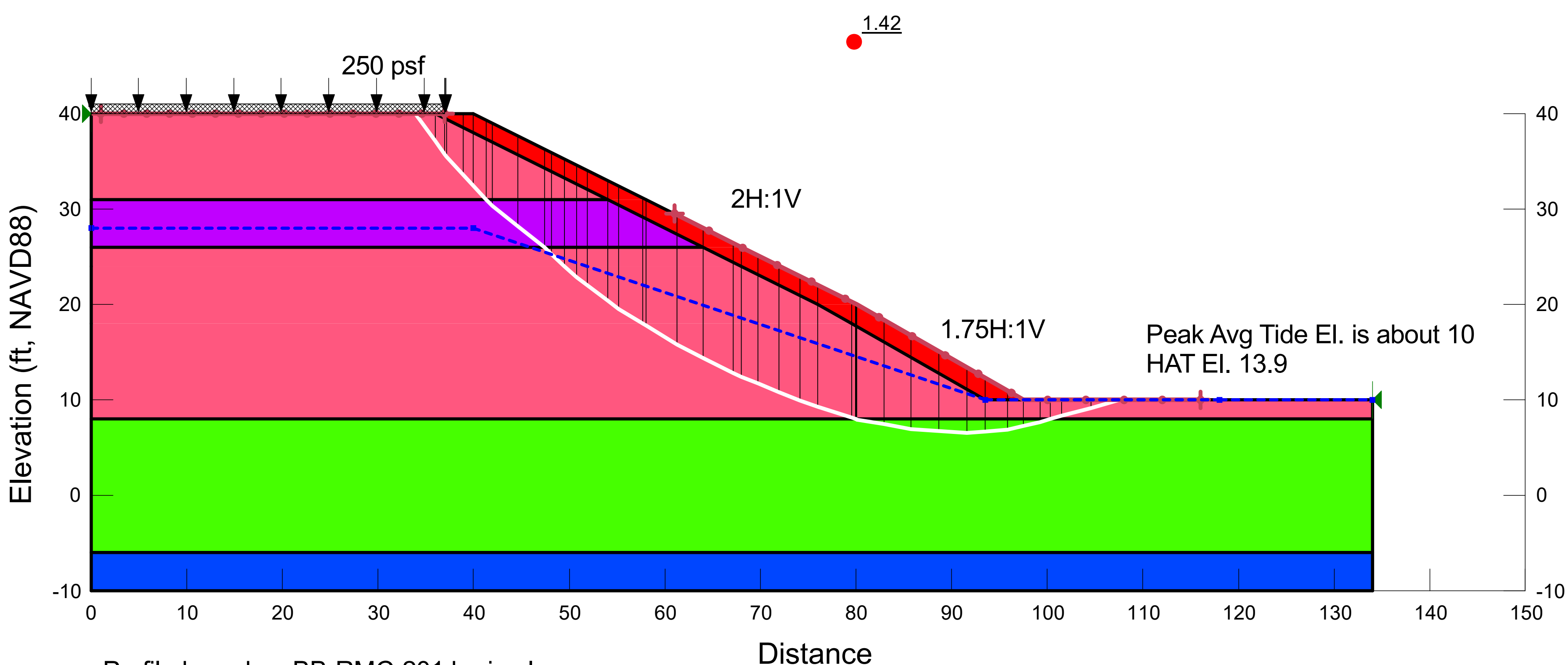
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface
Blue	Conglomerate	High Strength	170				1
Orange	Fill - 36 deg	Mohr-Coulomb	125	0	36	0	1
Green	Glacial Till	Mohr-Coulomb	130	0	36	0	1
Red	Rip Rap	Mohr-Coulomb	125	0	40	0	1
Purple	Silty Clay	Mohr-Coulomb	120	0	30	0	1



Profile based on BB-RMC-201 boring log
Surcharge load of 250 psf applied

Mill Cove New Bridge #6205
Slope Stability Analysis STA 19+50
38 Degree Fill, Slope 2H:1V over 1.75H:1V Riprap Slope

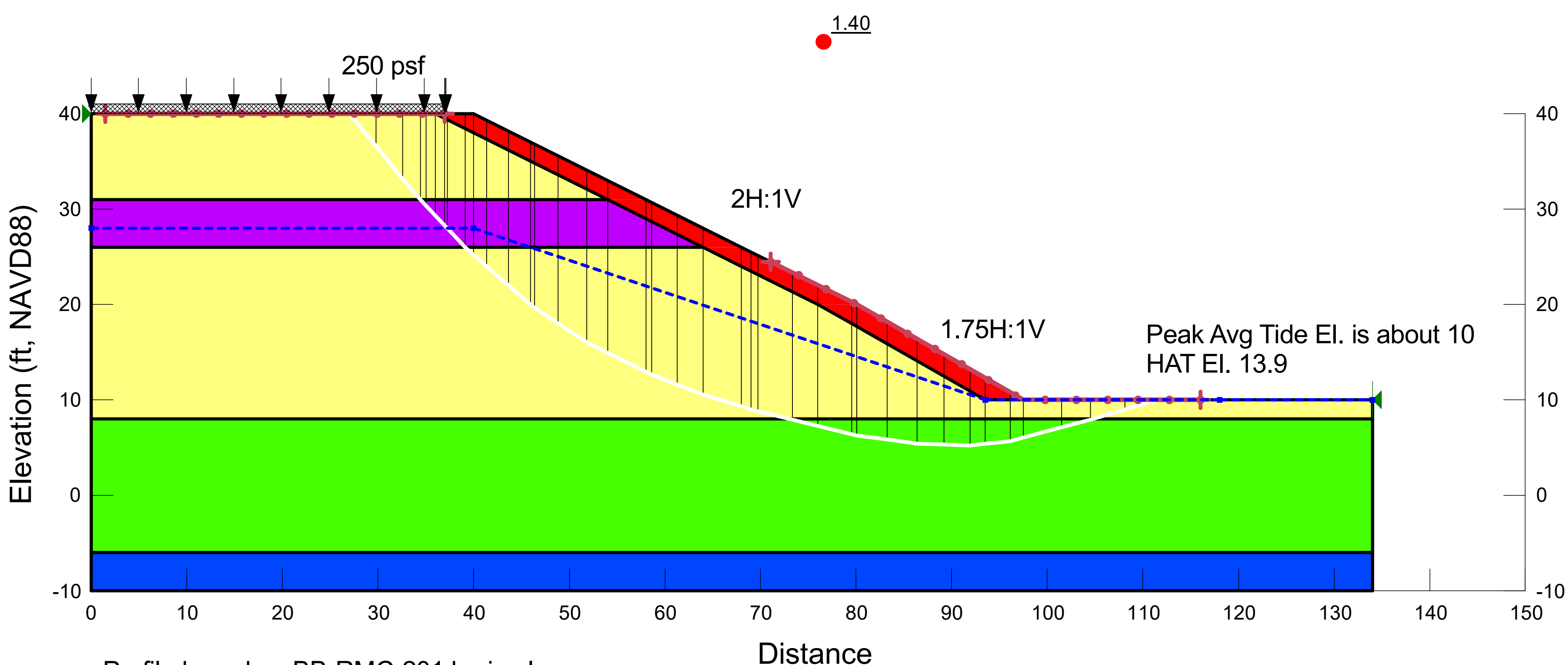
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface
(blue)	Conglomerate	High Strength	170				1
(pink)	Fill - 38 deg	Mohr-Coulomb	125	0	38	0	1
(green)	Glacial Till	Mohr-Coulomb	130	0	36	0	1
(red)	Rip Rap	Mohr-Coulomb	125	0	40	0	1
(purple)	Silty Clay	Mohr-Coulomb	120	0	30	0	1



Profile based on BB-RMC-201 boring log
Surcharge load of 250 psf applied

Mill Cove New Bridge #6205
Pseudo-Static Conditions Slope Stability Analysis STA 19+50
34 Degree Fill, Slope 2H:1V over 1.75H:1V Riprap Slope

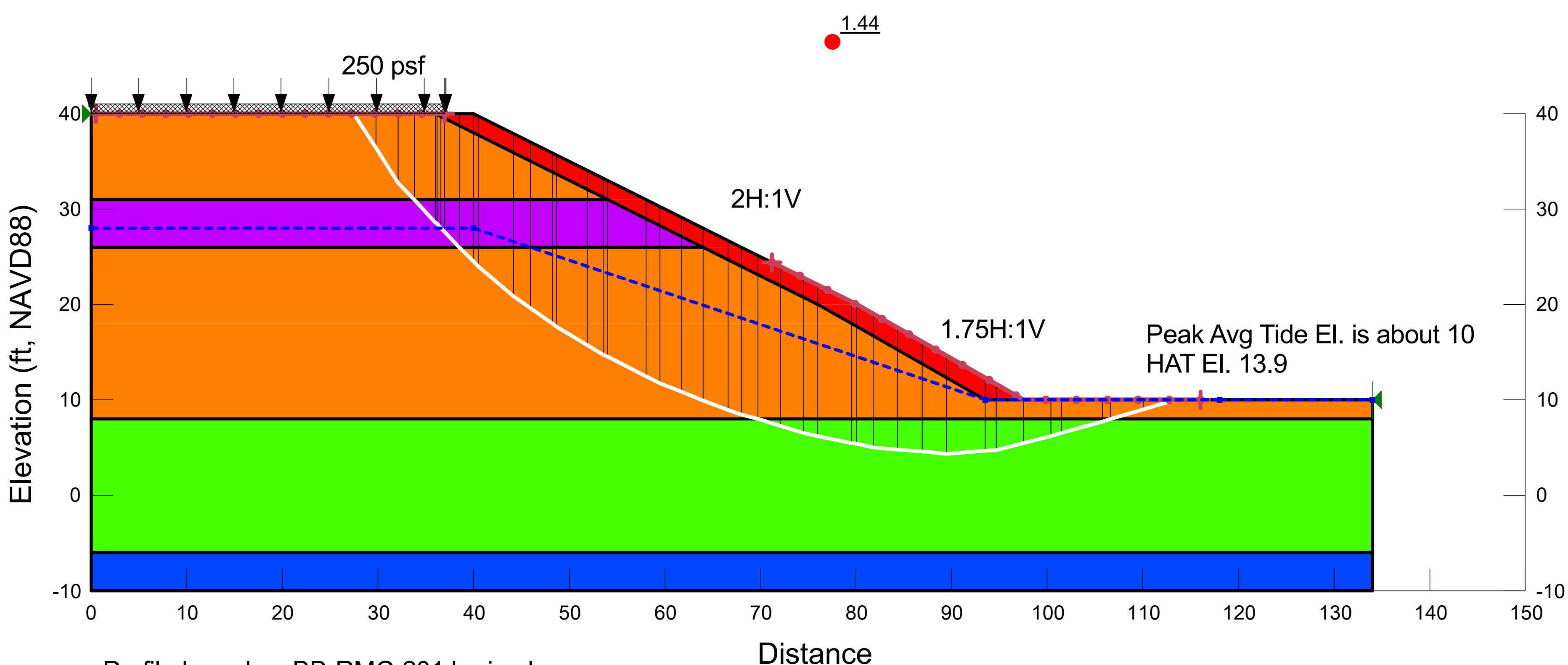
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface	Undrained Shear Strength (psf)
Blue	Conglomerate	High Strength	170				1	
Yellow	Fill - 34 deg	Mohr-Coulomb	125	0	34	0	1	
Green	Glacial Till	Mohr-Coulomb	130	0	36	0	1	
Red	Rip Rap	Mohr-Coulomb	125	0	40	0	1	
Purple	Silty Clay	Undrained (Phi=0)	120				1	2,000



Profile based on BB-RMC-201 boring log
Surcharge load of 250 psf applied   Horz Seismic Coef.: 0.048

Mill Cove New Bridge #6205
Pseudo-Static Conditions Slope Stability Analysis STA 19+50
36 Degree Fill, Slope 2H:1V over 1.75H:1V Riprap Slope, Lower Phreatic Surface

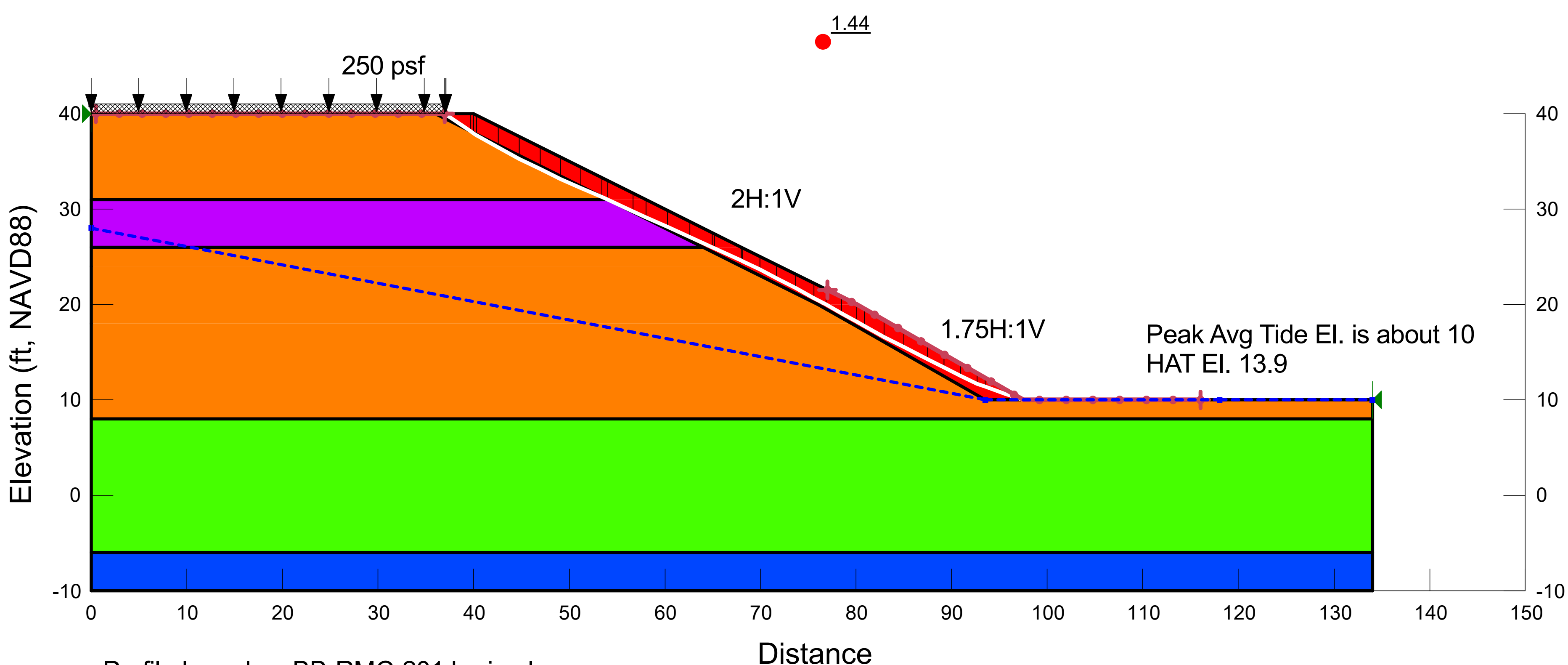
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface	Undrained Shear Strength (psf)
	Conglomerate	High Strength	170				1	
	Fill - 36 deg	Mohr-Coulomb	125	0	36	0	1	
	Glacial Till	Mohr-Coulomb	130	0	36	0	1	
	Rip Rap	Mohr-Coulomb	125	0	40	0	1	
	Silty Clay	Undrained (Phi=0)	120				1	2,000



Profile based on BB-RMC-201 boring log
Surcharge load of 250 psf applied
Horz Seismic Coef.: 0.048

Mill Cove New Bridge #6205
Pseudo-Static Conditions Slope Stability Analysis STA 19+50
36 Degree Fill, Slope 2H:1V over 1.75H:1V Riprap Slope

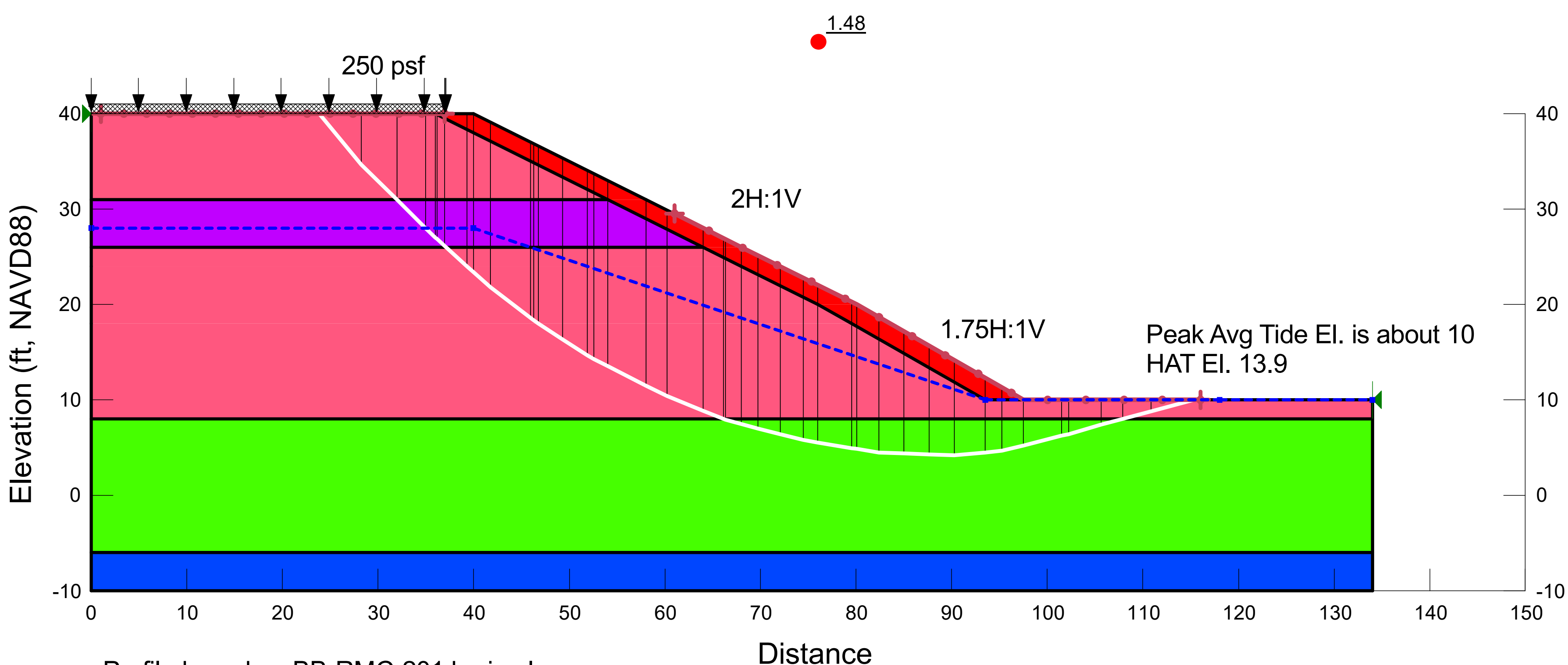
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface	Undrained Shear Strength (psf)
	Conglomerate	High Strength	170				1	
	Fill - 36 deg	Mohr-Coulomb	125	0	36	0	1	
	Glacial Till	Mohr-Coulomb	130	0	36	0	1	
	Rip Rap	Mohr-Coulomb	125	0	40	0	1	
	Silty Clay	Undrained (Phi=0)	120				1	2,000



Profile based on BB-RMC-201 boring log
Surcharge load of 250 psf applied
Horz Seismic Coef.: 0.048

Mill Cove New Bridge #6205
Pseudo-Static Conditions Slope Stability Analysis STA 19+50
38 Degree Fill, Slope 2H:1V over 1.75H:1V Riprap Slope

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)	Piezometric Surface	Undrained Shear Strength (psf)
Blue	Conglomerate	High Strength	170				1	
Pink	Fill - 38 deg	Mohr-Coulomb	125	0	38	0	1	
Green	Glacial Till	Mohr-Coulomb	130	0	36	0	1	
Red	Rip Rap	Mohr-Coulomb	125	0	40	0	1	
Purple	Silty Clay	Undrained (Phi=0)	120				1	2,000



Profile based on BB-RMC-201 boring log
Surcharge load of 250 psf applied Horz Seismic Coef.: 0.048